

# SUSTAINABLE DEVELOPMENT IN ENGINEERING AND TECHNOLOGY

*Various authors*

Ingeniería y Tecnología





# **SUSTAINABLE DEVELOPMENT IN ENGINEERING AND TECHNOLOGY**

*Various authors*



**Editorial Área de Innovación y Desarrollo,S.L.**

Quedan todos los derechos reservados. Esta publicación no puede ser reproducida, distribuida, comunicada públicamente o utilizada, total o parcialmente, sin previa autorización.

© del texto: **los autores**

ÁREA DE INNOVACIÓN Y DESARROLLO, S.L.

Avda. Juan Gil Albert, 1, ALCOY (ALICANTE) [info@3ciencias.com](mailto:info@3ciencias.com)

Primera edición: **marzo 2022**

ISBN: **978-84-124943-4-1**

# ÍNDICE DE CONTENIDOS

AUTOMATED CONTROL OF WATER OVERFLOW USING ELECTRONIC COMPONENTS.....	9
INDUSTRIAL MONITORING AND CONTROLLING USING WIRELESS SENSOR NETWORKS .....	17
SMART GLASS FOR THE VISUALLY IMPAIRED PEOPLE .....	29
INTELLIGENT VOICE DECODER NOTICE BOARD ANNOUNCER USING RF AND PIC MICROCONTROLLER .....	37
A REVIEW ON: DISCONTINUITY AND SIMILARITY BASED SEGMENTATION METHODS .....	49
AN INVESTIGATION ON COLOCALIZATION IN WOUND HEALING ASSAY AND INTERPRETATIONS WITH EZCOLOCALIZATION PLUGIN.....	61
ISSUES & CHALLENGES IN IOT .....	79
VEHICLE STARTING USING BIOMETRIC SCANNER (TWO WHEELER) .....	91
PERFORMANCE ANALYSIS OF BRAIN TISSUE SEGMENTATION AND CLASSIFICATION USING SOFT COMPUTING TECHNIQUES.....	99
FORENSIC INVESTIGATION ON ELECTRONIC EVIDENCES USING ENCASE AND AUTOPSY .....	117
PARTIAL CONNECTIVITY AWARE ROUTING FOR OPPORTUNISTIC NETWORKS ... ..	125
SECURING INTERNET OF THINGS DEVICES USING CONTAINERS .....	137
AN EFFICIENT DATA HIDING APPROACH ON MEDICAL IMAGE FOR SECRETE COMMUNICATION .....	149
SMART RATION SYSTEM .....	165
AUTOMATIC BRAIN TUMOR SEGMENTATION USING OPTIMIZED MACHINE LEARNING TECHNIQUES IN LABVIEW ENVIRONMENT .....	173
SMART SECURITY SYSTEM FOR WOMEN USING GSM.....	189
AUTOMATIC IRRIGATION SYSTEM BY SENSING SOIL MOISTURE .....	197
BOUNDS FOR VARIABLE STEP SIZE OF LMS ALGORITHM.....	207
RASPBERRY PI BASED READER FOR VISUALLY CHALLENGED PEOPLE .....	217
ACCIDENT AVOIDING SYSTEM USING MULTISENSORS USING LABVIEW .....	225

MEASURE OF TWT PERFORMANCE CHARACTERISTICS FOR KU-BAND APPLICATIONS.....	233
MODELING AND SIMULATION OF INALN/ALN/GAN HIGH ELECTRON MOBILITY TRANSISTOR BY POLARIZATION EFFECTS.....	243
ESTIMATION OF HEMOGLOBIN USING COLOR IMAGE PROCESSING TECHNIQUE .....	251
AN EMBEDDED ALERT SYSTEM AS ANTI-THEFT .....	263
WIRELESS MONITERING AND DECISION SUPPORT FORWATER SAVING IN AGRICULTURE .....	273
SMART BLIND STICK .....	279
SMART CROP PROTECTION SYSTEM.....	287
AMELIORATING BANDWIDTH USING NEXT GENERATION SYNCHRONOUS DIGITAL HIERARCHY .....	297
MORPHOLOGY AND SEGMENTATION USED IN AUTOMATED SCREENING OF TUBERCULOSIS.....	313
LABVIEW BASED INTELLIGENT HOME SAFETY AUTOMATION SYSTEM USING FACE RECOGNITION.....	329
PERFORMANCE COMPARISON OF SVM, NB FOR MRI PANCREAS IMAGE CLASSIFICATION .....	337
AUTOMATIC IRRIGATION SYSTEM USING SINGLE PHASE MOTOR CONTROL IN GSM .....	353
GAMING APPLICATION FOR ASSISTIVE TRAINING TO IMPROVE COGNITIVE AND MOTOR SKILLS OF CHILDREN WITH DYSPRAXIA .....	359
A COMPREHENSIVE ANALYSIS ON DIFFERENT MACHINE LEARNING AND DATA MINING TECHNIQUES FOR ANOMALY INTRUSION DETECTION.....	373
EDGE COMPUTING WITH CLOUD BASED MACHINE LEARNING WITH IOT INFRASTRUCTURE SECURITY ISSUE .....	391
SIMULATION OF COMBINED S BOX AND INVERSE S BOX IN AES .....	405
A HYBRID DISCRETE WAVELET TRANSFORM WITH NEURAL NETWORK RADIAL BASIS FUNCTION APPROACH FOR EFFICIENT MEDICAL IMAGE COMPRESSION .	417
ENHANCED BUILT IN SELF TESTING WITH REDUCED TIME AND POWER CONSUMPTION USING MINIMUM SPANNING TREE.....	429

BENDING LOSS OF MULTIMODE FIBER WITH VARIOUS DIP DEPTHS AND ELEVATION HEIGHTS AT CORE REFRACTIVE INDEX .....	441
EFFICIENT DATA RETRIEVAL IN SOCIAL IOT WITH CUSTOMIZED RELATIONSHIPS .....	451
FLOOR CLEANING ROBOT USING .....	471
BLUETOOTH AND ANDROID APPLICATION .....	471
A STUDY ON VARIOUS ALGORITHMS FOR GLOBAL ROUTING IN VLSI.....	481
HOME AUTOMATION WITH FIREBASE USING RASPBERRY PI.....	495
ANALYSIS OF OSTEO ARTHIRITIS (OA) IN INDIA FROM 2008-2018 .....	501
EFFICIENT VETERINARY PHYSIOLOGICAL MONITOR TO DIAGNOSE THE ABNORMALITIES IN VITAL PARAMETERS OF AN ANIMALS .....	515
SURVEY ON IOT APPLICATIONS & SECURITY ISSUES.....	529
A NOVEL REVIEW ON MICROMACHINED MICROPUMPS AND MICRONEEDLES FOR TRANSDERMAL DRUG DELIVERY.....	539
RFID BASED BUS PASS SYSTEM FOR UNIVERSITY .....	551
A NOVEL APPROACH ON MEDICAL IMAGING DATA SECURITY OPERATION BASED ON HONEY ALGORITHM .....	561
GLOVE FOR A COMMUNICATION DISORDERLY PERSON USING HAND GESTURE RECOGNITION .....	573
MULTITASK CNN FOR RECOGNITION OF TIGERS THROUGH THEIR STRIPES ..	581
REINFORCEMENT LEARNINING IN AUTONOMOUS VEHICLE TO UNDERSTAND TRAFFIC CONGESTION .....	593
IOT BASED EXPERT SYSTEM FOR MONITORING AND CONTROLLING CROP DAMAGE FROM WILD ANIMALS .....	601
IOT BASED SOIL MOISTURE DETECTION SYSTEM FOR AUTOMATIC IRRIGATION .....	609
SECURE ONLINE VOTING SYSTEM USING BLOCKCHAIN.....	619



# **AUTOMATED CONTROL OF WATER OVERFLOW USING ELECTRONIC COMPONENTS**

**Josephine Selle Jeyanathan**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: josephine@klu.ac.in, <https://orcid.org/0000-0003-2219-6748>

**Kotha Venkata Girishkumar**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: girishkumar11499@gmail.com

**Chintha Mohan Sai Sampath Kumar**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: chinthamohan998@gmail.com

**Kesara Durga Reddy**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: durgareddy.kotireddy@gmail.com

**Kandati Bharath Kumar Reddy**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: bharath.kandati1998@gmail.com

## **ABSTRACT**

This paper has carried out a work that reduces the water wastage with the help of economical components such as 555 timer IC, BC 547 transistor etc. Nowadays, water and electricity have become the basic indispensable needs of human beings. There is a high rate of water wastage despite a lot of water scarcity around the country. There is a necessity of water in many areas, especially for drinking and other basic needs which is turning the situation worse day by day. Most of the water loss is due to either carelessness or either due to fatigue nature of human beings to monitor the overflow in the water storage areas. This project has built a system that can monitor the overflow of the water and automatically shut off the valve once the water has filled in the storage areas.

**Keywords:** Water control management, 555 timer IC, BC 547 transistor.

## **1.INTRODUCTION**

Water and electricity, both play a major role in human life. Water is one of the natural resources, which is essentially necessary to utilize and manage usage in different sectors. As there is a decrease in the annual rainfall, the underground water levels are declining. Water usage according to human demand never end as water is one

of the basic elements required in every household. There is a need to monitor water usage. Mostly every house, office, industries are storing the water in overhead tanks. As manual switching ON and OFF the water pump is a difficult task. Every time it is tedious to watch the water filling process in the tank and rushing to switch off the motor when the tank is filled drives a person into dangerous accidents too. [6]. Sometimes when people are held up in their busy schedule, they also might forget to switch off the water pump leading to lot of wastage of water. To solve these types of problems and avoid manual switching OFF and ON of the pump, an automated process to shut off the water pump has been employed by using the the basic three components such as, BC547 transistor, 555 timers and relay [9]. The process automatically shuts off the pump when the water level reaches the top of the tank. The principle behind this process is based upon the electricity conduction inside water due to the presence of minerals and free flow of electrons. As the water level rises, the sensors detect the presence of water at a level and sends different signal in shutting OFF the valve immediately [3]. The entire process is economical and can be employed in the overhead water tanks effectively.

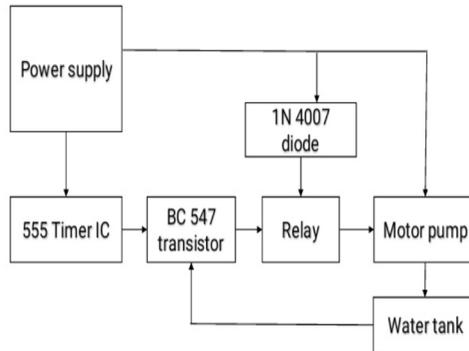
## **2. MOTIVATION**

The primary motive of this work is to conserve the water [8]. The main requirement was realized when a village survey was carried out in and around the south Indian districts where water tank overflow was a serious concern for many village dwellers. Some of the related problems were analyzed and it was observed that almost all the people in the villages use overhead tank in their houses. To rectify this common type of problem an auto shut off the pump was introduced to reduce water overflow in the overhead tanks [2]. As the manufacturing cost is low and these components are easily installed with less effort, it can be affordable by common people [3, 12-14].

## **3. MATERIALS AND METHODS**

In the proposed work, as shown in the Fig.1 [8] component such as 555 timer is used passing the signals to relay for switching purposes and to get the alert to the user [2]. The relay is used as a switch by its terminals NC and NO. BC 547 transistor is used for helping to control the overflow level of water. 1N 4007 diode is used to pass the required current to relay. Sensors are immersed in the starting level of the water in-order to indicate the level [6]. A two water levels bottom level and top level are pre-defined. One of the probes is from VCC. The power supply is given to the motor pump and other components. The motor pumps the water to the tank when the water level reaches the top-level probe then transistor goes to the ON stage [7]. The

collector immediately goes to vcc. The low voltage at the 4th pin resets the 555 Timer IC. Hence, the output of 555 timer becomes 0 volt. The transistor also sends the signals to relay based on the 555 timer instructions to switch off the motor pump. Hence the motor pump turnoff automatically [7].



**Figura 1.** General block diagram

The following components are economically available and can be installed easily in every house.

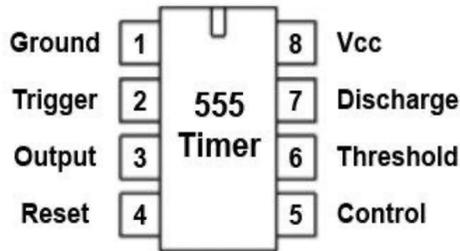
- 555 Timer IC
- BC 547 transistor
- 1N 4007 diode
- Relay(12v)
- Motor pump(230v,50hz)
- Resistor
- Capacitor
- Power supply

## 555 TIMER IC

The heart of this project is 555 Timer IC, the pin diagram is shown in the fig.2 [5]. The property of the timer is when the output goes to high voltage at 2nd pin (trigger pin) which is less than  $1/3V_{cc}$ . By applying a low voltage at the 4th pin (Reset pin), the IC is reset. In this circuit, bottom wire is connected to 2nd pin, top wire is connected to 6th pin and power supply is given to 8th pin of IC.

## BC547 TRANSISTOR

A transistor is a device which is used to switch electronic signals and to amplify and electrical power. It also plays a key role in this circuit. Its collector terminal sent the signal to relay for switch off the pump [6] when water level touches the top wire in the water tank [2]. Base terminal is connected to 3rd pin (output pin) of IC and emitter terminal is connected to ground.



## 1N 4007 DIODE

A diode is a device which passes current flow in only one direction from the anode to cathode. For 1N4007 diode, the maximum current carrying capacity is 1A, it withstands peaks up to 30A. The power dissipation of this diode is 3watts. It can be used to prevent reverse polarity problem. It is electrically compatible with other rectifier diodes and can be used as a replacement for any diode in the 1N400x family. In this circuit, it is connected to the collector terminal of BC547 transistor and power supply.

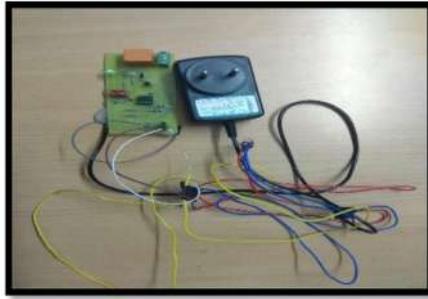
## RELAY

The relay is shown in Fig.3, is used as a electrically operating switch. Most of the relays use the electromagnet to operate the switch mechanically. These are used where several circuits must be controlled by one signal. In this circuit, it is connected to transistor for receiving signals from motor pump and power supply [6].

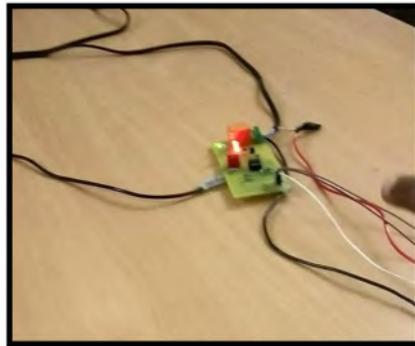


**Figura 3.** Relay

**Source:** <https://www.dnatechindia.com/5-Volt-SPDT-CUBE-RELAY.html>



**Figura 4.** Prototype



**Figura 5.** Working condition

## 4. RESULTS

Fig. 4 shows the components connected to each other. First the power supply is given to the motor pump (230v) and given to all the required components. In this diagram, the relay can be used as a switch (on or off) and to control the circuit. Transistor amplifies the signal and sent signal to relay for switch off [3] the motor pump. IC 555 timer is the heart of the circuit and sensors are connected which are used to indicate the water level [6]. The transistor gives the signal to the relay based on the timer instruction the motor will work. The diode 1n4007 will pass the required current to the relay from power supply. The wires in tank acts as sensors. The water tank is used for storing the water [1].

## 5. DISCUSSION AND CONCLUSIONS

The working condition of the above prototype is as shown in the Fig.5. The obtained result can be shown by the indication of lights when motor is in on or off condition [7]. Red light indicates the motor is on condition when water touches the top-level probe the red light will be turned off and only green light is glows.

Main aim of this project is to establish an economical and easy configurable system which can solve water losing problems. It is very useful in rural and urban areas [1]. It helps in the efficient use of available water resources. It can also be used in the agricultural purposes. In the future, the home automation web-based water level monitoring and controlling system can be implemented. It can be controlled via internet through smart phones [11].

## **6. REFERENCES**

- 1] Momin, M. S. A., Roy, P., Kader, M. M. G., Hasan, M. S., & Islam, S.** (2016). Construction of Digital Water Level Indicator and Automatic Pump Controlling System. *International Journal of Research*, 1-5.
- 2] Hongming, C., & Ziyi, C.** (2008, July). Design of a composite of sliding mode controller applied to water level control for a water tank level system. In 2008 27th Chinese Control Conference (pp. 619-623). IEEE.
- 3] Bhambhani, V., & Chen, Y.** (2008, December). Experimental study of fractional order proportional integral (FOPI) controller for water level control. In 2008 47th IEEE Conference on Decision and Control (pp. 1791-1796). IEEE.
- 4] Karwati, K., & Kustija, J.** (2018, July). Prototype of water level control system. In *IOP Conference Series: Materials Science and Engineering* (Vol. 384, No. 1, p. 012032). IOP Publishing.
- 5] Mani, N., Sudheesh, T. P., Joseph, V., Titto, V. D., & Shamnas, P. S.** (2014). Design and implementation of a fully automated water level indicator. *International Journal of Advanced Research in Electrical Electronics and Instrumentation Engineering*, 3(2).
- 6] Huang, W., Zeng, T., Ye, L., & Li, Z.** (2011, April). A self-acting water pump control system for residential buildings based on resonance water level sensor. In 2011 International Conference on Electric Information and Control Engineering (pp. 1112-1115). IEEE.
- 7] Reza, S. K., Tariq, S. A. M., & Reza, S. M.** (2010, October). Microcontroller based automated water level sensing and controlling: design and implementation issue. In *Proceedings of the world congress on engineering and computer science* (Vol. 1, pp. 20-22).

- 8]. de Miranda Coelho, J. A. P., Gouveia, V. V., de Souza, G. H. S., Milfont, T. L., & Barros, B. N. R.** (2016). Emotions toward water consumption: Conservation and wastage. *Revista Latinoamericana de Psicología*, 48(2), 117-126.
- 9]. Getu, B. N., & Attia, H. A.** (2016, December). Automatic water level sensor and controller system. In 2016 5th International Conference on Electronic Devices, Systems and Applications (ICEDSA) (pp. 1-4). IEEE.
- 10]. Getu, B. N., & Attia, H. A.** (2015, September). Automatic control of agricultural pumps based on soil moisture sensing. In AFRICON 2015 (pp. 1-5). IEEE.
- 11]. Richard C.. Dorf, & Bishop, R. H.** (2008). *Modern control systems*. Pearson Prentice Hall.
- 12]. Khan, N. H., Sohail, S., & Nasim, S.** (2018). Implementation of Water Distribution Monitoring Framework Using PLC. *Journal of Information Communication Technologies and Robotic Applications*, 39-44.
- 13]. Braddock, C. K., Debaugh, T. S., & Imsand, A.** (2021). U.S. Patent No. 11,064,844. Washington, DC: U.S. Patent and Trademark Office.
- 14]. Hadipour, M., Derakhshandeh, J. F., & Shiran, M. A.** (2020). An experimental setup of multi-intelligent control system (MICS) of water management using the Internet of Things (IoT). *ISA transactions*, 96, 309-326.



# **INDUSTRIAL MONITORING AND CONTROLLING USING WIRELESS SENSOR NETWORKS**

**Kalpana Murugan**

*Department of Electronics and Communication Engineering, School of Electronics and Electrical Technology, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: drmkalpanaee@gmail.com, <https://orcid.org/0000-0002-5121-0468>

## **ABSTRACT**

Industrial monitoring and controlling is essential for various industrial processes, like motors, machines, to collect all the relevant information, statistics and data for industry premises. This work proposes Long Transmission Range (LTR) method which is used to monitor and control the three parameters like temperature, humidity and moisture. These three parameters are monitored with the help of Wireless Sensor Network (WSN). The main aim of this work is real time implementation of monitoring and controlling of motor, temperature and Humidity without human actions. The sensed information can be sent it to a server through web domain. The user can monitor and control the parameters using a mobile device through the GSM module.

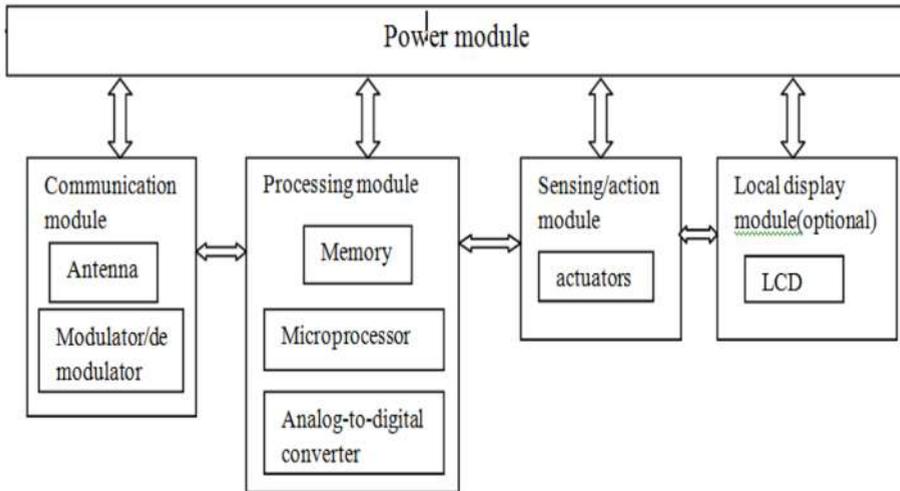
**Keywords:** Arduino, GSM Module, Temperature, Humidity, Motor, Mobile device, Wireless sensor networks.

## **1.INTRODUCTION**

In future wireless sensor network (WSN) as one of the most promising technology. Some of the potential application domains are environment, agriculture, healthcare, army, industry, transportation systems and security. Unlike other networks, WSN are designed for specific applications, and they must satisfy a set of requirements that differs from one application to another. Therefore, researchers must address a variety of challenges to facilitate the deployment of WSN technology in real-world domains. As a result, great efforts have been devoted to overcome the energy-saving problem and reliability.

In Industrial applications sensors are connected to the control station through wireless sensor network for continuous sensing and monitoring the status of the system. Wireless technology provides a suitable support to the industry offering advantages in terms of low installation cost, scalability, and flexibility, lack of cabling,

intelligent-processing capability, high mobility and ease of deployment compared to conventional solutions. Various modules used in an industry as shown in Graphic 1.



**Graphic 1.** Various modules used in an industry

### **A. Communication interface**

The implanted framework may need to, collaborate with other inserted frameworks at they need to transmit information to a work area. To encourage this, the inserted frameworks are given one or a couple of correspondence interfaces, for example, RS232, RS422, RS485, universal sequential transport and so forth.

### **B. Processing module**

Processors interact with the memory, where they execute a series of instructions. In these undertakings the processor comprises of a memory, microchip and a simple to advanced converter.

### **C. Sensing/Action Module**

Sensors used here are humidity, gas, temperature & current sensors. The sensors sense the surrounding and the sensing data is stored and send through the transceiver to the receiver.

### **D. Displaying the data**

Here the data which sensed and send to the receiver is displayed in a web browser. Here the output is displayed in a web browser to overcome the drawback of fixed

position monitoring system. With these method we can implement the mobility in monitoring system.

## **2.RELATED WORK**

Mechanical observing and control is a mix of structures, systems, and calculations utilized in the mechanical manufacturing plant for checking and control the exercises of modern forms, engines, machines and gadgets utilized in industry premises to accomplish the parameters like temperature, humidity. The present task is engaged an industrial applications that is destined to be persistently checked through a lot of sensors that establishes a sensor module. The sensor module gathers the pertinent information to decide regardless of which sensor to monitor the values of the parameters In [2] proposes the human advancement is distinguished using the passive infrared sensor (PIR) sensors. The structure triggers an alert perceiving the closeness of individual in a specific break of time and in the meantime sends the more number of individuals are gatecrasher. The security structure is instituted, the PIR sensor is started. This particularly responsive philosophy has low computational need. This reconnaissance security framework executed utilizing Microcontroller and sensors. In [3] framework contains sensor, microcontroller, ZigBee gadgets (Transceiver unit), and PC (Lab VIEW). For making entire framework Wireless Sensor Network utilizing ZigBee gadgets, in which the sensor sense the information and it is given to microcontroller for preparing and it changes over the sign from simple to advanced. The enormous measure of information and screen to entire power utilization and furthermore screens and control all the power supply parameters like stickiness, temperature, voltage and current with the assistance of zigbee organize alongside the sensor arrange and arduino mega likewise assume a significant job in the framework. A Remote Measurement and Control System for Greenhouse Based on Global System for Mobile Communications (GSM-SMS) [4] the framework presented a GSM-SMS remote estimation and control framework for PC-based database framework associated with base station. Base station is created by utilizing a microcontroller, GSM module, sensors and actuators. In functional task, the focal station gets and sends messages through GSM module. Estimation of parameters in each base station is set by focal station, parameters including the air temperature, the air gas. In [5] presents a creative GSM/based remote controlled inserted framework for businesses. The framework sets the time contingent upon the temperature and gas perusing from sensors and kind of yield and can consequently water the field when unattended. Data is traded between far end and structured framework by means of Short Message Service (SMS) on GSM arrange. A module is likewise interfaced with

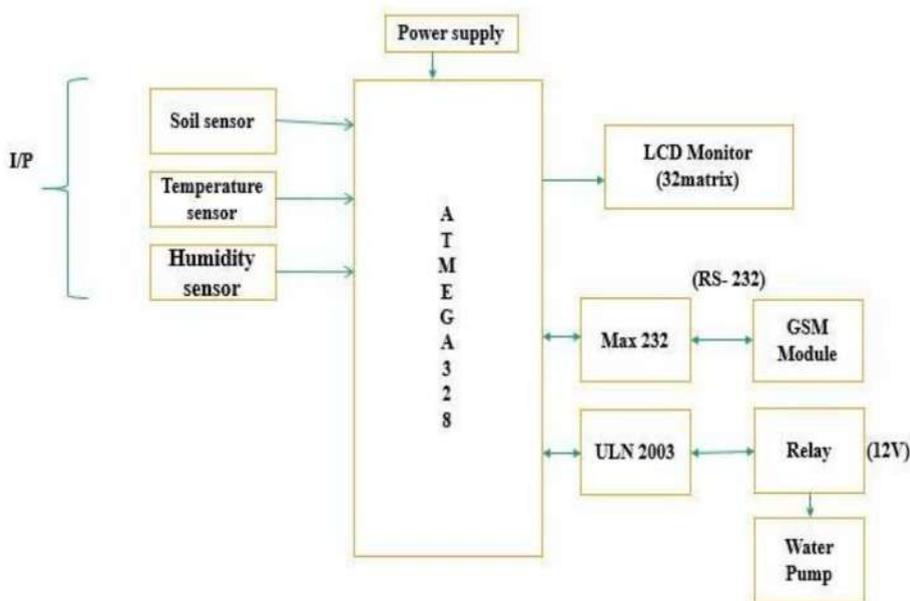
the fundamental microcontroller chip which decreases the SMS charges when the client is inside the constrained scope of few meters to the assigned framework. The framework illuminates clients about numerous conditions like status of power, dry running engine, expanded temperature, water content in soil and smoke by means of SMS on GSM arrange. In [6] utilizing programmed microcontroller based downpour firearm framework in which the will occur just when there will be extreme prerequisite of water that spare a huge amount of water. These frameworks carry a change to the executives of field asset where they built up a product stack called android is utilized for gadgets that incorporate a working framework, middleware and key applications. The android SDK gives the devices and APIs important to start creating applications on the android stage utilizing the Java programming language. Cell phones have nearly turned into an essential piece of us serving various needs of gasans. This application utilizes the GPRS for cell phone as for control framework. In IOT SMS alert framework dependent on SIM900A [7]. The framework can assemble parameters, for example, air temperature and air gas. In the meantime, with the utilization of AT direction, this framework can likewise acknowledge SMS programmed sending and accepting, natural parameters overwhelm alert and deficient equalization caution. In [8] presents a remote arrangement dependent on Internet convention to deal with the mechanical units effectively. Structure of industry framework with the usage of related programming and equipment. With the advancement of web, the idea of Internet Of Things (IOT) has turned out to be increasingly well known. Some principle highlights are recorded, for example, light control, remote control, keen vitality, remote consideration, security and wellbeing. In [9] Sulfur Dioxide sensors (SO<sub>2</sub>) changeability over an enormous fixation range and impedances from different gases have been real restrictions in modern SO<sub>2</sub> emanation checking. Analyzer includes a huge powerful estimation range and revision of obstructions from other coinciding infrared safeguards, for example, NO, CO, CO<sub>2</sub>, NO<sub>2</sub>, CH<sub>4</sub>, HC, N<sub>2</sub>O, and H<sub>2</sub>O. The motivation behind this venture is to give an ease incorporated sensor framework comprising of different sensors [10]. This contraption would assemble the data and send it to the basic database by methods for API where the information would be down and crucial measures can be taken to avoid disasters. In this manner structure sensor frameworks which are fit for detecting various parameters for example temperature, weight, moistness and so forth. These detected qualities are prepared by the microcontroller. Industry premises for monitoring and controlling the various industrial process like collecting relevant information, statistics and data related with the communication technique such as ZigBee, RF, Infrared. In [11] Internet Of Things (IOT) is used to monitor and control the parameters of industry which is used in the various application of modern society connected with GPRS. Without human action

electrical appliances in the industries are monitored and controlled by Raspberry pi3. Alerts are given to the authorized person using the concept of IOT with the help of wireless devices, smart phones, and sensor proposes in [12]. Bluetooth technology is proposes in [13] with the android mobile for controlling the speed of DC motor, heating coil and light intensity and also implementing the proto type for industrial appliances. This system will be cheap and affordable for society. 2G and 3G networks are not suitable for expanding the monitoring system of industrial applications. In [14] android is used to develop the convenient features of the user. For data accuracy IOT is needed, data acquisition and controlling is done with wireless sensor network is proposes in [15]. Sensor information's are detected and displayed in the webpage. In [16] Wi-Fi shield is used to transfer the temperature from an embedded design. This temperature transfer process is monitored with the help of android mobile. Integrating WSN with IOT is proposes in [17] to improve the resource and energy efficiency for the real time applications of environmental monitoring. To address the challenges of big data and data security realize the benefits of IOT. In [18] describing physical layer issues in communication, and also explain about the overview of existing wireless technologies in industrial monitoring and control.

### **3. PROPOSED SYSTEM**

#### **3.1. Long transmission Range (LTR) method**

This work proposes Long transmission Range method which is used for efficient monitoring of temperature, humidity, and moisture, level with the help of ATMEGa328. All the sensors are communicate to the mobile through the GSM. The output of the parameter values are shown in the mobile.

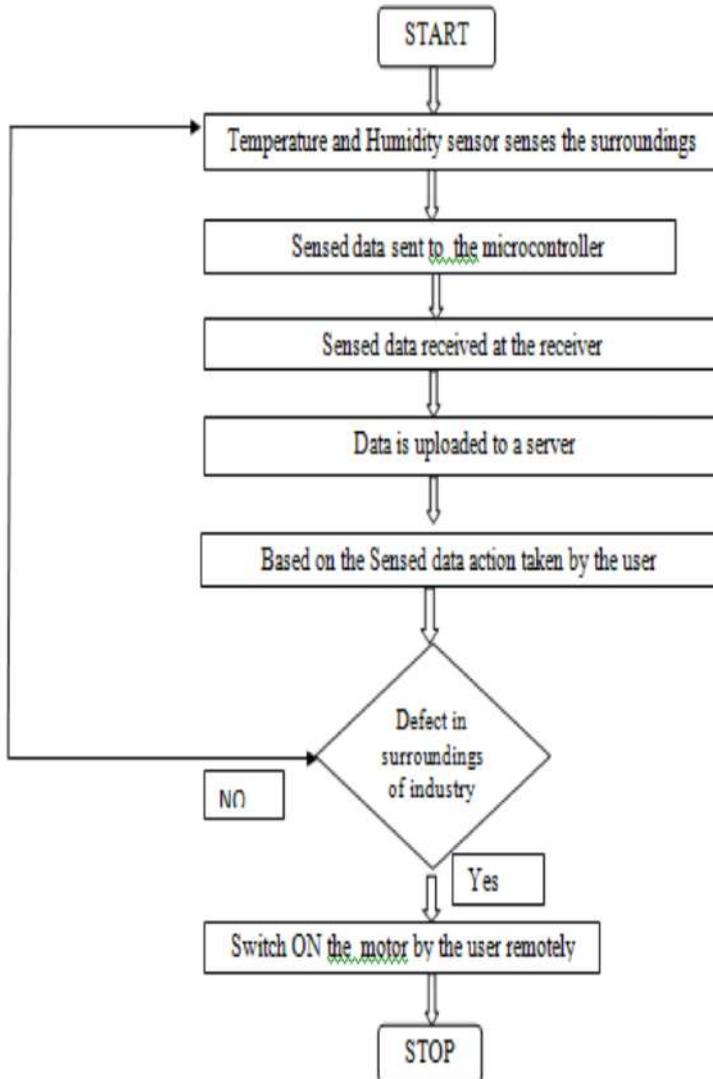


**Graphic 2.** BLOCK DIAGRAM for LTR Flow chart for LTR

### 3.2 Working Principle of LTR

Long Transmission Range (LTR) block diagram as shown in Graphic 2. LTR method is implementation in real time. Switch on the power supply with a 12v step up transformer and make every component in active condition. LCD displays the values of parameter level and initially displays as zero. Output of the temperature sensor is given to Analog to Digital Converter (ADC) which is connected to Microcontroller. Speed of wind is proportional to the Electro Magnetic Force (EMF) produced by the motor which is converted by ADC this process is done by the microcontroller. The first comparator acts as reference and compares the level according to the conditions which indirectly indicates the level/amount of water .The data from all the modules are collected in parallel to the microcontroller and according to the program it makes Liquid Crystal Display (LCD) to display the appropriate module data. Max232 is used to transfer the data from microcontroller to RS232 in the form of ASCII which is connected to laptop to monitor the values of the parameter same as on LCD. LTR system operated with two modes, one is automated mode and other is manual mode. Initially the system is an auto mode by default are activated which takes action automatically and intimates the user through SMS. User set manual mode using the keypad connected to port2 which acts as input for key to change into other mode as shown in Graphic 3. In order to establish communication between GSM and microcontroller by using MAX232.

### 3.3 Flow Chart for LTR



**Graphic 3.** Flow chart for LTR

## 4. RESULTS AND DISCUSSION

Long Transmission Range (LTR) method is proposed. LTR is efficiently measured and monitored the parameters like temperature, humidity and moisture. These parameters, are displayed in the seven segment display as shown in Graphic 4. Temperature and humidity are the major parameters in an industry. If the temperature increases then the humidity will decrease, which causes so many difficulties in an industries

like fire, food contaminations and people also affected. If the temperature increases then the microcontroller automatically sends the message to the user.



**Graphic 4.** Real time output of Temperature, Humidity, and Moisture level



**Graphic 5.** Message send to the user through GSM.

All the messages send to the user mobile through GSM as shown in Graphic 5 Micro-controller take immediate action when the temperature is increased.



**Graphic 6.** Screenshot of alert messages sent by GSM module

Measured temperature values are displayed in the mobile as shown in Graphic 6. If the temperature value is exceeded then the user sends a message to motor pump for controlling the system ON or OFF.

## 5. CONCLUSION

This work proposed Long Transmission Range method, which is implemented in real time. This method is viable approach than Time Synchronized Mesh Protocol (TSMP) methods. In this work three parameters are considered like Temperature, Humidity, and Moisture. All these three parameter values are measured in real time. The result shows that LTR method performs better than all viable approaches. The tested parameter values are stored in the cloud with the help of IOT for future references and implementations. These values are shown in the mobile by using the GSM module. Without human action electrical appliances in the industries are monitored and controlled by Raspberry pi3. Alerts are given to the authorized person using the concept of IOT with the help of wireless devices, smart phones, and sensor. Integrating WSN with IOT is proposes is to improve the resource and energy efficiency for the real time applications of environmental monitoring. This system will be affordable and useful for an industry without human interaction. This implemented system will be very useful for society.

## **6. REFERENCES**

- Aponte-Luis, J., Gómez-Galán, J. A., Gómez-Bravo, F., Sánchez-Raya, M., Alcina-Espigado, J., & Teixido-Rovira, P. M.** (2018). An efficient wireless sensor network for industrial monitoring and control. *Sensors*, 18(1), 182.
- Rajesh, G., Renuka, S., Parthipan, V., & Mizpah, J.** (2017). Industrial machine control and monitoring system using IoT. *International Journal of Pure and Applied Mathematics*, 116, 105-111.
- Kenil Chaklasiya, Hitesh Parmar,** (2017) 'Industrial Power Supply Parameter Monitoring and Controlling of Device Using Lab view', *International Research Journal of Engineering and Technology (IRJET)*.
- Bhagyashree Dattatray Daware, Prof. Hatkar A.A,** (2017) 'IOT Based Industrial Monitoring and Fault Detection Using Android', *International Journal of Innovative Research in Computer and Communication Engineering*.
- Kallappa, B. B. Tigadi,** (2016) Industrial Safety Parameters Monitoring in IOT Environment, *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*.
- Navneet Kaur, Snehal More , Komal Revanwar,** (2016) Industrial Environment Monitoring and controlling system using android application, *Imperial journal of interdisciplinary research*.
- Vinay M, Shivashankar s k,** (2016) Monitoring of smart equipment in manufacturing industry using iot applications, *International Journal of Technical Research and Applications*
- Alfred Ignatius A., Calvin Samjay D., Prathish R.,** (2016) Automated Monitoring of Industrial Loads Using Iot and Control Using Wireless Technology, *Middle-East Journal of Scientific Research*
- Youwen Sun, Cheng Liu,** (2016) Industrial SO<sub>2</sub> emission monitoring through multichannel gas analyzer with an optimized retrieval algorithm, *Atmos. Meas. Tech.*, 9, 1167–1180.
- Aksha Patil,, Bhavesh, Rewale, Omkar Sankhe, Gaurang,** (2016, March) Industrial Monitoring using Wireless Sensor Network, *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 5 Issue 3*.

- Civerchia, F., Bocchino, S., Salvadori, C., Rossi, E., Maggiani, L., & Petracca, M.** (2017). Industrial Internet of Things monitoring solution for advanced predictive maintenance applications. *Journal of Industrial Information Integration*, 7, 4-12.
- Deshpande, A., Pitale, P., & Sanap, S.** (2016). Industrial automation using Internet of Things (IOT). *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)*, 5(2), 266-269.
- Swain, K. B., Santamanyu, G., & Senapati, A. R.** (2017, May). Smart industry pollution monitoring and controlling using LabVIEW based IoT. In 2017 third international conference on sensing, signal processing and security (ICSSS) (pp. 74-78). IEEE.
- Telagam, N., Kandasamy, N., Nanjundan, M., & Arulanandth, T. S.** (2017). Smart Sensor Network based Industrial Parameters Monitoring in IOT Environment using Virtual Instrumentation Server. *Int. J. Online Eng.*, 13(11), 111-119.
- Murar, M., & Brad, S.** (2014, May). Monitoring and controlling of smart equipments using Android compatible devices towards IoT applications and services in manufacturing industry. In 2014 IEEE International Conference on Automation, Quality and Testing, Robotics (pp. 1-5). IEEE.
- Li, W., & Kara, S.** (2017). Methodology for monitoring manufacturing environment by using wireless sensor networks (WSN) and the internet of things (IoT). *Procedia CIRP*, 61, 323-328.
- Zand, P., Chatterjea, S., Das, K., & Havinga, P.** (2012). Wireless industrial monitoring and control networks: The journey so far and the road ahead. *Journal of sensor and actuator networks*, 1(2), 123-152.
- Merchant, H. K., & Ahire, D. D.** (2017). Industrial automation using iot with raspberry pi. *International Journal of Computer Applications*, 168(1), 44-46.



# SMART GLASS FOR THE VISUALLY IMPAIRED PEOPLE

**Ramesh Gurusamy**

*Assistant Professor, Department of ECE, Kalasalingam Academy of Research and Education,  
Krishnankoil, Virudhunagar (Dt), India.*

Email ID: ramesh.auvlsi@gmail.com, <https://orcid.org/0000-0001-7179-132X>

**Arun Prasath T**

*Associate Professor, Department of ECE, Kalasalingam Academy of Research and Education,  
Krishnankoil, Virudhunagar (Dt), India*

Email ID: arunaklu@gmail.com, <https://orcid.org/0000-0003-4891-4779>

**Sesha Sai. D. K**

*U. G. Student, Department of ECE, Kalasalingam Academy of Research and Education,  
Krishnankoil, Virudhunagar (Dt), India*

Email ID: dkseshasai8055@gmail.com, <https://orcid.org/0000-0001-9278-1980>

**Akram Javid.S**

*U. G. Student, Department of ECE, Kalasalingam Academy of Research and Education,  
Krishnankoil, Virudhunagar (Dt), India*

Email ID: 18smaj@gmail.com, <https://orcid.org/0000-0003-0743-8032>

**Sreenath. R**

*U. G. Student, Department of ECE, Kalasalingam Academy of Research and Education,  
Krishnankoil, Virudhunagar (Dt), India*

Email ID: revellasreenath1998@gmail.com, <https://orcid.org/0000-0002-0840-913X>

## ABSTRACT

This paper presents a design of Smart Glass for The Visually Impaired People. In highly populated Countries, blind people face many problems in mobility from place to place. They need assistance of another person for their mobility and help them in their mobility from to place to place. The ultrasonic sensor present on the small glasses detects the obstacles using ultrasonic waves. This signal is sent to Arduino and the Arduino switches the buzzer ON. This buzzer sound helps the person from contacting the obstacle. The proposed systems have been simulated and practically design using hardware components and the results are satisfied with the expectation.

**Keywords:** Blind people mobility, Arduino, Ultrasonic sensors, Buzzer.

## 1.INTRODUCTION

Across the globe on an approximation 285 million visually impaired people are present. Among them 246 million have low vision and 39 million are blind according to

WHO statistics of 2011. The world's largest number of blinds are present in India. Over 15 million people are blind. The objective of this project is to help the visually impaired in their mobility without the assistance of another person. When the blind person is about to come in contact the ultrasonic sensor senses the obstacles using ultrasonic waves. The signal generated in the ultrasonic sensor is sent to the Arduino which is pre-programmed. This Arduino switches the buzzer ON. This buzzer sound helps the person from making contact with the obstacle. With this project there will be no need for an assistance of another person in their mobility. This project is cost effective.

Blind people face many problems in their mobility. They also need other people's assistance in their mobility from place to place. This project helps them in moving from place to place without assistance of any person. This prototype helps them to move from place to place.

Due to no sight the blind people are facing many problems. They are not even able to do their own works without other people's assistance. The increase of population these days is also a huge problem in the mobility of blind people. so it is very much necessary to have visual aids like smart glass or cane.

## **2. MATERIALS AND METHODS**

### **2.1. ARDUINO UNO**

This is a microcontroller board made with ATmega32. It has 14 digital I/O pins of which 6 pins can be used as PWM outputs. It operates on 16 MHz crystal oscillator, a power Jack and a reset. It provides as a replacement to microcontroller development board; it is directly connected to computer with a cable wire and USB jack. Instead of using converter Arduino uses USB-to-serial converter.



**Figure 1:** Arduino Uno Board  
**Source:** electronicscomp.com

## 2.2. ULTRASONIC SENSOR

Ultrasonic sensors are primarily utilized in gadgets, inside and outside in the hardest conditions, for an assortment of utilization. High frequency sound waves are utilized to resound an ideal recurrence and convert to electrical into acoustic energy, and the other way around. These Sound waves are transmitted and reflected to the transducer. Certain factors, for example, point surface edge, changes in warmth and stickiness, and intelligent surface harshness, can influence the activity of the sensors. The ultrasonic is a developmental advance from the sensor, and has been intended to build adaptability, increment run, and to decrease costs even more.



**Figure 2:** Ultrasonic Sensor  
**Source:** electronicscomp.com

## 2.3. ULN DRIVER

The ULN2003 is an array of seven high voltage, high current NPN Darlington transistor pairs. It consists of common cathode fly-back diodes in case of switching inductive loads. The ULN2003 has a series base resistor to each Darlington pair, thus allowing operation directly with TTL or CMOS operating at supply voltages of 5.0V. The ULN2003 interfacing includes solenoids, relays, lamps, small motors, and LEDs.



**Figure 3.** ULN Driver  
**Source:** electronicscomp.com

## 2.4. BUZZER

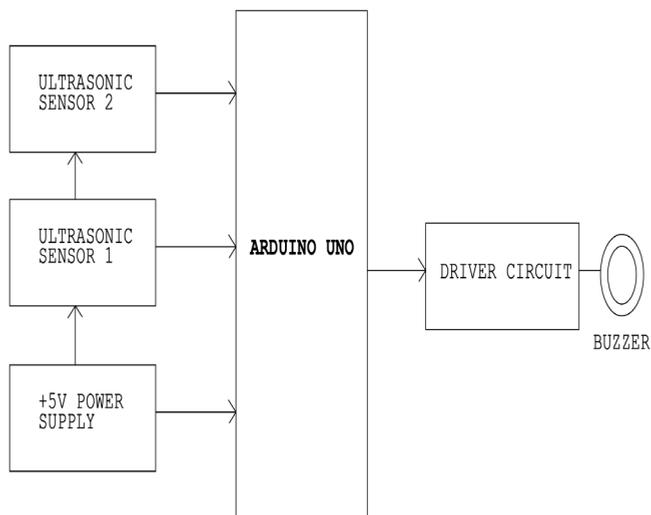
The buzzer is an audio signaling device. It may be mechanical, electromechanical or piezo electric. Buzzers may also include alarm devices



**Figure 4:** Buzzer

**Source:** electronicscomp.com

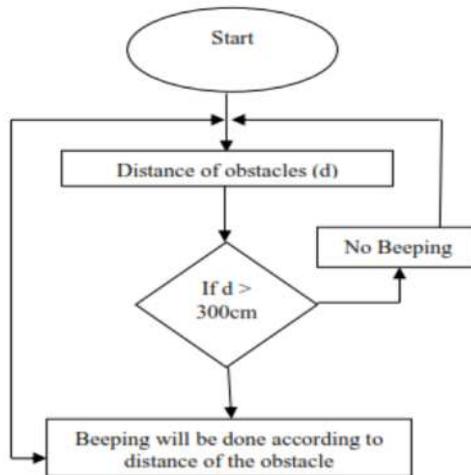
## 2.5. BLOCK DIAGRAM AND WORKING



**Figure 5:** Block Diagram

**Source:** own elaboration

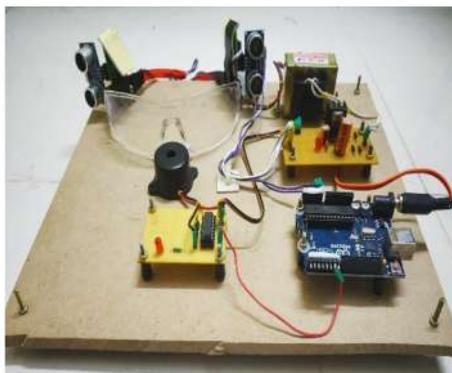
Connections are made as per the block diagram. The ultrasonic sensor 1 and ultrasonic sensor 2 are connected to Arduino. This Arduino circuit is pre-programmed. This Arduino board is powered by a 5V power supply. The ULN Driver acts as a bridge between the Arduino circuit and buzzer.



**Figure 6.** Flowchart  
**Source:** own elaboration

#### 4. RESULTS AND DISCUSSION

These days due to high population blind people are facing many problems in mobility. The proposed system addresses many functionalities that helps to detect the obstacles, fall and shock detection, Alerts and notification. The elderly people are having higher risk to run towards the obstacle. In this case, obstacle detection is very important. The ultrasonic sensors present on the either side of the glasses produce ultrasonic waves. These sensors can detect obstacles at 3-4 meters. When the obstacle is present in their way the ultrasonic waves bounces back and the sensor senses the obstacles. A signal is generated in ultrasonic sensors and this signal is sent to the Arduino board. This ultrasonic sensor is pre-programmed. This ultrasonic sensor is powered by a 5V powersupply. an ULN driver is present between the Arduino and the buzzer. This ULN Driver acts as the bridge between the Arduino and buzzer. As soon as the Arduino receives the signal from the sensor it switches the buzzer ON by the help of ULN driver circuit. This buzzer (alarm) helps the blind person from crashing or contacting the obstacle.



**Figure 7:** Prototype of the project

**Source:** own elaboration

#### 4. CONCLUSION AND FUTURE WORK

The paper objective is underlined by the necessity of Buzzer system for the increasing number of blind people all over the globe. The "Smart Glass for Blind People" is practically, a feasible device and can be conveniently carried by any blind person. It does have a few limitations which will be targeted to solve in its future developments.

#### 5. REFERENCES

- Agarwal, R., Ladha, N., Agarwal, M., Majee, K. K., Das, A., Kumar, S., & Saha, H. N.** (2017, October). Low cost ultrasonic smart glasses for blind. In 2017 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON) (pp. 210-213). IEEE. <https://doi.org/10.1109/IEMCON.2017.8117194>
- Lan, F., Zhai, G., & Lin, W.** (2015, November). Lightweight smart glass system with audio aid for visually impaired people. In TENCON 2015-2015 IEEE Region 10 Conference (pp. 1-4). IEEE. <https://doi.org/10.1109/TENCON.2015.7372720>
- Fink, W., & Humayun, M.** (2005). U.S. Patent Application No. 11/030,678.
- MacNamara, S., & Lacey, G.** (2000, April). A smart walker for the frail visually impaired. In Proceedings 2000 ICRA. Millennium Conference. IEEE International Conference on Robotics and Automation. Symposia Proceedings (Cat. No. 00CH37065) (Vol. 2, pp. 1354-1359). IEEE. <https://doi.org/10.1109/ROBOT.2000.844786>

- Lacey, G., MacNamara, S., Petrie, H., Hunter, H., Karlsson, M., Katevas, N., & Rundenschöld, J.** (1999). Adaptive control of a mobile robot for the frail visually impaired. In Proc. Int. Conference on Rehabilitation Robotics ICORR(pp.60-66). <http://rehabrobotics.org/icorr1999/papers/papers/lacey.pdf>
- Silverman, H. S.** (1996). U.S. Patent No. 5,508,699. Washington, DC: U.S. Patent and Trademark Office.
- Sofer, E., & Tidhar, A.** (2009). U.S. Patent No. 7,598,976. Washington, DC: U.S. Patent and Trademark Office.
- Ye, H., Malu, M., Oh, U., & Findlater, L.** (2014, April). Current and future mobile and wearable device use by people with visual impairments. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 3123-3132). <https://doi.org/10.1145/2556288.2557085>



# INTELLIGENT VOICE DECODER NOTICE BOARD ANNOUNCER USING RF AND PIC MICROCONTROLLER

**Deny John Samuvel**

*Department of Electronics and Communication Engineering, Kalasalingam  
Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [jdenysam@gmail.com](mailto:jdenysam@gmail.com), <https://orcid.org/0000-0001-6515-3575>

**Perumal Balasubramani**

*Department of Electronics and Communication Engineering, Kalasalingam  
Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [palanimet@gmail.com](mailto:palanimet@gmail.com), <https://orcid.org/0000-0003-4408-9396>

**Muthukumaran Elangovan**

*Department of Electronics and Communication Engineering, Dr.B.R.Ambedkar  
Institute of Technology Pahargaon, Port Blair, India*  
Email ID: [reachmemk@gmail.com](mailto:reachmemk@gmail.com), <https://orcid.org/0000-0002-0763-9902>

## ABSTRACT

In the present complex condition, manual correspondence is supplanted by specialized correspondence. Thinking about a school or industry or some other huge establishments, a data moved from the verified person1' is assume to be passed to every single individual under the organization. The data can't be passed by the verified individual to everybody by mean de ring himself all through the business. On the off chance that he should utilize someone else for imparting his contemplations, he is need of burning through cash in purpose of compensation. In such event, for appropriate exchange of data and simple method for correspondence we need a substitute method for correspondence. In this proposed framework we convert the content sign to voice signal and is moved starting with one point then onto the next point with the RF modem. The message is first composed in the PC and after that it is moved to the PC UART. From PC UART the instant message is moved to the microcontroller UART. At that point with content to discourse converter module, the instant message is changed over to voice message. This voice message can be conveyed to another point with the assistance of RF modem. The applications and future upgrades of this undertaking are laid out later.

**Keywords:** Voice Decoder, RF, PIC, Text to Voice Conversion.

## **1.INTRODUCTION**

### **1.1. EMBEDDED SYSTEM**

An implanted framework is an application that contains at any rate one programmable PC and which is utilized by people who are in the primary, uninformed that the framework is PC based. An implanted item utilizes a small-scale controller to complete one assignment as it were. It is a blend of programming installed on equipment.

### **1.2. DEFINITION OF MICROCONTROLLER**

A miniaturized scale controller is a PC on a chip or in the event that you like, a "solitary Chip PC". Micro recommends that the gadget is little and controller reveals to you the Device may be utilized to control items, procedures or occasions.

### **1.3. FEATURES OF PIC MICROCONTROLLER**

A regular smaller scale controller must have a few, yet not the majority of the accompanying properties:

- 8kB of glimmer program memory
- 368bytes of Data memory
- 256-EEPROM information memory
- 15 Interrupts
- In-circuit programming
- 3 inside equipment clocks
- Capture/Compare/PWM modules
- Up to 8 channels of 10-Bit A/D
- Built-in USART for sequential correspondence
- 5 computerized I/O ports (Up to 22 lines)

### **1.4. AIM OF THE PRODUCT**

The point of the item is to build up the task that a smart voice decoder notice board host with the remote innovation and the data ought to be passed by utilizing smaller scale controller.

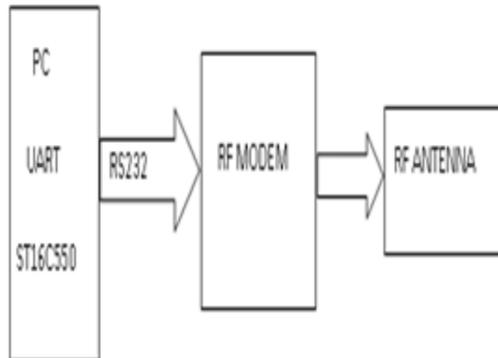
This venture is for the most part of

1. Content to discourse module (RC 8650)
2. PIC microcontroller (PIC16F877A)
3. RF modem
4. Power supply module.
5. PC UART

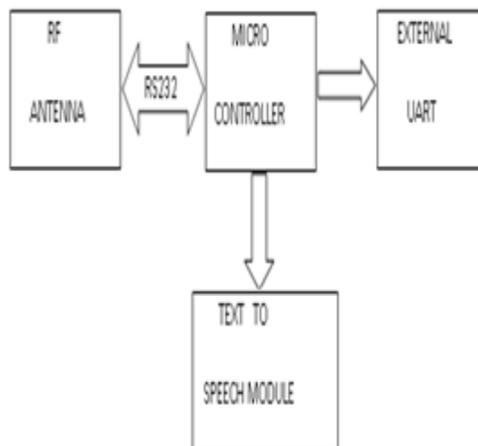
## 2. PROPOSED SYSTEM DESIGN

### 2.1. BLOCK DIAGRAM

The system design of this product comprises of two sections as mentioned earlier. They are transmitter and receiver section.



**Graphic 1.** Transmitter Block Diagram.



**Graphic 2.** Receiver Block Diagram.

## **2.2. BLOCK DIAGRAM DESCRIPTION**

### **PIC Controller**

A PIC Micro controller will go about as an ace controller for the development of the robot. It is in charge of the considerable number of choices taken by the robot. The PIC microcontroller here which we use is PIC 16F877.

### **Content to Speech Module**

An instant message is changed over to voice by the content to discourse module RC8650 and is sustained as a contribution to the speaker, so the speaker responds to it. It is the most recent rendition of IC where we can store and erase the client's voice. RF Modem

This unit is utilized to transmit and get the low power UHF remote information transmission. The information can make a trip up to 500 meters with 433.867MHz. The information is transmitted through a receiving wire, which is gotten by the collector reception apparatus. Sort of adjustment utilized here is FSK tweak.

### **PC UART**

The ST16C550 is an improved form of the NS16C550 UART with higher working velocity and lower access time. The ST16C550 on board status registers gives the blunder conditions, type and status of the exchange task being performed. Included is finished MODEM control capacity, and processor interfere with framework that might be programming custom-made to the client's necessities. The ST16C550 gives inside loopback capacity to on board symptomatic testing. The ST16C550 is accessible in 40 stick PDIP, 44 stick PLCC, and 48 stick TQFP bundles. It is created in a progressed CMOS procedure to accomplish low channel power and rapid prerequisites.

## **3. RESULTS AND DISCUSSIONS**

### **3.1. GENERRAL DESCRIPTION**

1. This unit is used to transmit and receive the very low power UHF wireless data transmission.
2. The data can travel up to 500 meters with 433.867 MHz.



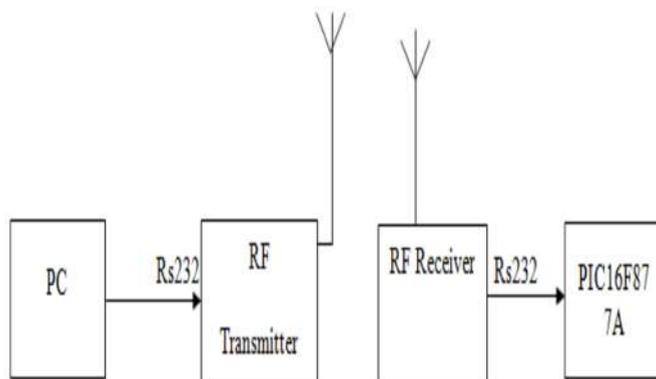
1. The Low-noise Amplifier amplifies the RF signals.
2. The amplified signals are converted into intermediate frequency by means of the Mixer, and then the signals are amplified and filtered before it reaches the demodulator.
3. After the signals are demodulated it sends to the RFBUF, from the buffer it sends to the serial port.

- **RF Transmitter**

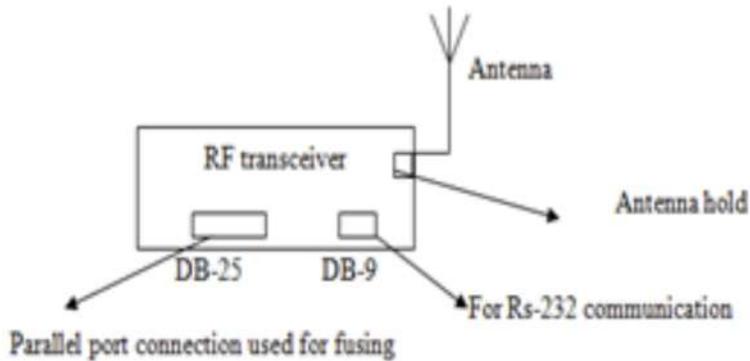
1. After the frequency gets synthesized it is fed to the Power Amplifier.
2. Where it gets amplified and fed into RFBUF, from where it transmits the 433MHz data.

- **Testing Procedure**

1. Connect the communication cable to the DB-9 of the RF Interface Unit. The other end of the cable is connected to the PC; antenna should mount on the antenna mountable hole.
2. Like the above procedure connect the other unit to the PC or CMRI
3. Now the two units are ready for RF Transmission, now fuse the program SIT-ERF.hex in the IC CC1010 by the procedure as explained.
4. This unit can be fused easily by means of the parallel port



**Graphic 4.** Connection Diagram 1.



**Graphic 5.** Connection Diagram 2.

5. When there is problem in fusing, check the power supply of the unit & the parallel port connection with the PC.
6. Check the voltages in 4245A (i.e. input signals is 5V and the output signals in 3.3V).
7. After it had been successfully fused the both the units, follow the steps as below
8. Go to PCTERM in two PC's select the baud rate selection as 9600, N.
9. Type the characters, and then that character will receive on the other side of the PC By this manner check on both the side.
10. When the characters received correctly on both sides, then we can say that the unit is ready for data transmission.
11. When the data doesn't reach check the battery voltage whether the voltage is greater than 7 volts.
12. Check the comm. Port connection on both the PC's and CMRI. If the is cable is correct check the transmit & receive pin in the DB-9 connector.
13. Check the signals in the MAX232 input and output pins. If the signal arises check the TX and Rx in the IC CC1010.
14. If TX not proper refuses the IC, even though there is the problem change the IC.



**Graphic 6.** Input Setup.



**Graphic 7.** Output Setup.

#### **4. CONCLUSIONS AND FUTURE ENHANCEMENT**

So, we presume that in our proposed arrangement of the voice sign achieves the goal immediately. There are further strategies to transmit an instant message into a voice signal one point to another. Be that as it may, our proposed framework assumes a noteworthy job in huge scale ventures where the message can't be conveyed at every single substation by more recognizable expert himself. In this manner our proposed framework has a simple method for moving information starting with one point then onto the next without clamor. Our proposed framework can be utilized in medical clinics where there can be data passed from an attendant to the specialist in regards to the patient. There will be no aggravation to other people while passing data between the specialist and any others in medical clinic. This can be executed in future.

## **5. REFERENCES**

- A.Godse**, (2005). Concepts of micro controller 3rd edition Technical Publication.
- Deny,J, G.Sridhar, M.Muneeswaran**, (2016). Implementation of Bidirectional Dc-Dc Converter For Aerospace Applications, International Journal of Pharmacy & Technology, Vol. 8, Issue 3
- Deny, J., & Sivasankari, N**, (2015). Approaches to Iterative Speech Feature Enhancement and Recognition using HMM and Modified HMM.
- H.L.Bertoni**, (1987). Radio Propagation for Modem Wireless Systems, Prentice Hall.
- Jack Smith**, (1989). Programing the PIC Microcontroller by Using Basic Embedded Technology, Hardcover Publication,5th Edition.
- Sudharsan, R. R., & Deny, J.** (2020). Field programmable gate array (FPGA)-based fast and low-pass finite impulse response (FIR) filter. In Intelligent computing and innovation on data science (pp. 199-206). Springer, Singapore.
- Sudharsan, R. R., Deny, J., Kumaran, E. M., & Geege, A. S.** (2020). An analysis of different biopotential electrodes used for electromyography.
- Deny, J., & Sudharsan, R. R.** (2020). Block rearrangements and TSVs for a standard cell 3D IC placement. In Intelligent Computing and Innovation on Data Science (pp. 207-214). Springer, Singapore.
- Deny, J., Sudharsan, R. R., & Kumaran, E. M.** (2021). An orbicularis oris, buccinator, zygomaticus, and risorius muscle contraction classification for lip-reading during speech using sEMG signals on multi-channels. International Journal of Speech Technology, 1-8.
- Sudharsan, R. R., Deny, J., Muthukumaran, E., & Selvi, S. C.** (2020). Design, implementation, and estimation of MFCV for 4-different position of human body using FPGA. Microelectronics Journal, 105, 104890.
- Sudharsan, R. R., Deny, J., Muthukumaran, E., & Varatharajan, R.** (2021). FPGA based peripheral myopathy monitoring using MFCV at dynamic contractions. Journal of Ambient Intelligence and Humanized Computing, 12(7), 7019-7027.

- Krishna, R. R., Kumar, P. S., & Sudharsan, R. R.** (2017, March). Optimization of wire-length and block rearrangements for a modern IC placement using evolutionary techniques. In 2017 IEEE international conference on intelligent techniques in control, optimization and signal processing (INCOS) (pp. 1-4). IEEE.
- Sudharsan, R. R.** (2019, December). Synthesis of FIR Filter using ADC-DAC: A FPGA Implementation. In 2019 IEEE International Conference on Clean Energy and Energy Efficient Electronics Circuit for Sustainable Development (INCCES) (pp. 1-3). IEEE.
- Perumal, B., Deny, J., Sudharsan, R., Muthukumaran, E., & Subramanian, R.** (2021). Analysis of Amplify Forward, Decode and Amplify Forward, and Compression Forward Relay for Single and Multi-node Cognitive Radio Networks.
- Deny, J., Sundarajan, M., Sudharsan, R., Muthukumaran, E., & Perumal, B.** (2021). Reduction of speckling noise of SAR Images using Dual Tree Complex Wavelet (DTCW) and Shearlet Transforms.
- Perumal, B., Aravind, C., Deny, J., & Rajasudharsan, R.** (2021, August). Detection of Food Adulteration using Arduino IDE. In 2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC) (pp. 262-267). IEEE.
- Deny, J., & Sudharsan, R.** (2021). Recognition of Tumours in Human Cerebrum.
- Kumar, D. M., Arthi, R., Aravindhan, C., Roch, A. A., Priyadarsini, K., & Deny, J.** (2021). Traffic Congestion Control Synchronizing and Rerouting Using LoRa. *Microprocessors and Microsystems*, 104048.
- Wan, X., Zhang, K., Ramkumar, S., Deny, J., Emayavaramban, G., Ramkumar, M. S., & Hussein, A. F.** (2019). A review on electroencephalogram based brain computer interface for elderly disabled. *IEEE Access*, 7, 36380-36387.
- Deny, J., Muthukumaran, E., Ramkumar, S., & Kartheeswaran, S.** (2018). Extraction of respiratory signals and motion artifacts from ppg signal using modified multi scale principal component analysis. *International Journal of Pure and Applied Mathematics*, 119(12), 13719-13727.
- Sakthimohan, M., & Deny, J.** (2020). An Enhanced 8x8 Vedic Multiplier Design By Applying Urdhva-Tiryakbhyam Sutra. *International Journal of Advanced Science and Technology*, 29(5), 3348-3358.

**John Peatman**, (2000). Design of PIC Microcontrollers 2nd edition, Technical Publication.

**M. Muneeswaran, P. Jenopaul, R. Sundaraguru, G. Sridhar, J. Deny and M. Sreedevi**, (2012). Real Implementation of Arm 9 Processor Based Digital Private Branch Exchange. Journal of Mobile Communication, DOI: 10.3923/jmcomm.2012.38.42

**J.Deny, G.Sridhar, M.Muneeswaran**, (2016). Implementation of Bidirectional Dc-Dc Converter for Aerospace Applications, International Journal of Pharmacy & Technology, Vol. 8, Issue 3.

**Rajkamal**, (1998). The concepts and features of micro controller, Prentice Hall.



# **A REVIEW ON: DISCONTINUITY AND SIMILARITY BASED SEGMENTATION METHODS**

**Kalaiyarasi Alagumani**

*Department of Electronics and Communication Engineering,  
V.S.B. Engineering College, Karur District, Tamil Nadu, (India).*

Email ID: mukalaiyarasi@gmail.com, <https://orcid.org/0000-0001-9306-2654>

**Perumal Balasubramani**

*Department of Electronics and Communication Engineering, Kalasalingam  
Academy of Research and Education, Virudhunagar District, Tamil Nadu, India.*

Email ID: palanimet@gmail.com, <https://orcid.org/0000-0003-4408-9396>

**Pallikonda Rajasekaran Murugan**

*Department of Electronics and Communication Engineering, Kalasalingam  
Academy of Research and Education, Virudhunagar District, Tamil Nadu, India.*

Email ID: m.p.raja@klu.ac.in, <https://orcid.org/0000-0003-4408-9396>

## **ABSTRACT**

Digital Image Processing (DIP) is an indispensable job in numerous appliances to recover essential data from the original input image such that, it has not influenced different attributes of the image. Image segmentation (IS) is one of the most significant actions in IP which is utilized to segment the image into a few separate subsets with the end goal that, every subset relates to an eloquent fragment of the image. The objective of image partitioning is, to group pixels into striking image locales comparing to distinct exteriors, substances, or usual parts of substances. With the developing research on IS, numerous strategies had been proposed and translated in an unexpected way towards content investigation and image understanding for various applications. Therefore, an organized review on IS techniques is important, and this paper gives a survey on different IS techniques that are generally based on discontinuity and similarity attributes that are used to segment the original image.

**Keywords:** Image Processing, Neural Network, Threshold, Segmentation, and clustering.

## **1. INTRODUCTION**

Digital image processing is having many recent applications in the fields of remote sensing, medicine, photography, film and video production, security monitoring and etc., DIP is an integrative activity, it has various types of procedures, for example, image illustration, separation, constriction, and renovation. IS is characterized as a

procedure of separating an original image into similar gatherings with the end goal that every locale is homogenous but the association of no two neighboring locales is homogenous (Chenh *et al.*, 2001; Sivakumar and Meenakshi, 2016) IS is a fundamental part of image analysis which is utilized to excerpt the required data from an input image in a reasonable and important approach to satisfy the needs of users. It has been utilized for object acknowledgment, edge approximation within movable and stereophonic systems.

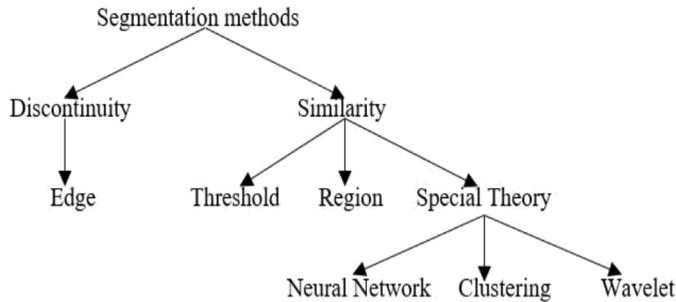
IS is a crucial issue in numerous applications, for example, restorative image preparing, bio measurements, object following an acknowledgment, vide, and computer vision applications (Hui *et al.*, 2008; Peng *et al.*, 2011). IS has been applied for a number of various types of applications such as image analysis and synthesis (Rui *et al.*, 1996). Even though there are a number of segmentation techniques that have been developed, still there is no suitable segmentation technique has been developed for different types of images (Kalaiyarasi *et al.*, 2021). The most generally utilized image segmentation strategies are Edge, Threshold, Region, Fuzzy and Neural Network-based segmentation (K. K. Singh and A. Singh, 2010).

This review paper audits the different IS systems developed in exploration writing. Section 2 depicts the idea and procedure of IS. Section 3 gives different discontinuity based IS methods. Section 4 describes the similarity based segmentation methods. Section 5 presents the analysis and discussion about the various segmentation techniques and Section 6 concludes the paper.

## **2. METHODOLOGIES**

Quality enhancement of an image is a difficult problem for portioning an image in IP. A nature of IS ought to give unwavering quality, lack of concern, lucidity, and reputability. It is valuable for disengaging the limits of any image as numerous portions dependent on the characteristics of an image incorporates shading, pixel values, and the surface of that image. IS systems have been isolated into two classifications, for example, Discontinuities and Similarities based – In discontinuity based segmentation, a subdivision of images is completed based on changes in the force of dim degrees of an image. Here, an image is apportioned dependent on sudden changes in force and this incorporates IS calculations like edge detection. In Similarities based segmentation, a subdivision of images is done based on likenesses in force of dim degrees of an image. Here, an image is separated into areas that are comparable as indicated by a lot of predefined measures and this incorporates IS techniques like thresholding, region growing, region splitting and merging. The different IS proce-

dures have been developed dependent on the above determined two classifications of segmentation strategies as appeared in Figure.1 are portrayed as the following,



**Figure 1.** Classifications of segmentation Techniques  
(Chakshu Puri & Sukhwinder Singh, 2014)

### 3. BASED ON DISCONTINUITY

#### 3.1.Edge Detection

It separates an image into locales from its surroundings. This method partitions an image by perceiving the adjustment in force of an image. There are various edge detection strategies used for IS. The most usually utilized edge detection techniques are Roberts, Sobel, Prewitt, Kirsh, Robinson, Marr-Hildreth and Canny Edge Detection methods

#### 3.2. Sobel edge detection

The Sobel edge detection operation extricates all of the edges in an image, paying little respect to the course. Sobel operation has the upside of giving both a differencing and smoothing impact. It is actualized as the aggregate of two directional edge upgrade activities. The subsequent image shows up as a unidirectional diagram of the articles in the original image. Steady brilliance areas become dark while changing the splendor area becomes featured.

#### 3.3. Roberts Edge Detection

This method plays out a straightforward, 2-D spatial slope estimation on an image. This strategy accentuates areas of high longitudinal recurrence which regularly compare the corners of an image. The input to this method is a grayscale image equivalent to the yield output is the most widely recognized use for this strategy. Pixel values in each point in the output represent the evaluated total extent of the spatial inclination of the original input image.

### 3.4. Canny edge detector

At first, an image is taken and it is to segment by utilizing a canny edge detection strategy. For this, first, the image is changed over from rgb to gray. The initial procedure is to sift through any unwanted data in the input image earlier attempting to find and recognize the edges. The Gaussian filter is utilized to remove the noises in the input images. Subsequent to smoothing the image and dispensing with the noise, the following stage is to discover the corner quality by captivating the slope of the image. Then the surmised outright slope size edge quality at each point is found by assessing the angle in the x-course sections and the other evaluating the inclination in the y-heading lines. Non greatest concealment is utilized to follow along the edge in the edge bearing and smother any pixel worth sets it equivalent to 0 that is not viewed as an edge. This provides a flimsy line in the yield image. Hysteresis is utilized as a method for dispensing with streaking. Streaking is the separating of an edge form brought about by the administrator yield fluctuating above and beneath the limit. To maintain a strategic distance from the edge, resemble a dashed line, hysteresis utilizes two limits, a high and a low. Accordingly, an image is fragmented by utilizing edge detection.

## **4. BASED ON SIMILARITY**

### 4.1. Thresholding

Thresholding based segmentation is one of the least complex way to segment the image depends on the image threshold. The threshold is chosen to change over a grayscale image into a binary image. The pixels over the threshold are viewed as obvious qualities in the double image, and the pixels underneath it is viewed as false. Threshold based segmentation gives significant data about the shape and position of an item. It tends to be determined with various procedures such as the Otsu, physically, p-tile and significantly more. The choice of the threshold value is significant for the segmentation process.

The image threshold value can be obtained either globally or locally (Chakshu and Singh, 2014). Global thresholding recognizes required locale from the foundation pixels by contrasting and edge worth picked and utilize digital partitioning to section the image. Local thresholding is likewise called as versatile thresholding. In this procedure, the threshold value changes over the image contingent upon the neighborhood normal for the subdivided locale of the image, and visual method.

#### 4.1.1. Local Thresholding

The local threshold depends on the normal gray value and force estimation of the original image. This technique partition input image into a few subregions and for each sub-area chooses distinctive Threshold value independently. Neighborhood thresholding techniques are 2-D entropy-based, histogram, and direct genuine thresholding, etc (Kang *et al.*, 2009).

#### 4.1.2. Global Thresholding

This method is utilized when there the intensity dissemination among the substances of frontal area and foundation are unmistakable. The contrasts between frontal area and foundation articles are much different, a solitary estimation of an edge can just be used to isolate the two objects separately. Hence, in this sort of thresholding, the estimation of the threshold depends exclusively on the characteristics of the pixel and the dim level estimation of the image. Most basic utilized worldwide thresholding techniques are Otsu strategy, entropy-based thresholding, and so forth (Huang and Chen, 2004).

#### 4.1.3. Adaptive Thresholding

Then the threshold value is set by getting the mean of the most extreme pixel size of image and least pixel size of the image. This value is used for the segmentation by fundamental thresholding system. The pixels fall inside the threshold value becomes one portion and above the threshold value becomes another fragment. Moreover, the procedure is rehashed, until the threshold value becomes unmatched with the pixel value. The threshold value additionally repeatedly acquires for each section. Hence an image is partitioned utilizing adaptive thresholding procedure.

#### 4.2. Region based

In this procedure, pixels are identified with a similar item that is gathered for segmentation. The territory that is recognized for separation ought to be shut. District based segmentation is likewise named as Similarity Based Segmentation. There will not be any hole because of missing limit pixels in this area-based division the limits are distinguished for segmentation. In the wake of distinguishing the adjustment in the color and surface, the threshold value is changed over into a vector. From this, the threshold value has been recognized further separation of image.

#### 4.2.1. Single Seeded Region Growing

A solitary seed is taken and utilizing this seed all the pixels identified with this seed frames the area. The situation of the seed point is given, in the event that it isn't given, it is chosen arbitrarily. In this execution, the most extreme force separation defaults to 0.2. The region is recursively created by differentiating all unallocated neighboring pixels with the area. The refinement between a pixel's force esteem and the locale's mean is used as a proportion of likeness. The pixel with the littlest contrast estimated is dispensed to the separate area. This procedure stops when the force distinction between locale mean and new pixel becomes bigger than a specific threshold. At last, the yield picture is given by consolidating the two locales. Hence segmented mage utilizing single seed locale developing is framed.

#### 4.2.2. Region Splitting and Merging

It is a top-down procedure, it starts with an entire image and partitions it up to such an extent that the isolated parts are more similar than the entire image. Thus, a merging stage after the splitting is continuously attractive, which is named as the split-and-merge technique. Any area can be part of sub locales, and the fitting areas can be converged into a region. Rather than choosing seed points, the user can divide an image into a set of arbitrary unconnected regions and then merge the regions (Kang *et al.*, 2009; Zhang *et al.*, 2008; M. Rastgarpour, and J. Shanbehzadeh, 2011; H. G. Kaganami, Z. Beij, 2009; Pham *et al.*, 2000; Zhang,2001) trying to fulfill the states of sensible image segmentation. Region splitting and merging are generally actualized with hypothesis dependent on quad tree information.

### 4.3. Special Theory

#### 4.3.1. Neural Network

Neural systems (NN) are frameworks of interrelated neurons for the determination behind communication with each other and compute values (Andrea *et al.*, 2006). ANN is an artificial portrayal of the human mind which is utilized to reenact the learning procedures of cerebrum for basic leadership process. NN that recreates the human cerebrum's learning techniques establishes an enormous number of parallel hubs. Every hub can play out some essential processing. The learning procedure can be accomplished by moving the associations among hubs and association weight. Neural networks have been broadly used to take care of the issue of therapeutic image segmentation and it lessens the necessities of master mediation during the segmentation process.

In the neural network, each neuron is comparing to the pixel of an image and the image is mapped to the NN. The image in the form of the neural network is trained using training samples, and after that association between neurons have been originated. At that point, the new images are fragmented from the trained image. In NN, an image is viewed as a mix of fragments in which image information are similar furthermore, the two factors that are utilized to decide the image sections are: (i) Classification of all pixels that fulfill the basis of homogeneousness. (ii) Detection of all pixels on the outskirts between various homogeneous zones. Segmentation of the image by utilizing the NN is performed in two stages that incorporate pixel arrangement and threshold identification. A NN utilizing threshold identification sort out each pixel is either part of a threshold or not. The pixel-based NN arrange the image substance dependent on the blend of surface and local shape. NN have additionally been produced for pre and post handling ventures in connection to segmentation.

#### 4.3.2. Clustering

Clustering techniques use a cluster of comparable properties of the image like pixel, color, and boundaries for sectioning an image. An original image is partitioned into clusters dependent on the comparative properties incorporate separation, availability, and force esteems. A similarity criterion is characterized among pixels and after that comparable pixel is assembled together to shape clusters. The gathering of pixels into bunches is based on the standard of augmenting the intraclass comparability furthermore, boosting the bury class comparability. Clustering does not use training data rather they reiterate between partitioning the image and portraying the characteristics of each class.

This method has been characterized into two classes, for example, hard and soft clustering. In hard clustering, information is isolated into various interesting clusters where every datum segment has a place with precisely in one group. Fuzzy K-means is the most recently utilized hard clustering. In soft clustering, information components can have a place with more than one group with a level of certain relationship esteems. Fuzzy clustering separates the information pixels into a cluster based on different similitude.

#### 4.3.3. Wavelets

Wavelet transform (WT) decays SAR image by means of an arrangement of basic functions, made from expansions and interpretations of premise functions known as mother wavelet. Wavelet transform can be actualized by utilizing a pair of LPF and HPF which are represented to by a grouping of coefficients

IS based on the wavelet technique has been completed in two phases. In the principal stage, the input image is decayed into squares of pixels and a WT is performed to every square to recognize the similar area of the required region, then transfer the whole square to a cluster. The underlying separation distinguishes hinders with comparative characteristics, clustering them into relating clusters. In the subsequent stage, non-homogeneous locales for occurrence squares are situated in boundaries among various locales are identified. Finally, segmented images have been recognized more absolutely (Senthilkumaran and S. Vaithegi, 2016; Stollnitz, 1996).

## 5. RESULTS AND DISCUSSION

On watching these systems, threshold identification yields better outcome with images that are having fine characteristics which includes bloom, waterway and satellite images. Thresholding procedure is ideal with images that are having fewer characteristics, for example, face and natural product images. Region growing methods, separate the images into parts as indicated by highlights in the image. Clustering-based segmentation partitions the images based on the color features of the original image. After analyzing these various types of strategies, region growing and thresholding produces preferable outcomes over clustering and threshold detection techniques. The merits and demerits of various methods are presented in table.1

**Table 1.** Comparison of image segmentation techniques (Senthilkumaran &Vaithegi, 2016)

SEGMENTATION METHODS	MERITS	DEMERITS
Edge Detection	<ul style="list-style-type: none"> <li>• Works well for the images having good contrast between the object and the background.</li> </ul>	<ul style="list-style-type: none"> <li>• Does not work well with images in which the edges are illdefined or there are too many edges.</li> </ul>
Thresholding	<ul style="list-style-type: none"> <li>• Simple to implement.</li> <li>• Fast (especially if repeating on similar images).</li> <li>• Good for some kinds of images (documents, controlled lighting).</li> </ul>	<ul style="list-style-type: none"> <li>• The detected threshold are consisted of discrete pixels and may be incomplete or discontinuous.</li> </ul>
Region Based	<ul style="list-style-type: none"> <li>• Gives better results when the homogeneity the criterion is easy to define.</li> <li>• More noise immune than edge detection approach.</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive in both computational time and memory.</li> </ul>
Neural Network	<ul style="list-style-type: none"> <li>• Can fully utilize the parallel nature of neural networks.</li> </ul>	<ul style="list-style-type: none"> <li>• Initialization may affect the result.</li> <li>• Overtraining should be avoided.</li> </ul>
Clustering	<ul style="list-style-type: none"> <li>• Easy to implement.</li> <li>• An instance can change cluster when the centroids are recomputed.</li> </ul>	<ul style="list-style-type: none"> <li>• Time complexity.</li> <li>• Initial seeds have a strong impact on the final results.</li> <li>• Difficult to predict the number of clusters.</li> </ul>
Wavelet	<ul style="list-style-type: none"> <li>• Able to separate the fine details of an image.</li> <li>• Small wavelets can be used to isolate very fine details, while large wavelets can identify coarse details.</li> </ul>	<ul style="list-style-type: none"> <li>• Consumes more time if the image is large</li> </ul>

## 6. CONCLUSION

In this paper, we have reviewed different segmentation methodologies. Here, six various segmentation methods such as Edge detection, Thresholding, Region based, Clustering, Wavelet and Neural networks are discussed. Each method has its own merits and demerits. Upon comparing the merits and demerits of different methods, we can conclude that, neural network methods can yield better outcome when compared with other methods. Further to improve the neural networks performance, optimization method can be used together with networks. On the other hand, there are different kinds of images such as medical images, SAR images, satellite images, and digital images are there. Even though, different kinds of segmentation techniques are available to segment different types of images, there is still no broad segmentation technique is available to segment all kind of images. Therefore, in this paper, we conclude that, in future there is a necessity of optimization based neural network segmentation method for segmenting all kinds of images.

## REFERENCES

- Andrea Gavlasov, Ale Prochazka. & Martina Mudrov||.** (2006). Wavelet Based Image Segmentation. In Proceedings of the 14th Annual Conference Technical Computing, Prague, 2006, pp.1-7.
- Bo Peng, Lei Zhang. & David Zhang.** (2011). Automatic Image Segmentation by Dynamic Region Merging. *IEEE Transactions on image processing*, 20 (12), 2011. Doi: 10.1109/TIP.2011.2157512.
- ChakshuPuri, & Sukhwinder Singh,**(2014). Image Segmentation and Classification- A Review. *International Journal of Innovative Research in Science, Engineering and Technology*, 3 (4), pp.11468-11471.
- Cheng, H.D., Jiang, X.H., Sun, Y.& Wang, J.** (2001). Color image segmentation: advances and prospects. *Pattern Recognition*, 34 (12), pp. 2259-2281. Doi: 10.1016/S0031-3203(00)00149-7.
- Huang, Y.L. & Chen, D.R.** (2004). Watershed segmentation for breast tumor in 2-D sonography. *Ultrasound in Medicine & Biology*, 30(5), pp.625-632. Doi: 10.1016/j.ultrasmedbio.2003.12.001.
- Hui Zhang, Jason E. Fritts. & Sally A. Goldman.** (2008). Image segmentation evaluation: a survey of unsupervised methods. *Computer Vision and Image Understanding*, Elsevier, pp. 260-280. Doi: 10.1016/j.cviu.2007.08.003.

- Jogendra Kumar, M., Raj Kumar, G.V.S. & Vijay Kumar Reddy, R.** (2014). Review on image segmentation techniques. *International Journal of Scientific Research Engineering & Technology*, 3 (6), pp.992-997. doi:10.14257/ijsep.2016.9.5.18.
- Kaganami, H.G. &Beij, Z.** (2009). Region Based Detection versus Edge Detection. *IEEE Transactions on Intelligent information hiding and multimedia signal processing*, pp. 1217-1221.
- Kalaiyarasi, M. Perumal, B. Pallikonda Rajasekaran, M. & Saravanan, S.** (2021). Color-Based SAR image segmentation using HSV+FKM clustering for estimating the Deforestation rate of LBA ECO LC-14 Modeled Deforestation Scenarios, Amazon Basin: 2002-2050. *Arabian Journal of Geosciences*, 14(9):777.
- Kang, W.X., Yang, Q. Q. & Liang, R.R.** (2009). The Comparative Research on Image Segmentation Algorithms. *IEEE Conference on ETCS*, pp. 703-707.
- Sivakumar, P, & Meenakshi, S.** (2016). A review on image Segmentation techniques. *International journal of advanced research in computer engineering and technology*, 5(3), pp.641-647.
- Pham, D.L., Ch. Xu. &Princo, J.L.** (2000). A survey on current methods in medical image segmentation. *Annual Review of Biomedical Engineering*, 2, pp. 315-337. Doi:10.1146/annurev.bioeng.2.1.315.
- Rastgarpour, M. &Shanbehzadeh, J.** (2011). Application of AI Techniques in Medical Image Segmentation and Novel Categorization of Available Methods and Tools. *Proceedings of the International Multi Conference of Engineers and Computer Scientists*, 1.
- Rui, Y., She, A.C. & Huang, T.S.** (1996). Modified Fourier descriptors for shape representation—a practical approach. In *Proceedings of the First International Workshop on Image Databases and Multi Media Search*, pp. 284-295.
- Senthilkumar, N. &Vaithegi, S.** (2016). Image segmentation by using thresholding techniques for medical images. *Computer Science & Engineering: An International Journal (CSEIJ)*, 6 (1), pp. 1-13. Doi:10.5121/cseij.201606101.
- Singh, K. K. & Singh, A.** (2010). A Study of Image Segmentation Algorithms for Different Types of Images. *International Journal of Computer Science Issues*, 7 (5).

- Stollnitz, E.J., DeRose, T.D. & Salesin, D.H.** (1996). *Wavelets for Computer Graphics*. Morgan Kaufmann Publishers, Inc., San Francisco, CA, USA.
- Zhang, H., Fritts, J.E. & Goldman, S.A.** (2008). Image Segmentation Evaluation: A Survey of unsupervised methods. *Computer vision and image understanding*, pp.260-280. Doi:10.1016/j.cviu.2007.08.003.
- Zhang, Y.J.** (2001). An Overview of Image and Video Segmentation in the last 40 years. *Proceedings of the 6th International Symposium on Signal Processing and its applications*, pp. 144-151.



# **AN INVESTIGATION ON COLOCALIZATION IN WOUND HEALING ASSAY AND INTERPRETATIONS WITH EZCOLOCALIZATION PLUGIN**

**Dr.S.Bama**

*Associate Professor, Department of Electronics and Communication Engineering,  
Kalasalingam Academy of Research and Education, India*

Email ID: [bama.s@klu.ac.in](mailto:bama.s@klu.ac.in), <https://orcid.org/0000-0002-9450-0692>

**Dr.R.Velumani**

*Independent Researcher, Tamilnadu, India,*

Email ID: [velumaniramesh@yahoo.com](mailto:velumaniramesh@yahoo.com), <https://orcid.org/0000-0002-9349-6919>

**Dr.D.Selvathi**

*Senior Professor /ECE MEPCO Schlenk ERngineering College Sivakasi, Tamilnadu, India,*

Email ID: [dselvathi@mepcoeng.ac.in](mailto:dselvathi@mepcoeng.ac.in), <https://orcid.org/0000-0003-1159-3879>

## **ABSTRACT**

Wound-healing assay is a protocol for studying cell mobility and migration in wound repair process. It is carried out by processing time-lapse images of a wound formed by scratching a confluent cell culture. The spatial associations between the concentrations of biomolecules in these images exhibit the progress of wound healing process. This association is quantified based on image similarity metrics termed, colocalization measures. Similarly, quantification of cytoskeletal responses to mechanical treatment of wound is vital for monitoring the wound repair process. This procedure is unique to different cytoskeletal structures and requires extensive computations with microscopic images. This paper proposes a simple and effective approach for monitoring the wound healing process based on colocalization analysis by visualization and analysis of various quantitative metrics irrespective of the cytoskeletal structure and the Glycosaminoglycans (GAGs) employed in the treatment of wounds. This investigation is performed with imageJ software with the ezcolocalization plugin on two pairs of images in a standard dataset and a pair of synthetic images generated with a simulation cell staining tool. The experimental results show that, colocalization can be integrated in wound healing assay workflow for reliable metrics for better interpretations, diagnosis and prognosis.

**Keywords:** wound healing, colocalization, ImageJ, ezcolocalization.

## 1. INTRODUCTION

Advances in medical imaging technologies have simplified many clinical procedures. Confocal images of wounds are commonly captured for monitoring the progress of wound repair. Generally, wound healing comprises the homeostasis, inflammation and remodeling phases. Monitoring the healing response of an injured tissue is vital for diagnosis and prognosis. The scratch assay [B.I. Pinto *et.al*, C. Liang *et.al*, B.I. Pinto *et.al* ] enables the investigator to collect representative cell migration data to extract translational physiologic information essential for the formulation of drug dosages, treatments protocols etc. This protocol involves the creation of a wound in a cell monolayer, microscopic image acquisition at regular intervals and comparing the images to quantify the migration rate of the cells.

Studies on cell migration during wound healing are based on Epithelial to Mesenchymal Transition (EMT). These approaches predominantly focus on the migration of individual cells, ignoring collective cell proliferations [S. Barber ]. This results in the failure to capture migratory dynamics of wounds. To overcome this limitation, recently Varankar and Bapat [A. Grada *et.al*] proposed a quantitative approach to assess cell migration using the displacement, velocity and number of nearest neighbours metrics.

Wound management requires accurate wound assessment. Medical practitioners manage wound healing visually and physiologically in multiple dimensions employing several wound specific parameters for assessing wound characteristics. Many such methods based on measuring the wounds by length, width, surface area, volume [S. Barber ] etc. have been reported in literature. Quantitative metrics such as wound width, wound area and relative wound density computed from microscopic images are used to assess the wound healing process [A. Grada *et.al* ]. Generally, Student's t-test is employed in the comparison of two samples in this process. Further, to compare three or more sets of data, it requires variance analysis with multiple testing corrections.

Confocal fluorescence microscopy is the common imaging modality for capturing the profile of the wounds due to its merits such as high spatial resolutions, optical sectioning of cells and faster data acquisition. Confocal microscopic images of bio-molecule pairs evaluate the spatial association between them, quantifying [S.Wang] the co-occurrence and correlation between them. Generally, colocalization is performed with pixel-based and object-based methods. Pixel-based methods determine various

correlations between the channels analyzing the pixels in the candidate channels. Object-based methods exploit the spatial information in the channels, identify the objects in the images and compare the objects between the channels. Bolte *et al* [S. Bolte] present a detailed review of pixel-based colocalization methods by Manders, Costes, van Steensel and Li. They also discuss object-based approaches and emphasize the significance of image segmentation in these methods, as different colocalization results are produced due to different segmentations.

Colocalization is a promising method to quantify cell migration under different experimental conditions. The scratch assay protocol is employed in the study of cellular migration in the wound healing process. It finds applications in the identification of therapies to promote cell migration in wound healing, studies on the inhibitor interactions, monitoring the effect of therapeutic drugs treating ulcers, skin lesions, cancer metastasis etc.

Review of literature on wound healing show that, wound healing approaches are discrete and specific to the nature of the wound. Similarly, methods for quantification of cytoskeletal structures need to be customized due to varying parameters of the fibers such as connectivity, inter-filament distance, straightness etc. This paper presents a novel approach for wound healing assay integrating image deconvolution and colocalization, irrespective of the protocol employed in wound healing and cell culture in wound scratch assays, for better interpretations in planning clinical procedures. The experimental results obtained with the ezcolocalization plugin of the imageJ software testify the efficacy of the proposed approach in the colocalization of monolayer assays and quantification of actin and tubulin interactions during wound healing.

Rest of this paper is organized as below. Section II presents a detailed review on prior researches on wound healing and colocalization, A discussion on the materials and methods employed in this paper in Section III. Experimental works along with statistical and visual results are presented in Section IV followed by a thorough discussion of results in section V. The paper is concluded in Section VI followed by references.

## **2. BACKGROUND**

Colocalization studies are performed to assess the geometric codistribution of a pair of proteins or molecular structures, each of which is tagged by distinct fluorescent labels. Various quantitative metrics for colocalization evaluation are discussed by Taylor *et al*. The linear and monotonic correlations that quantify the covariance of

the probe concentrations are evaluated with the Pearson's Correlation Coefficient (PCC) and Spearman's Rank Coefficient (SRC) respectively. Similarly, Manders Split Coefficient which is proportional to the amount of fluorescence of the colocalizing pixels in each colour channel measures the fraction of the signals' total gray-scale intensity that co-occupies the same pixels.

Wound healing is a complex process in which the damaged tissue is replaced by a new functional tissue in which, Glycosaminoglycans (GAGs) play a major role due to their ability to bind to a large array of proteins. GAGs are found in all connective tissues of the body, Extracellular Matrix (ECM) and on the surfaces of many cell types. Investigations on the pathobiology of the wound healing process facilitate the formulation of therapeutic approaches, which improve wound healing. Melrose *et.al* present a detailed analysis of the role of different types GAGs in the treatment of diabetic ulcers, bone and vascular repair. Hyaluronan (HA) is a prominent glycosaminoglycan (GAG) in fetal wounds, which interacts with cellular proteins, with great impacts on diverse physiological [Pomin *et.al*] processes including wound repair. A detailed discussion on the pharmaceutical applications of GAGs is presented in [Y. Monneau *et.al*]. Colocalization studies on different GAGs are presented in [S.Wang *et.al*]

The growth of new blood vessels from existing blood vessels, called angiogenesis is a vital process in wound repair, which is promoted by the quantity of Vascular Endothelial Growth Factor (VEGF) in a wound. Though the role of VEGF in wound repair is well-established, further studies are required for understanding the activities of VEGF during wound healing. The implications of VEGF in normal and pathological angiogenesis spanning wound healing and repair, metastasis, diabetic retinopathy, inflammatory process is reviewed by Melincovici *et al*. [R. Springer *et.al*].

Cytoskeleton, a network of actin filaments, microtubules and intermediate filaments is a major component of wound repair. Study of cytoskeletal responses is highly significant in the wound healing process. Actin and microtubules are highly dynamic and their interaction provides a clear indication on the growth and migration of neurons in the wound healing process. Microtubules play a significant role in the very stringently regulated cell migration process during wound healing. It has been reported that actin and microtubulin respond to mechanical stress during wound healing, according to which the cells adapt their functions and morphologies. It is clearly evident that VEGFs and GAGs have a significant influence on the cytoskeletal structures.

Contributions of actin and microtubulin to cell reorientation is investigated from cell straining experiments. Reorientation of cell body has been identified as the response of cell straining. Though reorientation is evidenced in the three types of cytoskeletal structures, it is unique to the individual cytoskeletal network. Research findings have shown that, cyclic stretch increases the correlation of direction of the actin and microtubule fibers. A detailed analysis of cytoskeletal reorientation is presented by Springer *et al.* The authors thoroughly review various methodologies on the quantification of cytoskeletal orientation and advocate auto and cross- correlation analysis, as a generic approach irrespective of the cytoskeletal structure. This approach involves segmentation of micrographs in two steps including construction of a binary mask of the cell followed by extraction of cytoskeletal structures. The binary masks of the cytoskeletal structures are then autoregulated for calculation of autocorrelograms. The resulting correlograms are averaged to provide an interpretation of the correlation between the cytoskeletal structures.

The above discussions clearly signify the need for a promising wound healing protocol backed by statistical and visual analysis. Further, to reinforce the potential of the proposed system, we present a comparison of the proposed workflow with wound healing assays thoroughly reviewed in a recent literature by Dhillon *et al.* [20]. This paper classifies wound healing assay into three types based on the statistical analysis as 1) Direct Rate Average 2) Regression Rate Average and 3) Average Distance Regression Rate. The authors have reported the results of experiments performed with the Chinese Hamster Ovary (CHO) cells both under starvation and incubation with N-acetylglucosamine (GlcNAc) concentrations. GlcNAc, a kind of GAG is a component of ECM and plays an important role in wound healing. Detailed discussions in this context are given in Section V.

### 3. MATERIALS AND METHODS

Colocalization analysis is performed with 2 sets of data including microscopic images from the standard Broad Bioimage Benchmark Collection BBBC019 [V. Ljosa *et al.* ] dataset and a synthetic image created with Thermofisher cell staining simulation tool. [<https://www.thermofisher.com/in/en/home/life-science/lab-data-management-analysis-software/lab-apps/cell-staining-tool.html>, Accessed on June 6 2019]

#### 3.1 Dataset 1

The TScratch [V. Ljosa *et al.*] dataset for running the experiments is taken from the BBBC019. It is a collection of 24 monolayer images captured with a Zeiss Axiovert

200 M microscope, equipped with a Zeiss AxioCam MRm camera with maximum contrast. Description of cell culture under mediums and image acquisition is detailed in [V. Ljosa *et.al.*].

### 3.2 Dataset 2

Microscopic wound images with actin and tubulin cytoskeletal structure were generated using the Thermofischer cell staining tool. Structural dynamics of cytoskeletons can be studied employing fluorescently labeled actin. The actin in the image was labelled with Alexa Fluor 488 phalloidin, which is a fluorescent green dye. It finds applications in the quantization of actin in tissues and cells. Similarly, tubulin was labelled with CellLight Tubulin-RFP BacMam 2.0, which is a red fluorescent protein.

### 3.3 Tools

The experiments are carried out with imageJ [C.T. Rueden *et.al.*] software and DeconvolutionLab2 [D. Sage *et.al.*] and Ecolocalization [W. Stauffer *et.al.*] plugins.

#### **Deconvolution**

This paper employs the DeconvolutionLab2 [D. Sage *et.al.*] plugin to perform deconvolution of the candidate image with the Richardson-Lucy algorithm, which is based on maximum likelihood approach.

Deconvolution is the mathematical operation to restore an image by reversing the distortions on an image acquired from an optical system. An optical image is generated by convolving the object, light source and a Point Spread Function (PSF). It represents the spatial distribution of the light intensity in the image of an optical system, formed from a point source object plane. Any object can be represented as a set of point sources, each of which is imaged as a PSF by the optics of the eye. An image from a fluorescence microscope is completely described by its PSF; therefore, knowledge of a system's PSF is an essential step in deconvolution.

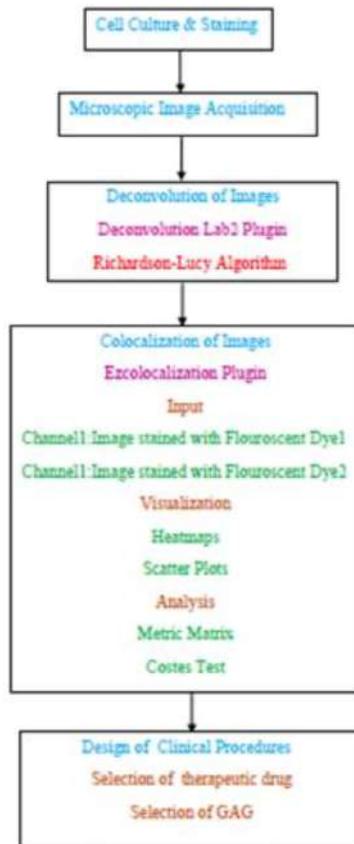
#### **Colocalization Visualization and Interpretation**

Colocalization is performed with the Ecolocalization plugin of imageJ which presents an interactive Graphical User Interface with tabs for input selection. The imageJ software has functionalities for generation of image stacks and image sequences, channel separation for image preprocessing etc. The results of colocalization are vi-

sualized with heat maps of the test images and metrics matrices. The metrics are analyzed with the Costes algorithm to evaluate statistical significance.

## 4. METHODOLOGY

The schematic of the proposed wound healing assay is shown in Fig.1. Since it is based on the Ezcolocalization plugin of the imageJ software, the workflow is similar to those depicted in [19], based on the functionalities of the software. The processes and sub processes are clearly distinguished in Graphic 1 with distinct colors.

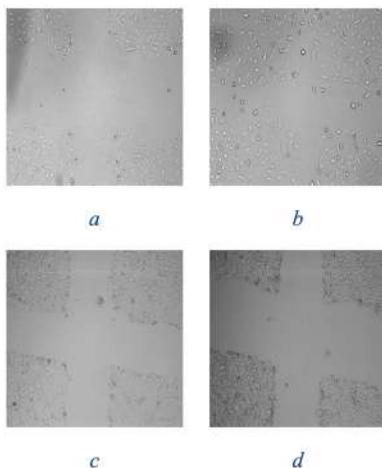


**Graphic 1.** Proposed Wound Healing Assay

## 5. EXPERIMENTAL RESULTS

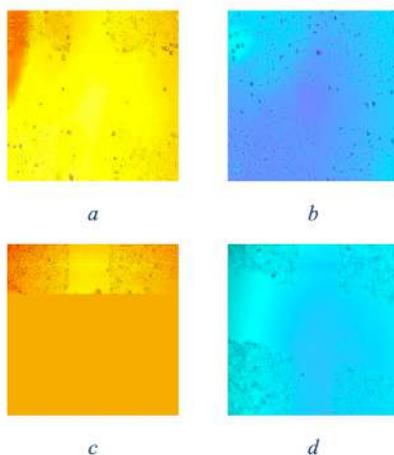
### 5.1 Experimental Results with Dataset 1

This section presents the results of colocalization on two pairs of Tscratch images. The first pair consists of 2 images acquired after starvation and the second pair consists of 2 images captured after 24 hours and is shown in Graphic.2.



**Graphic 2.** Input Images. **a**- Image captured after 0h of starvation **b**. Image captured after 24h of starvation **c**. Image captured with VEGF-A165 after 0h **d**. Image captured on incubation with VEGF-A165 after 24h

The pseudocolor heatmaps are used to visualize the heterogeneity of the candidate images, which is characterized by pixel intensity variations in the field of view. The pixel intensities are normalized in the range of 0-255 in the selected pseudocolor. The heat maps of the input images are shown in Graphic .3. It is seen that the heat and cool maps capture the heterogeneity in intensity variations.

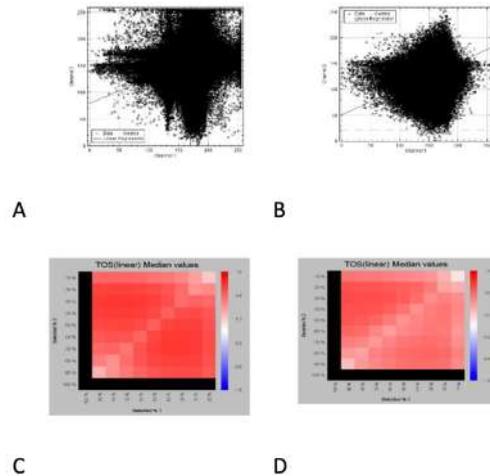


**Graphic 3.** Heat and Cool Maps **A**. Heatmap of image captured after 0h of starvation **B**. Coolmap of image captured after 24h of starvation **C**. Heatmap of image captured with VEGF-A165 after 0h **D**. Coolmap of image captured on incubation with VEGF-A165 after 24h

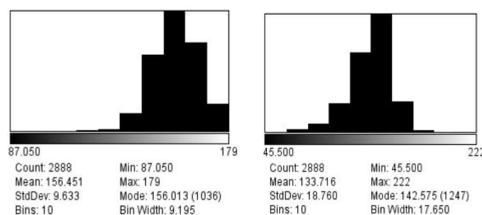
Similarly, the scatterplots are used to depict the relationship between the signal intensity of two reporter channels in a sample. Metric matrices are used to visualize lo-

calization patterns in the test images showing the colocalization metrics for different combinations of thresholds. This plugin features the analysis of localization patterns for two color channels for the threshold overlap score (TOS). It measures the colocalization between two images for different combination of different percentages of the individual image pixels. Further, this plugin also supports the calculation of TOS with logarithmic scaling, Pearson correlation coefficient (PCC), Manders' colocalization coefficients (M1 and M2), Spearman's rank correlation coefficient (SRCC) and Intensity Correlation Quotient (ICQ). The scatter plots and the metric matrices for the test images are shown in Graphic 4.

In addition to the above, histogram representation of the results are shown in Graphic .5 for the images of cells incubated in the two channels.



**Graphic 4. a.** Scatter Plot of images of starved cells **b.** Scatter Plot of images of cells incubated with VEGF-A165 **c.** TOS of images of starved cells **d.** TOS of images of cells incubated with VEGF-A165



**Graphic 5. a.** Histogram of Channel1 Image **b.** Histogram of Channel2 Image

The plugin generates the histogram of the images and presents a summary of statistical measures such as mean, standard deviation etc. for a detailed analysis of images. The permissible values of colocalization metrics and the corresponding interpretations are presented in Table 1. for a better understanding of the degree of colocalization.

The parameters, PCC, SRCC, ICQ, M1 and M2 are evaluated for the wound images under starvation and incubation. These values are extracted from the Log of the Plugin as shown in Table 2. along with the interpretations.

**Table 1.** Metric Values and Interpretations

METRIC	VALUE	INTERPRETATION
TOS (Linear)	-1	complete anticocalization
	0	noncolocalization
	1	complete colocalization
PCC	-1	complete anticocalization
	0	noncolocalization
	1	complete colocalization
SRCC	-1	complete anticocalization
	0	noncolocalization
	1	complete colocalization
ICQ	-0.5	complete anticocalization
	0	noncolocalization
	0.5	complete colocalization
M1	0	complete anticocalization
	1	complete colocalization
M2	0	complete anticocalization
	1	complete colocalization

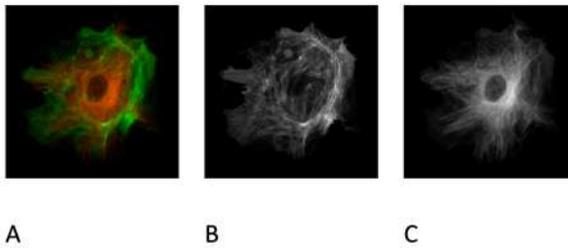
**Table 2.** Colocalization Metrics for Dataset 1

INPUT IMAGES	METRIC	VALUE	INTERPRETATION OF METRICS
1. A&B (Cells Under Starvation)	TOS(Linear)	0.654	Moderate Colocalization
	PCC	0.4262	Low Colocalization
	SRCC	0.6454	Moderate Colocalization
	ICQ	0.3090	High Colocalization
	M1	0.788	High Colocalization
	M2	0.895	High Colocalization

2. C&D (Cells incubated with VEGF-A165)	TOS(Linear)	0.742	High Colocalization
	PCC	0.326	Low Colocalization
	SRCC	0.487	Low Colocalization
	ICQ	0.190	Moderate Colocalization
	M1	1.0	Complete Colocalization
	M2	1.0	Complete Colocalization

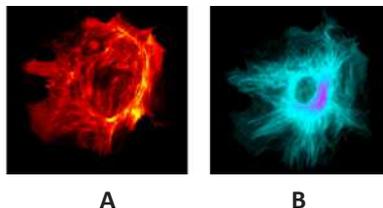
### 5.2 Experimental Results with Dataset 2

This section presents the experimental results with a pair of synthetic images generated with Thermofisher. The composite image in which actin and tubulin are stained with different fluorescent dyes and the individual color channels are shown in Graphic. 6. Cytoskeleton Actin is stained with Alexa Fluor 488 phalloidin fluorescent-green dye and cytoskeleton tubulin is stained with fluorescent-red CellLight Tubulin-RFP, BacMam 2.0. Though the Thermofisher cell staining tool supports staining of several cell structures, actin and tubulin are selected for this experiment as they are the common cytoskeletal structures associated with wound healing.

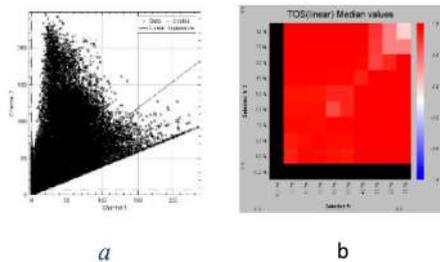


**Graphic 6.** **a.** Composite Actin and tubulin stained microscopic **b.** Green channel of image **c.** Red channel of image

The heatmaps of the synthetically stained cells are as shown in Graphic. 7. These heatmaps for actin and tubulin staining are shown with hot and cold maps respectively. Varying intensity levels in the heat maps are used to comprehend the differences in labelling. The scatter plot depicting the relationship between the signal intensities of the channels is shown in Graphic. 8. The interpretations of the metrics in Table 2 and 3 are given based on the proximity of the values to the standard permissible values



**Graphic 7.** **a.** Heatmap of cells stained with A. Actin **b.** Coolmap of cells stained with Tubulin



**Graphic 8. a.** Scatter Plot **b.** Metric Matrix for synthetic images

**Table 3.** Colocalization Metrics for Dataset 2

METRIC	VALUE	INTERPRETATION OF METRICS
TOS	0788	High Colocalization
PCC	.6313	Moderate Colocalization
SRCC	0.9066	High Colocalization
ICQ	0.3963	High Colocalization
M1	0.970	High Colocalization
M2	0.892	High Colocalization

## 6. DISCUSSION

Though microscopic images are not visually discernable, quantitative colocalization measures are sufficient to evaluate the cell migration in the wound healing process. The experimental results for the test images show varying levels of colocalization between them as evident from the PCC, SRCC, ICQ, M1 and M2 metrics.

For dataset 1, both for cells under starvation and incubation, the PCC metrics are lower signifying a lower colocalization. However, ICQ is higher for images under starvation while moderate for images under incubation. Here ICQ can be neglected as it is influenced by the Product of Difference between the Mean (PDM) of images in two distinct color channels. However, both M1 and M2 are closer to one, signifying a high degree of colocalization. These metrics are also found to be consistent with the visualizations in the scatter plots, which show a high degree of overlap between two images in Fig. 4 A and C. Further, the TOS measured in linear scale shown in Fig. 4 B and D show the colocalization of images for different combinations of pixels in the test images. The black pixels for a threshold of 100% for both images show that it is unrealistic to compute the colocalization when the threshold is 100 for one channel. It is seen that there is no anticocalization evidenced in this visualization which further testifies the correctness of the quantitative metrics.

For dataset 2, high level of colocalization is evidenced from all metrics including ICQ. It is also visualized in the scatter plots and metric matrices in Fig. 8 A and B which portrays the actin and tubulin interactions. The metric matrix gives a clear representation on the degree of colocalization for different thresholds of pixels from distinctly stained images. It is very useful for studying the effect of therapeutic drugs on the cytoskeletal structures during wound repair.

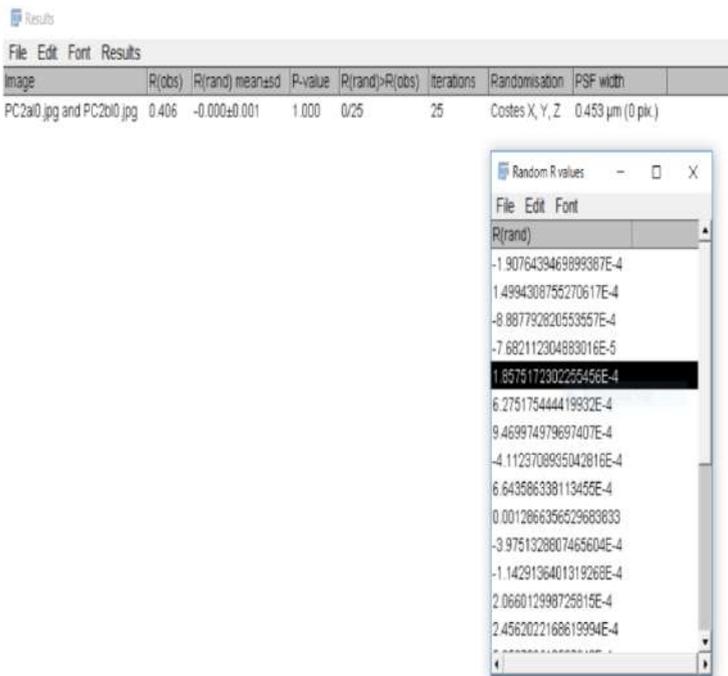
M1 is a measure of colocalization of image in channel1 with that of channel2. Similarly, M2 measures the colocalization of image in Channel2 with that of channel1. For the test images in dataset 1,  $M1=0.788$  and  $M2=0.895$  show that image2 colocalizes well with image1. M1 and M2 are both 1 for the images under incubation showing that the images are identical at 0h and 24h of incubation with VEGF-A165, signifying very low or null cell migration. For dataset2,  $M1=0.970$  and  $M2=0.892$  show a very high colocalization of actin with tubulin while a relatively lower colocalization between tubulin and actin.

PCC metric measures the extent to which the signal intensity variation in one image is based on the corresponding variation in the other image, characterized by a linear relationship. Hence, PCC is called a correlation metric and also it gives indication on the direction of correlation. Further, PCC is sensitive to noise as the computations are based on image intensity values. SRCC is a metric similar to PCC, applied on pixel intensity ranks rather than values. It is used for measuring the correlation in multi colored images. It has been shown empirically [19] that ideal values of these metrics sometimes provide complementary interpretations.

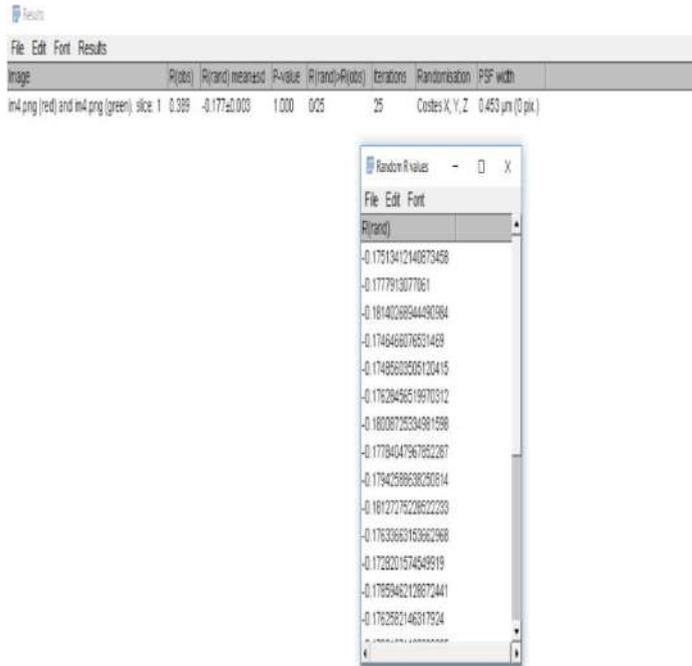
In order to ensure that true colocalization exists between a pair of images, Costes statistical significance test is conducted on the test images. This test is performed by scrambling one of the images and measuring the correlation  $r$  of this image with the unscrambled image. This procedure is repeated for hundreds of iterations, producing the probability distribution of the amounts of random overlap between the two images. Finally, the P-value which is the proportion of random images which had better correlation than the unscrambled image is evaluated. From literature, it is seen that, P-value of 1.00 indicates that none of the randomized images had better correlation. However, 0.95 is assumed to the normal statistical confidence limit of 95% universally. This test is conducted for the test images with the Colocalization plugin, the results of which are shown in Fig.9 and Fig. 10 for the images in dataset1 and dataset2 respectively.

It is seen that the P-value is 1 for the test images, which testifies the correctness of the process. Hence, from the experimental and validation results, it is evident that the proposed system can be integrated in wound healing assays irrespective of the GAG employed in the treatment process.

In [20], the authors present an extensive review of the papers which employ the three types of analysis and report the limitations of each of the method. This limits the comparison of the proposed approach only to the methods discussed in [20] as shown in Table.4.



**Graphic 9.** Cosets Statistical Significance Test for Dataset1



**Graphic 10.** Cosets Statistical Significance Test for Dataset2

From Table 4., it is seen that the proposed system is superior to the general methods discussed in [20]. Out of these methods, based on the complexity of the pathology one of the methods can be employed. Further, it is also reported that Type II method is sensitive to outliers. This limitation is eliminated in the proposed system using the DeconvolutionLab2 plugin and the proposed system is tested with both the standard data set and synthetic images.

**Table 4.** Comparison of Wound Healing Assays

COMPARISON ASPECTS	REFERENCES	
	Dhillon <i>et al.</i> (2017)	Proposed System
Methods	Three different Methods based on statistical computations are employed Complexity increases from Type I to type III	Only a single work flow is employed with deconvolution followed by Colocalization
Sensitivity	Type II is sensitive to inconsistencies	Inconsistencies are eliminated by deconvolution
Cell Type	CHO cells with GlcNac	Wound cells with VEGF-A165 Synthetic images for actin and tubulin interaction
Visualization	No Visualization	Visualization with heatmaps, scatter plots and metric matrix
Validation	One-way ANOVA Tukey's test	Costes Method

## 7. CONCLUSION

Quantification of cell migration and cytoskeletal responses is vital in the analysis of wound healing. It has been clearly testified that both procedures are specific to the GAGs employed and complex cell straining experiments followed by evaluation of correlation metrics. Based on the successful application of colocalization in the quantification of spatial association between biomolecules, this paper exclusively investigates colocalization in wound assays under cell starvation, GAG application and synthetic microscopic images with the ezcolocalization plugin of the imageJ software. The experimental results show that this plugin is effective in the quantification of metrics attributing to better interpretations for significant clinical decisions. Further, consistency of the visualizations with the evaluation metrics affirm the reliability of the proposed system. It is less complex and visually comprehensible compared to the existing methods of measuring wound width, area and density which provide only qualitative metrics which are not sufficient to study the spatio-temporal wound dynamics. This process can be seamlessly integrated with existing wound healing protocols irrespective of the cell culture procedures. Further, the proposed system can be enhanced with object-recognition capability in the colocalization of cell structures in complex metastases, immunology studies and angiogenesis.

## 8. REFERENCES

- A. Grada, M. Otero-Vinas, F. Prieto-Castrillo, Z. Obagi and V. Falanga** (2017), "Research techniques made simple: analysis of collective cell migration using the wound healing assay", *Journal of Investigative Dermatology*, 137(2), e11-e16.
- A.B. Taylor, M.S. Ioannou, J. Aaron and T.L. Chew** (2018), "Model-free quantification and visualization of colocalization in fluorescence images", *Cytometry Part A*, 93(5), 504-516.
- B.I. Pinto, A.J. Tabor, D.M. Stearns, R.B., Diller and R.S. Kellar** (2016), "A Bench-Top In Vitro Wound Assay to Demonstrate the Effects of Platelet-Rich Plasma and Depleted Uranium on Dermal Fibroblast Migration", *Applied in vitro toxicology*, 2(3), 151-156.
- B.I. Pinto, N.D. Cruz, O.R. Lujan, C.R. Propper, R. S. Kellar** (2019), "In Vitro Scratch Assay to Demonstrate Effects of Arsenic on Skin Cell Migration", *J. Vis. Exp.*, 144, e58838, doi:10.3791/58838.

- C. Liang, A. Park and J. Guan** (2007), "In vitro scratch assay: A convenient and inexpensive method for analysis of cell migration in vitro" , Nature Protocols, 329-333.
- C.S. Melincovici, A.B. Bosca, S. Susman, M. Marginean, C. Mihu, M. Istrate, I.M. Moldovan, A.L. Roman, and C.M. Mihu** (2018), "Vascular endothelial growth factor (VEGF)-key factor in normal and pathological angiogenesis", Rom J Morphol Embryol, 59(2), 455-467.
- C.T. Rueden, J. Schindelin, M.C. Hiner, B.E. DeZonia, A.E. Walter, E.T. Arena and K.W. Eliceiri** (2017), "ImageJ2: ImageJ for the next generation of scientific image data", BMC bioinformatics, 18(1), 529.
- D. Sage, L. Donati, F. Soulez, D. Fortun, G. Schmit, A. Seitz, R. Guiet, C. Vonesch and M. Unser** (2017) "DeconvolutionLab2: An open-source software for deconvolution microscopy", Methods, 115, pp.28-41. <https://www.thermofisher.com/in/en/home> Accessed on June 6 2019.
- J. Melros** (2018), "Glycosaminoglycans in wound healing", Bone and Tissue Regeneration Insights, 7, BTRI-S38670.
- J.S. Aaron, A.B. Taylor and T.L. Chew** (2018) "Image co-localization—co-occurrence versus correlation", J Cell Sci, 131(3), jcs211847.
- P.K. Dhillon, X. Li, J.T. Sanes, O.S. Akintola and B. Sun** (2017), "Method comparison for analyzing wound healing rates", Biochemistry and Cell Biology, 95(3), 450-454.
- Pomin, V. and Mulloy, B** (2018)., Glycosaminoglycans and proteoglycans, 27.
- R. Springer, A. Zielinski, C. Pleschka, B. Hoffmann and R. Merkel** (2019), "Unbiased pattern analysis reveals highly diverse responses of cytoskeletal systems to cyclic straining", PLoS ONE 14(3): e0210570. <https://doi.org/10.1371/journal.pone.0210570>
- S. Barber** (2008), "A clinically relevant wound assessment method to monitor healing progression." Ostomy Wound Management, 54.3, 42.
- S. Bolte and F.P. Cordelieres** (2006), "A guided tour into subcellular colocalization analysis in light microscopy", Journal of Microscopy, 224(3), 213-232.

- S.Wang, E.T. Arena, J.T. Becker, W.M. Bement, N. M. Sherer, K.W. Eliceiri and M. Yuan** (2019), "Spatially Adaptive Colocalization Analysis in Dual-Color Fluorescence Microscopy", IEEE Transactions on Image Processing.
- V. Ljosa, K.L. Sokolnicki and A.E. Carpenter** (2012), "Annotated high-throughput microscopy image sets for validation", Nature methods, 9(7), 637-637.
- W. Stauffer, H. Sheng and H.N** (2018), "EzColocalization: An ImageJ plugin for visualizing and measuring colocalization in cells and organisms", Scientific reports, 8(1), 15764.

## ISSUES & CHALLENGES IN IOT

**D. Balakrishnan**

*Assistant Professor, Department of Computer Science and Engineering  
Kalasalingam Academy of Research and Education, Virudhunagar, India.*

Email ID: d.balakrishnancse@gmail.com, <https://orcid.org/0000-0001-7312-6227>

**T. Dhiliphan Rajkumar**

*Assistant Professor, Department of Computer Science and Engineering  
Kalasalingam Academy of Research and Education, Virudhunagar, India*

Email ID: dhilipanrajkumar@gmail.com, <https://orcid.org/0000-0001-6309-0275>

### ABSTRACT

Now World is transforming in to digital world, so usages of digital devices are increasing potentially. Digital devices are performed well while connected with proper system. IoT is a platform for connecting, aggregating and performing with own decision making in digital devices. But digital devices may be authenticated by unauthorized persons with help of malware. Due to this, people privacy and security is a big question mark in modern digital world. The primary objectives are discussing about various issues and challenges associated with IoT. In this work various Issues and challenges encountered in IoT device utilization is discussed in detailed. This research work also provides the comparison analysis of different techniques in terms of their merits and demerits. The overall analysis of this research work is carried out interm of numerical analysis various research techniques.

**Keywords:** IoT, IoT issues, IoT challenges, Security issues.

### 1. INTRODUCTION

The Internet of Things (IoT) is a system of interconnecting various physical devices. Every device in the IoT is capable to collect and transferring the data through the network. The Global Standard Initiative (GSI), defined as IoT as “the infrastructure of information society”. Every devices which are connected in IoT network have unique, well-defined IP addresses which are continuously generate, transmit and receive the huge data.

Nowadays IoT system used in countless applications. With help of communication medium, digital devices are performed well. Digital device is nothing but physical elements connected with either computer or micro controller but now all are connected to smart phones, gadgets and etc., Analog devices also connected in IoT through

proper communication medium. Basically IoT is a group of elements connected together to do work such as hardware, analog elements, network communication medium and controlling elements etc., Mobile phone is one of the best digital device in the world. This is not only used for communication purposes, it may be used for connecting digital devices such as acting as a remote for television, controller for air conditioner and other household appliances. In world wide digital devices usages are increasing tremendously, As per research prediction, in 2025 the digital devices are increase more than 70 Billions as shown in following chart.

Approximately 70 Billions of connected devices will be used in 2025, Out of this 50 Billions are IoT devices remaining are computing devices like as smart phones, smart watches, tablets etc., Now imagine, how much data will be generated and processed from the billions of connected devices in every time.

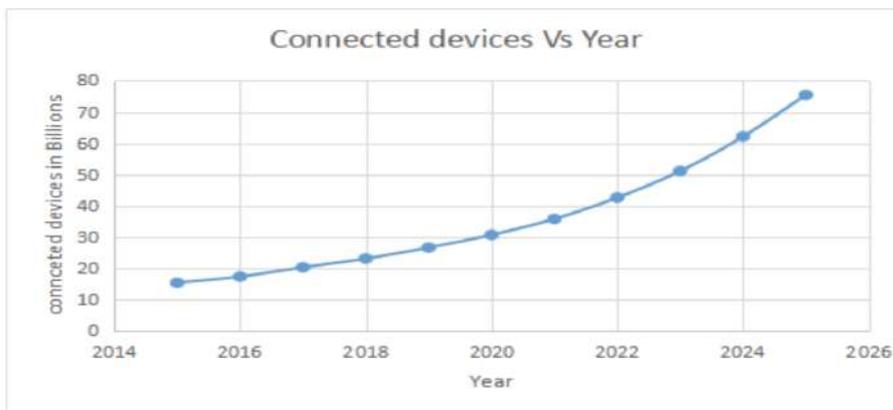


Figura 1. Connected devices in world

## 2. ISSUES AND CHALLENGES

IoT devices are working with number of devices, it may be connected to sensors, gateway, server and other IoT related devices. Security is a main concern while crowd is there[1]. Many issues will be handling while making IoT system, not only in initial stage, it may leads up to its entire operations. IoT is not a single device, it may group of devices for interchanging informations and control action. Security is a main concern in connected devices otherwise it may be threatened by some one else[1]. Decision making is an crucial feature in IoT system, it may be malfunctioned due to security issues. Another one urgent issue with the IoT system is that of user privacy[6]. Hacking is not only a security failure that also a violation of user privacy. A recent study shows that many of the IoT users are not happy with their system due to lack of privacy. Now people are aware about privacy issues. So people are expecting

ultimate privacy for their extend. Transparency is needed between user and developer regards connected devices.

A survey conducted by Hewlett Packard(HP) [8] revealed that more than 70% of the commonly used IoT devices carrying serious vulnerabilities. This can be vulnerable to security issues due to their design by lack of some security properties such as, improper authentication, unsecured communication medium and unauthorized configuration. Due to this security issues, industries and people are suffered to adopt the IoT system[5].

Security issues, challenges are addressed by provide better education to the developers and designers to enhance the security of the IoT system[4].

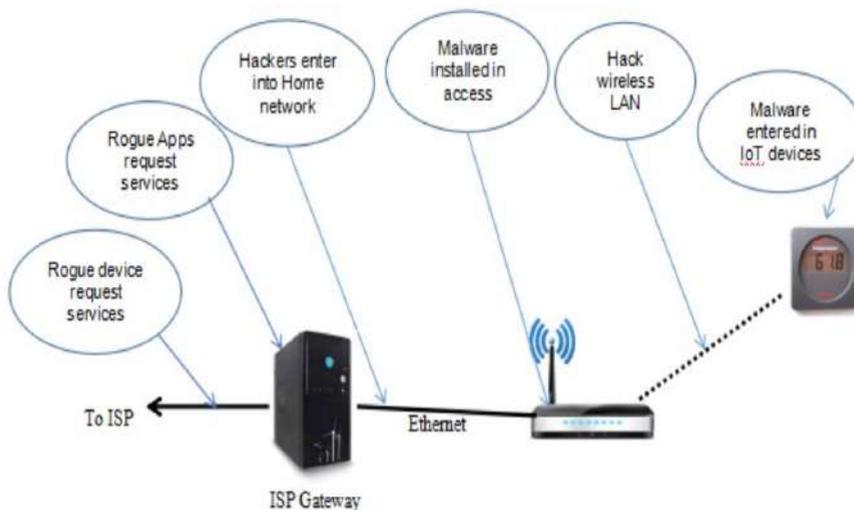
Security is a key quality of an any system or devices and related to some features which provides Trust and Privacy qualities in system. Nowadays internet is ruling the world, so IoT is a boon in world because it can connect the devices through internet. IoT Security is a platform to focus on secure the connected devices, secure data and networks in the Internet of things. In Worldwide number of inter connected devices are drastically increased, so security issues are increased and there are much security concerns will be considered for whole system. Unsecured IoT devices leads as entry points for cyber-attack by allowing unauthorized individuals to re-program a system or device cause it to be malfunction. Poorly designed devices can easily expose user data/information to theft by leaving data streams inadequately protected. Defective devices can create security vulnerabilities in IoT system. These malfunctions are happened in small, medium and large rated systems.

While increasing number of Internet-connected devices, created traffic can be expected to rise significantly. For an example, Recently a survey estimates that the Internet traffic will rise from 40% in 2014 to just under 70% in 2019 by non-PC devices. It means that IoT system is increased exponentially with help of smart devices. And also some research forecasts that the number of devices in “Machine to Machine” (“M2M”) connections are gradually increase from 24% of all connected devices in 2014 to 43% in 2019. The connected devices applications are including in home, personal health care, industrial, automotive, and etc.,[2].

Security is not a dilemma of secure or insecure. Instead, it is a spectrum of device vulnerabilities. This spectrum could be ranged from totally unsecured devices with null security features to infinitive secure systems with various layers of security features. It represents tom-and-jerry game, new security threats can be create, device

developers and network programmers continuously respond to address that threats and solve that issues immediately. otherwise system may go to critical stage. The overall security is a function where security risks are addressed, assessed and managed.

The essential important security for the connected devices are Authentication, secure communication during transmitting, processing and receiving stages and protecting data in storage places[7].



**Figura 2.** Various security issues in IoT devices

Hackers can easily enter in to out IOT network or devices through their technology. The different levels of hacking are network level, device level and basic chip level attack. Network level is nothing but hackers can entered through network where IoT system and devices are connected. Next level is device level, it means hackers can access our devices directly and make malfunctions. Last level is basic chip level that there hackers can enter in to the chips physically like as Reverse engineering.

While designing a IoT device, more number of questions are arising associated with it. We need following questions while designing IoT devices, they are Best design practices, Low cost devices, Data confidentiality and avoid unauthorized access and standards.

- a) Best design practices: Practice make a thing perfect, so IoT designers and software developer should posses good knowledge regarding connected device and communications. So adequate training and educational resources should

be implemented for the engineers and researchers those who involved in IoT[12].

- b) Economical design : Cost is one of the significant thing in our world. More than 70 percent people are living in rural areas that IoT system need to be design with low cost then only it will familiar with that kind of people in India. Manufactures should motivate device designers and developers to produce product with low cost but without compromising security problems.
- c) Data confidentiality and avoid unauthorized access : Nowadays digital devices are fulfilled with all people life. Some times it may make a big problem to us. IoT should connected with server, sensors and connecting medium ie., communication networks. So there are some possibilities are there to make security issue. Developers should give promises to consumers for data / information in safe or not. Data confidentiality is one of the important one in connected devices otherwise privacy will be affected. So all informations should be accessed by authorized persons only[6]. Programmers should encrypted all the data associated with IoT system otherwise hacker will enter into the system and make that system insecure.
- d) Standards : IoT system and related components manufacturer should follow the government rules and regulations. International standards should be incorporated in devices otherwise it may go to malfunctioning. Proper standards should be maintained for IoT devices for enhancing the security and maintaining the privacy of the system.

**Cryptography:** It is the best practice for hiding information. It is the study that can help to keep information secret and safe. Here small discussion about some basics on cryptography. Cryptography also a prominent security method and also do the following things. With help of cryptography, security can be assure in three different ways. They are authentication, confidentiality and Integrity. These functions are used to keep the information safe and detect if data was modified or erased. Cryptography is a robust one where connected through standard algorithms and proper key sizes. Standard algorithms and key sizes can be provided by national and international agencies..

In cryptography several algorithms have been developed. Symmetric algorithm is a method for sharing a secret key with two communicating users. The system will collapsed if the key is public. Asymmetrical algorithm have two keys, one is private

and other one is public. The public key should be exchanged. It uses more computing power consuming than the symmetric algorithms. Next one is hashing, it should be worked used with signature or verification.

### **3. SECURITY ISSUES**

Automaton is made with help of IoT, there are home automation, industrial automation, smart power handling ie smart grid etc., Commonly security issues can be classified into three types. They are

- 1) Authentication : It is the process for identifying communicating peers and assure their identities. IoT is not a single devices that may spread out large areas with vast number of interconnected devices. These inter connected devices needs to communicated with other devices for enhancing their duties, so all should be controlled by a common secret. But remember that secret is shared with others then security will be a question mark. A better authentication method can be provided with asymmetric method. Public key authentication is usually represented in an Internet connected servers,systems and devices to provide better authentication[7].
- 2) Secure communication: Communication is important one in IoT devices because it is not a single one which is connected devices. Various protocols should be used for better communication purpose. Secure communication is needed while transmitting data from devices, while processing between devices and receiving at the devices. The security code can be executed with IoT device that should be behave as our expectation and it should not be leaked the sensitive data that means it does not modified or corrupted.
- 3) Secure storage : In an IoT system, data need to be stored in variety of media with help of memory devices provided by semiconductor industries (OTP, ROM, RAM, Flash,EPRM, EEPROM...). A Cisco survey states that the IoT system would generate 400 zettabytes (ZB) of data by 2018. The data generated, comes under two categories. First one have images and videos that are captured from smart phones, CCTV and other devices which have large size data . This data consecutively accessed . Second type of data is very small in size, like as data captured from sensors and other actuators. It can be created billions of files that can be accessed randomly.

IoT is an useful for collecting information for various applications[2]. These informations may be health related, whether related or any industry related data. Data stored in semi conductor devices such as flash memory, RAM, ROM , EPROM etc.,These should be in safe otherwise severe issues may found, so secure the data while it is saved in storage device. Encrypting key and unique device identifier are the methods to secure the data. Data can be protected by encryption or stored in a tamper-resistant device, otherwise combination of both. In any cases, the access should be controlled or monitored only by authorized person or machines. Basically, crypto currencies are entries approximately token in decentralized consensus-databases.

#### 4. IOT APPLICATIONS:

IoT is used everywhere everyone life. In near future we cant live with out interconnected devices. IoT can make people to live with sophisticated one.

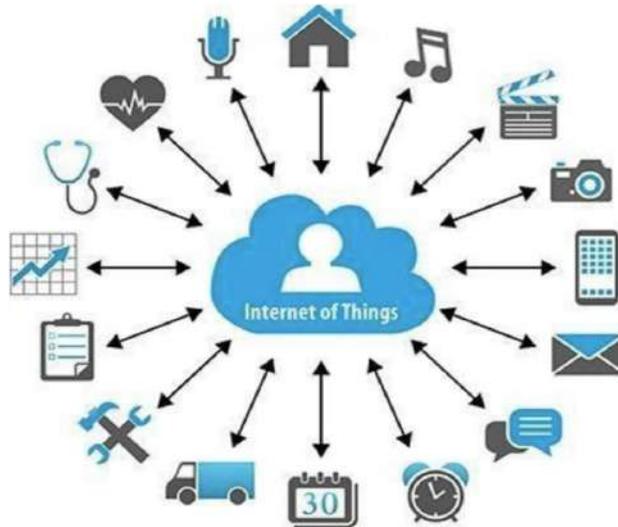


Figura 3. IoT applications

IoT will be a great impact in human life in food, transportation, health, industries, smart devices and energy management etc., The following are the applications that can be combined with IoT.

- A) Household appliances: Now IoT imposed in Remote enabled door locks, smart refrigerators, Smart air conditioners, air quality monitoring systems are used in home.. With the rapid growth in technology, some more appliances will come in future.

- B) Transportation: Recently many auto mobile companies are tie up with communication technologies.They make Vehicles with LTE facility which is a 4G wireless broadband technology which can provide high speed wireless communications for mobile phones and smart devices. This features can provide some real time information like as traffic updates etc.,
- C) Health care : This one of the sector which can fully adopted with IoT system near future. IoT can be useful for collecting various data in patients for monitoring through devices. Wearable technology also enhance its features such as wristbands and wristwatches that would record and monitor personal for the individual's day-to-day fitness activities, are already available in the market. IoT devices can useful to track the people fitness and overall wellness it can provide data to the physicians that can help the patients for closer monitoring by doctors.

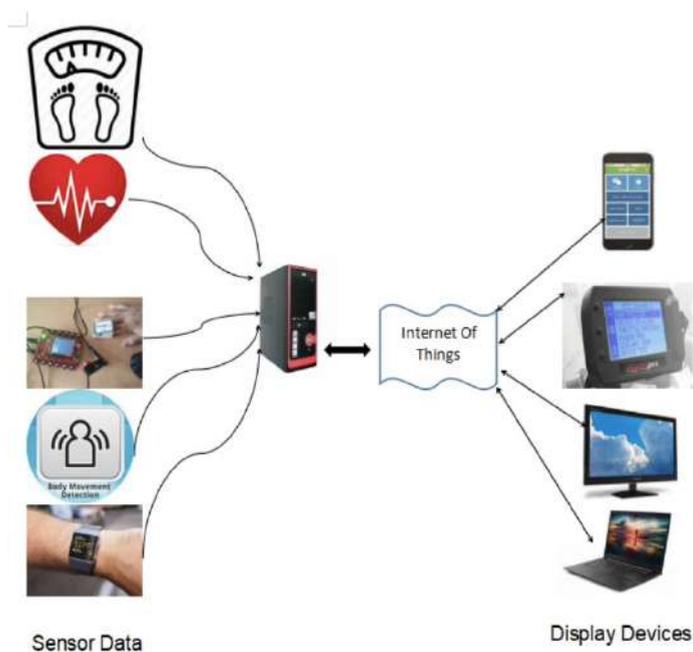
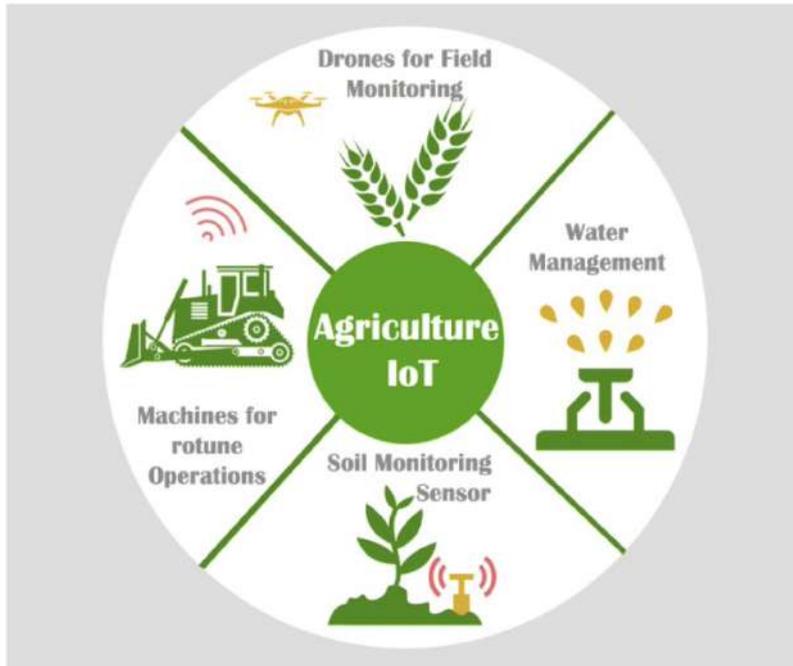


Figura 4. Health care maintained by IoT

- D) Smart farms: Farmers are the backbone of our India. Nowadays farms can be smart with help of connected devices. This system can be monitoring the crop fields or farms by sensors( light sensors, humidity , soil moisture sensor etc.,). Automated irrigation system should be controlled and monitored by IoT system. In india water scarcity problem is increased so IoT can initiate the au-

tomatic irrigation system. Large agriculture area which is nearer to hills are monitored by drones.



**Figura 5.** IoT in smart farms

## 5. DISCUSSION OF PREVIOUS RESEARCH WORK

Encrypted data are only outsourced to CSPs as proposed in Computing D.I.C (2017). However, at cloud, under various encryption schemes, duplicated data can be saved by different or same users. There is a huge cloud storage space. Networking resources are wasted due to this duplication and data management is complicated while consuming more power. Thus, for CSPs, a crucial task is storage saving.

For achieving stronger privacy, RAndomR Esponse (RARE) technique is proposed by Pooranian *et al* (2018). At once, for two chunks, deduplication request is send by uploading user in this proposed RARE solution. With careful design, randomized deduplication response is returned by cloud which receives deduplication request. Privacy leakages are minimized using this proposed system while preserving deduplication gain. Privacy guarantee are confirmed using analytical results and preservation of RARE privacy and deduplication benefits are shown in experimentation results.

An effective public auditing with secure deduplication scheme is proposed by Huo *et al* (2019). Aggregate signature idea is used in this scheme. With a constant computation cost, cloud service provider generated integrity proof’s correctness is verified by TPA in this scheme. Batch auditing can also be supported using this scheme. On TPA, auditing complexity is independent of auditing tasks count. At last, using performance evaluation and security analysis, efficiency and security of this scheme is proved.

For preventing side-channel attacks, a tenant-aware memory deduplication mechanism called Slicedup is presented by Vanó-Garcia *et al* (2018). While preventing side-channel attacks among tenants, deduplication saving benefits can be availed by cloud providers as enabled by this proposal. Irrespective operating system, its architecture, version and other system parameters, in any system, this solution can be implemented as it is a design solution. With minimum tenants count per physical host, similar memory saving are provided by Slicedup while preventing side-channel attacks are shown by authors.

**Table 1.** Comparison analysis of IoT data handling techniques

S.No	AUTHOR	METHOD	MERITS	DEMERITS
1	Computing D.I.C (2017)	Encrypted data management with deduplication (EDMD)	Lesser power consumption Efficient utilization of resources Better storage optimization	Not suitable for practical applications
2	Pooranian <i>et al</i> (2018)	RANdomREsponse (RARE) approach	Ensure privacy requirements Better deduplication results Increased security level	More computation overhead
3	Vanó-Garcia <i>et al</i> (2018)	tenant-aware memory deduplication mechanism (TMDM)	Less memory consumption Less and optimal resource utilization Better energy consumption	More processing overhead
4	Huo <i>et al</i> (2019)	Efficient public auditing with secure deduplication scheme (EPASDS)	Increased security Better resource utilization Lesser auditing cost	Lesser security with increased number of duplications

## 6. CONCLUSION

IoT system is not a single one which is group of connected devices. In this paper, we discussed about various applications of IoT systems. Nowadays all fields are going towards automation, this can be fulfilled by only connected devices through IoT system. Tremendous growth is going in IoT field. Whatever happen, security issues are

a big problem for that digital devices. Various security issues and challenges are discussed and provide solution for that[4]. Secure privacy for each information unless it may produce series effect on our environment.

## REFERENCES

- 1. M. Abomhara and G. M. Kjøien**, “Security and privacy in the internet of things: Current status and open issues,” in *Privacy and Security in Mobile Systems (PRISMS)*, International Conference on. IEEE, 2014, pp. 1–8.
- 2. Amit Kumar Sikder, Giuseppe Petracca, Hidayet Aksu, Trent Jaeger, A. Selcuk Uluagac** , “ Survey on Sensor-based Threats to Internet-of-Things (IoT) Devices and Applications” published in arXiv:1802.02041v1 [cs.CR] 6 Feb 2018.
- 3. N. Bari, G. Mani, and S. Berkovich**, “Internet of things as a methodological concept,” in *Fourth International Conference on Computing for Geospatial Research and Application (COM. Geo)*, 2013. IEEE, pp. 48–55.
- 4. S. Chen, H. Xu, D. Liu, B. Hu, and H. Wang**, “A vision of iot: Applications, challenges, and opportunities with china perspective,” *IEEE Internet of Things journal*, vol. 1, no. 4, pp. 349–359, 2014. [4] L. Atzori, A. Iera, and G. Morabito, “The internet of things: A survey,” *Comput. Netw.*, vol. 54, no. 15, pp. 2787–2805, Oct 2010.
- 5. L. Da Xu, W. He, and S. Li**, “Internet of things in industries: A survey,” *IEEE Transactions on industrial informatics*, vol. 10, no. 4, pp. 2233– 2243, 2014.
- 6. Y. H. Hwang**, “Iot security & privacy: threats and challenges,” in *Proceedings of the 1st ACM Workshop on IoT Privacy, Trust, and Security*. ACM, 2015, pp. 1–1.
- 7. Lui, Xiao, Chen**. “Authentication and Access Control in the Internet of things” *32nd International Conference on Distributed Computing Systems Workshops (ICDCSW)*, pp. 588 – 592, 2011.
- 8. H. Ning, H. Liu, and L. T. Yang**, “Cyberentity security in the internet of things,” *Computer*, vol. 46, no. 4, pp. 46–53, 2013.
- 9. K. Rose, S. Eldridge, and L. Chapin**, “The internet of things: An overview,” *The Internet Society (ISOC)*, pp. 1–50, 2015.

- 10. S. Singh and N. Singh**, “Internet of things (iot): Security challenges, business opportunities & reference architecture for e-commerce,” in *Green Computing and Internet of Things (ICGCIoT)*, 2015 International Conference on. IEEE, 2015, pp. 1577–1581.
- 11. R. H. Weber**, “Internet of things–new security and privacy challenges,” *Computer law & security review*, vol. 26, no. 1, pp. 23–30, 2010.
- 12. Y. Yu, J. Wang, and G. Zhou**, “The exploration in the education of professionals in applied internet of things engineering,” in *4th International Conference on Distance Learning and Education (ICDLE)*, 2010. IEEE, pp. 74–77.
- 13. COMPUTING, D. I. C. ENCRYPTED DATA MANAGEMENT WITH DEDUPLICATION IN CLOUD COMPUTING.**
- 14. Pooranian, Z., Chen, K. C., Yu, C. M., & Conti, M.** (2018, April). RARE: Defeating side channels based on data-deduplication in cloud storage. In *IEEE INFOCOM 2018-IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)* (pp. 444-449). IEEE.
- 15. Vanó-Garcia, F., & Marco-Gisbert, H.** (2018). Slicedup: a tenant-aware memory deduplication for cloud computing. In *UBICOMM International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies, UBIKOMM* (pp. 15-20).
- Huo, H., Jiang, T., Tan, S., & Tao, X.** (2019). Efficient public integrity auditing with secure deduplication in cloud computing. *International Journal of Embedded Systems*, 11(6), 764-777.

# VEHICLE STARTING USING BIOMETRIC SCANNER (TWO WHEELER)

**Dr.R.Sudarajan**

*Associate Professor, Department of Information Technology,  
Kalasalingam Academy of Research and Education, Krishnankoil, India*  
Email ID: [sundaradhira@gmail.com](mailto:sundaradhira@gmail.com), <https://orcid.org/0000-0002-4386-3565>

**Mr.K.Vijay**

*Department of Information And Technology ,  
Kalasalingam Academy Of Research And Education Krishnankoil, India.*  
Email ID: [xxxxxxx](mailto:xxxxxxx), <https://orcid.org/0000-0002-4386-3565>

**Mr.S.Adhipan Alagappa**

*Department of Information And Technology ,  
Kalasalingam Academy Of Research And Education Krishnankoil, India.*  
Email ID: [xxxxxx](mailto:xxxxxx), <https://orcid.org/0000-0002-6396-8460>

**Mr.M.Ramadass**

*Department of Information And Technology,  
Kalasalingam Academy Of Research And Education Krishnankoil, India.*  
Email ID: [xxxxxxx](mailto:xxxxxxx), <https://orcid.org/0000-0003-3553-9498>

## ABSTRACT

In this Techno world everything is being digitalized and getting automated. Automation is the main aspect in upcoming years, but security is also major part in automation . From earlier days to recent days the vehicle starts with the help of keys. To change this concept and bring it more secure our project idea is to start the vehicle(Motorcycle) with the Biometric. By using Biometric the vehicle's Engine get started and the vehicle runs. Here there are no fear of losing the Bike keys or Stealing a bike. The vehicles are more secure in this system. Here we also provide the messaging system facility, which means When the owner of the vehicle places the finger and starts the vehicle the alert message sends to the respective mobile number. At same time, if an unauthorized person tries to steal the vehicle the alert message sent to the registered mobile number. This project is more efficient and cost effective way to secure your vehicle.

**Keywords:** Biometric Scanner ,Relay, Sensor.

## 1. INTRODUCTION

Unique finger impression acknowledgment innovation license access to just those whose fingerprints that are as of now put away in the memory. Put away fingerprints

are held even in case of complete power disappointment or battery issue. These wipes out the fundamental for monitoring keys or recalling a mix secret key, or PIN. It must be opened when an affirmed client is available, since there are no keys or blends to be replicated or stolen, or bolts that can be picked. The unique mark based lock in this way gives an awesome answer for traditionally experienced bothers. This report centers around the utilization of fingerprints to open locks, instead of the set up strategy for utilizing keys .In request to forestall unapproved access to these gadgets, passwords and other example based verification technique are being utilized in late time. In any case, secret word based verification has an inherent shortcoming in secret word spillage. While the examples are anything but difficult to take and imitate. In this paper, we present a verifiable validation approach that upgraded the secret word design with extra security layer .Biometric frameworks have additional time filled in as hearty security systems in different spaces. Fingerprints are the most seasoned and most generally utilized type of biometric distinguishing proof. A basic advance in investigating its points of interest is to embrace it for use as a type of security in officially existing frameworks, for example, vehicles .Vehicle security framework has been a subject of incredible enthusiasm throughout the years because of the expanding vehicle burglary cases revealed everywhere throughout the world. A large portion of the propelled vehicle security frameworks best suit the four wheelers. As of the security framework for bikes is concerned, the frameworks accessible in market are of no match to the very much prepared hoodlums. At the point when enduring an onslaught, these frameworks can just immobilize the motor and sound a noisy caution. The proposed solid and vigorous plan of Two Wheeler Vehicle Security System with highlights improving the security of the vehicle and guaranteeing the wellbeing of the rider .Fingerprint coordinating strategies are of two kinds: diagram based and details based. The format size of the biometric data dependent on particulars is a lot littler and the preparing speed is higher than that of diagram based unique mark coordinating.

## **2. EXISTING SYSTEM**

This project is press-button in car starting and create and more adjustable and safe way to starting the engine with only press button.

We use push-button for engine on and off condition.

### 3. PROPOSED SYSTEM

we present a certain verification approach that upgraded the secret key example with extra security layer .Biometric frameworks have additional time filled in as hearty security instruments in different spaces.

Fingerprints are the most established and most broadly utilized type of biometric ID. A basic advance in investigating its points of interest is to embrace it for use as a type of security in officially existing frameworks, for example, vehicles.

The majority of the propelled vehicle security frameworks best suit the four wheelers. As of the security framework for bikes is concerned, the frameworks accessible in market are of no match to the very much prepared criminals.

#### Module Diagram

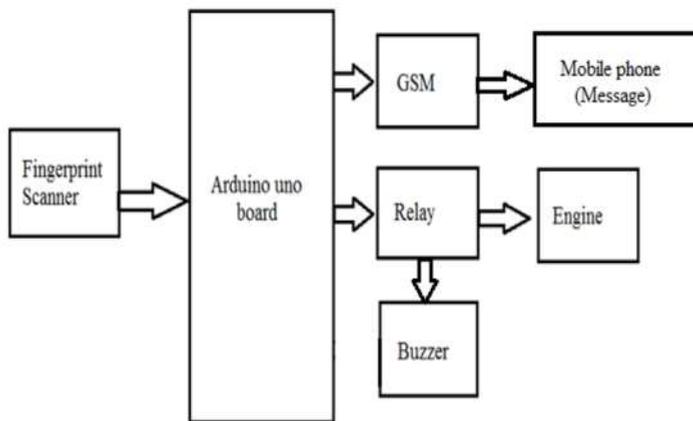


Figura 1: Workflow of fingerprint based vehicle starting system

#### FINGERPRINT SCANNER



Figura 2. fingerpr scanner

Like optical scanners, capacitive unique mark scanners create a picture of the edges and valleys that make up a finger impression. However, rather than detecting the print utilizing light, the capacitors utilize electrical flow.

The unique mark sensor module is little, and pleasantly constructed and it utilizes some progressed DSP (Digital Signal Processing) chips inside.

The sensor works this way. It is an optical sensor, which implies it examinations the photograph of a finger. It at that point renders the picture, makes a few computations, finds the highlights of that finger and afterward looks in its memory for a unique mark with similar qualities. It can accomplish all that in under a second.

### **ARDUINO UNO**



**Figura 3.** Arduino Uno board

This kit is used for connecting the all sensor

### **RELAY**



**Figura 4.** Relay board

This is used to control the power supply and connecting between arduino and engine

## **ARDUINO SOFTWARE**

We use the software for develop the code arduino uno.This can because embedded c language and develop the code

## **4. RESULT AND DISCUSSION**



**Figura 5.** Interfacing fingerprint with arduino and relay

Realizing a project physically has lots to do with research, choice of component and testing of the components. The project was implemented and tested to ensure proper operation under stated instruction. The various modules were tested and satisfactory results were obtained. As the components used fall within the tolerance value of the components, hence an assurance of the proper functioning of the system. .From the Figure 5 as depicted above, it shows that the designed system performs the measured values.

## **5. CONCLUSION**

This work is perform well of a unique mark based vehicle beginning system.The framework need a client's finger. Fingerprints can enlist new client's finger at request.This biometric sensor innovation improves the security of a car influence it feasible for bicycle to be utilized by just enrolled finger impression.

This work is a well operating prototype of a fingerprint based vehicle staring system. The system intelligent agents were able to communicate well and appropriate output is given under user input. The system requests for user's finger, process it and

give appropriate output based on if the finger is stored in the fingerprint module or not. The system is also able to enroll new user's finger at request but prompt for passcode before it could be done. Passcode editing can also be done on request in the system. Hence, fingerprint technology improves the security of an automobile making it possible for the car to be used by only authorized users. Therefore implementing this system on vehicles makes the achievement of our two wheeler security system comes in a cheap and easily available form. The output is viewed with the use of an LED. Biometric recognition systems present security and convenience than conventional methods of personal recognition. Future work this can also be implemented in other automobiles apart from two wheelers and Others types of bio-metrics can also be used.

## **6. REFERENCES**

- Ruchita,J.S.& Anuradha,P.G.** (2012).GSM based car security system. International Journal of Engineering and Innovative Technology,(4).
- Bagavathy,p.,Dhaya,R.&Devakumar,T.** (2011).Real time car Theft decline system using arm processor. Int.Conf.on Advances in Recent Technologies in Communication and Computing.
- Karthikeyan,A.&Sowndharya,J.** (2012).Fingerprint based ignition system. International Journal of Computational Engineering Research,2(2):236-243.
- Singh,D.N.&Tejaswi,K.** (2013).Realtime vehicle theft identity and control system based on . International Journal of Latest Trends in Engineering and Technology(IJLTET),2(1):240-245.
- AjinkyaKawale,** (2013). Fingerprint based locking system. International Journal of Scientific & Engineering Research, 4(5):899-900.
- Arpit Agrawal and Ashish Patidar,** (2014).Smart Authentication for Smart Phones. International Journal of Computer Science and Information Technologies, 5(4):4839-4843.
- Mudholkar, S. S., Shende, P. M. &Sarode, M. V** (2012).Biometrics Authentication Technique For Intrusion Detection Systems Using Fingerprint Recognition, International Journal of Computer Science, Engineering and Information Technology (IJCEIT),2(1).

**Prashantkumar R. , Sagar V. C. , Santosh S., SiddharthNambiar** (2013),Two Wheeler Vehicle Security System, International Journal of Engineering Sciences & Emerging Technologies,6(3):324-334.



# **PERFORMANCE ANALYSIS OF BRAIN TISSUE SEGMENTATION AND CLASSIFICATION USING SOFT COMPUTING TECHNIQUES**

## **Dr.A.Lakshmi**

*Associate Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: lakshmi@klu.ac.in, <http://orcid.org/0000-0002-6744-7048>

## **Dr.M.Pallikonda Rajasekaran**

*Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: m.p.raja@klu.ac.in, <https://orcid.org/0000-0001-6942-4512>

## **Dr.T.Arivoli**

*Professor/Principal, Department of ECE, Vickram College of Engineering*

Email ID: t.arivoli@gmail.com, <http://orcid.org/0000-0003-1612-1029>

## **S.Jeevitha**

*Assistant Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: Jeevitha.ramkumar@gmail.com, <https://orcid.org/0000-0002-0587-8301>

## **N.Bhuvaneswary**

*Assistant Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: bhuvaneswary@klu.ac.in, <http://orcid.org/0000-0001-6400-6602>

## **R.Vinupriyadharshini**

*PG Student, Kalasalingam Academy of Research and Education.*

*Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: Vinuindhu86@gmail.com, <https://orcid.org/0000-0003-3682-2842>

## **ABSTRACT**

An effective brain tissue segmentation of MR image is a necessary task in medical field. But thanks to the presence of noise, complexness of the brain structure, bone and also the intensity in homogeneity most of the segmenting algorithms suffer with low accuracy. Here, spatial FCM algorithmic rule and also the ANFIS are used for segmenting and classifying the brain tissue regions. The initiation of Pre-processing makes the image readily available for further process and reduces the complexity of procedures and is dispensed in 3 steps like improvement of image, artifact removal and bone remotion. The MRI pictures are typically contaminated by noise thanks to the transmission and deed of the photographs, therefore it is esesntial to use associate in Nursing economical deionising technique to reimburse such information

corruption. Here, noise from the MR image was removed by curvelet remodel. MR image contains each bone and brain tissue region. Sometimes the tumor won't be found in non brain region. Removal of non brain tissue regions was done by the bone removal method, which supplies higher accuracy. when the image improvement, the segmentation supported soft computing techniques like spatial FCM still as ANFIS was dispensed. The results of those two techniques are valid against the ground truth pictures and also the performance of those techniques has been compared for performance analysis. This comparison shows that the ANFIS classifier has improved PSNR and accuracy than the spatial FCM.

**Keywords:** ANFIS and SFCM, Curve let transform, Magnetic Resonance Image, Skull stripping.

## 1. INTRODUCTION

Segmentation and classification of White Matter (GM), Gray Matter (WM) and Cerebro Spinal Fluid (CSF) in brain tissue is a vital task in medical field. To classify the tumour stage such as moderate and severe it is necessary to own a method for segmenting and classifying the brain tissue. The brain tumour detection will be more accurate when the brain

tissues are classified and segmented. Since the data present in MRI is very large, is extremely massive, manual segmentation by the medical man is extremely time overwhelming and subject to variation with totally different physicians. To hurry up the diagnostic method the automated segmentation of brain region is extremely vital. This work aims at removing the noise, the artifact and skull in the MR images. An accurate segmentation depends on the preprocessing results. This precise segmentation of the brain tissues are going to be terribly useful for tumour analysis. Classification of the brain tissues can facilitate to understand wherever the neoplasm in found. The neoplasm found within the nerve tissue is moderate one. However the neoplasm situated within the CSF is severe and immediate treatment is required. In brain stroke analysis the segmentation of brain tissue plays a major role.

## 2. LITERATURE SURVEY

P.Karthikeyan etal [1] suggested an extensive deionising technique such as curvelet transform for sharp MR image processing so as to suggest perfect edges and different singularities on the curves. This combined curvelet and wavelet transform yield

higher noise detection provides superior resolution in reconstructing the original image than different methodologies.

Jean *et.al* [2] developed a digital denoising practice for high quality image recovery through ridglet and curvelet transform. This digitization practices offer precise renovation of images also enhances the stability even against the perturbations.

Rosniza Roslan *et.al* [3] introduced skull stripping methodologies using mathematical morphology and the other named as region growing for MRI brain images segmentation. Strength and weakness of the above two methods on MRI images has been investigated during this techniques.

Many researches on fuzzy logic techniques are done. Marcin Denkowski [4] presented segmentation and pixel categorization of MR brain image processing of via interference with fuzzy logic rule based techniques.

For automated segmentation of MR brain images a modified algorithm of fuzzy clustering technique such as fuzzy C-means has been presented by [5] Yang and Zheng. The fuzzy clustering models often try to enhance the competency in handling uncertainties as of human interpretation.

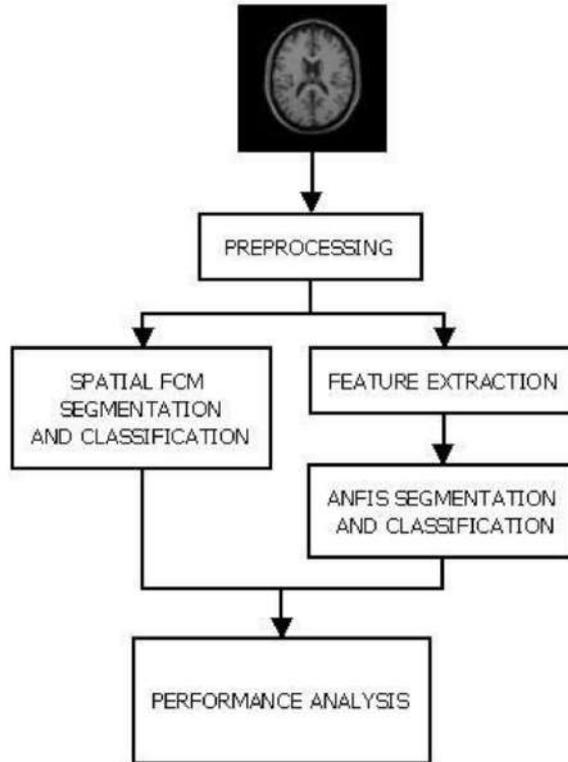
Adam.*et.al* [7] has given a modified system for seed growing region for skull removal which is applicable for segmentation of intensity images. Here every seed picture element is appended with nearer close picture element that has similar properties like explicit vary of gray level or color or pixel and hence the region grows.

Ajala Funmilola A. *et.al* [9], and [10], [11] described numerous strategies used for various medical image segmentation like , thresholding cluster, region growing, Classifier, mark off Model etc. Fischl, B., *et al* [24] presented Gaussian model for intensity distribution. The spatial proof is coded globally via probabilistic atlas through associate degree of non stationary Markov random field.

### **3. MATERIALS AND METHODS**

Twenty axial, coronal, sagittal T1 and T2 weighted datasets of usual subjects were acquired from the BrainWeb database. In which pre- generated Simulated Brain Database (SBD) were provided. The neuroimaging community will use these knowledge for playing numerous image analysis to judge the performances. The imaging datasets has been obtained from a scanner of Siemens 1.5T during April 2007 and

September 2007. The website „Whole Brain Atlas“ which is led by Department of Radiology and Neurology at Brigham and Women’s Hospital, Harvard grad school, Library of medication and the yankee Academy of Neurology has Fourteen abnormal datasets. These datasets had aeolotropic nature of voxels with stack of slices of size  $256 \times 256$ .



**Figure 1.** Flow diagram of proposed methodology

The whole technique comprised of two procedures. Initially Pre- processing has been completed. Pre-processing was accomplished with three strategies. After pre-processing, the processing of segmentation and classification order based of clustering techniques i.e.,depending upon Spatial FCM system is utilized. A similar segmentation was finished by methods for the system named as ANFIS. After the segmentation the presentation investigation was finished by utilizing some measurable execution parameters..

## **4. IMAGE PRE-PROCESSING**

Image enhancement absolute initial step for any image preparing procedures. Here the image enhancement was done under the name pre- processing. Sometimes skull portion leads to a mystifying conclusion of segmentation results. There are several brain extraction algorithms are available. Here the mathematical morphology procedure is utilized to remove the non cerebrum tissue from T1-weighted and T2-weighted MR examines separately.

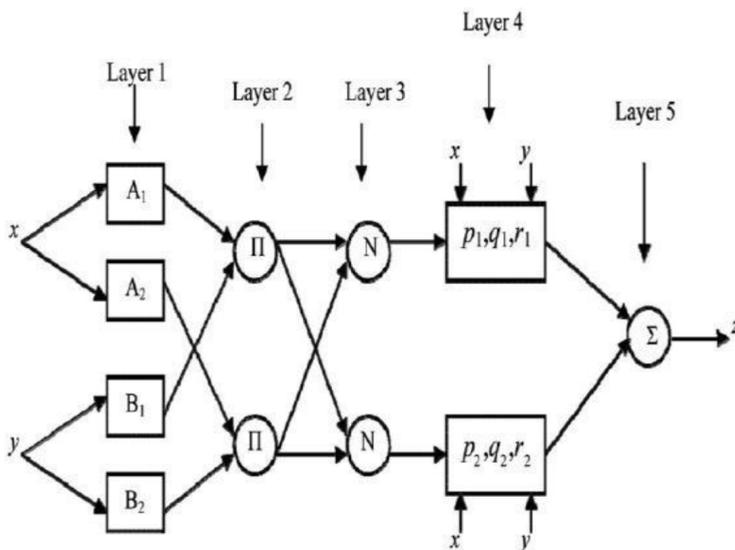
## **5. SPATIAL FCM**

Spatial information present in the image isn't completely utilized by the conventional FCM. By using the algorithm fuzzy C-means (FCM) it consolidates all the membership function required for clustering from spatial functions. It utilizes summation of membership function present in neighbourhood of each pixel under consideration. The combination of algorithms such as Fuzzy C-means clustering (FCM) and spatial constraints (FCM\_S) is most appropriate for image segmentation. For abuse of spatial function, the clarity of fuzziness for belongingness of each and every pixel is really powerful. FCM\_S has least resistant to noise and also outliers which are not appropriate for inputs of non- Euclidean structure owed to the utilization of Euclidean separation (L2 norm).

## **6. ANFIS**

ANFIS is one of the large utilized neuro-fuzzy systems. In this work, execution of MR brain tissue classification using adaptive neuro fuzzy inference system (ANFIS) is done. Merits of ANFIS are,

- For image segmentation fuzzy if-then rules was used
- Human ability isn't required at unsurpassed.
- Offers extra selections of membership function to practice.
- It offers quick combination time.



**Figure 2.** Basic Architecture of ANFIS

The diverse textural features proposed from each images are used as 7 inputs. Every training set forms with a fuzzy inference system comprising of 49 fuzzy rules. The informational index is isolated as two gatherings:

a) training data and b) testing data. The GRADE I to IV MRI brain images (Astrocytoma) are comprised under training data collection. These training examples are categorized in to four groups as follows- gray matter(GM), white matter (WM), cerebrospinal fluid(CSF) and the abnormal tumor region along with the algorithm fuzzy C-means (FCM) and (MATLAB-Built-in function). In these testing methods, highlights has been removed and attempted to come across top match.

ANFIS training information used in this work are Number of nodes- 12

Number of linear parameters- 4

Number of nonlinear parameters- 6

Total number of parameters- 10

Number of training data pairs- 24

Number of checking data pairs- 0

Number of fuzzy rules- 2

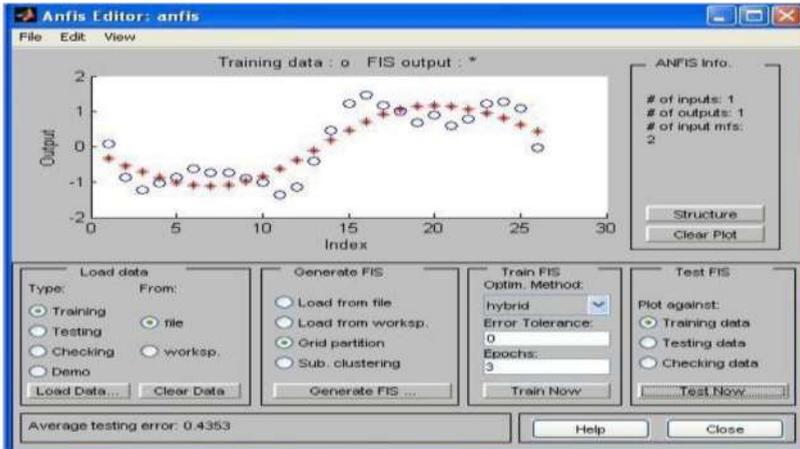


Figure 3. ANFIS Training Datasets

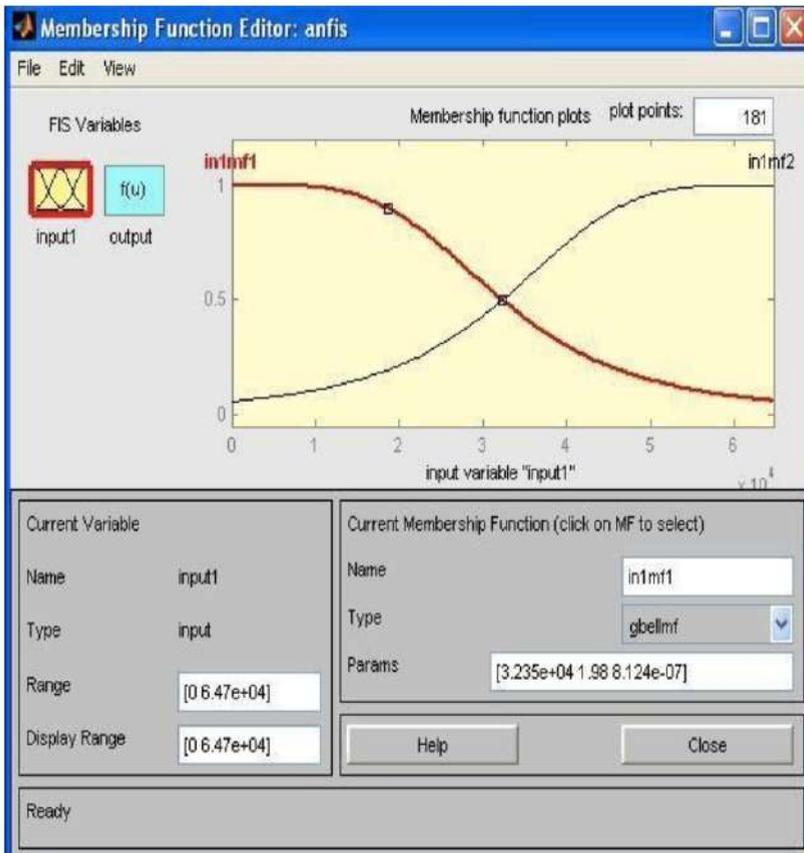


Figure 4. Membership Function in ANFIS

## 6. EVALUATION METRICS

The image quality determines the efficiency of reconstruction algorithm. The proportion of good nature of picture ought to mirror the modification on the image because of noise, blurring, sensor meagerness compression, and blurring. The commonly used measures are deviations observed among the innovative and coded images with Peak Signal to Noise Ratio (PSNR) diversities being the chief collective procedures. The Peak Signal to Noise Ratio (PSNR) has been utilized to assess and evaluate the image perfection. The PSNR is known as the ratio between the power of the original image and the power of distorting noise which affects the quality of its image depiction. Mean square error (MSE) is denoted as the ratio between average squared error between the reconstructed and the original image.

The PSNR measures is considered by the resulting equation,

$$PSNR = 10 \log_{10} [(255*255)/MSE].$$

The MSE is denoted as mean square error of two  $m \times n$  images  $f(i,j)$  and  $g(i,j)$  where one of the images is considered to be the noisy approximation of the other image and is known by

$$MSE = \frac{1}{mn} \sum_0^{m-1} \sum_0^{n-1} \|f(i,j) - g(i,j)\|^2$$

Distinctive algorithm of image segmentation can be compared with subsequent execution parameters:

True Positive (TP) :

Calculation of Proposed Segmentation and the specialist's manual division demonstrates the nearness of ailment.

True Negative (TN) :

Calculation of Proposed Segmentation and the specialist's manual division shows the nonappearance of infection.

False Positive (FP) :

Proposed Segmentation calculation shows the nearness of sickness and manual division by specialists speak to the nonappearance of illness.

False Negative (FN):

Proposed Segmentation calculation shows the nonappearance of infection and manual division by specialists results is nearness of illness.

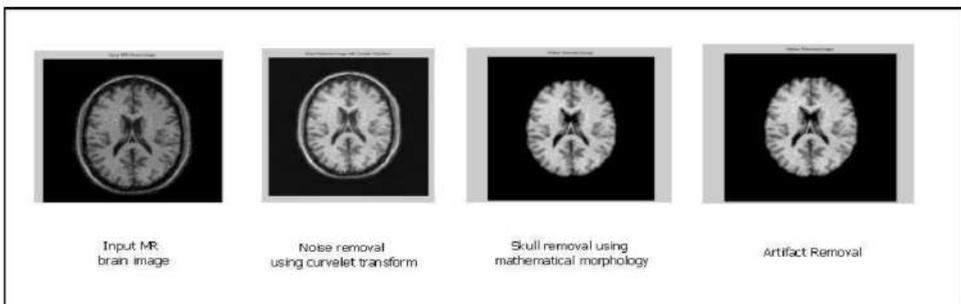
$$\text{Sensitivity} = \frac{TP}{(TP + FN)} * 100\%$$

$$\text{Specificity} = \frac{TN}{(TN + FP)} * 100\%$$

$$\text{Accuracy} = \left( \frac{TP + TN}{TP + TN + FP + FN} \right) * 100\%$$

## 7. EXPERIMENTAL RESULTS

The projected algorithm tested on many brain MR images. The outcomes are appeared in the accompanying figure. The initial preprocessing results are shown in the fig1.5. After that the segmentation results are shown in figure.1.6and figure.1.7. The fig.1.6 demonstrates segmented brain components of MR image in axial view and fig.1.7 demonstrates that segmented brain components of MR image in coronal view.



**Figure 5.** Preprocessing Results



**Figure 6.** Segmented components- GM, WM, CSF of the MR image in axial view

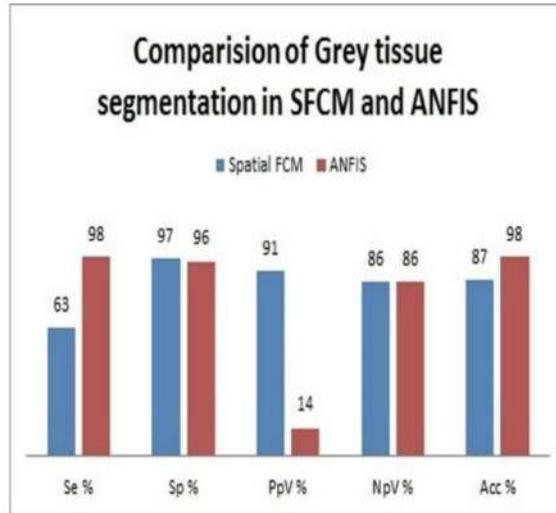


**Figure 7.** Segmented components- GM, WM, CSF of the MR image in coronol view

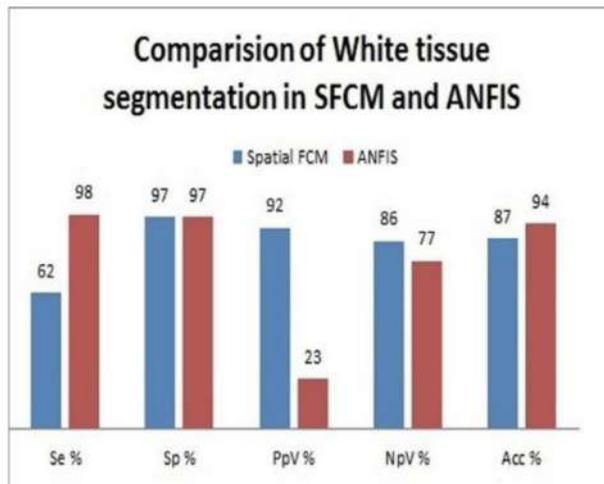
**Table 1.** Performance metrics

TECHNIQUE USED	SEGMENTED COMPONENTS	SE%	SP%	PPV%	NPV%	ACC%
Spatial FCM Based Classification	Gray Matter	63	97	91	86	87
	White Matter	62	97	92	86	87
	CSF	65	97	92	86	87
ANFIS Based Classification	Gray Matter	98	96	14	86	98
	White Matter	98	97	23	77	94
	CSF	89	91	37	63	90

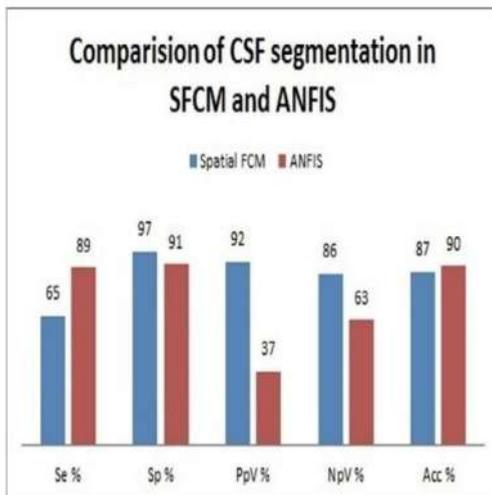
From the table 1.1 it is observed that the cataloging precision of all tissue types are comparatively slighter than the ANFIS classifier accuracy classification. From the above tables, obviously ANFIS yields preferred quality outcomes over the Spatial FCM classifier. The above table 1.1 is plotted in fig 1.8, 1.9 & 2.0. The average classification accuracy is 94% for ANFIS architecture.



**Figure 8.** Comparison of parameters (Se, Sp, PpV, NpV, Acc) in Spatial FCM and ANFIS classifier in Gray tissue segmentation of brain MR images.



**Figure 9.** Comparison of parameters (Se, Sp, PpV, NpV, Acc) in Spatial FCM and ANFIS classifier in White tissue segmentation of brain MR images.

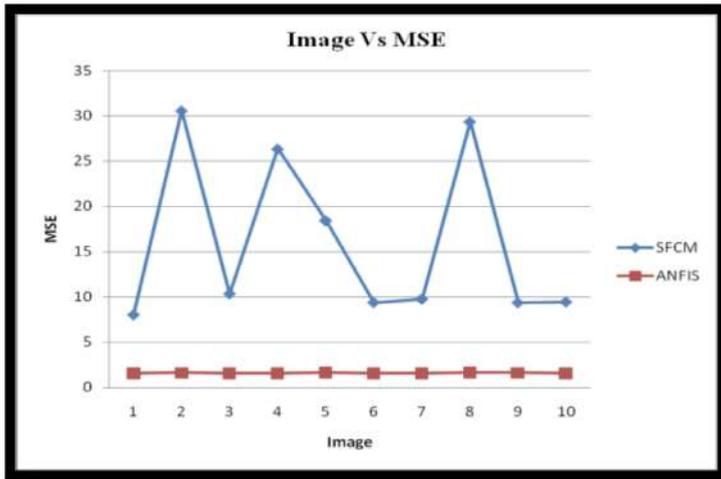


**Figure 10.** Comparison of parameters (Se, Sp, PpV, NpV, Acc) in Spatial FCM and ANFIS classifier in CSF segmentation of brain MR images.

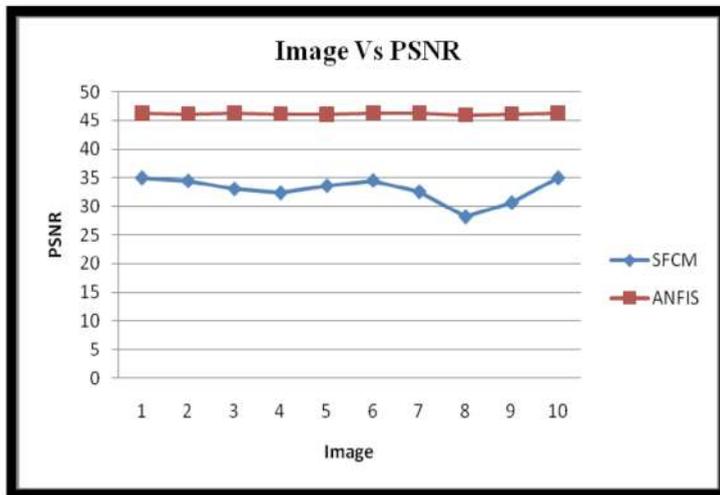
The below table 1.2 shows that the statistical parameters obtained in both Spatial FCM based segmentation and ANFIS based segmentation. The average classification accuracy of ANFIS architecture is 46 db. And it also has improved PSNR and reduced MSE. The value of PSNR should be high for less interference of noise signals lesser will be the interference of noise signals.

**Table 2.** Performance metrics

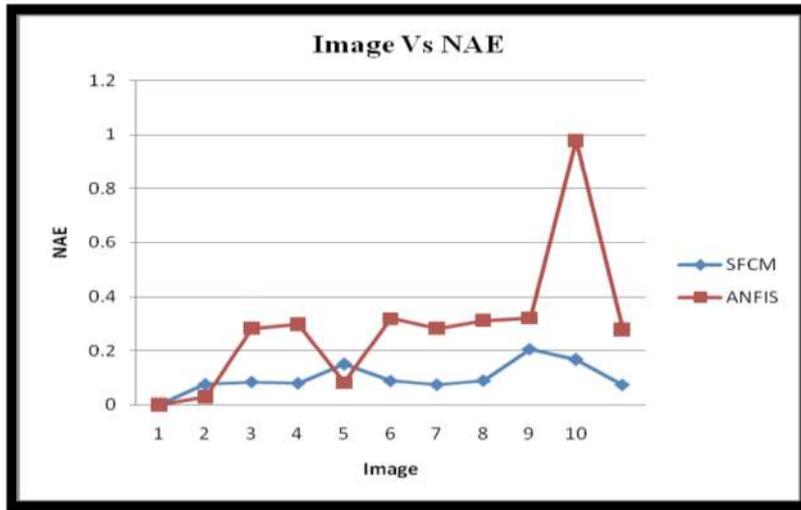
IMAGE	SPATIAL FCM				ANFIS			
	MSE	PSNR	RMSE	NAE	MSE	PSNR	RMSE	NAE
1	8.0189	35.0229	2.2933	0.0760	1.5532	46.2182	1.2463	0.02881
2	30.566	34.4711	5.5287	0.0845	1.5937	46.1065	1.2624	0.2830
3	10.333	33.0993	3.5789	0.0801	1.5352	46.2691	1.2390	0.2983
4	26.345	32.3787	5.0287	0.1509	1.5759	46.1554	1.2554	0.0818
5	18.423	33.6343	4.5175	0.0884	1.6144	46.0508	1.2706	0.3192
6	9.3642	34.5351	3.4189	0.0747	1.5403	46.2548	1.2411	0.2832
7	9.7492	32.5820	3.3047	0.0897	1.5461	46.2384	1.2434	0.3119
8	29.364	28.2154	5.4189	0.2057	1.6445	45.9704	1.2824	0.3214
9	9.3456	30.6970	3.9876	0.1676	1.5959	46.1007	1.2633	0.9794
10	9.4306	35.0138	3.3320	0.0740	1.5394	46.2573	1.2407	0.2792



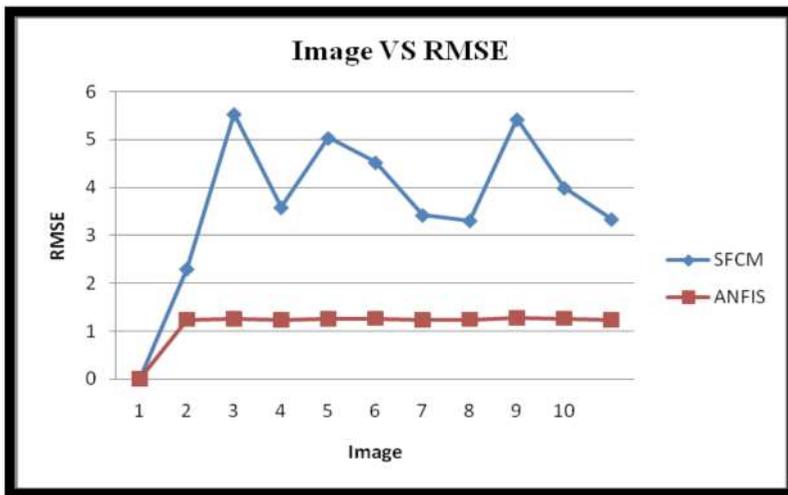
**Figure 11.** Relative chart with MSE values for 10 MRI input samples in both SFCM and ANFIS classifiers.



**Figure 12.** Relative chart with PSNR values for 10 MRI input samples in both SFCM and ANFIS classifiers.



**Figure 13.** Relative chart with RMSE values for 10 MRI input samples in both SFCM and ANFIS classifiers.



**Figure 14.** Relative chart with NAE values for 10 MRI input samples in both SFCM and ANFIS classifiers

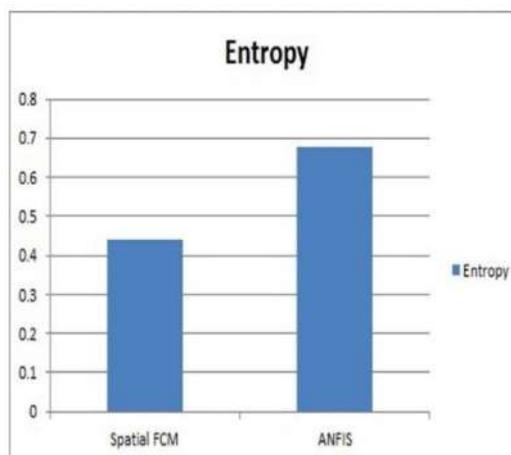
From the above fig 2.1 & 2.3 Errors such as mean square error (MSE and Root Mean Square Error (RMSE) obtained proves that there is minimum similarity between the images segmented. Thus the ANFIS has better performance than the Spatial FCM based segmentation. From the fig 2.2 ANFIS has improved Peak Signal to Noise Ratio

(PSNR) than SFCM. It is clearly that ANFIS yields better-quality results than the Spatial FCM classifier.

**Table 3:** Performance parameters

Nº OF SAMPLES	SPATIAL FCM		ANFIS	
	ENTROPY	JACCARD INDEX	ENTROPY	JACCARD INDEX
1	0.8722	0.001	0.8725	0.9881
2	0.8713	0.0011	0.8713	0.9891
3	0.0672	0.0053	0.8724	0.9897
4	0.0983	0.0097	0.1037	0.9848
5	0.874	0.0012	0.8737	0.9901
6	0.0829	0.0097	0.8709	0.9892
7	0.8628	0.0011	0.8639	0.9856
8	0.2356	0.0078	0.2302	0.9891
9	0.3366	0.0059	0.3537	0.986
10	0.0789	0.0053	0.8724	0.9868

The Entropy and the Jaccard index were depicted in the above table 1.3. The spatial FCM and the ANFIS based segmentations are compared in the table and graphs are plotted in fig 2.5. The quality of the image is compared by means of calculating the above said performance parameters. By taking the average value of Entropy and Jaccard index for 10 images of both SFCM and ANFIS classifier, the entropy of SFCM and ANFIS is 0.43798 and 0.67874 and the jaccard index of SFCM and ANFIS is 0.00481 and 0.9875 respectively. Thus the table 1.3 and fig 2.5 shows that the ANFIS have the better performance than the Spatial FCM.



**Figura 15.** Average value of Entropy in SFCM and ANFIS classifier.

## **8. CONCLUSION**

The implemented method segments the tissues of brain MR in an automatic manner. This paper has displayed a correlation of exhibitions of segmentation between two techniques of Spatial Fuzzy C-Means and along with Adaptive Network-based Fuzzy Inference System (ANFIS).

When the real data's are Fuzzy, such as functional MRI brain data, the use of ANFIS segmentation is always more effective than the use of the other one. The experimental consequences produce encouraging results for ANFIS in image classifier. The exact classification of ANFIS is reasonably superior than any other Spatial FCM classifier.

This work can be reached out in future to improve the ANFIS design to attain superior classification accuracy even at a lower rate of convergence. The resulting tissues are to be used in a finite element model of the brain. However, the complete finite element model should include more than these three tissues. The method could be extended to segment these tissues too. This can be done from the resulting classifications. However, the contrast between bone and CSF may be higher for other MR image weightings. If wanted other tissues like muscle and adipose tissue could also be segmented from the classifications to be included in the finite model element. The outcome presented in this paper is groundwork. However, to make it more robust and automatic improvements can be made to the algorithm. This work can be extended to help doctors in diagnostic of diseases.

## **9. REFERENCES**

- S.Rama Subramanian, P.Karthikeyan G.Rajasekaran, S.Musafar Rafee** (2012), Image denoising by curvelet transform using different wavelets in medical applications, *International Journal for Communications and Engineering* Volume 02– No.2, Issue: 04
- Jean-Luc Starck, Emmanuel J. Candès, and David L. Donoho** (2002), The Curvelet Transform for Image Denoising, *IEEE Transactions on Image Processing*, 11(6)
- Rosniza Roslan 1, Nursuriati Jamil and Rozi Mahmud** (2011), Skull Stripping Magnetic Resonance Images Brain Images: Region Growing versus Mathematical Morphology, *International Journal of Computer Information Systems and Industrial Management Applications*, 3,150-158,

- Denkowski. M, Chlebiej.M and Mikołajczak.P**(2004.), Segmentation of Human Brain MR Images Using Rule Based Fuzzy Logic Inference, IOS press, vol.105, pp:264-272
- Song.Y.S et al** (2006): Fuzzy C-Means Algorithm with Divergence- Based Kernel, Springer Berlin/Heidelberg, vol.4223, pp:99-108
- Yang.Y and Zheng.Ch.** (2005): Fuzzy C-means clustering algorithm with a novel penalty term for image segmentation, Opto-electronics review, vol.13, no.4, pp:309-315.
- R. Adams and L. Bischof** (1994.)Seeded region growing, IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 16(6), 641–646
- F. Segonne, a,b, A.M. Dale, E. Busa, M. Glessner, D. Salat, H.K. Hahn, and B. Fischl** (2004), A hybrid approach to the skull stripping problem in MRI, NeuroImage 22 1060–1075
- Ajala Funmilola A et. Al**(2012),Fuzzy k-c-means Clustering Algorithm for Medical Image Segmentation. Journal of Information Engineering and Applications, ISSN 2224-5782 (print) ISSN 2225-0506 (online) Vol 2, No.6
- S. Murugavalli and V. Rajamani.** “An Improved Implementation of BrainTumor Detection Using Segmentation Based on Neuro Fuzzy Technique”.Journal of Computer Science 3 (11): 841- 846,2007, ISSN 1549-3636.
- S.R. Kannan** (2005), Segmentation of MRI Using New Unsupervised Fuzzy C Mean Algorithm, ICGST-GVIP Journal. Vol. 5. No.2.
- Yan Li and Zheru Chi** (2005), MR Brain Image Segmentation Based on Self- Organizing Map Network, International Journal of Information Technology Vol. 11, No. 8
- Paresh Chandra Barman et.al**(2011),MRI image segmentation using level set method and implement an medical diagnosis system”. Computer Science & Engineering: An International Journal (CSEIJ), Vol.1, No.5.
- Y. Zhu, Z. Chi and H. Yan** (1994.),Brain image segmentation using fuzzy classifiers, Intelligent Information systems
- S. Murugavalli, V. Rajamani** (2006),A high speed parallel fuzzy c- mean algorithm for brain tumor segmentation, Bime Journal, Volume (06), Issue (1)

**Shijuan He et.al** (2000), MRI Brain Images Segmentation". IEEE 0- 78036253-5/00/\$10.00

**Yan Li and Zheru Chi** (2005), MR Brain Image Segmentation Based on Self-Organizing Map Network. International Journal of Information Technology, Vol. 11, No. 8

**Somasundaram k, and Kalavathi.P** (2012), Analysis of Imaging Artifacts in MR Brain Images, Orient. J. Comp. Sci. & Technol., Vol. 5(1), 135-141

**Nur Faiza Ishak, Rajasvaran Logeswaran, Wooi-Haw Tan** (2008), Artifact and noise stripping on low-field brain MRI, International journal of biology and biomedical engineering, Issue 2, Volume 2,

**W.G Bradley** (2004), Fundamentals of MRI: Part III– Forming an MR Image, Available at: [e-edcredits.com/articles/cme-bradley-mri- iii.doc](http://e-edcredits.com/articles/cme-bradley-mri-iii.doc)

**Tarasaikumar**, An Adaptive Threshold Algorithm for MRI Brain Image segmentation on Level set method, International Journal of ISSN 0974-2107 Systems and Technologies Vol.4, No.2, pp 95-103

**Francisco J. Galdamesa,d, Fabrice Jaillet c,d, Claudio A. Perez**, An accurate skull stripping method based on simplex meshes and histogramanalysis in magnetic resonance images, Rapport de recherche RR-LIRIS-2011-019

**Tsang, O., et al.**(2008).: Comparison of tissue segmentation algorithms in neuroimage analysis software tools. In: IEEE Engineering in Medicine and Biology Society3924{3928}

**Fischl, B., et al.** (2002): Whole brain segmentation: automated labeling of neuroanatomical structures in the human brain. NeuroImage 33 341{355}

# FORENSIC INVESTIGATION ON ELECTRONIC EVIDENCES USING ENCASE AND AUTOPSY

**A.Siva Chidambaram**

*Department of ECE, National Engineering College, Kovilpatti,(India)*

Email ID: sivaa0905@gmail.com, <https://orcid.org/0000-0003-3192-5033>

**K. Suthendran**

*Department of IT, Kalasalingam Academy of Research and Education, Krishnankoil,(India)*

Email ID: k.suthendran@klu.ac.in, <https://orcid.org/0000-0002-7030-4398>

**M.Satheesh Kumar**

*Department of ECE, National Engineering College, Kovilpatti, (India)*

Email ID: smskkece@nec.edu.in, <https://orcid.org/0000-0002-8113-3715>

## ABSTRACT

The Digital Forensics is an evolving field where lot of paid as well as open source forensic tools emerges day by day for providing better evidence to solve the case much easier. The main focus of this study is to compare forensic tools such as EnCase and Autopsy. EnCase is a paid software designed by Guidance Software and AUTOPSY is an open source software created by THE Sleuth Kit. The main aim of this study is to evaluate certain important factors in data acquisition such as Acquiring time, Meta data Information, Entropy, Encryption detection, OS Compatibility & Steganography Information in both the EnCase and Autopsy tool and compare it's reliability. From our study, we observed both the EnCase as well as Autopsy had some advantages and disadvantages.

**Keywords:** EnCase , Autopsy, Encryption.

## 1. INTRODUCTION

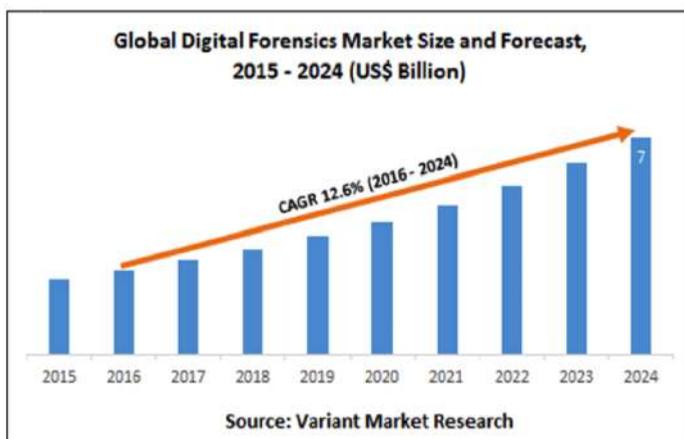
With the advancement in technology, the electronic devices we use increases tremendously day by day, which makes human life sophisticated and at the same time, it paves way for criminals to do crimes in favour of them. In earlier days, if a crime occurs the physical objects in the crime would be the major evidence for investigation. But now, the electronic devices are the major evidence for investigating the crime. Digital forensics is a branch of Forensic Science that deals with examination, analysis and acquisition of data obtained from digital devices in a crime incident. Due to increase in Cyber crime and increase in research of digital forensics shows a great demand in digital forensics in near future (Parker, C *et al.*(2006)). Increase in

sophisticated crime and terror attacks and security concerns in various industries are the major factors driving the global digital forensics market.

The rapid evolving Digital forensics fields have seen many forensic tools to acquire evidence from the digital device. There are wide variety of software tools both paid and open source for investigation purpose. Some top manufacturers of digital forensic tools are

- Global Digital Forensics
- Binary Intelligence
- Paraben Corporation
- Guidance Software Inc.,
- Access Data Group
- FireEye Inc.,
- LogRhythm., Inc.,

For our study, we compared EnCase forensic tool version 7.0.10 & Autopsy version 4



**Figure 1.** Statistics of Global Digital Forensics Market

## 2. BACKGROUND INFORMATION

The most important process in Digital Forensics is preserving the Integrity of the Evidence. The data present in the digital evidence obtained from the crime should be retained without even a single change (P N Ramakrishnan *et al.* (2018)). Only the unchanged data will be considered as the valid evidence that can be accepted by law.

So to retain the integrity of the digital devices, various techniques and tools were developed based on the type of digital devices(Watter, B. S. *et al.* (2013)). In Mobile Forensics, Faraday bags are used. Faraday bags are a type of Faraday Cage made of flexible metallic fabric. It is an enclosure used to block electromagnetic fields. They are named after the English scientist Micheal Faraday who invented them in 1836.

Since we were dealing with USB Drive, Write Blocker was used to preserve the integrity of the data present in the logical device. Write Blockers are devices that allow acquisition of information on a drive without creating the possibility of accidentally damaging the drive contents. They do this by allowing read commands to pass but by blocking write commands, hence their name (C. Aanandha Subramanian *et al.*(2019)).

### 2.1 ENCASE

As said earlier, EnCase is a forensic tool use for collecting evidence from digital devices and producing report from the acquired data. There are certain procedures involved in acquiring data in EnCase.

- 1) Before opening the EnCase Application in the computer, the investigator should connect the EnCase Dongle provided by GUIDANCE SOFTWARE.
- 2) After opening the Application, the investigator has to open a new case and specify the case name and also the output path where the files have to be stored.
- 3) Now the investigator has to add the digital evidences involved in the case.
- 4) After adding the evidence to the Case, now the examiner has to acquire and process the device for obtaining the EX01 file which is nothing but EnCase Image file format.
- 5) The Software then starts to process and Acquire the device.
- 6) After processing, acquiring and verifying the device, the output file will be saved in the output path given by the examiner.

## **2.2 AUTOPSY**

In Autopsy, the data acquisition process is somehow similar to the Encase like creating the Case name, then adding Evidence and specifying the output path for the image file.

## **3. METHODOLOGY**

For our Investigation we used a 16GB USB DRIVE with a normal image file, a copy of the image file with a pdf file hidden in it, a password protected document file and a compressed file to check the reliability of the software tools in extracting data from those files. We connected the USB Drive to the computer and added the USB Drive as the logical Evidence for our case named “test case”. After processing and acquiring data from both the tools we compared the tools based on few important parameters shown below.

The Computer we used was LENOVO Think Centre E73 Intel Core i5 4th Gen Processor 8GB RAM and 1TB Memory.

### **3.1 ACQUISITION TIME**

For a 16GB USB Drive, EnCase took 20 minutes to acquire the data present in it and further 15 minutes for Verification.. Whereas for the same USB Drive with no changes in files present in it, Autopsy took 35 minutes for Analyzing data.

### **3.2 ENCRYPTED FILES INFORMATION**

We included an Encrypted document file to check whether the forensic tools were capable of decrypting the file and make it viewable for further investigation. EnCase tool revealed the type of Encryption used and also the Protection complexity of the file but, we were unable to view the encrypted file. In order to view such encrypted file, Passware Forensic Kit another forensic kit which can be appended with EnCase could be used[5]. With the help of that tool the Encrypted files can also be viewed. We tried trial version with the EnCase but we can't able to view the password protected files, since trial version is compatible only with the EnCase version 8.

Name	File Ext	Logical Size	Category	Signature Analysis	File Type	Protected	Protection complexity	Last Accessed
4 SIVA		0	Unknown					
5 Compressed.zip	.zip	8,587,362	Archive	Match	ZIP Compressed	Extraction Pass...	Quick brute force	21.06.19
6 normal.jpg	.jpg	1,228,657	Picture	Match	JPEG Image Sta...			21.06.19
7 doc+file.jpg	.jpg	1,994,005	Picture	Match	JPEG Image Sta...			21.06.19
8 Captured Image.jpg	.jpg	1,342,957	Picture	Match	JPEG Image No...			21.06.19
9 Encrypted.doc	.doc	44,032	Document	Match	Compound Document File	Open Password, RC4 40-bit Encryption	Quick brute force	21.06.19
10 file.pdf	.pdf	755,346	Document	Match	Adobe PDF			21.06.19
11 Volume Boot		288,312	Unknown					

Name	Value
Name	Encrypted.doc
Tag	
File Ext	.doc
Logical Size	44,032
Category	Document
Signature Analysis	Match
File Type	Compound Document File
Protected	Open Password, RC4 40-bit Encryption
Protection complexity	Quick brute force
Last Accessed	21.06.19
File Created	21.06.19 10:59:58
Last Written	17.06.19 17:49:20
Is Picture	-
Is Indexed	-
Code Page	

Figure 2. Information about Encrypted files in EnCase

In the above picture, the Encrypted doc is the file that was protected with password. The EnCase tool gave clear description about the type of Encryption used, and protection complexity.

The same encrypted file was analyzed in Autopsy, but the tool only gave information that the files were encrypted and it didn't specify the type of encryption used to protect it.

Source File	S	C	O	Comment	Data Source
Encrypted.doc				Password protection detected,	G:
Compressed.zip				Full Encryption (Archive File)	G:

Figure 3. Information about Encrypted files in Autopsy

The above fig taken as a screenshot from Autopsy tool clearly shows that the tool was capable of only detecting the Encrypted files and they weren't able to tell the investigator about the Encryption used.

### 3.3 IMAGE METADATA INFORMATION

In order to know, whether the tools are capable of providing information regarding the images, we included a jpg file in which the image was captured from LENOVO K6 POWER mobile phone. In this Scenario, both the EnCase and Autopsy provided detailed information regarding the time and also the device which captured the image.

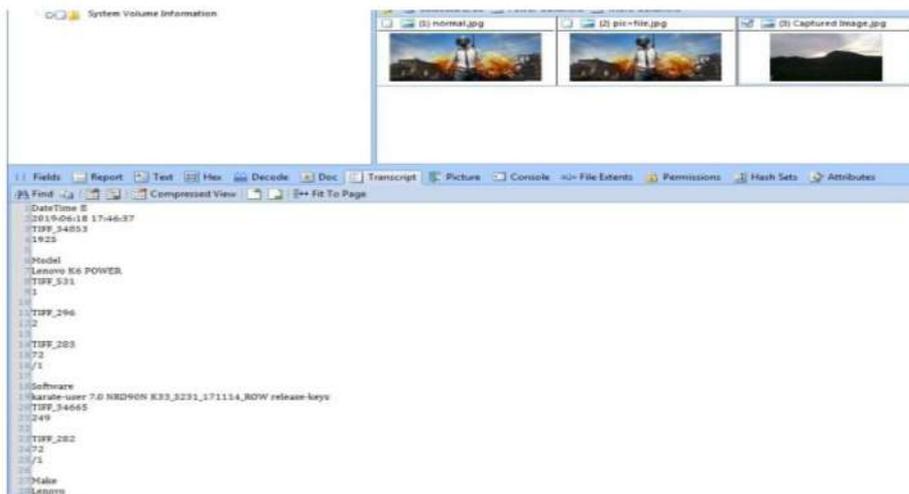


Figure 4. Device Information in EnCase.

### 3.4 GPS INFORMATION

Apart from the device information associated with the jpeg file, EnCase also provided the GPS information of the image. EXIF GPS Information Reader (P. Hannay *et al.*(2007)) and EXIF Viewer PLUGIN are some applications released by GUIDANCE SOFTWARE which helps to view the Geo-location of the image provided if GPS information is present in the image file (AK Theiss *et al.* (2005))

Autopsy didn't provide any information regarding the geographical location at which the image was captured.

### 3.5 ENTROPY

Entropy is simply defined as the measurement of randomness in given set of data. This Entropy value ranges from 0-8. Entropy value will be higher for Encrypted files and compressed files. To verify this, we had included an encrypted file as well as



### 3.7 OPERATING SYSTEM COMPATIBILITY

EnCase, tool works only with WINDOWS Operating System whereas the Autopsy tool is OS Compatible. It works with Mac OS, Linux and also with WINDOWS.

## 4. CONCLUSION

From our study, we observed that EnCase forensic tool provided better information about the GPS Location of the image, Entropy of the files and it took less acquisition time. At the same time, Autopsy is a better tool compared to EnCase when focusing on Financial and Compatibility perspective.

## 5. REFERENCES.

- P N Ramakrishnan** (2018). Forensic Analysis of Navigation System (Gps) – A Case Study. *Journal of Forensic Sciences & Criminal Investigation*, 7 (4), 001-005.
- P. Hannay** (2007). A Methodology for the Forensic Acquisition of the Tom One Satellite Navigation System. A Research in Progress. Paper presented at the 5th Australian Digital Forensics Conference.
- AK Theiss, DD CC Yen, CY Ku** (2005). Global positioning systems: an analysis of applications, current development and future implementations. *Computer Standards & Interfaces*.
- Parker, C.** (2006). GPS Tracking: the High-Tech Ball and Chain- System Lets Authorities Monitor Offenders and Helps Free Up Jail Space. *The Morning Call*.
- Watter, B. S., Schuttz, J. J.** (2013). Mapping simulated scenes with skeletal remains using different GPS in open environments: An assessment of accuracy and practicality. *Forensic Science International*. 228(1-3):33-46.
- C. Aanandha Subramanian, K. Suthendran and M. Satheesh Kumar** (2019). SIM Forensics: Extraction and Preparation of Digital Evidence using Sim Xtractor. *International Journal of Innovative Technology and Exploring Engineering*. 9(2),868-870.

# **PARTIAL CONNECTIVITY AWARE ROUTING FOR OPPORTUNISTIC NETWORKS**

**M.Syed Rabiya**

*Assistant Professor, Department of Computer Science and Engineering National Engineering College. Kovilpatti (India).*

Email ID: syedrabiya.m@klu.ac.in, <https://orcid.org/0000-0002-1903-8856>

**R.Ramalakshmi**

*Associate Professor, Department of Computer Science and Engineering Kalasalingam Academy of Research and Education. Krishnankoil (India).*

Email ID: rama@klu.ac.in, <https://orcid.org/0000-0001-7438-7445>

## **ABSTRACT**

This paper addresses a routing problem in the intermittently connected networks, a kind of delay-tolerant network where packets are delivered without establishing an end-to-end path between source and destination. It exploits the current contact between two nodes when they are within the transmission range of each other. As the nodes' mobility and storage help packet delivery between two nodes, the relay selection impacts the routing performance. The existing works utilize either the network's global connectivity record or the current encounter's delivery probability to deliver the packet to the destination. Since global connectivity data often becomes stale due to nodes failure, intermittent connectivity, and long delay, our proposed work employs a novel approach called 2-hops connectivity aware routing mechanism (2-CAR). The 2-CAR utilizes a past connectivity record consisting of 2-hops only. It allows each node to maintain the connectivity record for its neighbors and the neighbors of neighbors, instead of the entire network. The simulation is done to show the efficiency of the proposed work with increased network size. The simulation results show that 2-CAR achieves a 20% higher packet delivery rate than the state of art protocols with less overhead and latency.

**Keywords:** Delay Tolerant Networks, Intermittent connected networks, routing, and opportunistic networks.

## **1. INTRODUCTION**

An intermittently connected network is a delay tolerant network in which mobile devices relay messages between them in an ad hoc manner. The short transmission range, intermittent connectivity and long delay make maintaining a completely con-

nected path difficult between source and destination. Thus, it adapts a store-carry-forward routing mechanism. Nodes carry the packet until it finds the next suitable relay (Kevin Fall, 2003). It relies on the forwarding opportunity that occurs when two nodes are in direct contact of each other and the mobility of intermediate nodes to move the packet from source to destination.

The existing works deliver packets predicting future contacts utilizing the record of global connectivity (Xiao *et al.*, 2013). Since nodes are resource constraints, they have limited memory space, bandwidth and energy (Krifa Amir *et al.*, 2008; Wang En *et al.*, 2015). The global connectivity record becomes often stale because of node's failure due to intermittent connection and dead nodes. In addition, intermittent connectivity among nodes makes frequent refreshments of existing routing entries. Thus, it increases high overhead and affects message delivery rate.

In this proposed work, each node is forced to record contact information about nodes which are met already such as contact time and inter-contact time. So, each node can predict its next contact time with other known nodes. When two nodes are under direct contact, they update their contact time and inter-contact time with each other and they exchange the record about their known nodes. As the proposed work keeps a record of their known nodes, it reduces the overhead to maintaining the global connectivity of the whole network and avoids the stale route problem.

## **2. RELATED WORK**

The routing protocol of Delay Tolerant Networks is classified into single-copy and multi-copy-based (Sobin CC *et al.*, 2016). The multi-copy-based technique follows either a replication-based or quota-based mechanism. The single copy-based technique (Direct Delivery and first contact) allows a single copy of the message to be present in the network (Keranen Ari *et al.*, 2009). Direct delivery protocol waits until it meets the destination instead of forwarding the message to intermediate nodes. As a result, it generates less packet delivery rate with high delay. First contact protocol forwards the message only to the first contacted node.

In the case of multi-copy based technique, many copies of the message will be available in the network (Lindgren Anders *et al.*, 2012; Rabiya M.Syed & Ramalakshmi, 2019; Burgess John, 2006; Spyropoulos Thrasyvoulos *et al.*, 2005, 2007; Nelson Samuel *et al.*, 2009; Lin Yucheng *et al.*, 2018). Routing protocols that employ multi-copy with replication technique forward the replicas to its encounters blindly or whenever the replication condition is satisfied (Vahdar Amin & Becker David, 2000; Lindgren

Anders *et al.*, 2012; Rabiya M.Syed & Ramalakshmi, 2019). Epidemic blindly forwards the message whenever it meets a node. It achieves a high packet delivery rate but colossal overhead. PROPHET relays the message to a neighbor when the encounter has a higher delivery utility value than the message holder (Lindgren Anders *et al.*, 2012). So it generates high overhead when best-case scenarios occur. Replica Reduced Routing forwards the message to neighbors which have a higher delivery probability than both the message holder and the last selected relay (Rabiya M.Syed & Ramalakshmi, 2019). Even it faces the best and worst-case scenarios, it takes a long time in message delivery. MaxProp predicts the delivery probability for each packet and schedules and forwards them according to their probability value (Burgess John, 2006).

Multi-copy with quota-based techniques duplicate a fixed amount of copies for each message (Spyropoulos Thrasyvoulos *et al.*, 2005, 2007; Nelson Samuel, 2009; Le Tuan & Gerla Mario, 2017). It reduces the overhead but incurs long delays. Spray and Wait produces  $\lambda$  copies for each message, and the source node forwards those copies to the encounter nodes in a binary mode or non-binary mode (Spyropoulos Thrasyvoulos *et al.*, 2005). During the wait phase, the message holder waits and delivers the message to the destination directly. Spray and Focus follows the same spray phase as the Spray and Wait (Spyropoulos Thrasyvoulos *et al.*, 2007). However, in the focus phase, each message holder routes the message to the destination through the intermediate nodes predicting the encounter's delivery utility value instead of waiting for the destination itself. EBR forwards several copies to the neighbors according to the proportion of expected contacts (Nelson Samuel *et al.*, 2009).

Contact duration aware routing utilizes the history of one-hop and two-hop delivery probability to select the best relay (Le Tuan & Gerla Mario, 2017). However, it incurs high delay because it follows a single copy-based routing approach. Future contact behaviors with known nodes are predicted and used as a routing utility value in contact expectation routing. Nevertheless, it needs to maintain the global history of connectivity, resulting in high buffer consumption and high overhead (Chen Honglong & Wei Lou, 2016).

Since the topology of dynamic networks like the opportunistic networks is frequently changing, keeping 2-hops connectivity information avoids the need to maintain a table of an entire network. Thus, it reduces control overhead which is involved in updating the global connectivity table and consumes less memory.

The idea of employing a quota-based technique for message dissemination and maintaining only 2-hops connectivity prediction data for message forwarding motivates us to develop this novel routing technique.

### 3. THE PROPOSED WORK

The proposed work contains two phases called message spreading and message forwarding. During message spreading, the source node spreads ' $\lambda=10$ ' copies for each message into the network. Thus, the search space increases and the delivery delay decreases. The source node floods the network with  $\lambda-1$  copies for each message and keeps one copy. In message forwarding phase, each message custodian compares the remaining inter-contact time with the destination. It also checks the remaining inter-contact time of its known neighbors, current neighbors and neighbors of current neighbors with the destination. The node with the least remaining inter-contact time with the destination is selected as the next hop relay and the message will be forwarded. Each message holder removes the message from the buffer after it is forwarded to next-hop relay. The algorithm is given below and the notations used is given in Table. 1. The following terms are defined for the purpose of easy understanding.

- Contact time: The time for which two nodes say  $i$  and  $j$  are in contact. Fig. 1 shows two nodes  $i$  and  $j$  are within the transmission range of each. Solid line denotes contact between two nodes.



Figure 1. Contact between node  $i$  and  $j$

- Inter-contact time: The time for which two nodes are not in contact. In Fig. 2, the dashed line denotes that two nodes  $i$  and  $j$  are far away, which means they are not within the direct transmission range of each other.



Figure 2. Inter-contact between node  $i$  and  $j$

- Remaining inter-contact time: It is defined as how long it will take for two nodes to contact again.

**Table 1.** NOTATIONS.

NOTATION	DESCRIPTION
$N = \{V_1, V_2, \dots, V_N\}$	Set of nodes in the network
$n = \{M_1, M_2, \dots, M_n\}$	set of messages created
$\lambda=10$	Number copies per message
$RICT(S, D)$	Remaining inter-contact time between node S and D
$RICD(S's\ neighbor, D)$	Remaining inter contact time between known neighbor of S and D
Avg. ICTD	Average inter-contact time in second
$D \in N$	Destination

**ALGORITHM: 2-CAR**Step 1: startStep 2: if ( $V_i = \text{source}$ ) $V_i$  replicates  $\lambda-1$  copies into the networkStep 3: end ifStep 4: if ( $V_i$  with a copy of  $M_i$  contacts  $V_j$ );  $i, j \in N$ Step 5: if ( $\min(RICT(V_i, D), RICT(V_i's\ neighbor, D)) > \min(RICT(V_j, D), RICT(V_j's\ neighbor, D))$ ) $V_i$  forwards  $M_i$  to  $V_j$  $M_i$  is deleted from bufferStep 6: end if

Example:

Let node  $V_1$  has a message  $m_1$  to Destination node  $D$ . As in Fig. 3,  $V_1$  meets  $V_2$  at time ' $t$ '. Figure3 shows that  $V_1$  and  $V_2$  maintain the list of their known neighbors and neighbors of neighbors and their corresponding average inter-contact time represented in second.  $V_1$  and  $V_2$  calculate their remaining inter- contact time with  $D$  via itself and their known neighbors.  $V_1$  only forwards the message to  $V_2$  if the remaining inter-contact with  $D$  via  $V_2$  is less than itself.

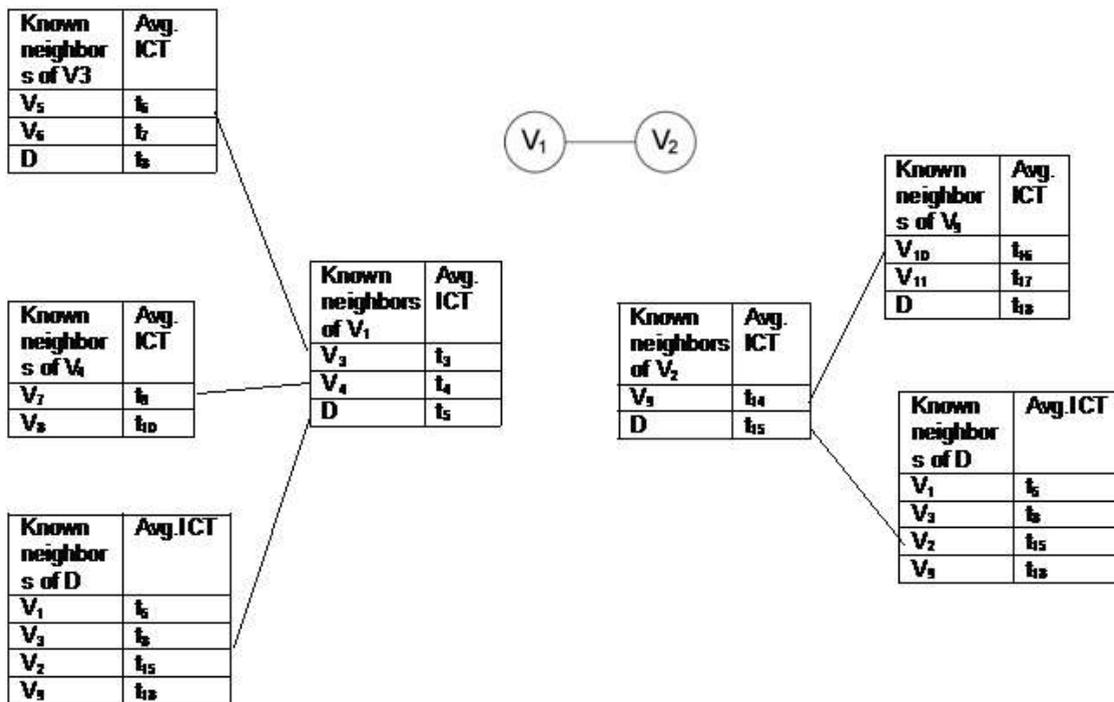


Figure 3. Representation of node’s contact record

### 4. SIMULATION

Simulation is done in ONE simulator with an area of 4500m x 3600m (Keranen Ari *et al.*, 2009). Nodes follow the Random Way point mobility model. Other simulation parameters are given in the following Table 2. The proposed work is implemented, and the performance is compared with the state-of-art protocols.

Table 2. SIMULATION SETTINGS

SIMULATION SETTING PARAMETERS	
Transmission Range	100m
Movement Speed	0..20 m/s
Pause Time	0,5s
Simulation Time	4500s
Antenna	Omni Directional Antenna
Mobility Model	Random Way point
Packet sending Rate	2 Kbps
Buffer size	100 k
Packet Size	1 KB
Time To Live (TTL)	10 m

### 3.1. SIMULATION RESULTS

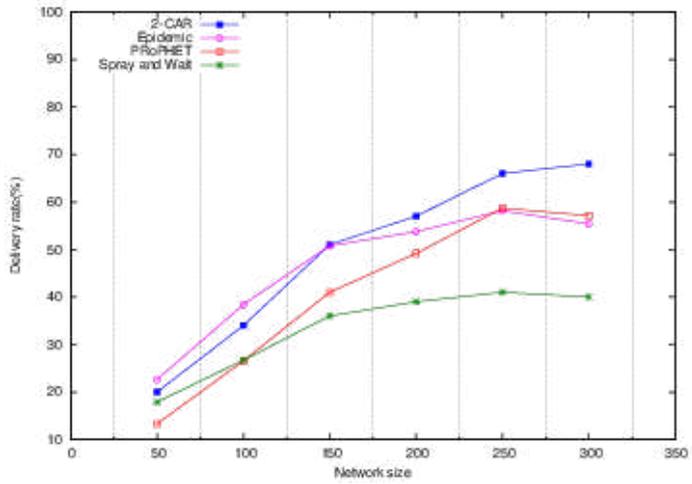


Figure 4. Delivery rate

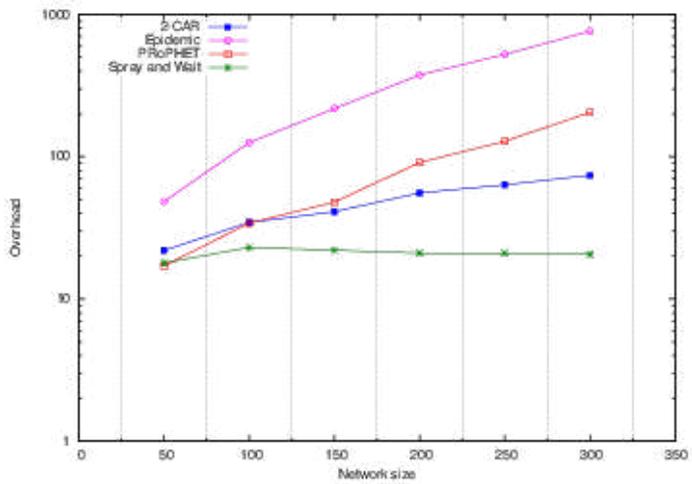


Figure 5. Overhead

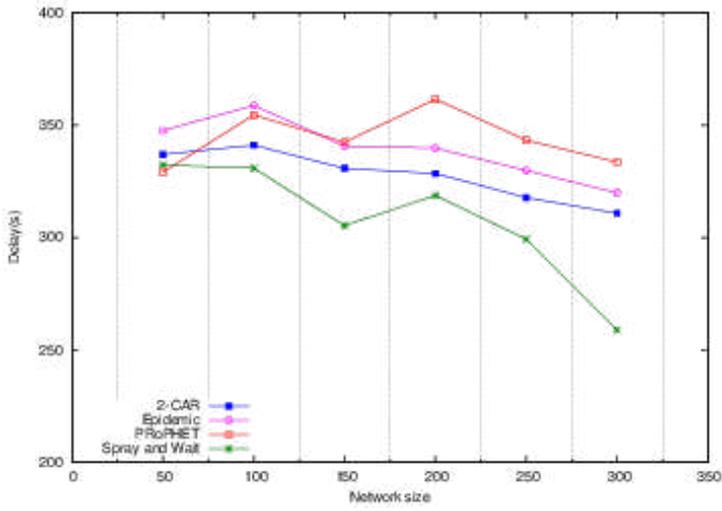


Figure 6. Delay

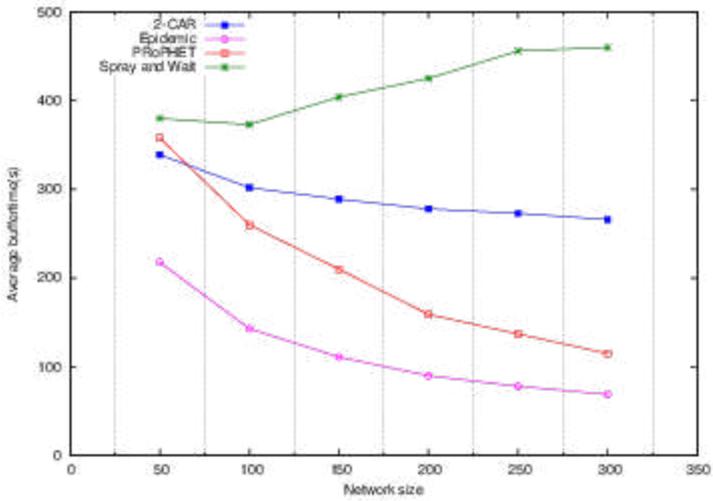
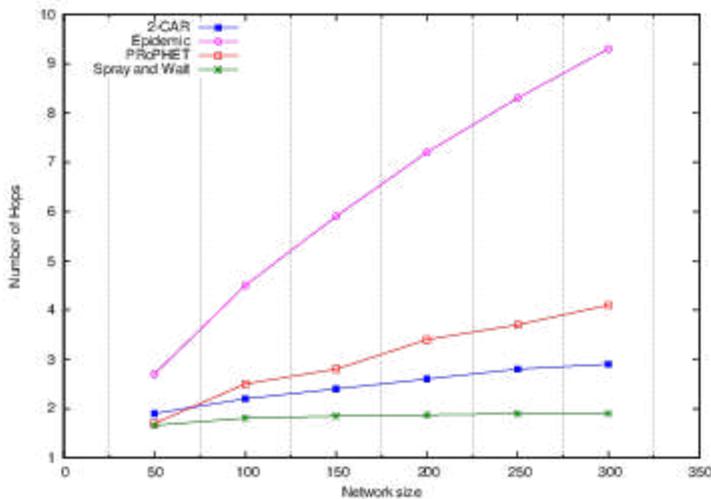


Figure 7. Average Buffer time



**Figure 8.** Hop count

Fig. 4- Fig. 8 show the performance '2-CAR' and other routing protocols. The 2-CAR achieves the highest delivery rate with less overhead. Since it utilizes the contact expectation between nodes and their known neighbors. It avoids unnecessary message forwarding and reduces buffer consumption. Thus, it produces the highest delivery rate than the state-of-art protocols with a very low buffer size (5%).

As Epidemic adapts a replication-based routing mechanism, it needs a tremendous amount of memory space to store the replicas and achieve a good result. Fig. 6 and Fig. 7 shows that Epidemic incurs longer delay and less buffer time than 2-CAR because each successfully delivered packet has traversed many hops as in Fig. 8.

PROPHET takes forwarding decision comparing the delivery probability of message custodian and currently encountered node not the neighbors of both. It creates less overhead and less buffer time than 2-CAR but incurs the longest delay, as in Fig. 6.

As Spray and Wait is a quota-based protocol, it generates the least overhead of all, as in Fig. 5. During the wait phase, each message holder needs to wait until it meets the intended destination. Each message needs to stay in a memory for a long time; thus, it incurs the longest buffer time and the lowest the delivery rate as in Fig. 4 and Fig. 7. The graphs exhibit that the proposed work can deliver more packets with less resource utilization.

## 5. CONCLUSION

The growing popularity of smartphones incurs increased network infrastructure coverage and bandwidth. But, the opportunistic networks can increase the network coverage and mobile data offloading, exploiting node mobility and opportunistic contacts.

The opportunistic networks leverage the context prediction to assess the delivery capability of intermediate nodes during the absence of end-to-end connectivity. However, manipulating global connectivity of topology information would eat up buffer and energy, resulting in high control overhead and less life span of the networks. This paper proposed partial connectivity-aware routing based on a history of contact information and quota-based forwarding strategy. The proposed paper demonstrates that manipulating only two-hop information reduces buffer utilization and control overhead. Since the quota-based forwarding strategy limits the replicas, the proposed paper balances the trade-off between delivery rate and resource overhead. However, it was found that the proposed paper needs to boost the delivery rate by exploiting multiple attributes such as social and mobility patterns, which impacts the routing performance.

In future work, we plan to optimize the delivery rate utilizing the social structure of users and points of interest. We also plan to examine the power management aspect of the proposed paper.

## 6. REFERENCES

- Burgess, J., Gallagher, B., Jensen, D. D., & Levine, B. N.** (2006, April). MaxProp: Routing for Vehicle-Based Disruption-Tolerant Networks. In *Infocom* (Vol. 6).
- Chen, H., & Lou, W.** (2016). Contact expectation based routing for delay tolerant networks. *Ad Hoc Networks*, 36, 244-257.
- Fall, K.** (2003, August). A delay-tolerant network architecture for challenged internets. In *Proceedings of the 2003 conference on Applications, technologies, architectures, and protocols for computer communications* (pp. 27-34). ACM.
- Keränen, A., Ott, J., & Kärkkäinen, T.** (2009, March). The ONE simulator for DTN protocol evaluation. In *Proceedings of the 2nd international conference on simulation tools and techniques* (pp 1-19). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering).

- Krifa, A., Barakat, C., & Spyropoulos, T.** (2008, June). Optimal buffer management policies for delay tolerant networks. In 2008 5th annual IEEE communications society conference on sensor, mesh and ad hoc communications and networks (pp. 260-268). IEEE.
- Le, T., & Gerla, M.** (2017, August). Contact duration-aware routing in delay tolerant networks. In 2017 International Conference on Networking, Architecture, and Storage (NAS) (pp. 1-8). IEEE.
- Lin, Y., Chen, Z., Wu, J., & Wang, L.** (2018). An Opportunistic Network Routing Algorithm Based on Cosine Similarity of Data Packets between Nodes. *Algorithms*, 11(8), 119.
- Lindgren, A., Davies, E., Grasic, S., & Doria, A.** (2012). Probabilistic routing protocol for intermittently connected networks. RFC series.
- Nelson, S. C., Bakht, M., & Kravets, R.** (2009, April). Encounter-based routing in DTNs. In IEEE INFOCOM 2009 (pp. 846-854). IEEE.
- Rabiya, M. S., & Ramalakshmi, R.** (2019). Replica Reduced Routing Protocol for Intermittent Connected Networks in Emergency Scenarios. *International Journal of Distributed Systems and Technologies (IJ DST)*, 10(2), 84-109.
- Sobin, C. C., Raychoudhury, V., Marfia, G., & Singla, A.** (2016). A survey of routing and data dissemination in delay tolerant networks. *Journal of Network and Computer Applications*, 67, 128-146.
- Spyropoulos, T., Psounis, K., & Raghavendra, C. S.** (2005, August). Spray and wait: an efficient routing scheme for intermittently connected mobile networks. In Proceedings of the 2005 ACM SIGCOMM workshop on Delay-tolerant networking (pp. 252-259). ACM.
- Spyropoulos, T., Psounis, K., & Raghavendra, C. S.** (2007, March). Spray and focus: Efficient mobility-assisted routing for heterogeneous and correlated mobility. In Fifth Annual IEEE International Conference on Pervasive Computing and Communications Workshops (PerComW'07) (pp. 79-85). IEEE.
- Vahdat, A., & Becker, D.** (2000). Epidemic routing for partially connected ad hoc networks. Technical Report CS-200006, Duke University.

- Wang, E., Yang, Y., & Wu, J.** (2015). A knapsack-based buffer management strategy for delay-tolerant networks. *Journal of Parallel and Distributed Computing*, 86, 1-15.
- Xiao, M., Wu, J., & Huang, L.** (2013). Community-aware opportunistic routing in mobile social networks. *IEEE Transactions on Computers*, 63(7), 1682-1695.

# SECURING INTERNET OF THINGS DEVICES USING CONTAINERS

**Senthil Kumaran. S**

*Department of Information Technology Kalasalingam Academy of Research and Education Krishnankoil. TamilNadu, India.*

Email ID: [sk@styleesen.org](mailto:sk@styleesen.org), <https://orcid.org/0000-0002-0354-1430>

**Balakannan. S.P.**

*Department of Information Technology Kalasalingam Academy of Research and Education Krishnankoil. TamilNadu, India.*

Email ID: [balakannansp@gmail.com](mailto:balakannansp@gmail.com), <https://orcid.org/0000-0003-0462-0541>

## ABSTRACT

Internet of Things (IoT) is enhancing the way in which humans co-exists with machines and stresses each field of computer science due to its proliferic nature. There are billions of devices that are getting onboarded and its exponentially growing year on year (Gartner *et al.*, 2017), which demands the best Quality of Service (QoS) and tight security requirements. Security takes prime importance when it comes to IoT since huge amount of personal data is being exposed via each device that gets onboarded to the internet and it is an important topic of research (Ivan *et al.*, 2016). Security in the era of IoT should come in simple form but without compromising on highest possible quality. Edge computing or fog computing (Wikipedia, n.d.) is getting popularity because of IoT and the traditional or legacy technologies should be enhanced to cope up with the devices that gets deployed on the edge. Containerization is the new light weight virtualization (Morabito *et al.*, 2017) which could be applied to any computing device. This paper discusses the use of containerization on edge computing devices to enhance security of the IoT devices. The edge devices provide more than one service as part of the IoT ecosystem and they are an important piece to enable QoS guarantees in the demanding IoT scenario. We will explore an architecture that can be used by Original Equipment Manufacturers (OEM) and other device vendors in order to enhance security of these IoT devices using containerization.

**Keywords:** Internet of things, iot, containers, security, edge computing, fog computing, device.

## 1. INTRODUCTION

Internet of Things (IoT) is getting adopted at scale and increases the number of devices that participate in this eco-system (Gartner *et al.*, 2017). Due to the proliferation of devices there is a need for better and innovative way to administer and secure the participating devices. There is fast paced development in the field of computer science and associated research to cater this increasing demands posed by IoT.

Security is a prime concern when it comes to IoT since there is huge data that is being consumed and floated as part of the IoT ecosystem (Ivan *et al.*, 2016). OEMs are considering new ways in order to secure the devices with light weight solutions considering the form factor and other resource constraints that exists in the IoT devices at large. In this paper we will discuss an architecture to secure IoT devices based on containers, focussing specially on the edge devices that exists on the fog.

## 2. LITERATURE SURVEY

Fog computing (Wikipedia, n.d.) is a concept that emerged in the recent past in order to deliver the Quality of Service that is required for IoT. Fog computing is mainly the localization of services and associated content that is required by the terminal devices that exists in the IoT. The traditional devices such as switches, routers and other networking equipments are the candidates for fog computing also known as edge computing devices or simply edge devices. This paradigm is driving the Original Equipment Manufacturers (OEM) to add innovative methods to deliver their devices in the fog that is deployment ready for IoT.

Containerization is a concept in which that same host operating system deployed in a device can create isolated environments ranging from a single process to a complete full fledged operating system. It came into existance right from the main frame days and was carried away by heavy weight virtualization technologies (Wikipedia, n.d.). Containers are considered as light weight virtualization technique (Morabito *et al.*, 2017) which is supported by the operating system kernel. In the Linux kernel (Wikipedia, n.d.) containers where first possible with the advent of cgroups (cgroups, n.d.) (control groups) implementation that was introduced in version 2.6.24 (Wikipedia, n.d.). The first container implementation in Linux kernel was known as LXC (LXC, n.d.) or Linux containers. This containerization became very popular in the year 2012 when the same LXC implementation was re-mastered as Docker (Docker, n.d.). Docker pioneered the concept of Linux containers and made it simple to use and deploy with the masses. Containers can work from small devices to large servers deployed in

the data centers. Different operating system versions or distributions can be supported within the same host operating running on a hardware or device. In most of the cases the containers use the same underlying kernel as the host operating system, but provide strict isolation between the environments of the containers.

### **3. PURPOSE**

IoT devices are mainly resource constrained with less processing power, low memory, stringent power requirements and network capabilities (S. Bandyopadhyay *et al.*, 2013). Due to its constrained resources we cannot employ the same technologies which are used in full fledged computing devices such as desktops, servers, etc. Each implementation of a service in an IoT device should take into consideration the available resources in the device and impose stringent techniques that will ensure maximum performance from these resource constrained devices. Traditional security algorithms cannot be used directly in order to secure IoT (Pirbhulal, S. *et al.*, 2017) devices due to the huge computing demands imposed by these algorithms which makes the device power hungry, which is a luxury as far as IoT devices are concerned.

In the same sense, traditional virtualization methodologies cannot be used in IoT devices due to their heavy weight nature. Containers are a perfect match for this situation which can provide isolation within these resource constrained IoT devices. When there are billions of IoT devices deployed in future, it becomes important to keep them secured and updated at all times in order to protect the privacy of users who are part of the IoT ecosystem. In traditional deployments we use a pull model (Hauswirth *et al.*, 1999) in order to deliver software updates to the hardware, which may not be the right thing to do in case of IoT devices, since these devices may not be monitored by humans or we cannot as the users to keep their devices up-to-date with the security fixes. With a fast paced environment, updates to software should happen in a really quick way and should be propagated to all the devices in an efficient manner. Thus, push model (Hauswirth *et al.*, 1999) for software updates are the way to go in order to deliver updates and keep the proliferated IoT devices in good and secured condition.

Most of the IoT devices are also connected via wireless communication channels, rather than with wired network communication. Over the Air (OTA) updates (Halder *et al.*, 2019) are a way in which all the software and firmware updates to the devices are sent over a wireless mechanism. The OTA provisioning follows a push model where all the participating devices will be subscribed to the OEMs infrastructure to receive these updates. Updates can be sent on a hourly, daily, weekly or monthly

basis which is quite different from how big server hardware used to get updated for software. When the updates are sent so frequently, caution must be taken in order to not break the devices to which these updates are being sent. There could be updates that are sent in small chunks which does not necessarily change all the services but fixes a small bug in one of the service deployed in the device. In such a scenario instead of disturbing other services running on the devices during an update, we should have a mechanism to update that specific service to which the bug fix applies without interrupting other services. These are the type of scenarios where our proposed architecture in this paper will help the IoT devices to stay updated and secured by employing containers within these device environments.

#### **4. METHODOLOGY**

The traditional networking equipments such as switches, routers, firewalls, proxies, etc. are taking up extra services in the fog computing era in order to provide more services within the IoT environment. For example, a switch can also provide additional service such as content caching within the network in order to make localized content readily available without the need to reach the cloud servers. The main objective of this paper is to secure these edge devices that are overloaded with unusual service.

In order to make such an edge device secure we will propose an architecture based on containers. The container technology could be anything that the device manufacturer or OEM is comfortable with and see a value in adopting it for the needs of the device. Some popular containerization technologies that are popular are listed below:

- LXC
- LXD
- Docker
- rkt
- Solaris Containers (Dzone)
- Microsoft Containers

Any container technology could be used for this purpose, provided the underlying host operating system supports it. Similarly this paper proposes the architecture without making any explicit preference to host operating system, any operating sys-

tem could be used within the host which is supported by the IoT device based on its hardware configuration.

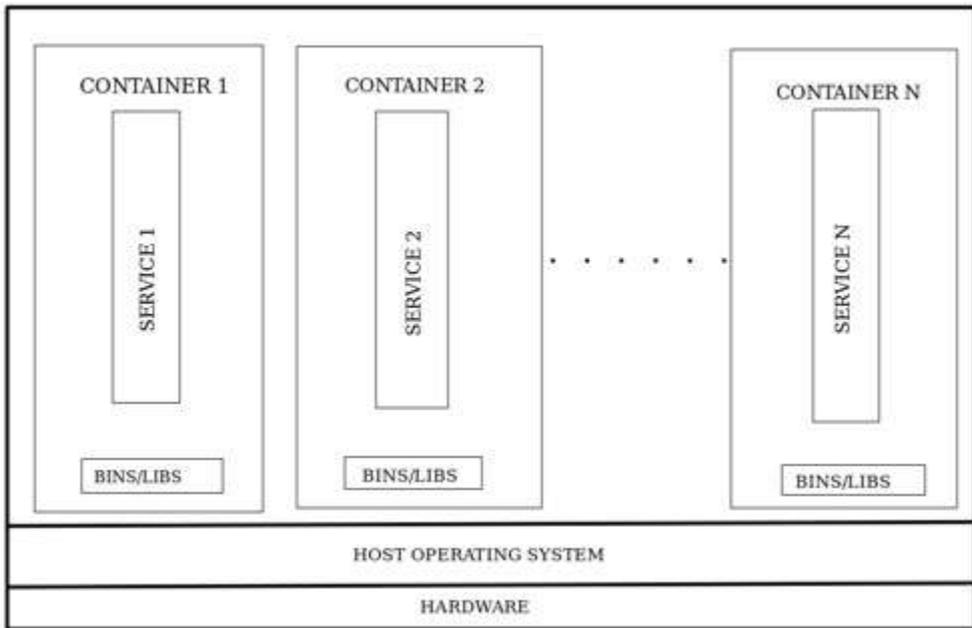
The architecture proposed in this paper will be a generic design choice that could be adopted in order to create a secured edge computing device that will be used in the IoT ecosystem, with the following parameters in consideration:

- Service Isolation
- Host operating system isolation
- Easy updates without breaking operation of the device
- Overloading services within the same edge device

LXC containers also known as Linux containers will be deployed on a Dragonboard 410c which is a popular IoT development board and performance benchmarks will be run on it both on the baremetal device and on top of the container to measure the performance of the device with and without container deployment in place. Each measurement will be run for 5 times on the physical Dragonboard 410c device (without any simulation) and the average value of the runs are taken into consideration and tabulated as part of the results of the performance benchmark experiment.

## **5. ARCHITECTURE**

The overall architecture of securing IoT device with containerization is shown in Figure 1. Containers are really light weight virtualization technology that provides performance equal to the one observed in bare metal hardware with minimal or no overheads (Kruger, C. P. *et al.*, 2014 & Senthil Kumaran. S. *et al.*, 2018). On top of the device hardware we have the host operating system which is the base operating system on top of which we deploy the containers. The host operating system is hardened and will poses only the basic functionality required to bring up the device and the associated hardware. The host operating system will not run any other services apart from running the basics to bring up containers within its environment.



**Figure 1.** Architecture for Securing IoT / Edge device

**Source:** Practical LXC and LXN book

As seen in Figure 1, each service that has to be run within the edge device can be run within a container. A container will have its own isolated operating system environment that is not related to the host operating system, except for sharing the host kernel depending on the container technology. Each container will have its own system libraries and binary utilities in order to run the service. Let us discuss the advantages and methodology of using this architecture on edge devices.

### A. Isolation

The major advantage of using containers is isolation (Cailliau *et al.*, 2016), where each process or service run within the container is independent and can be started and stopped without affecting other services running on the host operating system. Containers also provide process and data isolation which helps to secure the service running on the container (Cailliau *et al.*, 2016) from being affected by a bug that exists in other service that runs on a different container within the same device.

The service isolation within containers also brings in a huge security advantage of not sharing process space and memory. This helps in accidental overwriting and loss of data across services that are isolated within containers.

## B. Host Operating System

The host operating system is a minimal operating system image, which most of the time will not directly get involved in a network communications, but acts as a base for bringing up the containers. The host operating system could be considered as a stringent firmware without much functionality that will be updated very rarely and runs stable at all time in order to keep the device up and running. In modern edge devices these host operating system updates are delivered on a separate partition. Once the update is received it gets loaded to a special staging partition. The boot loader then switches to boot from this staging partition and the host operating system is booted. Once the boot process is complete and there is no errors observed, the current staging partition is interchanged as the actual partition which the host operating system is loaded to. In case of any errors, the old partition which holds the old host operating system image is booted by the bootloader, thereby bringing up the device without affecting the operation of the device.

Thus having two partitions that could be interchanged based on the arrival of a new image for host partition helps in bringing up the device or revert back without breaking the device, due to an error in the update. This is similar to the OTA update mechanism seen in Google Pixel (Wikipedia, n.d.) and other android based devices that helps in not breaking the device itself (Android, n.d.)

## C. Updates

Over the Air (OTA) (Halder *et al.*, 2019) is the common update mechanism that could be used in this architecture, where updates could be delivered for each and every container that is running in the device. There are the following possibilities that could be achieved with such a mechanism:

- Update sizes are very small
- Any number of updates could be sent in any frequency
- Targeted updates for specific services
- Targeted updates for security fixes
- Updates for changing dependent packages for specific services
- Transactional updates with a database to monitor
- Updates that does not require restart of the entire device
- Quick restarts after updates are installed since they are deployed in specific containers

Updates to the device services could be delivered at any point of time without affecting the operation of other services. There could be checks to ensure that the updates are not deployed when the service is doing some critical operation which could be programmatically detected and ensure the updates are deployed only after the critical operation is completed by the service. By maintaining a transactional log of each of the updates and the corresponding patches, we can ensure that if an update is not working as intended or is breaking a service, we can revert to the previous patch or image of the container, so that the service is not down or getting affected.

Containers are really light weight virtualization and hence booting or starting a container and the associated service within the container is going to take few seconds or even milli-seconds depending on the service that is getting started. This ensures quick restarts to services neglecting long delays and keeping the service down for a long time.

## 6. RESULTS

The basis of this paper comes from the idea that containers provide light weight virtualization within the device. In the Architecture section above we discussed the various methodology to enhance security using containers within the device. In this section we will conduct an experiment to prove that containers provide light weight virtualization which does not hinder the performance of the device, with the help of Dragonboard 410c (Qualcomm, n.d.) which is a popular ARM (ARM, n.d.) based development board that is widely used to develop edge and fog computing solutions. The configuration of Dragonboard 410c is shown in Table 1.

**Table 1.** Dragonboard 410c Configuration

<b>SoC</b>	Qualcomm Snapdragon 410E
<b>CPU</b>	ARM Cortex A53
<b>Cores</b>	Quad Core
<b>Clock Speed</b>	1.2 GHz
<b>Instruction Set</b>	ARMv8
<b>RAM</b>	1GB LPDDR3
<b>eMMC</b>	8GB
<b>Storage</b>	MicroSD
<b>Wireless</b>	802.11 b/g/n
<b>Bluetooth</b>	4.1
<b>GPIO</b>	40 pins
<b>Price</b>	\$75 USD

**Source:** Qualcomm <https://www.qualcomm.com/>

The Dragonboard 410c is installed with Debian (Debian, n.d.) GNU/Linux operating system with Linux kernel (Wikipedia, n.d.) version 4.13. LXC was used as the container technology in order to run the benchmarking. The benchmarking tool sysbench (Sysbench, n.d.), is a standard benchmark which evaluates the performance of Linux machines. Measurements were taken using sysbench on bare metal and within the LXC container, for the following parameters. Each benchmark was run four times and the average of the four runs were taken as the final result, which are presented and discussed in this section.

1. Memory
2. CPU
3. Input Output (I/O)

**Table 2.** Dragonboard 410c Benchmark Completion Time in Seconds

Parameter	Inside LXC	Baremetal
Memory	35.05	35.01
CPU	7.50	7.50
I/O	9.95	9.70

**Source:** Performance Benchmark experiment result

Table 2 shows the benchmark completion time in seconds. Based on the results shown in Table II we can see the difference in time (in seconds) for the execution of sysbench on parameters such as Memory performance, CPU performance and I/O performance are negligible or in some cases similar.

Thus, from this experiment we can clearly see there is no performance overhead in using containers within a device and the results are similar to running a bare metal device without any containers involved. This helps in understanding that by deploying the architecture shown in Figure 1. within a device will help in enhancing security of the device with minimal or no performance overheads.

## 7. FUTURE DIRECTIONS

An edge computing device that runs more than one service such as IPv6 assignment, switching, content caching, wire less configuration and communication, Zigbee / Bluetooth protocol communications, etc. should be implemented on a IoT development board such as DragonBoard, RaspberryPi, HiKey, etc. to demonstrate the effectiveness of this proposed architecture with containers. The implementation on this

development board should also show OTA updates that could be done for each of these services independently and make use of all the advantages listed in the above sections. A performance analysis should be done to benchmark the overall operation of the edge device, thus created.

## **8. CONCLUSION**

The principal aim of this paper was to showcase an architecture that can take advantage of latest containerization technologies in order to deliver the required Quality of Service (QoS) on the edge computing devices that are part of the IoT ecosystem, thus by ensuring service level isolation and security. The host operating system will be stable and always kept small with basic functionality in order to ensure availability of the edge device at all times, even though some of the services may get affected due to a faulty or erroneous update. This paper shows the usage of light weight virtualization technique without compromising the performance of the IoT device itself since majority of them are resource constrained. In these resource constrained devices when we use light weight virtualization techniques such as containers, we can ensure security without degrading the performance of the device which is shown via the experiments conducted on the Dragonboard 410c device. This paper will also stand as reference model for researchers and OEMs to deliver IoT edge devices that can be overloaded with as many services they can depending on the resources available on the device with minimal overhead for isolation and security implementation.

## **9. REFERENCES**

- Gartner.** (2017, February 7). Report on connected things. <https://www.gartner.com/en/newsroom/press-releases/2017-02-07-gartner-says-8-billion-connected-things-will-be-in-use-in-2017-up-31-percent-from-2016>
- Ivan Cvitić, Miroslav Vujić, Siniša Husnjak.** (2016). Classification of Security Risks in the IoT Environment. Proceedings of the 26th DAAAM International Symposium, 0731-0740. <https://www.doi.org/10.2507/26th.daaam.proceedings.102>
- R. Morabito, I. Farris, A. Iera & T. Taleb.** (2017). Evaluating Performance of Containerized IoT Services for Clustered Devices at the Network Edge. IEEE Internet of Things Journal, 4(4), pp.1019-1030. doi:10.1109/JIOT.2017.2714638

- S. Bandyopadhyay and A. Bhattacharyya.** (2013). Lightweight Internet protocols for web enablement of sensors using constrained gateway devices. International Conference on Computing, Networking and Communications (ICNC), 334-340. doi: 10.1109/ICCNC.2013.6504105
- Pirbhulal, S., Zhang, H., E Alahi, M.E., Ghayvat, H., Mukhopadhyay, S.C., Zhang, Y.-T., Wu, W. A.** (2017). Novel Secure IoT-Based Smart Home Automation System Using a Wireless Sensor Network. 17(1), 69. doi: <https://doi.org/10.3390/s17010069>
- Hauswirth, Manfred & Jazayeri, Mehdi.** (1999). A Component and Communication Model for Push Systems. ACM Sigsoft Software Engineering Notes. 24. 20-38. doi: 10.1145/318774.318784.
- Halder, Subir & Ghosal, Amrita & Conti, Mauro.** (2019). Secure Over-The-Air Software Updates in Connected Vehicles: A Survey.
- Kruger, C. P., and Hancke, G. P.** (2014). Benchmarking Internet of things devices. Proceedings 12th IEEE International Conference on Industrial Informatics, 611-616. <https://doi.org/10.1109/INDIN.2014.6945583>
- Senthil Kumaran. S., and Balakannan. S.P.** (2018). A Performance Evaluation of Linux Containers on similar ARM based Internet of Things Development Boards. Proceedings 3rd International Conference on Internet of Things & Connected Technologies. <https://dx.doi.org/10.2139/ssrn.3178682>
- Cailliau, Enias & Aerts, Nick & Noterman, Lander & Groote, Lars.** (2016). A comparative study on containers and related technologies.
- Wikipedia.** (n.d.). Fog Computing. [https://en.wikipedia.org/wiki/Fog\\_computing](https://en.wikipedia.org/wiki/Fog_computing)
- Wikipedia.** (n.d.). Linux Kernel. [https://en.wikipedia.org/wiki/Linux\\_kernel](https://en.wikipedia.org/wiki/Linux_kernel)
- Libvirt.** (n.d.). Virtualization APIs. <https://libvirt.org/>
- Linux Kernel Documentation.** (n.d.). cgroups <https://www.kernel.org/doc/Documentation/cgroup-v1/cgroups.txt>
- Linux Containers.** (n.d.). LXC. <https://linuxcontainers.org/>
- Docker.** (n.d.). <https://docs.docker.com/>
- Wikipedia.** (n.d.). Google Pixel. [https://en.wikipedia.org/wiki/Google\\_Pixel](https://en.wikipedia.org/wiki/Google_Pixel)

**Android Community.** (n.d.). A/B (Seamless) System Updates.<https://source.android.com/devices/tech/ota/ab>

**ARM.** (n.d.). ARM architecture.<https://www.arm.com/>

**Debian.** (n.d.). The Universal Operating System.<https://www.debian.org/>

**Qualcomm.** (n.d.). Dragonboard 410c. <https://www.qualcomm.com/products/dragonboard-410c>

**SysBench.** (n.d.). A modular, cross-platform and multi-threaded benchmark tool.  
<https://github.com/akopytov/sysbench>

# **AN EFFICIENT DATA HIDING APPROACH ON MEDICAL IMAGE FOR SECRETE COMMUNICATION**

**Pallath Mohanakrishnan**

*Research scholar Department of Computer Science Kalasalingam Academy of Research and Education Krishnan koil - 626126, Tamilnadu, India.*

Email ID: mohanp2248@gmail.com, <https://orcid.org/0000-0001-6614-2712>

**Suthendran**

*Department of Information Technology Kalasalingam Academy of Research and Education Krishnan koil - 626126, Tamilnadu, India.*

Email ID: k.suthendran@klu.ac.in, <https://orcid.org/0000-0002-7030-4398>

**Jarin**

*Department of Electrical Engineering Jyothy Engineering College*

Email ID: jeroever2000@gmail.com, xxxxxxxx

## **ABSTRACT**

Noise removal is an essential and challenging operation in image processing. Noise is the random, generally undesirable signal that interferes with the presentation, measurement or transmission of other signals. The Additive White Gaussian Noise and Riccian noise combined together called as mixed noise. The noise removal method first detects the position of noise pixels and then removes mixed noise. Mixed noises degraded the quality of the system, we need to remove the mixed noises and also encrypt the sensitive information in the medical images also ensures its secure transmission to meet this objectives we propose kalman filter to remove noises and honey encryption to hide sensitive information. the advanced encryption method (Honey encryption) is introduced to protect data stored on password manager services. The security of honey encryption is based on the fact that the probability that an attacker classifies plain text as legitimate can be calculated at the time of encryption. Diffie-Hellman key exchange is a digital method that produce decryption key for secret key cryptography. Our method performs well compared to the previous works, Performance evaluation metrics such as PSNR, SSIM, CNR, IE, MSE shows better results.

**Keywords:** Additive White Gaussian Noise, Riccian noise, Honey encryption, Discrete Cosine Transform, Diffie Hellman key.

## **1. INTRODUCTION**

An image is frequently corrupted by noise during storage, transmission and capture of the image. First, the location of the riccian noise is detected and then the mixed noise is eliminated. Mixed noise are removed based on two phases i.e. detect noise and eliminate noise. Weighted Encoding with sparse non-local regularization method are used to eliminate the mixed noise. Sparse nonlocal regularization method is used for encoding purpose. The novel technique is used in existing method i.e. Blind in-painting algorithm (BPA). BPA is used to remove noise iteration and results better performance. By using BPA method, the outperforms provides 2 to 6 db in PSNR. The result of BPA is a satisfactory result and 2 to 6 db higher than full vibration method and handle extremely high noise level described in (Mohanakrishnan. P, K. Suthendran, S. Arumugam, and T. Panneerselvam 2016 )

One-pass framework that allows lossless data hiding and lossless compression of the highlighted stream. The data hiding technique uses a hyperspectral data image to extract the original data. Watermarking method hides the data from the remote sensing area. It achieve high quality stego images well explained by (Carpentieri, Bruno, Arcangelo Castiglione, Alfredo De Santis, Francesco Palmieri, and Raffaele Pizolante 2019) .

Reversible data hiding is a technique that enables the embedding of hidden data into cover images. Turtle shell is a new scheme to hide the data used in reversible data hiding. This method offers better image quality and greater embedding capacity. Studies done on the (Lin, Jiang-Yi, Yanjun Liu, and Chin-Chen Chang 2019) The pixel value differencing histogram provide excellent imperceptibility for the stego image. This method calculates the embedding ratio and PSNR value .

P2DCA framework for Internet of multimedia things applications such as traffic management, healthcare surveillance. In this approach, the framework is based on IoMT devices such as multimedia sensor nodes (MNs) that are able to generate multimedia and non-multimedia data. The CP-ANN is used at the cloud server to process the aggregated data and segment the fore and back ground regions for extract the information and also track the moving objects it is described by (Usman, Muhammad, Mian Ahmad Jan, Xiangjian He, and Jinjun Chen 2019) .

In recent study on (Shankar, K., and Mohamed Elhoseny 2019) Optimal Data hiding key with light weight encryption method are used for secure the data. Enhanced

Cuckoo search optimization method permits the extraction of two embedded watermarks from the encrypted image and recover it after decryption .

Because the human visual system is less sensitive, the edge detection method is used to recognize and impact the edge pixels that enhance Stego image quality. Information security uses the electronic medical record scheme (ERP) that is encoded into medical images

without compromising image quality and, in particular, the region of interest is well explained by( Al-Dmour, Hayat, and Ahmed Al-Ani 2016) .

A new technique is formulated to reversible data hiding based on histogram shifting using multilayer localized n-bit truncation image. The average PSNR verifies the effectiveness of the LBPTI technique since the average PSNR is not less than 50 dB even though it obtains a high EC. The LBPTI method maintains the balances between ability and deformity of embedding images is explained in (Abbasi, Rashid, Lixiang Xu, Farhan Amin, and Bin Luo 2019) .

An alternative technique for hiding data is a design-based technique for hiding data that converts a secret message directly into a fingerprint image. It is based on the fingerprint hologram phase, which includes a grayscale fingerprint image, a binary fingerprint image, and a diluted fingerprint image. A better approach to spiral phase design should be explored by adequately limiting the distribution of coded spirals is elaborated in the study (Li, Sheng, and Xinpeng Zhang. 2018).

Now a days, the security and the integrity of the medical data are the great challenges for health services applications. The medical image data of the diagnostic text is protected using a hybrid security model. The proposed model based either 2D-DWT-1L or 2D-DWT-2L steganography and hybrid blending AES and RSA cryptographic techniques. The performance of frameworks such as PSNR, MSE, BER, SSIM, SC and correlation are measured and the study is done by (Elhoseny, M., Ramírez-González, G., Abu-Elnasr, O.M., Shawkat, S.A., Arunkumar, N. and Farouk, A., 2018) .

Here (S. Fepslin Athish Mon, K. Suthendran, K. Arjun , and S. Arumugam 2016) A Novel Reversible Data Hiding Method proposed a method to embed and hide patient details in the medical image and encrypt the cover medical image, once after decrypting cover image patients information can be extracted. two keys are there for encryption and data hiding, it provides double protection ,so the privacy of the patients and

hospitals can be ensured. this method provides good results in terms of data capacity and PSNR values. so the data loss is improved.

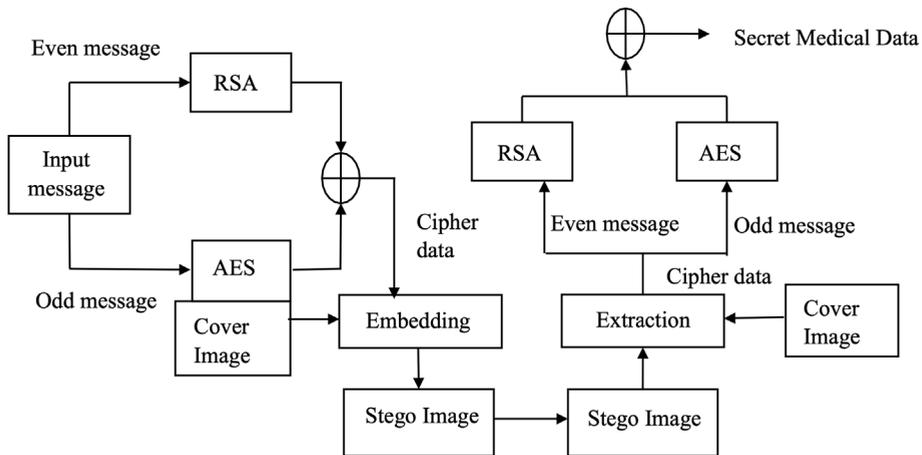
On Improved security of electronic medical records (EMR) using data encryption and reversible data hiding in tele radiology (Fepslin Athish Mon .S Suthendran K 2018) explains the a method to maintain the medical image integrity and authenticity and also hide patients information on medical image using reversible data hiding method, their idea was to use medical image as cover image and patients information is encoded in medical image. it uses reversible data hiding and straight forward approach of encryption .it also provide good data capacity and integrity. Here evaluating key is patients basic information and patient information is encrypted using initialization vector of the encryption process.

Accuracy of the radiographic image is improved when salt and pepper noise is eliminated with FPGA based filters, this paper, Performance Analysis of Algorithms over FPGA for Removing Salt and Pepper Noise (E. Ieno Junior, L. M. Garces, A. J. Cabrera and T. C. Pimenta 2016) explains on this noise removal with some performance analysing of algorithm over FPGA

## **2. EXISTING METHOD**

In the existing method, the confidential data of the patient's is encrypted using both AES and RSA encryption algorithms. The cryptographic technique is composed of encryption and decryption processes. For the encryption process, the plain text is divided into odd message and even message. The AES encryption algorithm is used to encrypt odd message using a secret public key. The RSA encryption algorithm is used to encrypt even message using a secret public key. For both odd and even message encryption different secret public key is used. In receiver side, the same key used by the sender is used over the cipher text throughout the encryption process.

## Module Description



**Graphic 1.** Framework for securing the medical data transmission

**Source:** Own Elaboration

In sender side, the input message is encrypted by the hybrid encryption algorithm (AES and RSA). The even messages are encrypted by RSA algorithm and odd message are encrypted by AES algorithm. In embedding process, Haar DWT-1 L and Haar DWT-2L are used. The Steganographic scheme is composed of embedding and extraction process. At the receiver side, the decryption process is done to recover the message.

### Algorithm for AES and RSA Encryption

The algorithm used in the encryption procedure is explained below

Inputs: secret plain M text message. Output: main\_cipher message, key m

Begin

1. Divide plain message into two parts (odd message, even message)
2. New AES key m is generated
3. EncOdd = AES-128 (odd message, m)
4. New RSA key (public = n) and (private = y) is generated
5. EncEven = RSA(even message, n)

6. Build FullEncTxt by inserting both EncOdd and EncEven in their indices
7. EncKey = AES-128 (y,m)
8. Compress FullEncmessage by convert to hash
9. Compress EncKey by convert to hash
10. Define message empty main\_cipher=""
11. Main\_cipher = Concatenate (FullEncmessage, EncKey)
12. Return main\_cipher and m

End

The decryption algorithm is explained below

Inputs: main\_cipher (secret) message, key.

Output: secret (plain, text) message.

Begin

1. Divide main\_cipher into two parts; HashedTxt and HashedKey
2. FullEncmessage = Decompress (HashedTxt)
3. EncKey = Decompress (HashedKey)
4. y = Decrypt\_AES-128 (encmessage,m)
5. EncOdd = Split (FullEncmessage, odd)
6. EncEven = Split(FullEncmessage, even)
7. Odd\_message = Decrypt\_AES-128 (EncOdd,m)
8. Even\_message = Decrypt\_RSA (EncEven,y)
9. Define main\_plain message

10. Loop on All Char

If odd

    Insert odd characters into odd indices within main\_plain message

Else

    Insert even characters into odd indices within main\_plain message

11. End of Loop

12. Return main\_plain (text) message

End

The calculation of certain statistical metrics determines the quality of the security model. Performance is based on parameters such as mean square error, bit error rate, structural similarity, structural content, peak signal-to-noise ratio, and correlation. In this technique, text is encrypted using AES and RSA encryption algorithms and embedded using either 2D –DWT-1L or 2D-DWT-2L stenography technique.

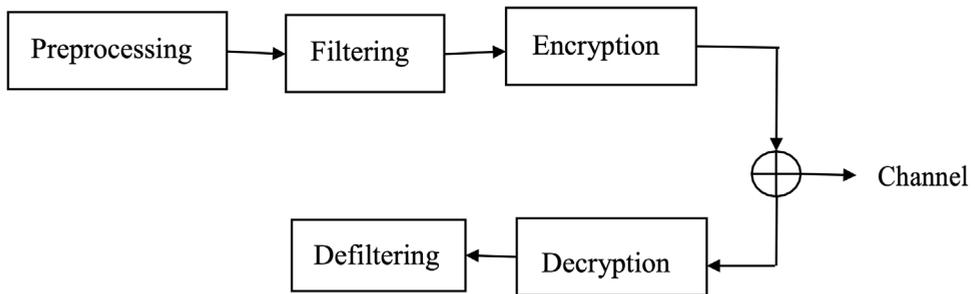
### 2.2 Disadvantage

AES is a symmetric block cipher which can encrypt and decrypt information. AES uses simple algebraic structure so the third party can easily corrupt the data. AES in counter mode is complex to implement in software for both performance and security. If large data needs to be encrypted on the same computer, the RSA algorithm is slow. RSA requires a third party to verify the authenticity of the public key. To recover the inconvenience of traditional password-based encryption (PBE) with low-entropy passwords, the Honey Encryption (HE) algorithm has been introduced.

## **3. PROPOSED METHOD**

In all the systems, the presence of noise is unavoidable. One of the challenging tasks in image processing is noise removal. There are various types of noise that affect the system i.e. impulse noise, adaptive white gaussian noise, shot noise, quantization noise. The proposed methodology deals to remove noise and also advanced encryption method is used to encrypt the images and provide secure information. Here,

Honey encryption technique is used for data encryption and prevents hackers by providing fake data for every incorrect guess of key code.



**Graphic 2.1** Block Diagram of Proposed Method

**Source:** Own Elaboration

### **Kalman Filter**

Noise is an unwanted contribution to a measured signal. Noise is typically a high-frequency random perturbation of measured pixel values caused by electronic noise of participating sensors (such as camera or scanner) or by transmission or digitization processes. The process of finding the best estimate from noisy data amounts to filtering out the noise. Kalman filter is the important technique for removal of noise in an image. It is used to measure the noise and other inaccuracies and produce values that be closer to true values of the measurements. Performance of Kalman filter is determined by a measurement and system noise covariance. The Kalman Filter is an algorithm which makes optimal use of imprecise data in a linear system with noises to continuously update the best estimate of the system's current state. Kalman filter theory is based on a state-space approach in which a state equation models the dynamics of the signal generation process and an observation equation models the noisy and distorted observation signal.

### **Application of Kalman filter**

- i. Kalman filter mainly used in computer vision applications such as depth measurements, feature tracking, cluster tracking, fusing data from radar, laser scanner and stereo-cameras for depth and velocity measurement.
- ii. It is used for tracking objects, economics and navigation.

## **Encryption**

Encryption encodes the messages or information. In an encryption scheme, information or messages are referred to as plain text that is encrypted using an encryption algorithm. Authorized recipients can easily decrypt the message using the key that the sender provided to the recipient, not the unauthorized user. The encryption types are symmetric key and public key. In a symmetric key scheme, the encryption key and decryption key are the same. The communication partner must have the same key to achieve secure communication. Public key cryptography exposes the encryption key so that anyone can use and encrypt the message. Therefore, only the recipient can access the decryption key and read the message. An open public key encryption application called Pretty Good Privacy (PGP).

## **Proposed Honey Encryption**

Honey encryption is a type of data encryption that generates a ciphertext that decrypted with an incorrect key as suggested by the attacker, contains a plausible-looking but incorrect plain-text password or key. The Honey encryption technique is used for data encryption and prevents hackers by providing fake data for any misconception of the key code. Not only does this approach slow down attackers, it may also bury the right key in a haystack of false hope. Then there are new methods, such as quantum key distribution, where the key embedded in photons is transmitted across the fiber. Honey encryption prevents such attacks by first converting the plaintext to a space where the distribution of the plaintext is uniform. The security of honey encryption is based on the fact that the probability that an attacker classifies plain text as legitimate can be calculated at the time of encryption. Honey Encryption can protect against these attacks by first assigning credit card numbers to a larger area in which they match their legitimacy. Numbers with invalid IINs and checksums are not assigned at all. Large brand numbers such as MasterCard and Visa are assigned to large regions in this area, while less popular brands are assigned to smaller regions and so on.

## **Operation of Honey Encryption**

The idea of honey encryption is that encryption of plaintext  $N$  is randomized with a password  $kp$  and decryption of cipher text gives output as plausible-looking plaintext  $N'$  with wrong password  $kp'$ . The distribution-transforming encoder is used for encoding and decoding of message as bit, string denoted  $DTE = (\text{encode}, \text{decode})$ . The

overall process are  $HE[DTE, Sym.E] = (HEnc, HDec)$ . The cipher text are  $C = HEnc(kp; N)$  and decryption  $N = HDec(kp; C)$

### **Diffie Hellman Key Exchange**

The Diffie-Hellman key exchange describes the shared confidentiality between two parties which can be used for confidential communication for data transmission over a public network. This key exchange is also known as exponential key exchange.

Algorithm for Diffie Hellman Key

For example public key  $P=23$ ,  $G=9$ ,  $x=4$ ,  $y=3$

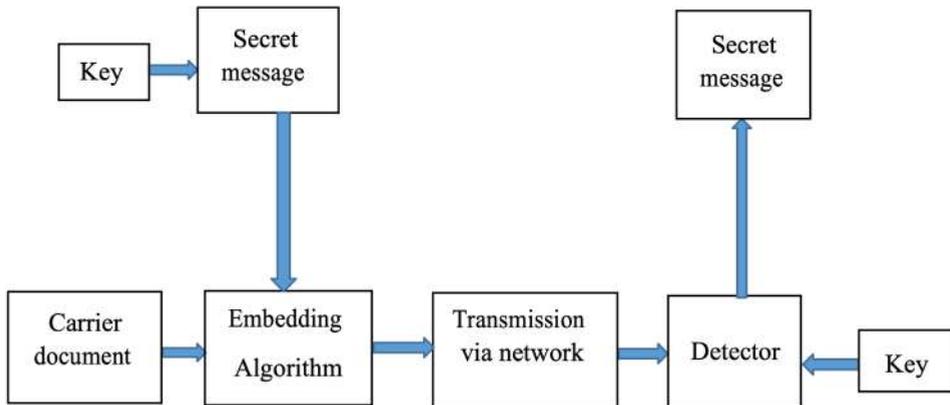
1. Prince and Mathew get public numbers  $P = 23$ ,  $G = 9$
2. Prince selected a private key  $x = 4$  Mathew selected a private key  $y = 3$
3. Prince and Mathew compute public values

Prince:  $a = (G^x \text{ mod } P) = (9^4 \text{ mod } 23) = (6561 \text{ mod } 23) = 6$

Mathew:  $b = (G^y \text{ mod } P) = (9^3 \text{ mod } 23) = (729 \text{ mod } 23) = 16$

4. Prince and Mathew exchange public numbers
5. Prince receives public key  $b = 16$  and Mathew receives public key  $a = 6$
6. Prince and Mathew compute symmetric keys Prince:  $kx = b^x \text{ mod } P = 65536 \text{ mod } 23 = 9$  Mathew:  $ky = a^y \text{ mod } P = 216 \text{ mod } 23 = 9$
7. 9 is the secret key

## Data Flow Graph



**Graphic 3.2** Data Flow graph  
Source: Own Elaboration

## 4. RESULT ANALYSIS

The input image is loaded to the corresponding load tab as shown in fig.4.1. The message file is incorporated into the input image for the data to be transfer to the destination without anyway of accessing by the unauthorized user.



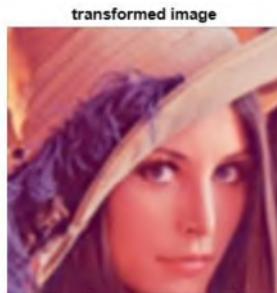
**Graphic 4.1** Input image and the message file  
Source: Internet

The input image with the hidden file is then filtered using Kalman filter method. The purpose of filter to remove the mixed noise in the image taken for processing as shown in graphic 4.2.



**Graphic 4.2.** Filtered image  
**Source:** own Elaboration(Matlab)

The filtered image is then transformed which undergoes the process of encryption for sending the image through the Rayleigh channel which can be received at the receiver side as shown in graphic 4.3.



**Graphic 4.3.** Transformed Image  
**Source:** own Elaboration (Matlab)

A secret key is a collection of data that performs encryption and decryption message in a symmetric manner. The secret key is combined with the input image to get the stego image as shown in graphic 4.4.



**Graphic 4.4.** (a) Input Image (b) Secrete Image (c) Stego image  
**Source:** own Elaboration(Matlab)

The stego image are send to the receiver side through the channel which contain the input image with message and also the Diffie Hellman key which helps the receiver to retrieve the original file as shown in graphic 4.5.



**Figure 4.5.** Input image in receiver side  
**Source:** own Elaboration(Matlab)

Now at the receiver side, the user provide with the public key decrypts the stego image into the input image and the message file content and also the converted message as shown in graphic 4.6



**Graphic 4.6** Conversion image and original message  
**Source:** own Elaboration(Matlab)

### 4.1 Performance Analysis

The performance analysis of this method indicates the quality of images increases when the PSNR value increase. From the obtained results, the PSNR value range above 25 indicates the best performance. Hence the below listed table includes the PSNR value based on SSIM, IE to remove the noise.

**Table 4.1.** Performance Analysis

PSNR	Cross Correlation	SSIM	CNR	IE	MSE
21.29	0.97	0.49	6.1	7.26	0.017
21.3068	0.98	0.53	7.53	6.68	0.015
22.45	0.987	0.57	7.915	7.19	0.013
23.40	0.998	0.68	8.30	0.000120	0.011
29.74	0.98	0.710	8.02	10.69	0.0022

Source: Matlab output

## 5. CONCLUSION

Many network and Internet applications, the transmission security is critical. The proposed methodology focuses not only on image noise removal but also on encryption of image and hiding data for the purpose of secure communication. The noise can be removed by using filter. Using honey encryption, the filtered image is encrypted and secure the data by secrete key. By using this technique it is possible to have communication between transmitter and receiver using denoised image and the data also an image which can be hidden. In the modern world data must be kept secretly the sensitive medical information must be secure. Mixed noises in the images highly degrade the quality. The noises must be eliminated from the sensitive medical images to ensure its efficiency. The sensitive image and important information must be kept secure for transmitting through any network. Here our proposed method to encrypt the data and its decryption together with noise elimination performs well. In the modern society it will be helpful to avoid intentional attack against the sensitive information. The experimental results were highlighting that the PSNR, quality of image and elapsed time are interconnected and the proposed system is showing high PSNR value. Experiment carried out in our proposed system indicates that the quality of image improves as PSNR value increases.

## 6. REFERENCES

- Abbasi, Rashid, Lixiang Xu, Farhan Amin, and Bin Luo.** (2019). "Efficient Lossless Compression Based Reversible Data Hiding Using Multilayered n-Bit Localization." *Security and Communication Networks*. <https://doi.org/10.1155/2019/8981240>
- Al-Dmour, Hayat, and Ahmed Al-Ani.** (2016): "Quality optimized medical image information hiding algorithm that employs edge detection and data coding." *Computer methods and programs in biomedicine* 127 24-43. DOI: 10.1016/j.cmpb.2016.01.011

- Carpentieri, Bruno, Arcangelo Castiglione, Alfredo De Santis, Francesco Palmieri, and Raffaele Pizzolante.** (2019): "One-pass lossless data hiding and compression of remote sensing data." *Future Generation Computer Systems* 90 222-239. <https://doi.org/10.1016/j.future.2018.07.051>
- Elhoseny, M., Ramírez-González, G., Abu-Elnasr, O.M., Shawkat, S.A., Arunkumar, N. and Farouk, A.** (2018). Secure medical data transmission model for IoT-based healthcare systems. *IEEE Access*, 6, pp.20596-20608. DOI: 10.1109/ACCESS.2018.2817615
- E. Ieno Junior, L. M. Garces, A. J. Cabrera and T. C. Pimenta** (2016) Performance Analysis of Algorithms over FPGA for Removing Salt and Pepper Noise "IEEE Latin America Transactions, Vol. 14, No. 5. DOI: 10.1109/TLA.2016.7530404
- Lin, Jiang-Yi, Yanjun Liu, and Chin-Chen Chang.** (2019): "A real-time dual-image-based reversible data hiding scheme using turtle shells." *Journal of Real-Time Image Processing* 16, no. 3 673-684. DOI <https://doi.org/10.1007/s11554-019-00863-0>
- Li, Sheng, and Xinpeng Zhang.** (2018): "Toward construction-based data hiding: from secrets to fingerprint images." *IEEE Transactions on Image Processing* 28, no. 3 1482-1497. DOI: 10.1109/TIP.2018.2878290
- Mohanakrishnan. P, K. Suthendran, S. Arumugam, and T. Panneerselvam.** (2016). "Mixed Noise Elimination and Data Hiding for Secure Data Transmission." In *International Conference on Theoretical Computer Science and Discrete Mathematics*, pp. 156-164. Springer, Cham. DOI [https://doi.org/10.1007/978-3-319-64419-6\\_21](https://doi.org/10.1007/978-3-319-64419-6_21)
- S. Fepslin Athish Mon, K. Suthendran** (2018) "On Improved security of electronic medical records (EMR) using data encryption and reversible data hiding in tele-radiology" *International Journal of Pure and Applied Mathematics* Volume 120 No. 6 31-48 <https://www.researchgate.net/publication/328163282>
- S. Fepslin Athish Mon, K. Suthendran, K. Arjun , and S. Arumugam** (2016)," ) A Novel Reversible Data Hiding Method" in *International Conference on Theoretical Computer Science and Discrete Mathematics* 55-62 Springer, Cham, DOI:10.1007/978-3-319-64419-6\_7

**Shankar, K., and Mohamed Elhoseny.Cham,** (2019) "Optimal Data Hiding Key in Encrypted Images Based Digital Image Security in Wireless Sensor Networks." *In Secure Image Transmission in Wireless Sensor Network (WSN) Applications*, pp. 99-113. Springer,. DOI [https://doi.org/10.1007/978-3-030-20816-5\\_7](https://doi.org/10.1007/978-3-030-20816-5_7)

**Usman, Muhammad, Mian Ahmad Jan, Xiangjian He, and Jinjun Chen.** (2019) "P2DCA: A Privacy-Preserving-Based Data Collection and Analysis Framework for IoMT Applications." *IEEE Journal on Selected Areas in Communications* 37, no. 6: 1222-1230. DOI: 10.1109/JSAC.2019.2904349

## SMART RATION SYSTEM

**K.Vignesh**

*B.E, Electronics and Communications Engineering*  
*Anand Institute of Higher Technology, kazhipattur, Chennai-603 103*  
Email ID: kvignesh98@gmail.com, XXXXXXX

**S.Santhosh kumar**

*B.E, Electronics and Communications Engineering*  
*Anand Institute of Higher Technology, kazhipattur, Chennai-603 103*  
Email ID: XXXXXXX, XXXXXXX

**S.Soosai sagaya subash**

*B.E, Electronics and Communications Engineering*  
*Anand Institute of Higher Technology, kazhipattur, Chennai-603 103*  
Email ID: XXXXXXX, XXXXXXX

**D.Sivaraman**

*B.E, Electronics and Communications Engineering*  
*Anand Institute of Higher Technology, kazhipattur, Chennai-603 103*  
Email ID: XXXXXXX, XXXXXXX

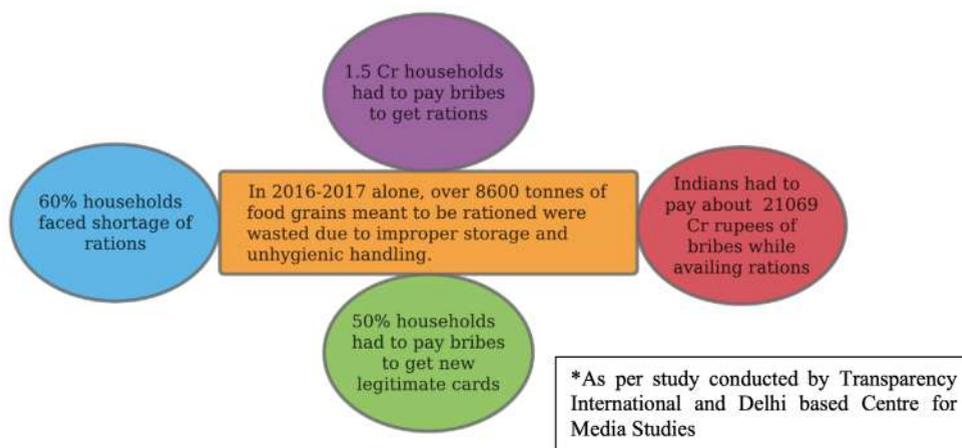
### ABSTRACT

The smart ration system is a semi-automated system that consists of three main components. The user is provided with an RFID (radio frequency identification) card. This contains personal details and inventory of the user. It also provides a unique identity to each customer. The second component is a database which stores details such as purchase history and other details of the user. This database is updated on a real time basis depending upon the user's transactions. The third component is a dispenser which is used to dispense the specified item as per the user's requirements. Also, there is an additional security feature in the form of messages sent to the users' mobile phone through the GSM module. Thus this smart ration system provides a convenient, cost effective, sustainable and transparent way to overcome the existing shortcomings in the current rationing system and improves the user experience. Overall it would benefit the underprivileged and low socioeconomic people of the country.

**Keywords:** Smart ration system, modernization of public distribution system, socio-economic impact.

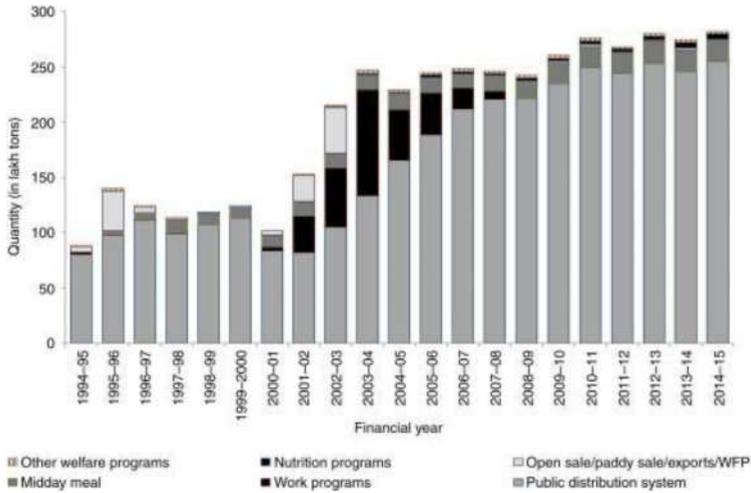
## 1. INTRODUCTION

Public distribution system (PDS) is a government sponsored subsidized distribution of food ration to the underprivileged and low socioeconomic people of India. Customers in ration shops face a lot of problems like unsanitary conditions, price manipulation and corruption (shown in figure 1). This system is designed to address such problems. It provides data security, improves hygienic conditions and updates real time transaction details. This also speeds up the process of food distribution. It is sustainable and cost effective. Overall the system has the potential to enhance user experience and makes sure there is accountability and maintenance of standards. This system achieves transparency and accountability for every transaction through the use of RFID cards provided to each user that keeps track of every activity of the user, thereby maintaining a thorough record of history.



**Figure 1.** Various issues with PDS

The above figure shows the various issues concerning the public food distribution system in India. Hygiene is top priority handling food material. This system assures the food is maintained in airtight containers and is not exposed to external elements. The automatic food dispenser further reduces the risk of contamination since it minimizes manual handling of the items. The following figure shows that substantial amount of rice offered by the government is designated for the public distribution system. A message is sent to the mobile number registered by the particular user as a safety measure. The importance of PDS in India is shown in figure 2 below.



**Figure 2.** Amount of rice in PDS compared to other schemes [4]

## 2. COMPONENTS

### 2.1. Arduino Mega 2560

ATmega2560 is the basis of the Arduino Mega 2560 microcontroller board. There are 54 digital input/output pins and 14 of these can be used as PWM output. 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

### 2.2. Load cell

This is a transducer which is used to produce electrical signal which is directly proportional to the force applied. There are different types of load cells like hydraulic, pneumatic, and strain gauge.

### 2.3. Strain gauge load cell

Strain gauge load cells are the maximum not unusual in enterprise. These load cells are especially stiff, have excellent resonance values, and generally tend to have long existence cycles in utility. Strain gauge load cells function on the principle that the pressure gauge (a planar resistor) deforms when the surface of the load cells deforms appropriately. Deformation of the pressure gauge modifications its electric resistance, by way of an amount this is proportional to the pressure. The exchange in resistance of the pressure gauge presents an electrical output change which is calibrated to the weight placed at the load platform.

A load mobile commonly consists of four stress gauges in a Wheatstone bridge configuration. Load cells of one stress gauge (zone bridge) or two pressure gauges (1/2 bridge) also are available.[1] The electrical sign output is typically in the order of some millivolts (mV) and calls for amplification by means of an instrumentation amplifier earlier than it could be used. The output of the transducer can be scaled to calculate the force carried out to the transducer. Sometimes an excessive resolution ADC, normally 24-bit, may be used.

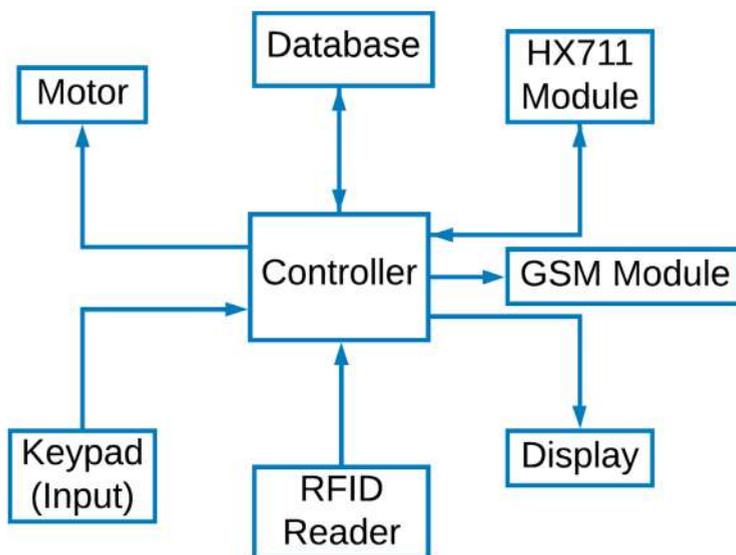
### 2.4. Servo motor

The servo motor is used to open and close the nozzle of the container in which the commodities to be rationed are stored. The motor is interfaced with the controller and it is suitably programmed to perform the required operations. Once the authorization of the user is done and input is given, the servo motor rotates and the nozzle is opened and the commodity falls on the measuring platform. Once the required weight is reached, the motor rotates in the opposite direction and the nozzle is closed.

### 2.5. GSM module

The GSM module is used to send messages to the registered mobiles after the transaction is completed. This provides an added layer of security.

## 3. ARCHITECTURE



**Figure 3.** Architecture of the smart ration system

The architecture of the smart ration system is shown above in figure 3. It shows various components like RFID reader, motor and database that are interfaced with the controller. The GSM module that facilitates connection between the system and the user's mobile device is also connected to the controller.

The schematic diagram that shows the interface between the microcontroller and the load cell is shown below in figure 4.

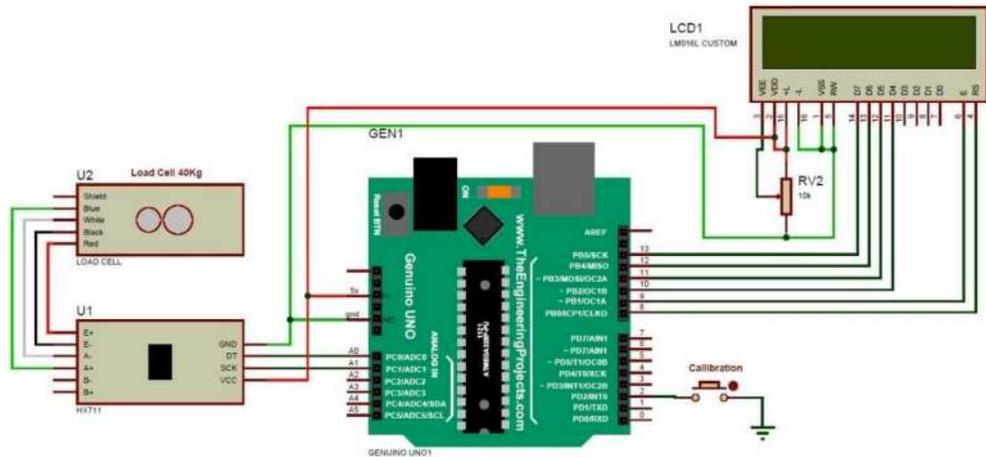


Figure 4. Interfacing load cell with controller

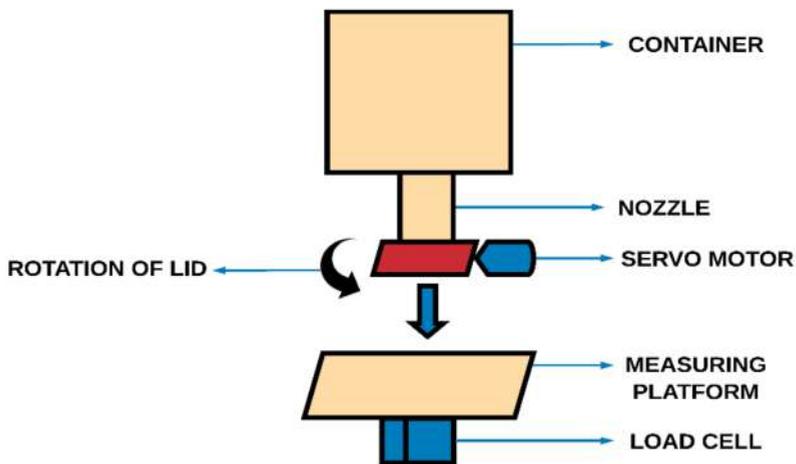
## 4. WORKING PROCEDURE

When the user's RFID card is detected by the reader placed at the ration shop, the details of the user are displayed on a screen. There the user can choose to purchase what item and how much quantity. Once the user selects the commodity and the quantity, the corresponding inputs to the controller make the motor of the respective containers to rotate, thereby opening the nozzle. The commodity starts falling into a measuring platform placed below the container. The weight is measured by the load cell and it constantly sends the measured value to the controller which compares it with the required value, and keeps the nozzle open until the required weight is reached. Once the transaction is completed, a message regarding the transaction will be sent to the registered mobile number.

## DESIGN

The design of the smart ration system is in such a way that once the user scans the RFID card on the reader and enters the required data, the servo motor rotates in

order to open the nozzle of the container. Thus the required commodity false on the platform below. There, the load cell starts measuring the weight and it essentially functions as a feedback loop. Until the demanded quantity is greater than the measured quantity, the nozzle remains open. Once the condition is met, the motor rotates and the nozzle closes. The design of the above mentioned dispenser is given in figure 5 below.



**Figure 5.** Design of dispenser

## 5. PURPOSE

Through this system we can achieve a system for food rationing that is efficient, fast, simple and hygienic. This greatly reduces the need for manual labor and provides a sense of accountability. This in turn reassures the customers and enhances their experience. It is also sustainable and cost effective. If implemented in a large scale, this system has the potential to revolutionize the way food rationing is done in India and around the world

- Makes rationing a fast and simple process
- Reduces need for manual intervention
- Ensures hygienic storage of food
- Keeps track of all transactions and avoids user fraud
- The message sent through the GSM module provides security.

## 6. APPLICATIONS

- Implementation of smart public distribution system
- Digitalization of transactions to improve transparency

### 6.1. Scope for further development

An advanced version of this system can be introduced by incorporating IOT with the existing system thereby enabling long distance transactions through a mobile application.

## 7. CONCLUSIONS

The already existing ration system has a lot of flaws like lack of hygiene, inaccurate measurement, wastage and theft of commodity to name a few and manpower requirement to name a few. Thus, the smart ration system provides a cost effective, sustainable, easy, hygienic way of distributing food rations to end users who are underprivileged and will have a socio-economic impact. The following have been achieved. (I) Unique customer identity is created. (II) User friendly and secure transaction is facilitated. (III) Commodities are provided in hygienic and accurate quantities. (IV) A message with the details of the transaction is sent to the registered mobile number.

## 8. SOURCE OF FIGURES

The figures 1,3,4 and 5 are our own diagrammatic representation. Figure 2- <https://www.sciencedirect.com/science/article/pii/B9780128053744000026>

## 9. REFERENCES

- [1] Smart dog feeder design using wireless communication, MQTT and Android client(2016) Kanisius Karyono ; I. Hargyo Tri Nugroho
- [2] Smart card using RFID, biometrics and SMS gateway(2017) Anshu Prasad; Aparna Ghenge; Sonali Zende
- [3] Data Storage in RFID Systems, Dirk Henrici, Aneta Kabzeva, Tino Fleuren and Paul Müller University of Kaiserslautern Germany
- [5] The Future Rice Strategy for India, Academic Press, 2017, Pages xiii-xv, ISBN 9780128053744, <https://doi.org/10.1016/B978-0-12-805374-4.00021->

**X.** (<http://www.sciencedirect.com/science/article/pii/B978012805374400021X>)

# **AUTOMATIC BRAIN TUMOR SEGMENTATION USING OPTIMIZED MACHINE LEARNING TECHNIQUES IN LABVIEW ENVIRONMENT**

**V.Muneeswaran**

*Assistant Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [munees.klu@gmail.com](mailto:munees.klu@gmail.com), <http://orcid.org/0000-0001-8061-8529>

**Dr.M.Pallikonda Rajasekaran**

*Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [m.p.raja@klu.ac.in](mailto:m.p.raja@klu.ac.in), <https://orcid.org/0000-0001-6942-4512>

**R.Keerthiga**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [keerthi5027@gmail.com](mailto:keerthi5027@gmail.com), <https://orcid.org/0000-0002-7929-8940>

**R.Sornalatha**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [sonasara019@gmail.com](mailto:sonasara019@gmail.com), <https://orcid.org/0000-0003-4038-6078>

**D.Nusarath Jahan**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [nusrath14351@gmail.com](mailto:nusrath14351@gmail.com), <https://orcid.org/0000-0002-8097-5435>

## **ABSTRACT**

Brain tumor is the strange development of cell inside the brain which confines the working of the brain. Early discovery of the brain tumor is conceivable with the ongoing headway of AI and labview. This work gives the substantial innovation which can be utilized for foreseeing the brain tumor. Other than having a constructive outcome against over fitting less assortment masses with system and furthermore researching on the use of force standardization as a pre-handling, which isn't basic in convolution neural system based classification systems. The proposed system uses the classification system for differentiating the tumorous and normal tissues effectively and also at an earlier stage thus preventing the spread of tumors. The LabVIEW uses Image analysis tool for useful analysis of pixel intensity and classification process. The operational process of CNN is accompanied with morphological operations to increase the accuracy of the proposed system to 87%. Thus the proposed system can be used as computer aided diagnosis system for better patient treatment.

**Keywords:** Segmentation, Tumour, Convolutional Neural Networks, LabVIEW.

## 1. INTRODUCTION

The World Health Organization developed a gathering and assessing system to institutionalize, treatment master braining, and predicts the outcomes for brain tumors and measure that 78,000 people will be resolved to have the fundamental cerebrum tumor in this year. In India 2016, 40,000-50,000 individuals are resolved to have brain tumor. cerebrum Tumor Foundation Of India says that, brain tumor is the second most customary contamination among children after leukemia. In 2018, New cerebrum tumor cases are represented in India, of which 20% are cases of brain tumor in youths. This signifies in excess of 2,500 children consistently. Global Association of Cancer Registries (IARC) related with the WHO, New cerebrum tumor causes each year are represented in India, while there are upwards of 24003 passings. According to the report done by government restorative facility in west Bengal 13.6% ailment causes selected is cerebrum tumor and besides included eastern India was done by clinical threat incorporating 130 cases with brain tumor found male predominance. The cases were appropriated in a wide age go from 4 years to 78 years with in the mean time of 42.38 years. Most essential tumor type in this examination was neuroepithelial tumor (70%), astrocytic tumor (41%), the second most perpetual tumor was meningioma (15.3%), the higher occurrence of oligodentrogial tumor (8.46%), and medulloblastoma tumor (7.69%) in game plan. The subject of the paper is essentially founded on image classification. Image classification in basic terms can be portrayed as the initial step from low level image handling changing a greyscale or shading image into at least one different images to abnormal state image depiction regarding highlights, protests, and moving components. Classification parcels an image into particular districts containing every pixel with comparative qualities. A definitive objective of classification is to discover importance from a image whether it is to distinguish an article, comprehend communications, and so forth coming about to make everything less demanding than discovering significance from pixels. While concentrating on deformities in particular: Tumor in brain by classification, altered procedures for its quicker location are likewise been engaged. Tumor in brain is additionally a normally caused sickness in patients which can likewise be analyzed by the convolution neural systems. At the point when cells isolate strangely and wildly, they can frame a mass or piece of tissue. This knot is known as a tumor. As the tumor develops, unusual tissue can uproot solid tissue.

Image order is one of the essential issues in PC vision. It shapes reason for some other PC vision assignments, for example, object acknowledgment, image classification and article discovery. The undertaking of arranging images into one of a few predefined classes is called image arrangement. Despite the fact that the assignment of arranging images is simple for individuals, it is exceptionally troublesome for a computerized framework. By utilizing AI methods, images can be ordered. These AI calculations falls under the class of profound learning. Profound learning is a sort of neural system calculations in which each layer is in charge of separating at least one highlights of the image. Image grouping should be possible utilizing both directed arrangement calculations and unsupervised order calculations. Managed characterization utilizes preparing information alongside human mediation while in unsupervised grouping human intercession isn't required as it is completely PC worked. The regulated characterization has two stages in particular preparing stage and order stage. In preparing stage, the classifier is given data about classes. This is where learning of a model happens. In arrangement stage it utilizes the data given by the preparation information and orders the image into one of the predefined classes. Different calculations, for example, least separation calculation, K-Nearest neighbour calculation, Nearest Clustering calculation, Fuzzy C- Means calculation, Maximum probability calculation, Watershed Algorithm are utilized for characterization images. (CNNs) have turned into standard for image characterization. Convolutional neural system based image classifier will distinguish and isolate the damaged images from that of typical hip joint alongside recognizable proof of the deformity. Conventional neural systems like Alex Net, Inception which are truly adept at doing image grouping need GPU (Graphics Processing Unit) and take couple of long stretches of preparing time. In contrast with that, a little CNN of six layers is assemble, expending less of the time giving altered yield also. Image segmentation and pre-processing is used widely in medical image understanding [1-5].

## **2. RELATED WORKS**

Sergio[6] have analyzed gliomas are the most notable and intense, inciting an amazingly short future in their most raised assessment. X-ray particularly profitable evaluate gliomas, it's conceivable get magnetic resonance imaging groupings giving essential information. In CNN they have found the area that heterogeneity achieved by multi-site multiscanner acquisitions of MRI images used power institutionalization. Additionally it is extraordinary for classification. Stijn Bonte, Ingeborg Goethals, Roel Van Holenthey [7] have surveyed another Random Forests based classification methodology for depicting various personality tumor compartments, starting

from surface and variety from the standard incorporates on distinction improved T1-weighted and FLAIR MRI. They got that, no cerebrum tumor classification strategy is available using only these two MRI courses of action. They proposed and endorsed another and robotized brain tumor classification count. Explicitly a high evaluation glioma, they achieve incredible output segmenting improving tissues, tumor focus and all over counting unpredictable zone. dependent on (WLS) calculations. Atomic prescription positron outflow Positron Emission Tomography photo turns through-out long-suffering, enthralling movies radionuclide conveyance inside long-suffering various points. Term technique order assemble term estimate to get a long-suffering image is named image reproduction. HebaMohsen , El-Sayed A. El-Dahshan , El-Sayed M. El-Horbaty , AbdelBadeeh M. Salem [8] tells about utilized DNN classified for characterizing a data collection of 66 brain magnetic resonance imaging into four classes for example typical, glioblastoma, sarcoma and metastatic bronchogenic carcinoma tumors. The classifier was joined with the discrete wavelet change (DWT) the ground-breaking highlight extraction device and important parts investigation (PCA) and the assessment of the execution was very great over all the execution measures. The new technique engineering look like the convolutional neural systems (CNN) design yet requires less equipment particulars and takes a helpful time for preparing long estimate images (256to 256). Konstantinos Kamnitsas, Christian Ledig [9] proposed a double way, eleven layers profound, 3D CNN for the testing assignment of cerebrum injury classification. Huge development accomplished by auxiliary regularization provided by the Conditional Random Field, in spite of the fact that it could be halfway represented by over fitting the preparation information amid the CRF's configuration.. PimMoeskops, Max A. Viergever, Adriëne [10] showed a technique for the programmed classification of MR cerebrum images into various tissue classes utilizing a CN system. To guarantee that the method gets precise classification subtleties just as spatial consistency, the system utilizes various fix bulk and numerous convolution portion sizes to gain each voxel. The technique isn't reliant on express highlights, yet figures out how to perceive the data that is vital for the characterization dependent on preparing information. The technique requires a solitary anatomical MR image as it were. They have exhibited a technique for the programmed classification of grown-up images. Zeynettin Akkus and Alfiia Galimzianova [11] studies based on segments proposed for cerebrum magnetic resonance imaging are picking up enthusiasm because of their self-learning and speculation capacity over a lot of information. As the profound learning designs are winding up increasingly, they progressively outflank past cutting edge established machine learning calculations. First we audit the present profound learning models utilized for classification of anatomical brain shape named cerebrum sores. Next, the execution, fast, and

properties of profound learning proposed are outlined talked about. At long last, we give a basic appraisal of the present state and distinguish likely future improvements and patterns. Yan Wang, Chen Zu, Guangliang Hu, Yong Luo, Zongqing Ma, Kun He, Xi Wu, Jiliu Zhou [12] build up a programmed classification technique for NPC in MRI for radio medical procedure applications. To this end, we present to portion NPC utilizing a profound convolutional neural system. In particular, to acquire spatial consistency just as exact component subtleties for classification, different convolution piece sizes are utilized. The system contains an expansive number of trainable parameters which catch the connection between the MRI force images and the comparing name maps. The exhibited technique in this paper could be valuable for NPC finding and accommodating for managing radiotherapy. Darko Zikic , Yani Ioannou, Matthew Brown , and Antonio Criminisi [13] examined the likelihood to specifically apply convolutional neural network (CNN) to classification of brain tumor tissues. As contribution to the system, we use multi-channel force data from a little fix around each point to be marked. Just standard power pre-processing is connected to the information to represent scanner contrasts. No post-preparing is connected to the yield of the CNN. Under the referenced issues over, this paper set forward another strategy: Based on conventional convolutional neural systems (CNNs), another engineering model is proposed for programmed brain tumor classification, which joins multi-methodology images.

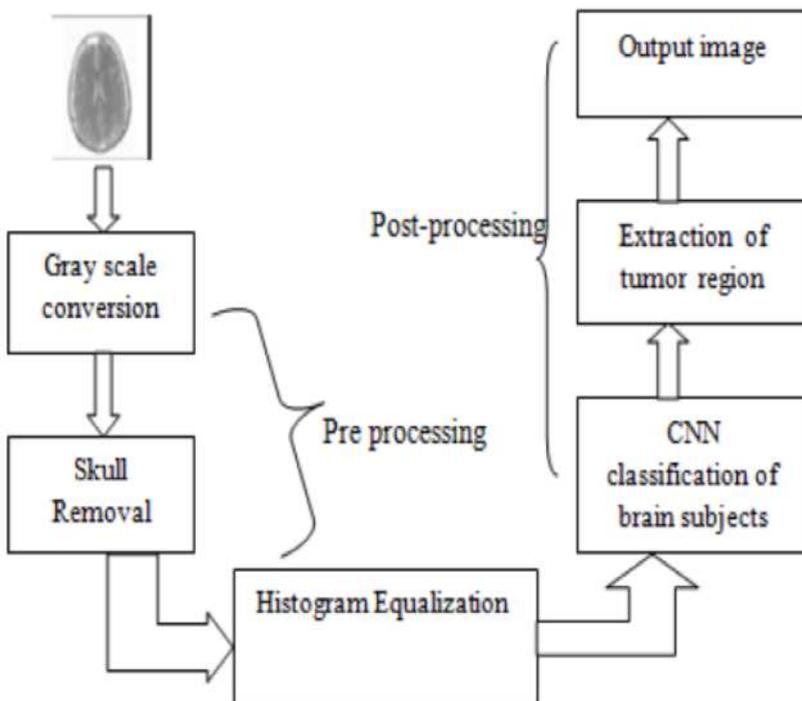
### **3. PROPOSED WORK**

The LabView program used here comprises of three inputs. They are,

#### **3.1. Pre-processing:**

The Pre-processing frameworks are required on report images shading, dim dimension or twofold containing substance and moreover structures. In character affirmation systems most of the applications use dark or parallel images since taking care of shading images is computationally high. Such images may moreover contain non-uniform establishment and furthermore watermarks making it difficult to remove the report content from the image without playing out some kind of pre-processing, subsequently; the perfect come about on account of pre-processing is a matched image containing useful content. Along these lines, to achieve this, few phases are required, first, some image update techniques to empty confusion or right the multifaceted nature in the image, second, thresholding to oust the establishment containing any scenes, watermarks and also uproar, third, page classification to isolate representations from substance, fourth, character classification to disengage characters from

each other and, finally, morphological getting ready to improve the characters in circumstances where thresholding and furthermore other pre- processing strategies crumbled bits of the characters or included pixels to them. The above techniques present few of those which may be used in character affirmation structures and in specific applications; few or a segment of these procedures or others may be used at different periods of the OCR system. As demonstrated by the need of the accompanying measurement the pre-processing step convert the image. It performs isolating of commotion and distinctive collectibles in the image and sharpening the edges in the image. RGB to dull change and Reshaping likewise occurs here. It consolidates center channel for commotion departure. The potential results of arriving of noise in current MRI inspect are less. It may arrive because of the warm effect. The essential purpose of this paper is to perceive and parcel the tumor cells. Be that as it may, for the all system it needs the method of clamor expulsion. Superior comprehension the limit of center channel, we incorporated salt and pepper noise commotion erroneously with ousting that utilizing middle channel. The pre-handling of the info MRI image is completed utilizing three methods of RGB to dim transformation, skull strip expulsion and histogram leveling

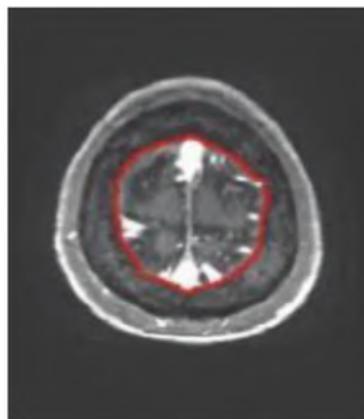


**Figure 1.** Proposed Methodology  
**Source:** own elaboration.

## **Gray Scale Conversion**

Gray scale conversion of a color image to a grayscale image requires more learning about the color image. Nature of a color image depends upon the shading addressed by the amount of bits the electronic device could reinforce. The amount of bits picks the most outrageous number of different tones reinforced by the mechanized device. The 24 bit addresses the shade of a pixel in the shading image. The grayscale image has addressed by luminance using 8 bits regard. The luminance of a pixel estimation of a grayscale image ranges from 0 to255. In case each Red, Green, and Blue has 8 bit then the mix of RGB includes 24 bit and support 16,777,216 one of a kind tones. The 24 bit addresses the shade of a pixel in the shading image. The reduction redesigns the shading reach and figures the grayscale betterly.

Skull Removing or Skull Stripping of the quantitative morphometric examinations of MR cerebrum images consistently require a starter dealing with to isolate the brain from extra cranial or non-brain tissues from MRI head channels, more often than not insinuated as skull stripping . Since the cerebrum images that have pre- processed with customized skull stripping at last lead to hint at progress classification of different personality zones which results for exact assurance of various brain related diseases. The brain districts must be skull-stripped before the use of other image taking care of figurings, for instance, image enlistment and twisting, cerebrum volumetric estimation , in homogeneity change , tissue request , examination of cortical structure , cortical surface multiplication , cortical thickness estimation, ID of cerebrum parts , diverse sclerosis examination, Alzheimer's ailment, schizophrenia , and checking the progression or developing of the brain.



**Figure 2.** Skull Stripping Process  
**Source:** own elaboration.

## **Histogram Equalization**

The Histogram alteration is used to overhaul the idea of the image. The histogram square registers the repeat flow of the parts in the data. The diligent probability thickness work and consolidated probability dissemination limits are resolved. The condition is used to process probability dispersal work. From the histogram balance, we can see that the distinction of the image is improved. All things considered, a histogram is the estimation of the probability scattering of a particular kind of data. An image histogram is a sort of histogram which offers a graphical depiction of the tonal scattering of the dim characteristics in a propelled image. By audit the image's histogram, we can separate the repeat of appearance of the changed dark measurements contained in the image. In Figure we can see an image and its histogram. The histogram exhibits to us that the image contains only a little measure of the hard and fast extent of dull measurements. For this circumstance there are 256 dim measurements and the image simply has values between around 50– 100.

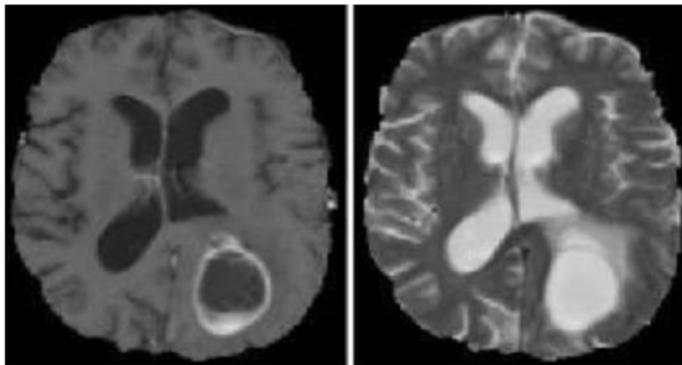
### *3.2. Post-processing:*

A Post handling are including some of image preparing strategies. In this paper are incorporating into CNN order of brain subjects and Extraction of brain tumor region.

CNN classification of brain subjects In AI, a convolution neural framework sort drip positive phony neural framework which a accessibility plan between its neurons is awakened by the relationship of the animal's visible dressing. Particular neurons of the animal's dressing are planned with the goal the response to covering districts tiling the visible system logically a convolutional task. Convolution systems was moved regular strategies next assortments multilayered perceptron's proposed to use unimportant proportions sub-processing. we having broad request on image with video's affirmation, advocate framework with taking care of. The convolution neural framework are generally called move invarianced or space invarianced fake neural framework, there are title reliant in regular burdens structure and transfer invarianced traits. aggregations this operation part of the information image. These yields of gatherings is then tiled with the objective their data areas spread, procure an prevalent depiction of these main image; Repeated for each such coating. Tiling grants CNN suffer understanding for data image. Convolution frameworks might join close-by with overall pooling coating are solidify yields of neuron bundles. Those similarly involve diverse mixes of convolutional and totally related layers, with point quick nonlinearity associated around the completion with following every coating. Convolutional movement in little areas data are familiar with diminish those amount

of release boundary with develop hypothesis. first significant favored angle of convolution frameworks are usage for sharing burden in convolution coating, which suggests that a comparable channel (loads bank) is used for each pixel in the layer; this two diminishes rebrainer impression with developing execution.

A Convolutional neural framework is a champion among the most noticeable figurings for significant acknowledging, which can be portrayed as a kind of brain in which a model makes sense of how to perform plan endeavors direct from images, video, substance or sound. CNN is particularly useful for finding structures in images to perceive things, faces and movies as in CNNs give a perfect plan to image affirmation and precedent area. For example, significant learning applications use CNNs to take a gander at countless reports to apparently recognize threatening development cells, tumors, breaks and diverse infirmities. As showed up in Figure1, it is used for ID of tumor in brain. Using Convolutional neural framework is continuously helpful in therapeutic field as it can particularly image the defects and damage in a particular domain.



**Figure 3.** Enhancement process after post-processing  
**Source:** own elaboration.

A Convolutional neural framework includes distinctive layers all of which makes sense of how to recognize different features of an image. Channels are associated with every readiness image at different objectives, and the yield of each convolved image is used as the commitment to next layer. The features can start as fundamental features, for instance, quality and edges, and augmentation in unconventionality to focus on the remarkably portrayed article. gathering with Loss work is performed to make a figure show. At first, mark the readiness image set. In the pre-processing image resizing is associated with change size of the image. Finally, the convolution neural framework is used for modified cerebrum tumor portrayal. The cerebrum image dataset is taken from image net. Image net is a one of the pre-arranged model.

If you have to get ready from the earliest starting point layer, we have to set up the entire layer (i.e) up to finish layer. So time use is high. It will impact the execution. To avoid this kind of issue, pre-arranged model based cerebrum dataset is used for request steps.



**Figure 4.** Structure of CNN

**Source:** own elaboration.

Convolutional Neural system [11] is involved neurons that having studies burdens with tendencies. Every neurons gets a couple of information sources. It plays out a spot thing and on the other hand are non-linearities. ConvNet structures frame unequivocal supposition the wellsprings of data images that empowers us to encode sure property in the building. A Convolutional Neural Network is contained somewhere around one Convolution layers normally and pre testing step with after that sought after by no less than one totally related coating as the standard multiple coating neural framework. A designing of a CNN are planned to abuse the two dimensional Extraction of brain tumor to remove the brain region and to oust the not impacted cerebrum parts and to recognize the brain tumor territory .extraction systems are used to the clear the cerebrum tumor region in the brain.

#### Step 1: Convolution of Kernels (Filters)

#### Step 2: Non-straight initiation work

To get highlights that are non-straight changes of the info, a component insightful non- linearity is connected to the consequence of the piece convolution. There are numerous decisions for this non-linearity, for example, the sigmoid, hyperbolic digression and corrected straight capacities.

#### Step 3: Max Pooling

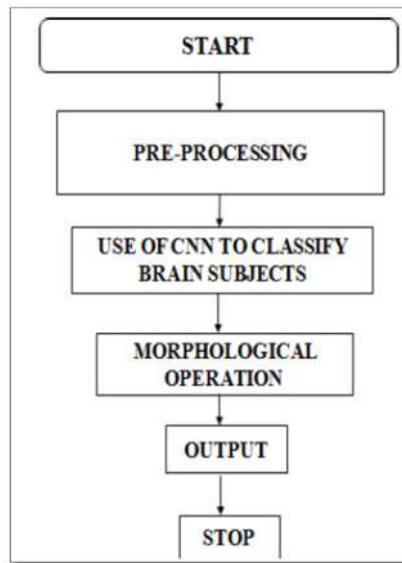
This task comprises of taking the most extreme component (neuron) esteem over sub-windows inside each element map.

#### Step 4: Fully Connected Layer

Completely associated layers interface each neuron in one layer to each neuron in another layer. It is on a fundamental level equivalent to the customary multi-layer perceptron neural system (MLP). The leveled grid experiences a completely associated layer to order the images.

#### Step 5: Loss Layer

The "loss layer" specifies how training penalizes the deviation between the predicted (output) and true labels and is normally the final layer of a neural network. Various loss functions appropriate for different tasks may be used. Softmax loss is used for predicting a single class of K mutually exclusive classes



**Figure 5.** Flow Chart of the projected scheme  
**Source:** own elaboration.

## 4. RESULTS

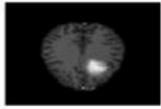
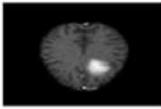
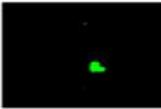
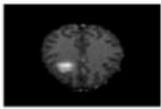
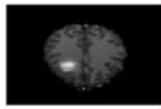
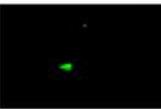
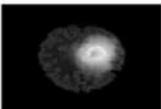
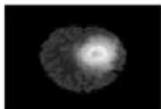
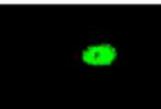
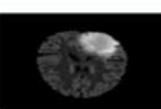
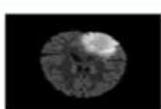
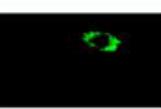
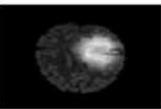
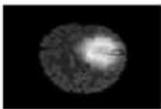
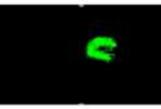
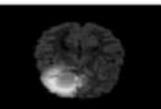
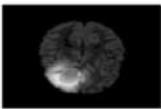
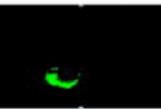
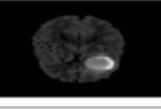
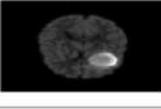
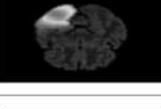
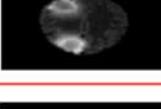
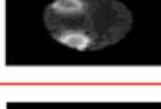
Figure number	Input Image	Morphological Image	Segmentation image
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Figure 6. Output evaluation of images  
Source: own elaboration.

**Table 1:** Performance metrics of input images

FIGURE NUMBER	DIMENSIONS (hight x width) pixels	HORIZONTAL resolution (dpi)	VERTICAL resolution (dpi)	BIT RATE
1	260 x 258	96	96	24
2	301 x 304	96	96	24
3	300 x 301	96	96	24
4	301 x 304	96	96	24
5	303 x 300	96	96	24
6	302 x 303	96	96	24
7	303 x 301	96	96	24
8	301 x 303	96	96	24
9	303 x 302	96	96	24
10	302 x 300	96	96	24
SEGMENTATION IMAGES PARAMETER				
1	256 x 257	96	96	24
2	327 x 323	96	96	24
3	322 x 324	96	96	24
4	325 x 323	96	96	24
5	325 x 323	96	96	24
6	324 x 323	96	96	24
7	323 x 326	96	96	24
8	322 x 322	96	96	24
9	325 x 323	96	96	24
10	324 x 325	96	96	24

**Source:** own elaboration.

## 5. CONCLUSION

We propose a novel CNN-based technique for classification of cerebrum tumors in MRI images. We begin by a pre-handling arrange comprising of predisposition field rectification, power and fix normalization. Using a pre-processing strategy and post handling strategy in LabVIEW platform and also utilizing convolutional neural organize and furthermore get the after effect of cerebrum tumor classification accurately. The proposed work can be used to computer aided diagnosis system to effectively diagnose the disease at an early stage. Future work includes improving the architecture of CNN and thus increasing the classification accuracy.

## 6. REFERENCES

- 1. Muneeswaran, V. and Rajasekaran, M.P.,** (2019). Automatic segmentation of gallbladder using bio-inspired algorithm based on a spider web construction model. *The Journal of Supercomputing*, 75(6), 3158-3183.
- 2. Muneeswaran, V., & Rajasekaran, M. P.** (2017, March). Beltrami-regularized denoising filter based on tree seed optimization algorithm: an ultrasound image application. In *International Conference on Information and Communication Technology for Intelligent Systems* (pp. 449-457). Springer, Cham.
- 3. Muneeswaran, V., & Rajasekaran, M. P.** (2016, December). Analysis of particle swarm optimization based 2D FIR filter for reduction of additive and multiplicative noise in images. In *International Conference on Theoretical Computer Science and Discrete Mathematics* (pp. 165-174). Springer, Cham.
- 4. Muneeswaran, V., & Rajasekaran, M. P.** (2019). Local contrast regularized contrast limited adaptive histogram equalization using tree seed algorithm—an aid for mammogram images enhancement. In *Smart intelligent computing and applications* (pp. 693-701). Springer, Singapore.
- 5. Muneeswaran, V., & Rajasekaran, M. P.** (2019). Automatic segmentation of gallbladder using intuitionistic fuzzy based active contour model. In *Microelectronics, Electromagnetics and Telecommunications* (pp. 651-658). Springer, Singapore.
- 6. Pereira, S., Pinto, A., Alves, V., & Silva, C. A.** (2016). Brain tumor segmentation using convolutional neural networks in MRI images. *IEEE transactions on medical imaging*, 35(5), 1240-1251.
- 7. Bonte, S., Goethals, I., & Van Holen, R.** (2018). Machine learning based brain tumour segmentation on limited data using local texture and abnormality. *Computers in biology and medicine*, 98, 39-47.
- 8. Mohsen, H., El-Dahshan, E. S. A., El-Horbaty, E. S. M., & Salem, A. B. M.** (2018). Classification using deep learning neural networks for brain tumors. *Future Computing and Informatics Journal*, 3(1), 68-71.
- 9. Kamnitsas, K., Ledig, C., Newcombe, V. F., Simpson, J. P., Kane, A. D., Menon, D. K., ... & Glocker, B.** (2017). Efficient multi-scale 3D CNN with fully connected CRF for accurate brain lesion segmentation. *Medical image analysis*, 36, 61-78.

- 10. Moeskops, P., Viergever, M. A., Mendrik, A. M., De Vries, L. S., Benders, M. J., & Išgum, I.** (2016). Automatic segmentation of MR brain images with a convolutional neural network. *IEEE transactions on medical imaging*, 35(5), 1252-1261.
- 11. Akkus, Z., Galimzianova, A., Hoogi, A., Rubin, D. L., & Erickson, B. J.** (2017). Deep learning for brain MRI segmentation: state of the art and future directions. *Journal of digital imaging*, 30(4), 449-459.
- 12. Wang, Y., Zu, C., Hu, G., Luo, Y., Ma, Z., He, K., ... & Zhou, J.** (2018). Automatic tumor segmentation with deep convolutional neural networks for radiotherapy applications. *Neural Processing Letters*, 48(3), 1323-1334.



## SMART SECURITY SYSTEM FOR WOMEN USING GSM

### **A.Pranavi**

*Electronics and Communication Engineering Kalasalingam Academy Of Research  
and Education Krishnanloil, Tamilnadu*

Email ID: [apranavi73@gmail.com](mailto:apranavi73@gmail.com), XXXXXXXX

### **P.Shoba Rani**

*Electronics and Communication Engineering Kalasalingam Academy Of Research  
and Education Krishnanloil, Tamilnadu*

Email ID: [papasanishobha333@gmail.com](mailto:papasanishobha333@gmail.com), XXXXXXXX

### **S.Kalaiselvi**

*Electronics and Communication Engineering Kalasalingam Academy Of Research  
and Education Krishnanloil, Tamilnadu*

Email ID: [kalaiselvigrace@gmail.com](mailto:kalaiselvigrace@gmail.com), XXXXXXXX

### **S.Keerthana**

*Electronics and Communication Engineering Kalasalingam Academy Of Research  
and Education Krishnanloil, Tamilnadu*

Email ID: [keerthana191421@gmail.com](mailto:keerthana191421@gmail.com), XXXXXXXX

### **N.Bhuvaneshwary**

*Electronics and Communication Engineering Kalasalingam Academy Of Research  
and Education Krishnanloil, Tamilnadu*

Email ID: [bhuvaneshwary.n@klu.ac.in](mailto:bhuvaneshwary.n@klu.ac.in), <https://orcid.org/0000-0001-6400-6602>

## ABSTRACT

In the present situation women security has emerged as one of the most important requirements in our country. In this world of advanced technology and smart electronics it is required to have a simple and cost-effective safety gadget that helps the women during dangers. This paper covers details about the design and implementation of prototype for an electronic gadget which has the potential to serve as a safety wear in the coming years. The device consists of GSM (SIM800), Accelerometer, Flux sensor, temperature sensor, Buzzer. The main working of this project is that anytime a woman senses danger, all she has to do, is to hold on the emergency button of the device. Once the mechanism is activated, the device sends the emergency messages using GSM, to the already registered mobile numbers. Flux sensor is used for measuring of heat during danger. The use of sophisticated components makes device accuracy and makes it reliable.

**Keywords:** Emergency switch, GSM Module, Switch, Security, Sensors etc...

## **1. INTRODUCTION**

According to present world's scenario, safety of women has become a major problem in our country as women can't come out of their house at any time, especially during night. It is mainly due to fear of violence against them or being physically or sexually abused. Though the technology is growing the problems also increasing day by day. Though new gadgets are developing still women and girls are facing problems rapidly. Though our society know about the importance of women safety[1], it is also a responsibility of every individual that they should be properly protected. This device can be accessed by a person in any time in 24/7. Once the device is turned on, GSM will automatically turns on and sends messages to the registered mobile numbers. This device can also checks the temperature and heart beat of the person, if it goes abnormal the device sends messages to the registered mobile numbers and ambulance[2]. This prototype can be made small in the future and can be inserted in the jewelleryes, watches, shoes etc... to make it handy .This can also help police department to reduce the crimes, the evidence can be used to trace the crime.[6][7]

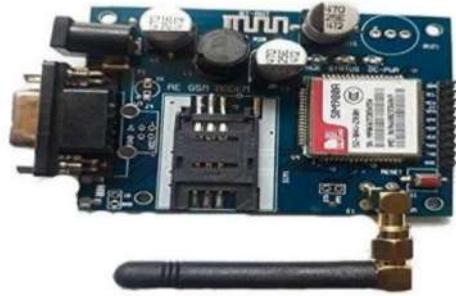
## **2. PURPOSE**

The purpose of designing this gadget is: To design and develop easy-to-use personal safety gadget. To employ Arduino Uno (ATmega328P micro-controller) for the gadget. To integrate Arduino circuit board with a SIM800 GSM . To use the present technology for social welfare by providing a low cost device for safety and communication.[3]

## **3. DESCRIPTION**

### **A. GSM(SIM800)**

GSM stands for Global System for Mobile Communication which is used in a digital mobile telephony system. SIM800 can fit almost all the space requirements in the M2M application with dimensions of 24mm x 24mm x 3 mm. This is a GSM compatible Quad band cell phone, which works on a frequency of 850/900/1800/1900MHZ and can be used for accessing the Internet, and for SMSs and calls. The processor is also in charge of a SIM card which is attached to the outer wall of the module. The module works on voltage between 4V and 5V.[4]



**Figure 1.** GSM Module

### *B. Temperature Sensor*

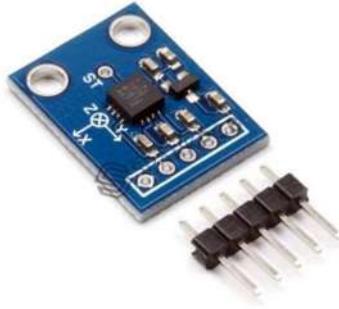
A temperature device may be a device that is a thermocouple junction or RTD. It provides temperature measure through associate degree electrical signal. A thermocouple junction (T/C) is created from 2 dissimilar metals to get electrical voltage in direct proportion for measure changes in temperature. associate degree RTD (Resistance Temperature Detector) may be a resistor which will amendment its impedance in direct proportion to changes in temperature during a precise.



**Figure 2.** Temperature Sensor

### *C. Accelerometer*

An accelerometer is measuring device that measures the physical acceleration experienced by an object or person because of inertial forces or mechanical forces applied on the them. Acceleration is defined as rate of modification in the velocity with respect to time. It is a vector quantity which have both magnitude and direction. An ability of an accelerometer is to sense acceleration which is used to measure a variety of things like tilt, vibration, rotation, collision etc...



**Figure 3.** Accelerometer

#### D. Flux sensor

A heat flux sensor generates an electrical signal proportional to the overall heat rate applied to the surface of the sensor. The measured heat rate is divided by the surface area of the sensor and that is determined as heat flux.



**Figure 4.** Flux Sensor

#### E. Arduino

The Arduino UNO is an ASCII text file micro-controller board which was supported by the semiconductor that was developed by Arduino.cc The board is provided with set of digital and analog input/output (I/O) pins that are interfaced to numerous growth boards (shields) and other circuits. The board has fourteen Digital pins, half dozen analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a kind of B USB cable. It is often powered by a USB cable or by an external nine volt battery. It will accepts voltage between 5 and 15 volts.



Figure 5. Arduino Board

Source: Google

#### 4. BLOCK DIAGRAM

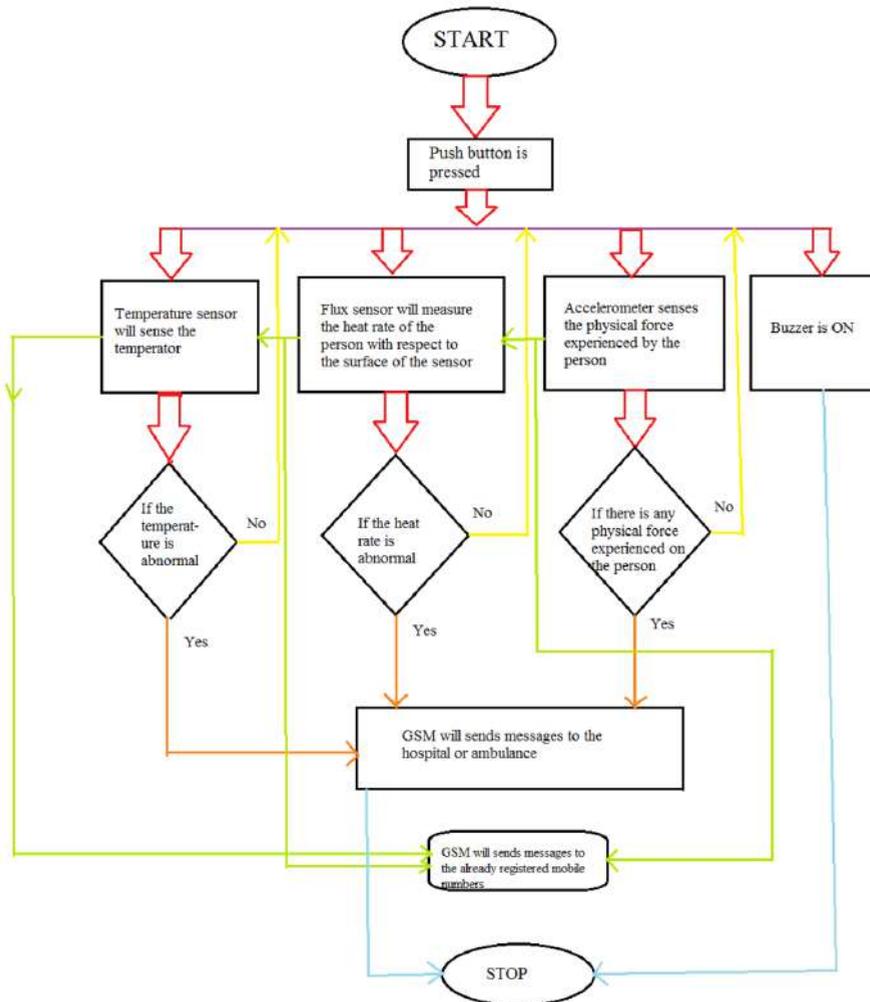


Figure 6. Block diagram

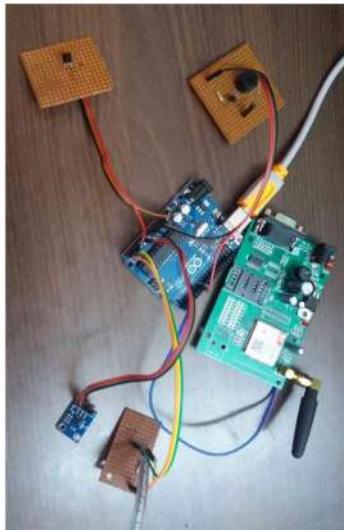
## 5. EXISTING METHOD

- In the existing method there is only chance of measuring the pulse of the victim and tracking of location.
- All the existing systems works when they are connected to internet, though it is having GPS it cannot be used during emergency situations.

## 6. PROPOSED METHOD

This method consist of GSM, Temperature sensor, flux sensor, accelerometer etc. Temperature sensor measures the persons temperature and alerts the person who monitors the device. Flux sensor is a sensor which is used to generate electrical signal which is proportional to the overall heat rate which is applied to the surface of the sensor. In this method, we used accelerometer to check whether the person is being bet or any physical damage.

## 7. RESULTS



**Figure 7.** Prototype of our project

Here, figure 9 says about the prototype of our project which consists of arduino, GSM modem, temperature sensor, flux sensor, accelerometer and a buzzer[5]. In this prototype power supply of 5V is given to the arduino. Once the power supply is given the sensors will sense with respect to their function.



**Figure 8.** Emergency message send by the victim

Here figure no 10, the emergency message received by the registered mobile number is shown. When the GSM modem is activated it automatically sends messages to the registered mobile numbers that the person is in danger.

## 8. CONCLUSION

The main motto of this project is to ensure that every woman in our society to feel safe and secured. In India, especially women who are working in night shift are facing insecure according to the survey. While comparing to the other places, women in Delhi, Kolkata, Bangalore, Hyderabad etc..are facing more insecure. This device can play a major role in providing security to women in all situations like threatened, harassed, robbery, stalked. Implementing this device as a real time application, we can solve many problems to some extent. On further research, this project is made as a tiny wearable device like watch, pendent, shoes, in handbag etc..and can be made as invisible.

## 9. REFERENCES

**Chand D, Nayak S, Bhat KS, Parikh S.** A mobile application for Women's Safety: WoS App. 2015 IEEE Region 10 Conference TENCON; Macao. 2015 Nov 1-4. p. 1–5. 10.1109/TENCON.2015.7373171

**GeorgeR, Anjaly Cherian V, Antony A, et al.** An intelligent security system for violence against women in public places, *International Journal of Engineering and Advanced Technology*

**Gowri S, Anandha Mala GS.** Eicacious IR system for investigation in textual data. *Indian Journal of Science and Technology*. 2015 Jun; 8(12):1-7, 10.17485/ijst/2015/v8iS9/43102

**Pantelopoulos A, Bourbakis NG.** A survey on wearable sensor-based systems for health monitoring and prognosis. *IEEE Transactions on Systems, Man and Cybernetics – part C: Applications and Reviews*. 2010 Jan; 40(1):1–12. 10.1109/TSMCC.2009.2032660

**Sethuraman R, Sasiprabha T, Sandhya A.** An effective QoS based web service composition algorithm for integration of travel and tourism resources. *Procedia Computer Science* 2015;48:54-7, 10.1016/j.procs.2015.04.133

**Suraksha.** A device to help women in distress: An initiative by a student of ITM University Gurgaon. *efytimes.com*. 2013. Available from: <http://efytimes.com/e1/118387/SURAKSHA-A-Device-To-Help-Women-In-Distress-An-Initiative-By-A-Student-Of-ITM-University-Gurgaon.pdf>

**Toney G, Jaban F, Puneeth S.petal.** Design and implementation of safety arm band for women and children using ARM7. 2015 *International Conference on Power and Advanced Control Engineering (ICPACE)*; Bangalore. 2015 Aug 12-14. p. 300–3. 10.1109/ICPACE.2015.7274962

**Vigneshwari S, Aramudhan M.** Social information retrieval based on semantic annotation and hashing upon the multiple ontologies. *Indian Journal of Science and Technology*. 2015 Jan; 8(2):103–7. 10.17485/ijst/2015/v8i2/57771

# **AUTOMATIC IRRIGATION SYSTEM BY SENSING SOIL MOISTURE**

**K. S. Dhanalakshmi**

*Assistant professor III, Department of ECE School of Electronics And Electrical  
Technology Kalasalingam Academy of Research And Education  
Anand Nagar.Krishnankoil, Virudhunagar District, India*

Email ID: [k.s.dhanalakshmi@klu.ac.in](mailto:k.s.dhanalakshmi@klu.ac.in), <https://orcid.org/0000-0001-6285-3656>

**Manikanta deenadayal**

*UG Scholar, Department of ECE School of Electronics And Electrical  
Technology Kalasalingam Academy of Research And Education  
Anand Nagar.Krishnankoil, Virudhunagar District, India*

Email ID: [manikantakondisetty100@gmail.com](mailto:manikantakondisetty100@gmail.com), <https://orcid.org/0000-0002-0468-0395>

**Saigireesh bollineni**

*UG Scholar, Department of ECE School of Electronics And Electrical  
Technology Kalasalingam Academy of Research And Education  
Anand Nagar.Krishnankoil, Virudhunagar District, India*

Email ID: [saigireesh2014@gmail.com](mailto:saigireesh2014@gmail.com), <https://orcid.org/0000-0002-6955-2458>

**Surendra varma yallamraju**

*UG Scholar, Department of ECE School of Electronics And Electrical  
Technology Kalasalingam Academy of Research And Education  
Anand Nagar.Krishnankoil, Virudhunagar District, India*

Email ID: [surendravarma12356@gmail.com](mailto:surendravarma12356@gmail.com), <https://orcid.org/0000-0002-5237-2469>

## **ABSTRACT**

Irrigation is defined as artificial application of water to land or soil. Irrigation process can be used for the cultivation of agricultural crops during the span of inadequate rainfall and for maintaining landscape. An automatic irrigation system does the operation of a system without requiring manual involvement of persons. Every irrigation system such as drip, sprinkler and surface gets automated with the help of electronic appliances and detectors. The project is designed to operate a pump for automatic irrigation. It comprises of moisture sensing arrangement interfaced to an op-amp configured as a comparator. So whenever moisture in the soil reduces, it turns the water pump ON. This result in increase of the moisture content which in turn switches OFF the motor. The above operations are monitored by a 8051 family microcontroller.

**Keywords:** Automatic Irrigation system, Microcontroller, Soil Moisture, Sensor.

## **1. INTRODUCTION**

Continuous increasing demand of food requires the control in highly specialized greenhouse vegetable rapid improvement in food production technology. In a production and it is a simple, precise method for country like India, where the economy is mainly based on irrigation. It also helps in time saving, removal of human agriculture and the climatic conditions are isotropic, still error in adjusting available soil moisture levels and to we are not able to make full use of agricultural resources. Maximize their net profits. The main reason is the lack of rains & scarcity of land Irrigation is the artificial application of water to the soil reservoir water. The continuous extraction of water from usually for assisting in growing crops. In crop production earth is reducing the water level due to which lot of land is it is mainly used in dry areas and in periods of rainfall coming slowly in the zones of un-irrigated land. Another shortfalls, but also to protect plants against frost. Very important reason of this is due to unplanned use of Types of Irrigation water due to which a significant amount of water goes to surface irrigation waste. Localized irrigation in modern drip irrigation systems, the ,the most significant Drip Irrigation advantage is that water is supplied near the root zone of sprinkler irrigation. The plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been the conventional irrigation methods like overhead using irrigation techniques in India through manual control sprinklers, flood type feeding systems Lower leaves and stem of the plants. The entire soil this process sometimes consumes more water or surface is saturated and often stays wet long after irrigation sometimes the water reaches late due to which crops is completed. Such condition promotes infections by leaf get dried. Water deficiency can be detrimental to plants mold fungi. On the contrary the drip or trickle irrigation is before visible wilting occurs. Slowed growth rate, lighter a type of modern irrigation technique that slowly applies weight fruit follows slight water deficiency. This problem small amounts of water to part of plant root zone. Water is can be perfectly rectified if we use automatic micro supplied frequently, often daily to maintain favorable soil controller based drip irrigation system in which the moisture condition and prevent moisture stress in the plant irrigation will take place only when there will be acute with proper use of water resources. Drip irrigation saves requirement of water because only the plant.

## **2. METHODOLOGY**

The endeavor is planned to develop a modified water framework structure which switches the siphon motor ON/OFF on recognizing the soggy substance of the soil. The use of real water framework procedure in the field of agribusiness is fundamental. The upside of using this methodology is to diminish human intercession and still assurance proper water framework. The endeavor uses a PIC(16F887) plan microcontroller which is altered to get the data banner of fluctuating soggy condition of the soil through the distinguishing game-plan. This is cultivated by using an activity amp as a comparator between the action identifier and the microcontroller as an interface. It makes a yield when the controller gets this banner, which drives a hand-off for the water siphon to work. An LCD show is moreover interfaced to the microcontroller to indicate status of the earth and water siphon. The recognizing strategy is made by using two firm metallic shafts installed into the field at a division. Relationship from the metallic shafts are interfaced to the control unit.

Microcontroller pic (16F887), Op- Amp, Relay, Water Siphon, Diodes, Voltage Regulator, Capacitors, Resistors, Led, Crystal, Transistor are the required parts. The power supply consists of a downstage transformer that ventures down to 12VAC voltage. This AC is changed to DC by using an extension rectifier, at that point it is directed to 5v using a voltage controller that is used for microcontroller activity. The square outline of Automatic Irrigation System on Sensing Soil Moisture Content undertaking involves three primary segments in particular a pic (16F887) microcontroller, comparator and hand-off.

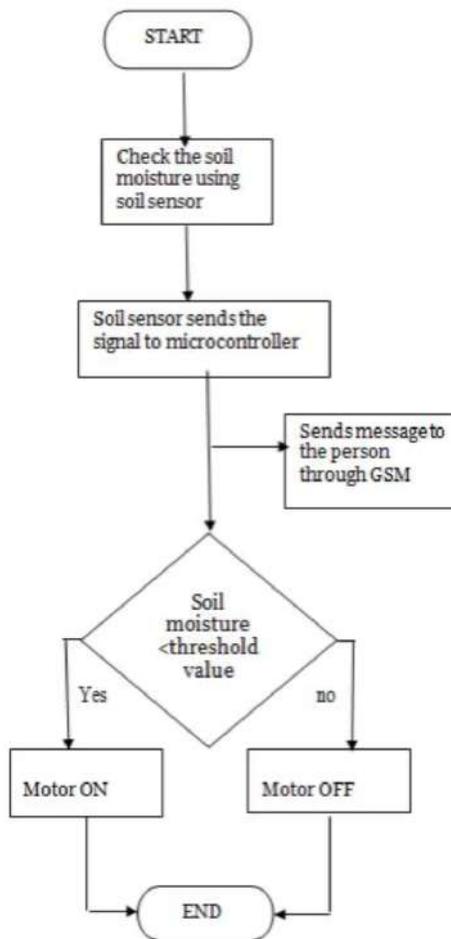


Figure 1. Flow Chart

This undertaking utilizes a pic (16F887) microcontroller which is modified in inserted C programming. When the sensor plan detects the dirt's dampness, by using a comparator, it sends the flag to the microcontroller. Here, the comparator is used as an interface between the action detection course and the microcontroller. Detecting course of action is accomplished by using two hardened metal bars set in a separate field. Once the microcontroller gets the flag, it creates the yield that drives a hand-off and encourages the engine to siphon the plants with water. The water siphon and soil status is displayed on the microcontroller interfaced LCD. The idea we improved by incorporating GSM innovation, with the end goal that at whatever point the water siphon switches ON/OFF, a SMS is conveyed to the concerned individual in regards to the status of the siphon. We can likewise control the siphon through SMS

### 3. PROPOSED SYSTEM

The major components used in this project are:

- Microcontroller based control system with regulated power supply
- Soil moisture sensor
- Electromagnetic relay to control the electrical motor (pump)
- Relay driver
- GSM modem attached to Microcontroller for remote communication LED Indicators

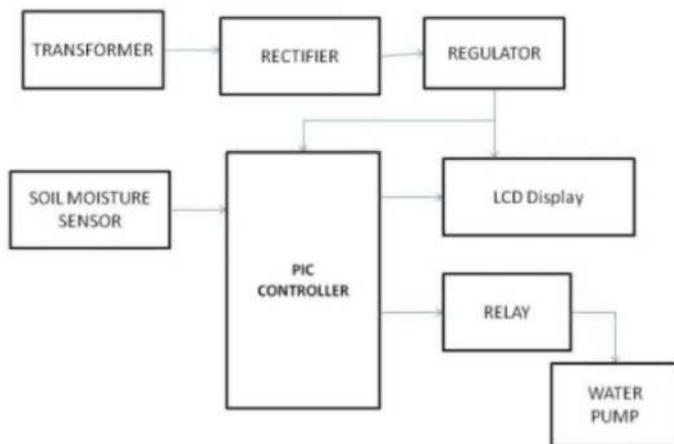


Figure 2. Block Diagram

#### 3.1. PIC MICROCONTROLLER

PIC microcontrollers are a group of specific microcontroller chips created by microcontroller Technology in Chandler Arizona. The abbreviation PIC represents peripheral interface controller despite the fact that that term is seldom utilized now a days. A normal microcontroller incorporates processor and memory and peripherals. Here we use PIC microcontroller, it is quick a direct result of utilizing RISC engineering. when contrasting with different microcontrollers, control utilization is extremely less and writing computer programs is additionally simple.

#### 3.2. IRRIGATION

Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can Irrigation system uses valves to turn irrigation ON and

increase yields and decrease both water requirements and OFF. These valves may be easily automated by using labor. Controllers and solenoids. Automating farm or nursery Drip irrigation requires about half of the water needed by irrigation allows farmers to apply the right amount of sprinkler or surface irrigation. Lower operating pressures water at the right time, regardless of the availability of and flow rates result in reduced energy costs. A higher labor to turn valves on and off. In addition, farmers using degree of water control is attainable. Automation equipment are able to reduce runoff from over Plants can be supplied with more precise amounts of watering saturated soils, avoid irrigating at the wrong time water. Disease and insect damage is reduced because plant of day, which will improve crop performance by ensuring foliage stays dry. Operating cost is usually reduced. Adequate water and nutrients when needed. Automatic Federations may is system is automatically activated when to continue during the irrigation process Drip Irrigation is a valuable tool for accurate soil moisture because rows between plants remain dry. The capacity of soil to retain water is a function of soil texture and structure. When removing a soil sample, the soil being evaluated is disturbed, so its water-holding capacity is altered. Indirect methods of measuring soil water are helpful as they allow information to be collected at the same location for many observations without disturbing the soil water system. Content without any need for soil density determination. The new soil moisture sensor uses Immersion Gold which protects he nickel from oxidation. Electrodes nickel immersion, Overview of Automated Irrigation System gold (ENIG) has several advantages over more conventional (and cheaper) surface plating such as This one explains about important parameters to be HASL (solder), including excellent surface planarity measured for automation of irrigation system are soil (particularly helpful for PCB's with large BGA packages), moisture.

The entire field is first divided into small good oxidation resistance, and usability for untreated sections such that each section should contain one contact surfaces such as membrane switches and contact moisture sensor. These sensors are buried in the ground at points required depth. Once the soil has reached desired moisture a soil moisture sensor can read the amount of level the sensors send a signal to the micro controller to moisture present in the soil surrounding it. It's a low tech turn on the relays, which control the motor. Sensor but ideal for monitoring an urban garden, or your .In proposed system, automated irrigation pet plant's water level. This is a must have tool for a mechanism which turns the pumping motor ON and OFF connected garden. On detecting the dampness content of the earth. In this sensor uses the two probes to pass current through domain of farming, utilization of

appropriate means of the soil, and then it reads that resistance to get the irrigation is significant. The benefit of employing moisture level. More water makes the soil conduct these techniques is to decrease human interference.

### **3.3. SOIL MOISTURE**

Soil moisture is an important component in the Atmospheric water cycle, both on a small agricultural scale and in largescale modelling of land/atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Knowledge of the degree of soil wetness helps to forecast the risk of flash floods, or the occurrence of fog. Soil water content is an expression of the mass or volume. The work focuses on Microcontroller based irrigation of water in the soil, while the soil water potential is a system proves to be a real time feedback control system expression of the soil water energy status. The relation which monitors and controls all the activities of drip between content and potential is not universal and depends irrigation system efficiently. The present proposal is a on the characteristics of the local soil, such as soil density model to modernize the agriculture industries on a small and soil texture. Scale with optimum expenditure. Using this system, one the basic technique for measuring soil water content is the can save manpower, water to improve production and gravimetric method. Because this method is based on ultimately profit. Direct measurements, it is the standard with which all other methods.



**Figure 2.** Soil Moisture Sensor

### 3.4. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button.

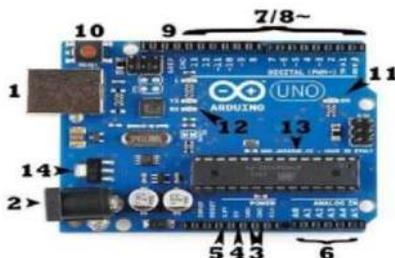


Figure 3. Arduino Uno Board

### 3.5. L293D Module

L293D Description. L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.



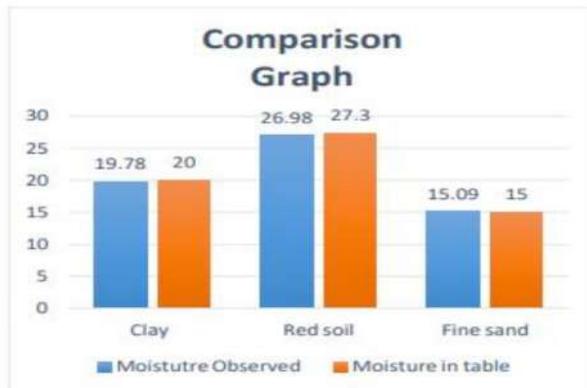
Figure 4. L293D Module

## 4. RESULTS AND DISCUSSION

Table 1. Comparison Table

Soil Type	Observed Moisture level (%)	Required moisture as per soil moisture dataTable (v)	Accuracy (%)
Clay	19.75	20.00	99
Red soil	26.98	27.3	99
Fine sand	15.074	15.00	100

The above table shows the comparison of various soil type with soil moisture table database. It shows that our observed moisture values for soil types such as clay, red soil and sand almost matched with values in the soil moisture table as shown in comparison table.. When comparing our system with required soil moisture content table taken from agriculture database, the result shows that 99% accuracy in average of all the sample soils taken for test. Here we tested with three soil types.



The comparison table shows the reading for the soils such as clay, redsoil, finesand.

## 5. CONCLUSION

This paper proposing the system for soil moisture content level testing with PIC microcontroller. In order to validate our proposed system, the soil moisture level database values were compared with our observed moisture level values. For example, from the comparison table for the soil type clay value is 19.75 and reading from the soil moisture table value is 20. Its show that our observed values is almost equal to the values in soil moisture table. Hence, our proposed system can be applied to any type of soil to measure the moisture content to help the farmers in irrigation purpose. The information received from the sensors is sent to the Database folder through the Android device. In the control section, the system is activated using the application, this is finished using the ON/OFF buttons in the application. Also, the soil moisture is low, the pump is switched ON based on the moisture content.

## 6. REFERENCES

**Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra NietoGaribay, and Miguel Ángel Porta- Gándara** (2018) "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module " IEEE (2013)

- Klute, A. (ed.)**, (1986) “Methods of Soil Analysis, Part 1: Physical and Mineralogical Methods” American Society of Agronomy, Madison, Wisconsin, United States, 1188 pp
- Knight, J.H.**, (1992) “Sensitivity of time domain reflectometry measurements to lateral variations in soil water content”, *Water Resources Research*, 28, pp. 2345–2352
- Purnima, S.R.N Reddy**, (2012) Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM Bluetooth on IJCA 2012.
- R.suresh, S.Gopinath, K.Govindaraju, T.Devika, N.SuthanthiraVanitha** (2014) GSM based Automated Irrigation Control using Raingun Irrigation System 3 (2), pp – 5654- 5657
- Samy Sadeky, Ayoub Al-Hamadiy, Bernd Michaelisy, Usama Sayedz**, (2004) An Acoustic Method for Soil Moisture Measurement IEEE (2004)
- Veena Divyak, AyushAkhouri** (2013) ,A Real time implementation of a GSM based Automated Irrigation Control System using drip IrrigationMethology 4 (5)
- Bircher, S., Skou, N., Jensen, K.H., Walker, J.P., & Rasmussen, L.** (2011). A soil moisture and temperature network for SMOS validation in Western Denmark. *Hydrol. Earth Syst. Sci. Discuss.*, 8, 9961-10006.
- Sheetal Mohite, Mr. Mrityunjay Ojha** “Microcontroller Based Plant Irrigation” *International Journal of Advance Technology in Engineering and Science*, Vol. No 3, Issue 10, October 2015
- Muzammil Hussain\*, Prof. S. P. Gawate, Prof. Dr. P. S. Prasad, Prof. P. A. Kamble** *International Journal of Advanced Research in Computer Science and Software Engineering* Volume 5, Issue 1, January 2015 ISSN: 2277 128X
- Mritunjay Ojha, Sheetal Mohite, Shraddha Kathole & Diksha Tarware** *International Journal of Computer Science and Engineering Research in Microcontroller Based Automatic Plant Watering System* Vol. 5, Issue 3, Apr- May 2016; 25-36 (IJCE) ISSN(P): 2278-9960; ISSN(E): 2278-9979
- M. D. Dukes**, *Transactions of the ASABE* Vol. 55(2): 563-569 © 2012 American Society of Agricultural and Biological Engineers ISSN 2151-0032

# BOUNDS FOR VARIABLE STEP SIZE OF LMS ALGORITHM

**K. Suthendran**

*Department of IT, Kalasalingam Academy of Research and Education,  
Krishnankoil, (India)*

Email ID: k.suthendran@klu.ac.i, <https://orcid.org/0000-0002-7030-4398>

**S. Subburam**

*Department of Mathematics, Kalasalingam Academy of Research and Education,  
Krishnankoil, (India)*

Email ID: ssrammaths@yahoo.com, <https://orcid.org/0000-0001-6691-0777>

## ABSTRACT

Fixing the Inter Symbol Interference has always been a challenging task in wireless communication system. As the number of communication device usage is increasing day to day results in more interference. In order to fix this, extraordinary kinds of filters are required. Recent studies in this domain witness that the variable step size equalizers are performing better than the fixed step size equalizers. In this paper, the variable step size least mean square algorithm concerning the adaptive equalizer is improved by modifying the bounds of step size. A twofold algorithm is proposed to optimize the tap weight and the same is proved with help of lemmas.

**Keywords:** Equalizer, Inter Symbol Interference, Least Mean Square Algorithm.

## 1. INTRODUCTION

In the modern wireless data communication, plenty of attempts have been committed to utilize the available channel bandwidth with efficiency. However, the performance of data transmission is degraded by two factors, namely Inter-Symbol Interference (ISI) and Thermal Noise (TN). The conventional filters fail to reconstruct the original data when the received data contains either ISI or in-band noise. These issues could be stabilized by a special kind of filter called equalizer (D. Falconer *et al.*, 2011). Adaptive channel equalization plays vital role in compensating ISI sourced by linear distortions in unknown channels (S. Hykin *et al.*, 2003). An adaptive filtering requires known sequence at the receiver side so as to calculate the error signal which is essential for adaptive method. It operates in two modes called training and tracking. Due to time varying nature of the wireless channels, training signals should be sent time after time and this engages additional bandwidth. In many applications better-known training sequence is considered as necessary to adapt the equalizers

by diminishing the mean square error [MSE], however this being not feasible and expensive when lengthy training sequence is indispensable (B. Farhang *et al.*, 2013). Widrow and his scholar Hoff have proposed least mean square algorithm [LMS] in the course of their studies about the pattern recognition in 1960. The LMS algorithm is employed in numerous areas of adaptive filtering applications, because of its simplicity and easy to implement it in hardware. The stability of the algorithm is achieved by choosing the step size  $\mu$  between the bounds as shown below (A. Lee *et al.*, 2009)

$$0 < \mu < \frac{2}{\lambda_{\max}}$$

where  $\lambda_{\max}$  is the largest Eigen value of the input autocorrelation matrix  $R$ . In 1992, author (A.Ghosh *et al.*, 1992) has studied the least mean square based adaptive optimal equalizers. To make sure the stability of the algorithm the step size value  $\mu$  is chosen to satisfy the following condition

$$0 < \mu < \frac{2}{\text{tr}[R]}$$

where  $\text{tr}[R]$  denotes the sum of diagonal elements of  $R$  (B. Das *et al.*, 2014). In 2006, the authors in (A. García *et al.*, 2006) have proposed an effective way to improve the performance of the adaptive filters by convex combination of adaptive filters and have chosen the step size  $\mu$  to guarantee the stability of the algorithm as shown below

$$0 < \tilde{\mu}_{\text{opt}} < \frac{2}{\text{tr}[R]}$$

where  $\tilde{\mu}_{\text{opt}}$  is optimum step size. In (A. Lee *et al.*, 2009), the authors have analysed the LMS adaptive networks for distributed estimation in the presence of transmission errors. The upper and lower bounds of the step size  $\mu$  is given as

$$0 < \mu_k < \frac{2}{\sigma_{uk}^2},$$

where  $k = 1, 2, \dots, N$ ,  $\mu_k$  is the step size at node  $\sigma_{uk}^2$  and is the white Gaussian random variable with variance. The authors in (B. Gelfand *et al.*, 1999) have proposed the improved least mean square algorithm with variable step size and its condition to guarantee the stability of algorithm is shown below

$$0 < \mu < \frac{2}{3\text{tr}[R]}$$

It is clear that all the above works have used the same lower bound but not at the upper bound. In this work, the bounds are modified results better performance than the existing.

In this paper, we prove the following results: Let  $u(0), u(1), u(2), \dots, u(m)$  be the input signals which are positive real,  $M$  the length of the filter,  $\mu$  the step size and let  $d(0), d(1), d(2), \dots, d(m)$  be the desired signals which are positive real. Fix  $w_0(0) = w_1(0) = \dots = w_{M-1}(0) = 0$ . Let

$$w_i(n + 1) = w_i(n) + u(n - i)e(n)\mu,$$

for  $n = 0, 1, 2, 3, \dots, m$  and  $i = 0, 1, 2, \dots, M-1$  where

$$e(n) = d(n) - y(n)$$

and

$$y(n) = \sum_{i=0}^{M-1} w_i(n)u(n - i) \tag{1}$$

**Theorem 1.** Let  $\delta$  be real with

$$\frac{d(n + 1) - e(n) - \sum_{0 \leq i \leq M-1} w_i(n)u(n + 1 - i)}{\min_{0 \leq i \leq M-1} u(i)} < \delta < \frac{2e(n)}{\lambda_{\max} \min_{0 \leq i \leq M-1} \left\{ \frac{1}{u(n - i)} \right\}}$$

Then

$$e(n + 1) \leq \begin{cases} d(n + 1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{0 \leq i \leq M-1} w_i(n)u(n + 1 - i), & \text{if the first inequality is true} \\ d(n + 1) - \delta \sum_{0 \leq i \leq M-1} u(n + 1 - i) - \sum_{0 \leq i \leq M-1} w_i(n)u(n + 1 - i), & \text{if the second inequality is true.} \end{cases}$$

Moreover, the upper bounds are strictly less than  $e(n)$  and the sequence  $\{e(n)\}$  converges to zero.

Also, in this paper, we provide an algorithm to calculate error and tab weight coefficients, using Theorem 1.

## 2. BOUNDS FOR $\mu$

**Lemma 1.** Let  $\varepsilon > 0$  and  $\delta > 0$  be defined as Theorem 1. If  $e(n+1) > \varepsilon$  for some  $n$ , then

$$\varepsilon < d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i)$$

or

$$\mu < \min_{0 \leq i \leq M-1} \left\{ \frac{\delta}{u(n-i)e(n)} \right\}.$$

*Proof.* Fix  $\varepsilon > 0$  and  $\delta > 0$ . Assume that  $e(n+1) > \varepsilon$  for some  $n$ . It is clear that

$$w_i(n+1) = w_i(n) + u(n-i)e(n)\mu$$

implies that

$$\frac{w_i(n+1) - w_i(n)}{e(n)u(n-i)} = \mu.$$

Suppose that

$$w_i(n+1) - w_i(n) \leq \delta,$$

for all  $i$ . From this, we have

$$\mu \leq \frac{\delta}{e(n)u(n-i)}.$$

Therefore

$$\mu \leq \min_{0 \leq i \leq M-1} \left\{ \frac{\delta}{e(n)u(n-i)} \right\}.$$

Next we shall assume that

$$w_i(n+1) - w_i(n) > \delta,$$

for some  $i$ . By (1), we have

$$y(n+1) = \sum_{i=0}^{M-1} w_i(n+1)u(n+1-i).$$

Then we can rewrite the equation as

$$y(n+1) = \sum_{i=0}^{M-1} (w_i(n+1) - w_i(n) + w_i(n))u(n+1-i)$$

and so

$$y(n+1) = \sum_{i=0}^{M-1} (w_i(n+1) - w_i(n))u(n+1-i) + \sum_{i=0}^{M-1} w_i(n)u(n+1-i). \quad (2)$$

Let

$$S_1 = \{0 \leq i \leq M-1: w_i(n+1) - w_i(n) \leq \delta\}$$

and

$$S_2 = \{0 \leq i \leq M-1: w_i(n+1) - w_i(n) > \delta\}.$$

Consider the sum  $S = \sum_{i=0}^{M-1} (w_i(n+1) - w_i(n))u(n+1-i)$ . Then

$$S = \sum_{i \in S_1} (w_i(n+1) - w_i(n))u(n+1-i) + \sum_{i \in S_2} (w_i(n+1) - w_i(n))u(n+1-i).$$

Therefore

$$S \geq \sum_{i \in S_2} (w_i(n+1) - w_i(n))u(n+1-i)$$

and so

$$S \geq \delta \sum_{i \in S_2} u(n+1-i).$$

Therefore

$$y(n+1) \geq \delta \sum_{i \in S_2} u(n+1-i) + \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Since  $e(n+1) > \varepsilon$ ,  $e(n+1) = d(n+1) - y(n+1)$  implies that

$$\varepsilon < d(n+1) - \delta \sum_{i \in S_2} u(n+1-i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Therefore

$$\varepsilon < d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i),$$

since

$$\sum_{i \in \mathcal{D}_2} u(n+1-i) \geq \min_{0 \leq i \leq M-1} u(i).$$

From the above cases, we have the lemma.

**Lemma 2.** Let  $\varepsilon > 0$  and  $\delta > 0$  be defined as Theorem 1. If  $e(n+1) > \varepsilon$  for some  $n$ , then

$$\varepsilon < d(n+1) - \delta \sum_{0 \leq i \leq M-1} u(n+1-i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i)$$

or

$$\mu < \min_{0 \leq i \leq M-1} \left\{ \frac{\delta}{u(n-i)e(n)} \right\}.$$

*Proof.* Fix  $\varepsilon > 0$  and  $\delta > 0$ . Assume that  $e(n+1) > \varepsilon$  for some  $n$ . Suppose that

$$w_i(n+1) - w_i(n) \leq \delta,$$

for some  $i$ . Then, the equation

$$w_i(n+1) = w_i(n) + u(n-i)e(n)\mu$$

Implies that

$$\mu \leq \frac{\delta}{e(n)u(n-i)}.$$

Therefore

$$\mu \leq \max_{0 \leq i \leq M-1} \left\{ \frac{\delta}{e(n)u(n-i)} \right\}.$$

Next we shall assume that

$$w_i(n+1) - w_i(n) > \delta,$$

for all  $i$ . By equation (2),

$$y(n+1) = \sum_{i=0}^{M-1} (w_i(n+1) - w_i(n))u(n+1-i) + \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Therefore

$$y(n+1) \geq \delta \sum_{0 \leq i \leq M-1} u(n+1-i) + \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Since  $e(n+1) > \varepsilon$ ,  $e(n+1) = d(n+1) - y(n+1)$  implies that

$$\varepsilon < d(n+1) - \delta \sum_{0 \leq i \leq M-1} u(n+1-i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

From the above cases, we have the lemma.

The following lemma appears in (S. Rad *et al.*, 2015).

**Lemma 3.** The mean  $E(e(n))$  converges to zero iff

$$0 < \mu < \frac{2}{\lambda_{\max}},$$

where  $\lambda_{\max}$  is the largest eigenvalue of the matrix  $[u(n)][u(n)]^T$ .

Proof of Theorem 1. By Lemma 1, if

$$\mu \geq \min_{0 \leq i \leq M-1} \left\{ \frac{\delta}{u(n-i)e(n)} \right\}$$

and

$$\varepsilon \geq d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i),$$

then we have  $e(n+1) \leq \varepsilon$ . Choose

$$\varepsilon = d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Then, we have

$$e(n+1) \leq d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i).$$

Consider the first inequality. Since

$$\frac{d(n+1) - e(n) - \sum_{0 \leq i \leq M-1} w_i(n)u(n+1-i)}{\min_{0 \leq i \leq M-1} u(i)} < \delta,$$

we have

$$d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{i=0}^{M-1} w_i(n)u(n+1-i) < e(n).$$

Because of

$$\delta < \frac{2e(n)}{\lambda_{\max} \min_{0 \leq i \leq M-1} \left\{ \frac{1}{u(n-i)} \right\}},$$

we get

$$\frac{\delta}{e(n)} \min_{0 \leq i \leq M-1} \left\{ \frac{1}{u(n-i)} \right\} < \frac{2}{\lambda_{\max}}.$$

Choose  $\mu$  such that

$$\frac{\delta}{e(n)} \min_{0 \leq i \leq M-1} \left\{ \frac{1}{u(n-i)} \right\} < \mu < \frac{2}{\lambda_{\max}}.$$

By Lemma 3, we have that  $\{e(n)\}$  converges to zero. Similarly, we can prove the other result.

### 3. ALGORITHM

**Step 1.**  $w_0(0) = w_1(0) = \dots = w_{M-1}(0) = 0$  and  $e(0) = d(0)$ .

**Step 2.** Assume that  $n \geq 0$ . Choose  $\delta$  as in Theorem 1 such that it is very close to the upper bound. Find

$$D = \begin{cases} d(n+1) - \delta \min_{0 \leq i \leq M-1} u(i) - \sum_{0 \leq i \leq M-1} w_i(n)u(n+1-i), & \text{if the first inequality is true} \\ d(n+1) - \delta \sum_{0 \leq i \leq M-1} u(n+1-i) - \sum_{0 \leq i \leq M-1} w_i(n)u(n+1-i), & \text{if the second inequality is true.} \end{cases}$$

Consider  $D$  as an approximation of the  $e(n+1)$ . Choose  $\mu$  satisfying

$$\min_{0 \leq i \leq M-1} \left\{ \frac{\delta}{u(n-i)e(n)} \right\} < \mu < \frac{2}{\lambda_{\max}}.$$

Also, find

$$w_i(n+1) = w_i(n) + u(n-i)e(n)\mu,$$

for  $i = 0, 1, 2, \dots, M-1$ .

## 4. RESULTS

During the initial run the tap weights are assigned with zero and  $e(0)=d(0)$ .with reference to the theorem 1 the  $\delta$  value is chosen so that it becomes very close to upper bound. Then the step size value is determined between the minimum and maximum boundaries with the help of two inequalities. In the proposed algorithm  $\delta$  value is calculated from the theorem 1 and same is proved with the help of lemmas. It is known that the step size value should be optimum for better performance. When the step size is minimum or close to zero then the equalizer may take more number of iterations to reconstruct the original signal. Likewise if the step size is maximum then it completes the operation in less number of iterations but there may be the chance sometimes bigger step size may mislead wrong signal reconstructions. So, it is important to choose the optimum size. The above twofold algorithm is proposed to update the tap weights.

## 5. CONCLUSION

From the literature it is observed that all the communication researchers have chosen their step size value between zero and some value. In general, if the step size is zero then it takes more number of iterations to reconstruct the signal. So, our proposed work not starts from zero. Instead, it starts with above zero and upper bounds are limited to  $e(n)$ . Also, in this paper, we provide an algorithm to calculate error and tap weight coefficients, using Theorem 1.The proposed theorem is proved with the help of lemmas.

## 6. REFERENCES.

- B. Das and M. Chakraborty** (2014). Sparse Adaptive Filtering by an Adaptive Convex Combination of the LMS and the ZA-LMS Algorithms. IEEE Transactions on Circuits and Systems-I, 61 (5), 1499-1507.
- D. Falconer** (2011).History of Equalization 1860-1980. IEEE Communications Magazine, 42-50.

- B. Farhang-Boroujeny** (2013). Adaptive Filters: Theory and Applications. John Wiley & Sons.
- S. Hykin and B. Widrow** (2003). Least means square adaptive filters. John Wiley & Sons.
- A. García, Anibal, R. Vidal and H. Sayed** (2006). Mean-Square Performance of a Convex Combination of Two Adaptive Filters. IEEE Transactions On Signal Processing. 54 (3), 1078-1090
- B. Gelfand, Y. Wei and V. Krogmeier** (1999), The Stability of Variable Step-Size LMS Algorithms. IEEE Transactions on Signal Processing. 47 (12).
- A. Ghosh, J. Barner and P. Paparao** (1992). Design of Least Mean Square based adaptive optimal equalizers. Optical Communication. 91, 280-292.
- A. Lee, S. Gan and M. Kuo** (2009). Subband Adaptive Filtering Theory and Implementation. John Wiley & Sons Ltd, UK
- S. Rad and F. Labeau** (2015). Formulation and Analysis of LMS Adaptive Networks for Distributed Estimation in the Presence of Transmission Errors. IEEE internet of things journal, (99) DoI: 10.1109/JIOT.2015.2451220

# **RASPBERRY PI BASED READER FOR VISUALLY CHALLENGED PEOPLE**

**Jeya Prakash Kadambarajan**

*Assistant Professor, ECE Department, Kalasalingam Academy of Research and Education.  
Krishnankoil (India).*

Email ID: [k.jeyaprakash@klu.ac.in.](mailto:k.jeyaprakash@klu.ac.in.), <https://orcid.org/0000-0001-7493-1914>

**Mohammed Arbas Ali Khan**

*UG Student, ECE Department, Kalasalingam Academy of Research and Education.  
Krishnankoil (India).*

Email ID: [mdarbaskhan786@gmail.com](mailto:mdarbaskhan786@gmail.com), <https://orcid.org/0000-0003-3177-3754>

**Kethi Venkateswarlu**

*UG Student, ECE Department, Kalasalingam Academy of Research and Education.  
Krishnankoil (India).*

Email ID: [venkeyvenkatesh101@gmail.com](mailto:venkeyvenkatesh101@gmail.com), <https://orcid.org/0000-0001-5593-7990>

**Ragipudi Kalyan**

*UG Student, ECE Department, Kalasalingam Academy of Research and Education.  
Krishnankoil (India).*

Email ID: [ragipudikalyan@gmail.com](mailto:ragipudikalyan@gmail.com) , <https://orcid.org/0000-0003-4590-2115>

## **ABSTRACT**

This work talks about the document or handwritten book or textbook reader that can read for visually challenged people, developed on the Raspberry Pi 3 board. It uses the standard ASCII unique identification technology for the printed characters in the notebook or a newspaper or handwritten book or any other book using the camera and then capture the image and then convert to speech with software coding. The image present in the computer is converted into the voice by using the OCR technology and Text is converted into speech. The process is done using Raspberry Pi 3 which uses Tesseract library, and Python programming. The file is processed, and the audio is heard through the speaker and thus the person can listen whatever text that camera capture.

**Keywords:** Extracting text, Optical Character Recognition technique, Text is converted into Speech, Image capture.

## **1. INTRODUCTION**

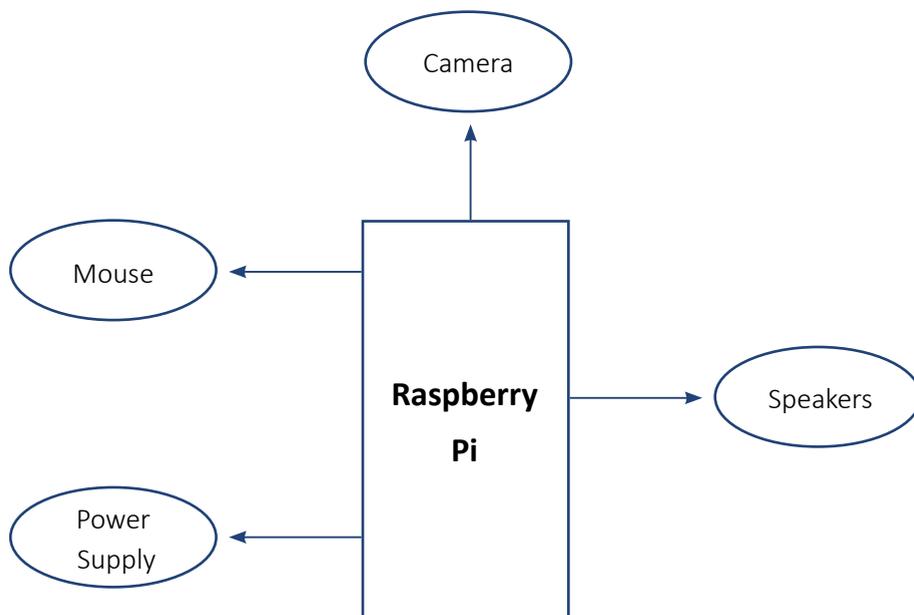
The Proposed work is used for the detection of text from the printed paper or hand-written and it is used to help the blind and visually challenged people for reading. Success rate of this project is about 90%. There is a camera that read text from

a certain distance. This is a method that extract text from printed papers and after using some Digital Image Analysis process the text is converted into speech Our main aim is to provide a solution for the visually challenged people for reading and to gain knowledge through a voice output in clear way.

Now this will help blind people to read text from any printed papers. In this project a camera extracts text and acts as the input to the system and python is used in Raspberry pi 3. With Open CV library, the extracted text region from the paper will come through the speaker or headset as sound.

If the reader wants to read some data from the internet, then the reader can easily read because a Wi-Fi connection is setup in the Raspberry pi 3. Components which we used here are mouse, Keyboard, Camera, Speaker or a headset.

## 2. MATERIALS



**Figure 1.** Raspberry Pi 3 Setup Design Model

Raspberry PI 3 Board

Camera

HDMI Cable / USB Cable

Speaker/ Headset

Power Supplier for Raspberry Pi 3 Board

Micro SD Card

Monitor

Mouse

Programming: Python

Tesseract- Open CV Library: OCR engine and TTS engine



**Figure 2.** Raspberry Pi 3 Board



**Figure 3.** Open CV



**Figure 4.** Camera



**Figure 5.** Earphones

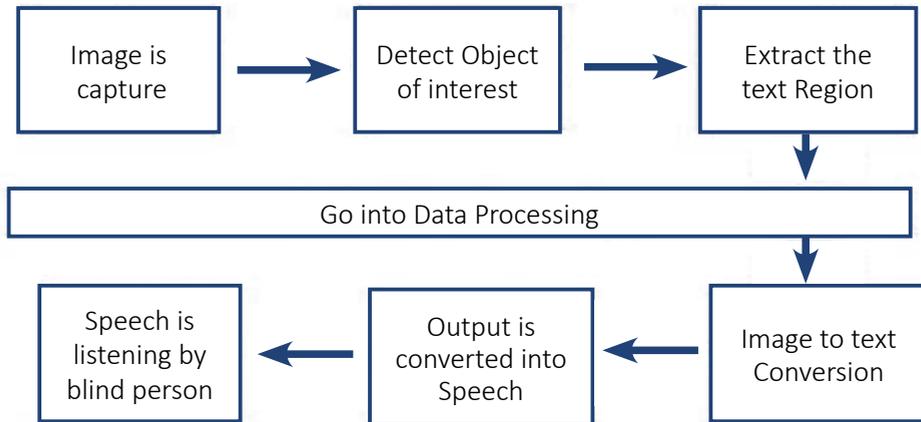
### **RASPBERRY PI 3 BOARD:**

This board was developed by UK which is small and easily movable. To promote this new technology over teaching knowledge, say about the Raspberry pi 3 board in collage and developing the model of Raspberry pi in other countries. The first model is getting very famous (or) popular than they expected with the target market for the uses such as projects and minicomputers. Raspberry Pi 3 board was cheap cost when compared to other boards. The Raspberry pi 3 board is in a small sized computer that plugs into the three components for the raspberry pi 3 that are computer monitor and standard keyboard and mouse are used in the processes of book reading.

### **3. WORKING**

The document is placed at the correct position of camera connected to the Raspberry pi 3 board through the USB cable and image is captured. Then that captured image undergoes to the ORC technology that allows all the conversation present in the image or handwriting book or textbook or document or any other one, that having the text or any information that will be understanding by the computer programme. The TESSERACT library files for the ORC technology are used. The text is converted into the speech audio voice this is present in the library file in the form of text-to-speech

for the blind. The camera can take images through the internet in which you find something interesting to read with the help of LAN/WAN or WIFI. Now for the image the label is created by using through the open cv library then the image is processed then converted into audio and finally the voice is coming through the connected headset of 3.5 mm audio jack or by Bluetooth speaker or a normal speaker.



**Figure 6.** Block representation of the system

### STEP 1. PHOTO CAPTURING

The Starting step is to place the document or textbook or a handwritten book or any other one in front of the camera view and then the photo is captured by the camera. It is to make sure there is a good lighting to take a photo and the text will be clear, thus, the good quality of photo will be captured.

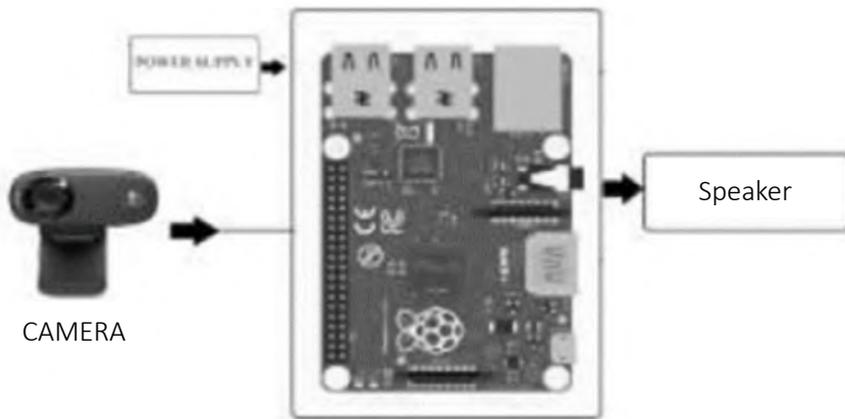
### STEP 2. CONVERTING IMAGE INTO TEXT FORMAT

As per the standard reorganization of the ASCII values that each one text or value has unique code is present to all the alphabets from A-Z and also for the special characterizes has unique code is given by using this code the computer will understand the text format and then it goes through speaker. The OCR technology converts the image to text.

### STEP 3. TEXT TO SPEECH

Main part of this work is to convert the text format into the speech format, for this the text characterize recognition using the ASCII standard vales in that the values are converted in the audio signal then then it sends to the Raspberry pi 3 board there it will correct if any error occurs by using the Python coding, after this the audio

is listened through the speaker or headset or Bluetooth speaker connected to the Raspberry pi 3 board.



**Figure 7.** Hardware Setup Overview

#### **4. RESULTS, DISCUSSION AND CONCLUSIONS**

The project we have is a book reader, in this first the text will be capture and then it will have converted into the audio output thus the blind people can listen or understand the text in the captured image. The Visually challenged people will find easy to read the texted document or handwritten book or novel or any other data they want to read they easily read by using this book reader. The algorithm is simple but offers a very elegant solution to the ones who need it the most



**Figure 8.** Model Implemented

#### **5. REFERENCES**

**Baskar V, Aarthi N, Jeya Prakash K, Manikandan P, Sivakumar P** (2018), Smart Glass for Visually Challenged Person's, International Journal of Innovative Research in Management, Engineering and Technology, pp 58-64, Vol. 3, Issue 3, March 2018

- D. Dakopoulos and N. G. Bourbakis** (2010), "Wearable Obstacle Avoidance Electronic Travel Aids for Blind: A Survey," in *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, vol. 40, no. 1, pp. 25-35, Jan. 2010, doi: 10.1109/TSMCC.2009.2021255.
- Htun, H., Zin, T., & Tun, H.** (2015). Text To Speech Conversion Using Different Speech Synthesis. *International Journal of Scientific & Technology Research*, 4, 104-108.
- Kadambarajan, J. P., Pothiraj, S., & Kadarkarai, P.** (2021). GPU Implementation of Thermal Aware 3D IC Floorplanning. *International Journal of Computer Information Systems and Industrial Management Applications*, 13, 043–050.
- Kadambarajan, J. P., & Pothiraj, S.** (2021). TSV aware 3D IC Partitioning with Area Optimization. *Arabian Journal for Science and Engineering*. <https://doi.org/10.1007/s13369-021-05604-9>
- Kwang In Kim, Keechul Jung and Jin Hyung Kim** (2003), "Texture-based approach for text detection in images using support vector machines and continuously adaptive mean shift algorithm," in *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 25, no. 12, pp. 1631-1639, Dec. 2003, doi: 10.1109/TPAMI.2003.1251157.
- Pothiraj, S., Kadambarajan, J. P., & Kadarkarai, P.** (2021). Floor planning of 3D IC design using Hybrid Multi-verse Optimizer. *Wireless Personal Communications*, 118(4), 3007–3023. <https://doi.org/10.1007/s11277-021-08166-z>
- Prakash, K. J., & Sivakumar, P.** (2020). Memetic algorithm based on hill climbing algorithm for IC partitioning. *3C Tecnología. Glosas de innovación aplicadas a la pyme. Edición Especial, Marzo 2020*, 181-193. <http://doi.org/10.17993/3ctecno.2020.specialissue4.181-193>.
- S. Kumar, R. Gupta, N. Khanna, S. Chaudhury and S. D. Joshi** (2007), "Text Extraction and Document Image Segmentation Using Matched Wavelets and MRF Model," in *IEEE Transactions on Image Processing*, vol. 16, no. 8, pp. 2117-2128, Aug. 2007, doi: 10.1109/TIP.2007.900098.
- Todd, C.A., Rounaq, A., Nur, U.K., & Boufarhat, F.** (2012). An Audio Haptic Tool for Visually Impaired Web Users. *Journal of Emerging Trends in Computing and Information Sciences*, VOL. 3 (8), Aug 2012, 1136-1145

**Vikram Shirol, Abhijit M, Savitri A, Pooja R, Amrutha K** (2015), "Drashti- An Android Reading Aid", International Journal of Computer Science and Information Technologies, Vol. 6 (4), 2015, 3434-3437

**Xiangrong Chen and Alan L. Yuille.** (2004). Detecting and reading text in natural scenes. In Proceedings of the 2004 IEEE computer society conference on Computer vision and pattern recognition (CVPR'04). IEEE Computer Society, USA, 366–373.

**Xilin Chen, Jie Yang, Jing Zhang, and A. Waibel** (2004), "Automatic detection and recognition of signs from natural scenes," in IEEE Transactions on Image Processing, vol. 13, no. 1, pp. 87-99, Jan. 2004, doi: 10.1109/TIP.2003.819223

# **ACCIDENT AVOIDING SYSTEM USING MULTISENSORS USING LABVIEW**

**Dr.A.Lakshmi**

*Associate professor, Department of ECE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: lakshmi@klu.ac.in, <http://orcid.org/0000-0002-6744-7048>

**N.Mahidhar**

*B. Tech Student, Department of ECE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: nelapatemahithzmr@gmail.com, <https://orcid.org/0000-0003-2894-223>

**M.Manoj**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: manojraju5432@gmail.com, <https://orcid.org/0000-0003-1869-4330>

**K.Kalyan**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: kkalyan5080@gmail.com, <https://orcid.org/0000-0001-8776-7201>

## **ABSTRACT**

The objective of this project is to develop a system to avoid accidents. This can be used as the safety instrument in the automotive industries. Most of the accidents are happened due to drunk and drive, driving in sleepy mode, uncontrolled speed and unexpected obstacles. The main aim of this project is to control the speed of vehicle and check the condition of driver whether he is drunken or not and he is sleepy or not by using multiple sensors. Here in this system three types of sensors are used, namely ultrasonic sensor, eye blink sensor, alcohol sensor. Ultrasonic sensor is used to detect the distance between the front and side vehicles. To avoid collision and sudden kitting of the obstacles, the ultrasonic sensor has been implemented. It senses the nearby obstacles and intimate the driver front panel. The distance between the nearby vehicles is also informed to the driver front panel so that the speed and separation distance can be adjusted. If the vehicles are very closer to the nearby vehicle, then the buzzer will give the alarm to the driver and automatically the speed of the vehicle will be reduced. If the driver closes his eyes more than 10 seconds the driver gets alerted by using eye blink sensor using buzzer. Alcohol sensor is used to detect the condition of the driver whether he is in drunken or not. It also helps the driver while performing the reversing of the vehicle and indicate whether any vehicle is nearby or not. Ultrasonic sensors are placed on all the

four sides to assist the driver. By using this device as assistance, the accident can be reduced to the maximum extent.

**Keywords:** Accident Avoidance, Multi-sensor, LabVIEW

## **1. INTRODUCTION**

The Over 1,37,000 were killed in road accidents in 2013 alone and sixteen children dies everyday and there is a death for every four minutes in Indian roads due to road accidents. According to the recent survey in India, the total number of persons died due to road accidents are 17218 in Tamil Nadu, 11133 in Karnataka ,12935 in Kerala and 8541 in Andhra Pradesh. These accidents are mostly due to the distance unknown unconsciousness. From this survey, Tamil Nadu has more number of deaths due to accidents. So the government of Tamil Nadu had targeted to minimize the number of deaths from 2017-2020 from 17218 to 3572 by some of the Industrial arrangements and awareness campaigns. The accident avoidance system using multi sensors helps to avoid the accidents in highways and town traffic. These accidents are mainly due to unconsciousness, distance unknown between the vehicles. It's an automobile safety system designed to reduce the severity of an accident. Once the detection is done, these systems provide a warning to the driver or take an automatic action in the vehicle. It is also called as pre crash intimation system or collision warning system.

## **2. SYSTEM MODEL**

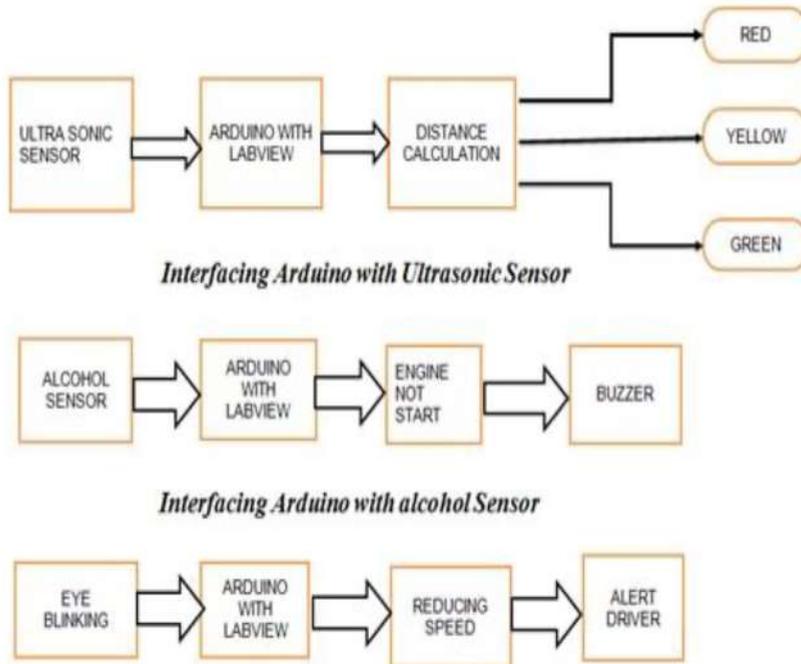
The complete system model of our proposed system is divided as two main modules as:

1. Collision Avoidance System (CAS)
2. Automated Accident Detection and intimation system (AADIS)

### **2.1. COLLISION AVIODANCE SYSTEM:**

The main objective of the CAS is to avoid the accidents due to distance unknown, drunken drivers, sleepy drivers. Collision Avoidance System consists of several sensors like ultrasonic sensor, Eye blink sensor, alcohol sensor. In the bad weather conditions the driver was not able to see the road clearly, due to this accident may happen. To overcome this type of accidents ultrasonic sensors are used, to detect the distance between the nearby vehicles. During driving the drivers

can feel sleepy and there is a chance of no eye blink for every 10 seconds. This may can cause accidents, to avoid this type of accidents eye blink sensor is used in this system to alert the driver by sound. If the driver is in drunken condition, there is a chance of accident occurring. To avoid this type of accidents alcohol sensor is used in this system. If it was detected that the driver was over drunken the ignition of the vehicle gets stop immediately. The project “Automatic speed control of vehicle using ultrasonic sensors, eye blink sensors has been successfully implemented.

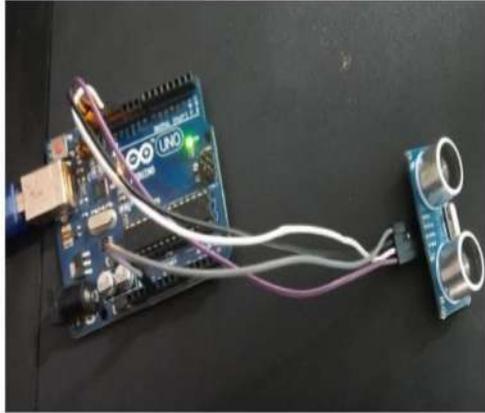


**Graphic 1.** Block diagram of Vehicle Accident Automatic detection and intimation system

### 2.2. Automated Accident Detection and Information System (AADIS):

The basic idea of this project is to avoid accidents using Labview. It is an precautionary measure that alerts the driver. The operation of this project starts with ultrasonic sensor, interfaced with Arduino and measures the distance between vehicles. The second operation is with alcohol sensor, interfaced with Arduino, if the driver is detected the excess intake of alcohol the engine will not start. The third operation is with eyeblink sensor, interfaced with Arduino, ,if the driver is in sleepy mode the system alerts the driver by using buzzer.

### 3. ULTRASONIC SENSOR

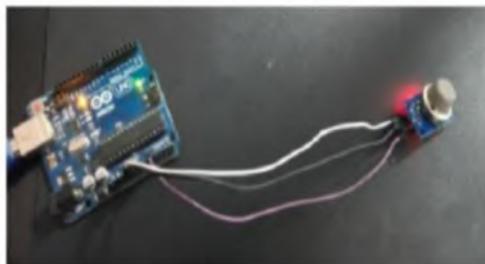


Interfacing Arduino with Ultrasonic Sensor

**Graphic 2.** arduino interface with ultrasonic sensor

From the above figure the design structure consists of a Arduino interfacing with ultrasonic sensor. The ultrasonic sensor is used to detect the distance between the vehicles by using ultrasonic waves. The ultrasonic sensor sends ultrasonic waves to front and sides of the vehicle to measure the distance of the near vehicles. The waves moves in straight way and hits the obstracles (if exists) and returns to the sensor. By this we can be able to detect the distance. The distance is intimated to the driver by using different colours of Led. If the distance is 25 cm the red colour led will be glow, if the distance is 50 cm yellow colour led will be glow, if the distance is 75 cm green led will be glow. A programme is given to Arduino by giving a certain distances like 25 cm, 50 cm, 75 cm. Here we used low range of ultrasonic sensor in prototype, so the distance is in cm. If we implement in real car we can use large range of sensor, so we can be able to estimate the distance in meters

### 4. ALCOHOL SENSOR



Interfacing MQ6 (Gas/Alcohol sensor) with Arduino

**Graphic 3.** Arduino interface with alcohol sensor

From the above figure the design structure consists of Arduino interface with alcohol sensor. This sensor is used to detect the condition of driver whether he is drunken or not. If the condition of the driver is over drunken the ignition of the engine will get stop and the vehicles will not move front and back. The percentage of the alcohol is calculated from the driver. A programme had given to the Arduino with a certain amount of percentages. The given percentages are 600 and 350, If the detected percentage of alcohol is more than 600, it means that the driver is over drunken. If the percentage of alcohol is detected less than 350, it means that the condition of the driver is normal. The vehicle moves when the condition of the driver gets normal (if the presence of alcohol is evaporated). An alcohol sensor detects the attentiveness of alcohol gas.



Front Panel for displaying absence of alcohol



Front Panel for displaying presence of alcohol

**Graphic 4.** Block diagram of absence and presence of alcohol using alcohol sensor

## 5. RESULTS

For our proposed work, The accident avoidance system is implemented and developed. Using this system we may avoid many accidents happening due to the unknown distance, sleeping, drunken drivers. The system comprises low cost components such as ultrasonic sensors, eyeblink sensors, alcohol sensor. By using this system, some features can be developed in future. such as, use to know the distance of the following vehicle, the system can reduce the speed of one vehicle according

to the following distance of other vehicle, by using this system, many accidents can be prevented and INDIA may become a accident less country.

Applications:

- This system can be used to avoid accidents
- Transportation applications.

## **ACKNOWLEDGEMENT**

We would like to thank our institution Kalasalingam Academy of Research and Education for support.

## **6. REFERENCES**

- Yao Jin** (2010) The discussion of Road Traffic Safety Countermeasures System, Private Science and Technology.
- Deotale, M. S., Shivankar, H., & More, R.** (2016). *International Journal on Recent and Innovation Trends in Computing and Communication Review on Intelligent Braking System*.<http://www.ijritcc.org>
- Garethiya, S., Ujjainiya, L., & Dudhwadkar, V.** (2015). Predictive vehicle collision avoidance system using Raspberry - pi. *ARPN Journal of Engineering and Applied Sciences*, 10(8), 3655–3659.
- Hemalatha, Pooja, P., T. R. R., & Professor, A.** (2007). Automatic Braking System for Automobiles Using IR Sensor. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO, 3297(5))*.  
<https://doi.org/10.15662/IJAREEIE.2016.0505111>
- Wang, Y., & Zhang, Q.** (2013). Design of an active automotive safety system. *Journal of Engineering Science and Technology Review*, 6(2), 155–159.
- Zhu Yi, Yang Shubo**(2008)MMA series of acceleration sensor principles and application, Medical equipment. SIEMENS(2003) Hardware Interface Description.
- Wang Wei and Fan Hanbo**(2011) Traffic accident automatic detection and remote alarm device.

**Ram, Jvs., & Kumar, Br.** (2017). Automatic Braking System Using Ultrasonic Sensor. In *International Journal of Innovative Science and Research Technology* (Vol. 2, Issue 4).[www.ijisrt.com](http://www.ijisrt.com)

**Triveni Shinde and B. V. Pawar** (2013), Car anti-collision and intercommunication system using communication protocol||, *International journal of engineering sciences and research technology* ISSN:2319-7064,Volume-2, No-6, pp.187-191.



# MEASURE OF TWT PERFORMANCE CHARACTERISTICS FOR KU-BAND APPLICATIONS

**Dr.T. Senthil**

*T. Senthil completed his Ph.D. at Kalasalingam University in the year 2017.*

*He received his B.E and M.E degree from M.K university, India. Currently he is working as Associate Professor in the department of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, Tamilnadu (India).*

Email ID: [senthilkast@gmail.com](mailto:senthilkast@gmail.com), <http://orcid.org/0000-0002-0044-5371>

## ABSTRACT

Traveling wave tubes (TWTs) are linear beam-based microwave vacuum tubes used for amplifying power. The high-power, high efficiency vacuum electronic amplifiers that are used predominantly in space to ground satellite communication. High bandwidth, High power efficiency and light weight of TWT makes it as a right choice for space applications. Analysis of Ku-band folded waveguide TWT can be performed using CST studio software for improving its characteristics like gain, efficiency and bandwidth. Folded waveguide is used in TWT, as slow wave structure for increasing the interaction between weak RF signal and electron beam. Characteristics of slow wave structure includes materials for helical structure, axial length, pitch angle, circumference and operating frequency. The above parameters are varied and analysed for the efficient TWT using the microwave CST studio software. With the above simulation the power efficiency, return loss and antenna gain of TWT are analysed for Ku-band microwave frequency applications.

**Keywords:** TWT, Ku band, CST studio, Folded waveguide, Slow wave structure.

## 1. INTRODUCTION

The slow wave structure is used in the TWT for matching the phase velocity of the RF signal with the velocity of the collimated beam of electrons. The folded waveguide with different shapes like helical, rectangular, square, normal, rigid loaded, tapered rigid loaded are available for improving the power efficiency of TWT. Normally the folded waveguide is constructed using the metals like aluminum, copper, iron etc. Some of the folded waveguide structures are made up of semiconductor material for adding structural flexibility. TWT is used for ground to satellite communication in amplifying the tv and other signals. Compared to other vacuum tubes like multi cavity klystron, the TWT has very good interaction between the electron and fields inside the tube and this is the reason why TWT is used in satellite communication.

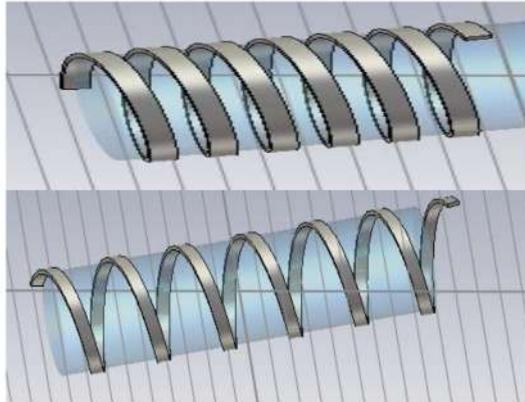
The other tube doesn't have high interaction between movement of electron and fields which lacks in efficiency to boost up the signal. Thus, the traveling wave tube act as a power amplifier which can amplify RF signals in microwave range. It has higher bandwidth with lower noise. The TWT is placed between focusing permanent magnets. The TWT is constructed with heater, cathode, anode, accelerating electrodes and folded waveguide structure. Both Heater and cathode generates electron beam, which is called as electron gun. The Folded waveguide is wrapped around the glass envelope mostly in helical structure. Due to the interaction between electron beam and rf signal at slow wave structure the signal is amplified and energy transfer happens due to the retarding field. An attenuator section is introduced at the middle of the slow wave structure to avoid the possible oscillations due to the positive feedback between input and output signal. The low power ac signal which travels inside the TWT waveguide interacts with electric and magnetic field. The electron beam velocity is varied in the slow wave structure due to the applied RF signal and bunching of electron beam occurs. This bunching has the fundamental component of the RF signal and by selecting proper resonant structure density modulated beam converted to current modulated. At the end of the folded waveguide, the bunching also increased to the maximum level and converted to a stronger RF output ac signal using the resonant structure. The CST studio software act as a best platform to design microwave components and circuits. The CST studio software is used to design the proper slow structure for operating in the Ku- band frequency ranging from 12 to 18 GHz. The performance characteristics like return loss, gain of the TWT is analysed for Ku – band frequencies by varying the helical slow wave structure like pitch , diameter , materials of the helix.

## **2. MATERIALS AND METHODS**

### **PROPOSED SYSTEM**

By comparing the work carried out in the related work articles I designed the helical slow wave structure using the microwave CST studio software. The materials used for constructing the helical structure, axial length of helix, pitch and diameter of helix are varied in simulation tool. The variation in the geometrical parameters of the helix results in the variation of level of interaction of RF input signal and electron beam at TWT. The extension of matching of phase velocity of rf wave and velocity of electron beam results in the changing values of performance characteristics of TWT like operating frequency range, return loss and power gain etc. The geometrical dimensions of helix influence the deep bunching of electron beam and thus improves the gain. The

ground to satellite communication need TWT to be operated in the saturation region i.e. maximum power gain region and this is simulated using CST studio.



**Graphic 1.** Helix model of Slow wave structure in CST studio

**Source:** Our Project

The software helps to analyze and optimize the helix geometrical parameters for maximum gain and operating frequency of TWT at Ku- band. (Fig.1) shows the helical structure designed using CST. In this figure the helix pitch at the start of the output section is selected with the aim of increased phase velocity to introduce electron bunches in the electron beam as effectively as possible for maximum normalized bunching current. Moreover, the helix pitch at the end of the output section is selected with reduced phase velocity to extract the energy from the electron beam efficiently for maximum electronic conversion power efficiency. This design (Fig.1) of helix pitch profile increases electronic efficiency with high linearity and provides well bunched electron beam for high power efficiency.

## **SOFTWARE IMPLEMENTATION**

In CST studio, a TWT folded waveguide with the Ku band specification is designed. The Ku-band extends from 12 to 18GHz and corresponding wavelength ranges from 16.7 to 25mm (or) 2.5 to 1.67cm. Here I designed the helix slow wave structure with PEC and copper material, both are having the same phase velocity but its response is different with operating frequency in Ku-band range. I have simulated the wave structure by selecting different material in CST studio, which are adaptable to the helix structure made up of the semiconductor material also. Due to selection of specific semiconductor material I can able to vary the interaction between the RF input signal and cylindrical electron beam.

The SWS (slow wave structure) of TWT pull/push the electrons in the alternating RF field i.e. accelerating in the positive cycle and decelerating the electron beam at negative cycle of RF input signal. This results in the amplification due to the energy transfer from electron beam to RF field. In this work, I analyzed the variation of phase velocity with different materials like copper, aluminum, PEC (Perfect Electronic Conductor) and the combination of copper and aluminum. Each selected material result with the different kind of amplitude variation in the graph which is represented as modes of TWT. In simulation software it has amplitude of electric field, magnetic field, and propagation direction, which is represented in 3D format. The operating frequency of the material is varied according to the specifications like linear, logarithmic and dB scale etc... It covers frequency up to 30 GHz and it is varied according to the specification in simulation tools.

The various modes in TWT are represented by different colours in simulated graph. Using that I can conclude and identify the range of radiations and the limits of the designed slow wave structure for TWT. When electron source in electron gun is not heated properly, the accelerated electrons are not found in the helical slow wave structure. So, alternatively structure parameters are selected in terms of providing dielectric loading. Hence, the selected parameters are altered until the desired dielectric load is achieved. For the purpose of exploring the behavior of the SWS in TWT the following specifications of the helical slow wave structure is assumed in the CST simulation tool.

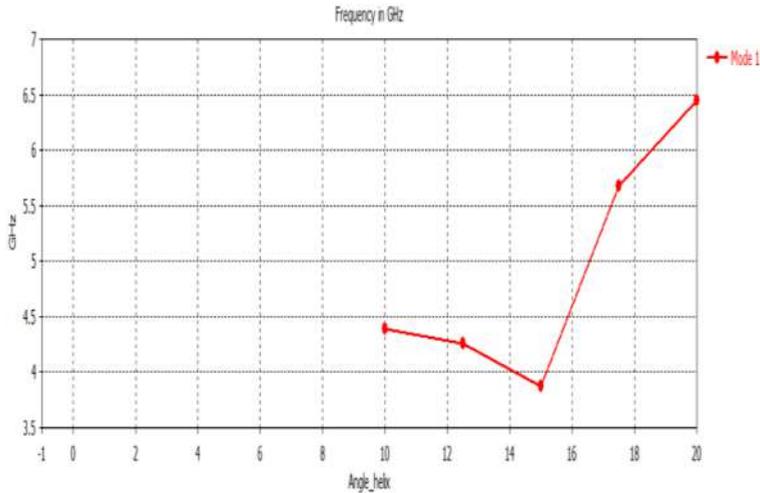
**Tabulation 1.** Parameters of Helical SWS.

PARAMETERS	VALUE 1	VALUE 2
T helix	0.1	0.1
W helix	1	1
R helix	4	4
Angle helix	15	15
Period helix	15 (pitch expanded)	5 (pitch compressed)
L extend	30	30
L helix	250 (to increase number of turns)	154 (to decrease number of turns)

In Tabulation I, I have indicated the parameters used for designing the helical slow wave structure in simulation. The pitch and number of turns in the design is varied and its effect on the mode characteristics of TWT is analyzed graphically. I have calculated the propagation constant, gain, saturated power, phase velocity and efficiency of TWT for desired band of operating frequency. For this simulation I assumed the

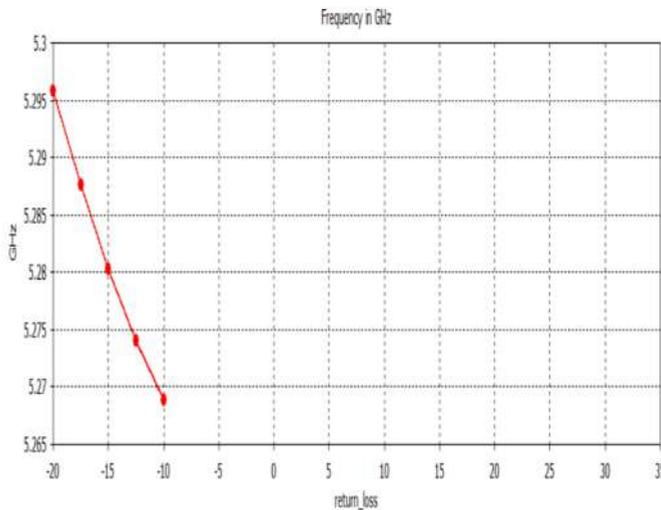
practical Ku band 10.7 to 12.75 GHz which is used for carriers in downlink of satellite communication.

### 3. RESULTS



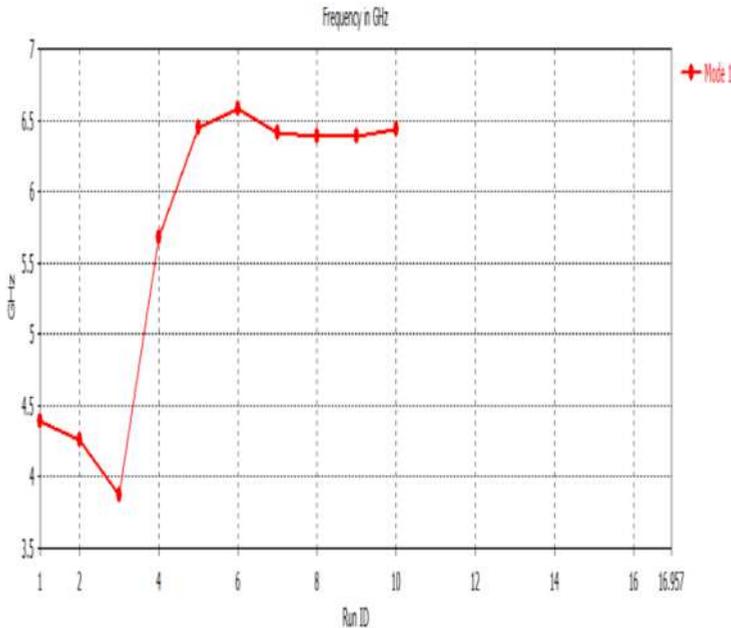
**Graph 2.** Variation of operating frequency with respect to pitch of SWS  
**Source:** Our Project

In Fig.2, the graph shows the selection of helical angle for the desired band of operating frequencies. With this graph, the helical angle of folded waveguide is decided for the selected band of operating frequencies in TWT applications. Varying the angle also affects the propagation characteristics of the EM waves in the helical structure.



**Graph 3.** Variation of Return loss with respect to operating frequency  
**Source:** Our Project

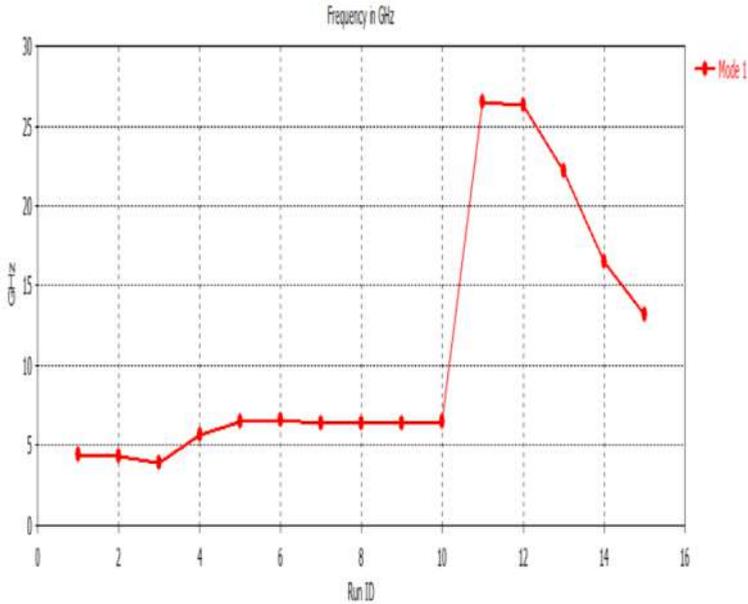
In Fig.3, the graph represents the return loss of SWS in the operating frequency with Ku-band specification. Thus optimized operating frequency for the other parameters in SWS is calculated for different return loss.



**Graph 4.** Variation of Run ID (L Extend-Model extended towards y axis) with operating frequency .

**Source:** Our Project

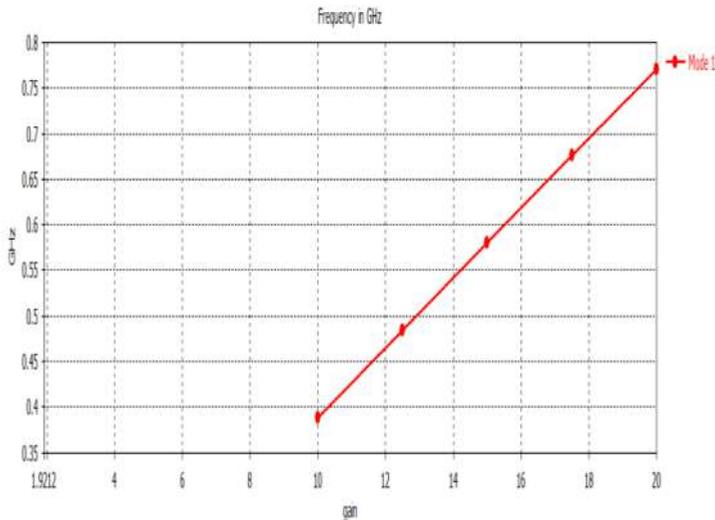
In Fig.4, this graph depicts variation of the operating frequency for the variation of geometrical parameter – length of helical the slow wave structure. This relation is based on the wavelength of the operating frequency, with respect to the length L of the SWS. In this graph the operating frequency decreases and then slightly increases at a certain range of frequency. Here the L extends shows a maximum operating frequency as 6.7 GHz and it is the half of our needed Ku band frequency. In this the remaining frequency range may be expanded to x axis of the helical structure.



**Graph 5.** Variation of Run ID (L Helix-SWS extended with operating frequency)

**Source:** Our Project

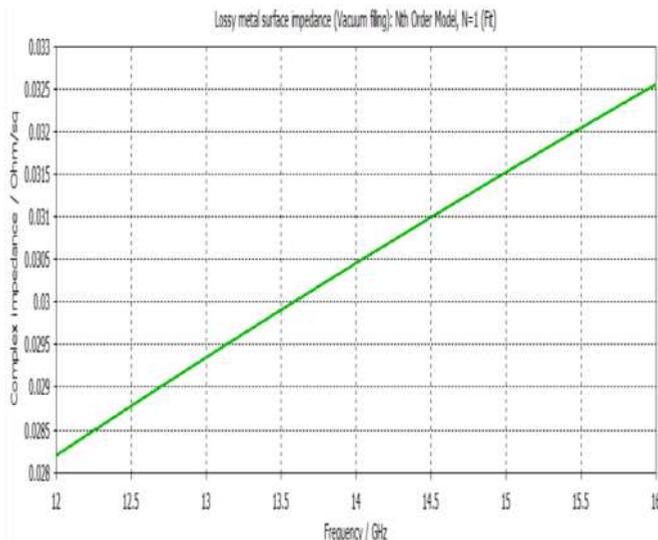
In Fig.5, the graph represents the variation of operating frequency for the geometrical parameter elongation of axis of SWS. The slope of the graph remains almost constant and shows the linear increases in high range of operating frequency for varying elongation of axis.



**Graph 6.** Variation of gain with operating frequency

**Source:** Our Project

In Fig.6, the graph represents that interaction of electrons increases with the applied input frequency which turns increases the gain of TWT .By varying the number of turns and angle of the helix the gain of the TWT is selected for the respective frequency.



**Graph 7.** Variation of Complex input impedance with frequency  
**Source:** Our Project

In Fig.7, the variation of complex input impedance of the lossy materials selected for the construction of SWS of TWT is analyzed with operating frequency. This graph shows the material characteristics impedance which is matched to the Ku-band frequency range and I can select appropriate lossy material for the desired Ku-band frequency. The variation of complex impedance affects the return loss of the SWS due to the improper matching with the external load.

#### 4. CONCLUSION

In this paper I have designed a helical slow wave structure for TWT at Ku- band operating frequency. In the Ref 1.the authors included the design for maximum power and in my paper focused on the maximum gain. My paper calculated the various TWT parameters of Ku band like phase velocity, propagation constant, and angle helix by varying the geometrical parameters of SWS. The result shows that gain of the TWT depends upon the pitch angle of the SWT and my paper attempts to find the optimized pitch angle. The graph 3 clearly depicts the dependence of the operating frequency with respect to pitch angle. The variation of parameters like return loss,

efficiency and gain of the TWT for the Ku-band operating frequency for varying the helical structure is analyzed. Thus optimized pitch angle and materials for helical structure for the desired maximum gain are calculated for the specific operating frequency. My proposed future work, attempt to study the design of SWS in the Ku band operating frequency with the operating power greater than 200W with various geometrical configurations and less weight by suitably selecting the SWS materials.

## 5. REFERENCES

1. **David Charmin, Thomas M. Antonsen, Jr, Alexander N. Vlasov, Baruch Levush, Rasheda Begum, and James R. Legarra.** (2011). "Large-Signal Multi frequency Simulation of Coupled-Cavity TWTs", VOL. 58, NO. 4.
2. **Djamschid Safi, Philip Birtel, Sascha Meyne and Arne F. Jacob.** (2018) "A Traveling-Wave Tube Simulation Approach with CST Particle Studio" VOL. 65, NO. 6.
3. **Fei Shen, Yanyu Wei, Hairong Yin, Yubin Gong, Xiong Xu, Shaomeng Wang, Wenxiang Wang and Jinjun Feng.** (2012). "A Novel V-Shaped Microstrip Meander-Line Slow-Wave Structure for W-band MMPM", VOL. 40, NO. 2.
4. **G. Ulisse and V. Krozer.** (2014). "W-Band Traveling Wave tube amplifiers based on slow wave structure", VOL. 61, NO. 6.
5. **Huarong Gong, Yuban Gong, Tao Tang, Jin Xu, and Weng-Xiang Wang.** (2011). "Experimental Investigation of a High-Power Ka-Band Folded Waveguide Traveling-Wave Tube" VOL. 58, NO. 7.
6. **Igor A. Chernyavskiy, Thomas M. Antonsen, Alexander N. Vlasov, David Chernin, Khanh T. Nguyen, and Baruch Levush.** (2016). "Large-Signal 2-D Modelling of Folded-Waveguide Traveling Wave Tubes" VOL. 63, NO. 6.
7. **Khanna. T. Nyugven Alexander N. Vlasov, Lars Ludeking Colin D. Joye, Alan M. Cook, Jeffrey P.** (2017). "Design Methodology and experimental verification of Serpentine Folded Waveguide TWT's", VOL. 38, NO. 1.
8. **Sudeep Bhattacharjee, John H. Booske, Carol L. Kory, Steve Limbach, S. Gallagher, John D. Welter, Mike R. Lopez, Ronald M. Gilgenbach, R. Lawrence Ives, Michael E. Read, Ralu Divan, and D. C. Mancini.** (2004). "Folded Waveguide Traveling-Wave Tubes Sources for Terahertz Radiation", VOL. 32, NO. 3.

- 9. Thomas M. Antonsen, Jr, Alexander N. Vlasov, David P. Chernin, Igor A. Chernyavskiy, Member, IEEE, and Baruch Levush, Fellow.**(2013).IEEE  
“Transmission Line Model for Folded Waveguide Circuits”, VOL.60 ,NO. 9.
- 10. Young Ho Na, SangWook Chung, and JinJooChoi.**(2002).“Analysisof a Broadband Q Band Folded Waveguide Traveling-Wave Tube”, VOL. 30, NO. 3.

# MODELING AND SIMULATION OF INALN/ALN/ GAN HIGH ELECTRON MOBILITY TRANSISTOR BY POLARIZATION EFFECTS

**J. Charles Pravin**

*Associate Professor, Centre for VLSI Design, Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Virudhunagar, (India).*

Email ID: [charles@klu.ac.in](mailto:charles@klu.ac.in) , <http://orcid.org/0000-0002-9009-6274>

**N. Santhosh Sivaraman**

*Student, Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Kottayam, (India).*

Email ID: [santhoshraman89@gmail.com](mailto:santhoshraman89@gmail.com), XXXXXXXXX

**B. Rajkumar**

*Student, Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Virudhunagar, (India).*

Email ID: [9915005049@klu.ac.in](mailto:9915005049@klu.ac.in), XXXXXXXXX

**V. Gowrishankar**

*Student, Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Virudhunagar, (India).*

Email ID: [9915005142@klu.ac.in](mailto:9915005142@klu.ac.in), XXXXXXXXX

## ABSTRACT

In InAlN/GaN heterostructures with an AlN spacer (InAlN/AlN/GaN hetero-structure), the polarization and sheet carrier density profiles are examined. The effects of the AlN spacer on the electron concentration and polarization effects at the interfaces of InAlN, GaN, and AlN layers are investigated in this article. At a peak value of  $6.5 \times 10^{13} \text{ c/m}^2$ , an effective 2DEG density is reached. The graph was interpolated using cubic spline techniques, allowing for more exact data interpretation. When compared to traditional AlGaIn/GaN HEMTs, the carrier concentration and mobility in the 2DEG area is much higher. The proposed InAlN/AlN/GaN heterostructure's carrier concentration reached around  $5.23 \times 10^{13} \text{ cm}^{-2}$ , which is substantially higher than the traditional AlGaIn/GaN structure. When compared to the present structure, the charge density due to polarization effects and carrier concentration values for the structure reached a maximum of  $6.5 \times 10^{13} \text{ cm}^{-2}$ , which is an increase of 45% and 22% correspondingly. These results prove that for high-power applications such as high-energy RF acceleration and radar, an InAlN-based device could be a viable alternative.

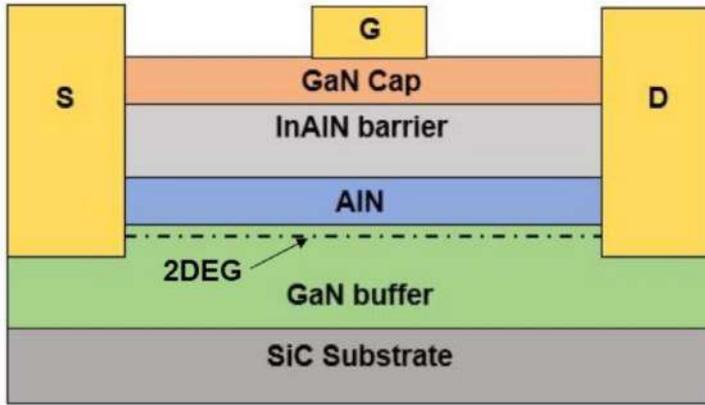
**Keywords:** 2DEG, HEMT, InAlN/GaN, AlN, carrier concentration, charge density.

## **1. INTRODUCTION**

High-electron mobility transistors are the future for high power operations at microwave frequencies. The AlGa<sub>N</sub>/Ga<sub>N</sub> HEMT structure can be used in microwave power devices as a channel material since it has larger breakdown voltage. The hetero-structure formed in this HEMT material develops a Two-Dimensional Electron Gas (2DEG) at the interface, which is capable of attaining a sheet carrier concentration of  $2 \times 10^{13} \text{cm}^{-2}$ , much higher than that of the other semiconductor materials. One of the common attributes of group III-V semiconductor materials are the presence of polarization induced charge density at the meeting between the divergent materials. As a consequence of the induced charges present, the electrons in the region are limited to the 2DEG area. An approximation of the sheet carrier concentration for the InAlN/AlN/GaN structure by means of evaluating its polarization induced charge density is concentrated in this paper. The calculated sheet carrier concentration is compared with self-consistent Poisson and Schrodinger equation solver. Also we address the degree of relaxation of the barrier. Wurtzite AlGa<sub>N</sub>/Ga<sub>N</sub> have piezoelectric polarization higher than AlGaAs/GaAs. It can be seen that there is increase of sheet carrier concentration due to polarization induced electric fields. Not only piezoelectric polarization is higher in wurtzite group III nitrides, the spontaneous polarization is also comparatively very high which increases in an order from GaN to InN to AlN. This results in an increased polarization induced effect in the AlGa<sub>N</sub>/Ga<sub>N</sub> HEMTs. The device modeled in this would be InAlN/GaN/AlGa<sub>N</sub>, which has advantages like better structural stability and reliability.

## **2. DEVICE CROSS-SECTION**

There is Ga<sub>N</sub> bulk layer present below the AlGa<sub>N</sub> layer; this is how hetero-structure is created. The Schottky barrier height is increased due to an extra Ga<sub>N</sub> cap layer formed above AlGa<sub>N</sub>/Ga<sub>N</sub>. Therefore gate leakage current is reduced. This is the reason for considering structures with and without cap layer for this analysis. The thickness of Ga<sub>N</sub> bulk layer is  $1.5 \mu\text{m}$ . We compared the AlGa<sub>N</sub> and cap layer thickness to calculate their impact charge density of two dimensional electron gas (2DEG). There is addition of Si<sub>3</sub>N<sub>4</sub> passivation layer. The Si<sub>3</sub>N<sub>4</sub> passivation layer is between source, drain and gate contact that is present at the top.



**Fig 1.** Cross section of the proposed InAlN/AlN/GaN structure

### 3. PROPOSED METHODOLOGY

The AlGaN/GaN generally is grown on a semi-insulating substrate having large thermal stability and having close lattice matching with GaN. A buffer layer is grown above the substrate by acting as isolation between channel and the substrate. Any lattice mismatching or crystal defects from the substrate are minimized using this GaN buffer layer. The device usually uses a Schottky gate contact and Ohmic source and drain contact. The channel in a HEMT is formed at the hetero-junction interface of the AlGaN barrier and GaN channel layer.

#### A. 2DEG Charge density model

Short Channel Effects are created as the length of the gate decreases due to the rising hetero-materials (SCE). A set of self-consistent coupled Poisson and Schrodinger equations was used to calculate the device's carrier concentration.

The lattice mismatch between the GaN and AlN layers, as well as the GaN and InAlN barriers, causes piezoelectric constants to emerge. The lattice constants differ between a broad band-gap (InAlN) and a lower band-gap (GaN) material. Confinement difficulties in the device can be avoided, and the CB level can be improved, by using the AlN spacer. The polarization-induced charge density can be found through two prominent polarizations happening in the barrier and buffer region: Spontaneous and piezoelectric polarization.

Total polarization charge density:

$$\sigma(P_{SP} + P_{PE}) = \sigma(P_{SP}) + \sigma(P_{SP}) \quad (1)$$

The spontaneous polarization effects happening due to structural defects happening alongside the InAlN and GaN layers can be determined by:

$$P_{SP}(x) = (-0.052x - 0.029) \quad (2)$$

The lattice mismatching occurring between the GaN buffer and the InAlN barrier layers causes piezoelectric polarization that can be formulated as shown:

$$PPE(x) = 2 \{r(x) - 1\} \left\{ \frac{a_0 - a(GaN)}{a_0} \right\} \times \left\{ e_{31}(x) - e_{33}(x) \frac{C_{13}(x)}{C_{33}(x)} \right\} \quad (3)$$

### B. Carrier concentration model

Spontaneous Polarization occurs when the polarisation vector in the c-axis points from nitrogen to gallium, forming an internal electric field in the opposite direction of the electron wave offset. Both piezoelectric and spontaneous polarizations must be included when calculating the total carrier concentration.

The overall polarisation charge density at the 2DEG area is given by  $\sigma_{tot}$ . Finally, the total carrier concentration ( $n_s$ ) can be expressed as follows:

$$n_s = \sigma_{tot} - \frac{\epsilon}{qt_{AlGaN}} (\gamma(\Phi_M - \chi_{AlGaN}) (1 - \gamma)\Phi_0 - \frac{\gamma q N_D t_{AlGaN}}{C_{ox}} + E_F - \Delta E_C) \quad (4)$$

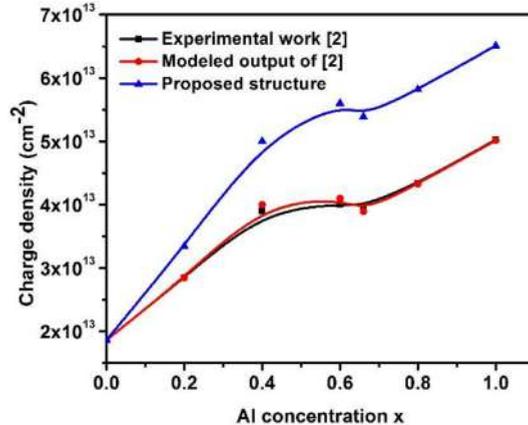
Here  $\epsilon$  will be the dielectric constant of barrier layer; the charge of electrons is given by  $e$ .  $E_F$  is the fermi energy level;  $\Delta E_C$  the energy band offset,  $t_{AlGaN}$  is the thickness of the AlGaN barrier. The potential difference between CB edge and neutral level is denoted by  $\Phi_0$ .  $N_D$  is the doping concentration, and  $C_{ox}$  is the oxide capacitance of  $Al_2O_3/ZrO_2$  dielectric.

## 4. RESULTS AND SIMULATION

The polarization characteristics and gate capacitances of the proposed InAlN/AlN/GaN hetero-structure have been determined using a model. An increase in the conduction band edge at the GaN/InAlN interface is noticed, and a sharp potential barrier is generated near the 2DEG, due to the AlN layer having an opposing piezoelectric polarization to the AlGaN barrier. A barrier of such dimensions can better confine electrons and improve buffer isolation.

The DC characteristics for the InAlN/AlN/GaN HEMT are shown in Fig.2. Ambacher *et al.* [2] experimented on the AlGaIn/GaN HEMT hetero-structure reduced buffer leak-

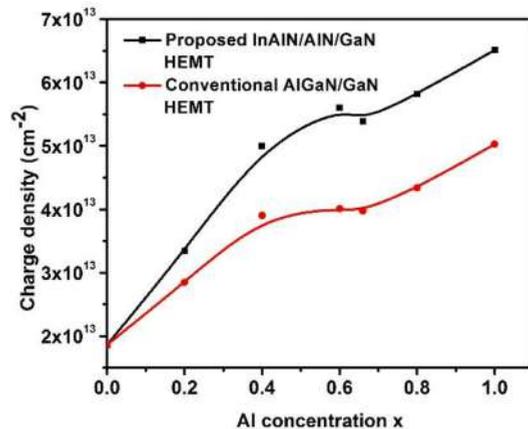
age. A maximum polarization induced charge density of  $5 \times 10^{13} \text{ cm}^{-2}$  was achieved. An AlN spacer layer of 3 nm was used here. The above-mentioned experimental data has been given in Fig.2 along with their corresponding modeled outputs from the proposed model, showing excellent agreements.



**Fig 3.** Polarization-induced charge density validated with existing structure [2] with excellent agreement. The output for proposed structure is also given.

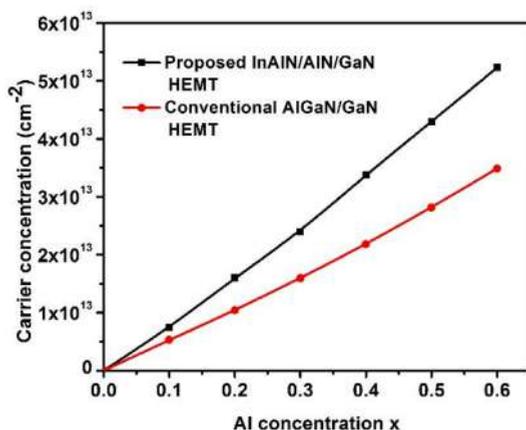
Compared to a AlGa<sub>N</sub>/Ga<sub>N</sub> structure, upon incorporating InAlN as barrier and AlN as spacer, the charge density increases to nearly two times.

Figure 4 shows the charge density due to polarization effects for the proposed InAlN/AlN/GaN heterostructure. The charge density is measured at various Aluminum mole concentrations ranging from 0 to 1. The polarization effect properties of the proposed HEMT device were outstanding. At a 0.66 Al mole fraction, the quality of InAlN device is much improved. A huge current can flow through the channel as a result of this phenomenon.



**Fig 4.** Charge density due to polarization effects for the proposed InAlN/AlN/GaN hetero-structure

Fig.5 shows the maximum computed electron concentration  $n_S(x)$  in the 2DEG region. Carrier concentrations of  $1.5$ ,  $3.25$  and  $5.23 \times 10^{13} \text{ cm}^{-2}$  are claimed for the AlGaInN/GaN structure with mole fractions  $x=0.2$ ,  $0.4$ , and  $0.6$  respectively with a barrier width of  $30 \text{ nm}$ . The carrier concentration at the GaN/AlN interface will be similar to the maximal  $n_s$  at the InAlN/GaN interface. The polarisation induced charge density and electron concentration results for the InAlN/GaN hetero-structure with AlN spacer layer are explained in Fig.5.



**Fig 5.** Sheet carrier concentration for the proposed InAlN/AlN/GaN structure.

These findings show that by including a spacer layer modulation efficiency of the gate, efficient suppression of SCEs can be achieved. The varied charge densities and carrier concentrations of the hetero-structure have been analysed with regard to the Al mole fraction.

## 8. CONCLUSION

The charge density induced by polarization is evaluated for the structure InAlN/AlN/GaN with help of the piezoelectric constants and other constant values derived previously by linearly interpolating the physical properties of GaN and InAlN structure. Even though there are differences in piezoelectric constants, the bounded sheet charge due to polarization is calculated with an enhancement of 45%. The polarization induced sheet carrier concentration in two dimensional electron gases (2DEG) using self-consistent Poisson Schrodinger equation has been evaluated. The comparative sheet carrier concentration shown a much-improved performance of 22% in comparison to their performance with the conventional AlGaInN/GaN HEMT. With the use of spacer layer applications, this work is minimally complex and takes less time than the currently available InAlN/GaN material. This type of device can

be used for high-frequency applications such as measuring the intensity of radiation and the current created as a result of that effect.

Even though it produces a fine concentration and charge density values, it is still susceptible to many kinds of leakage effects happening near the gate. An efficient dielectric material can drastically cause a decline in the leakage. Hence in future, this HEMT device can be developed into a Metal Oxide Semiconductor-HEMT (MOS-HEMT) with an efficient high-*k* dielectric as the oxide.

## 9. REFERENCES

- [1] **Yu, E. T., Dang, X. Z., Yu, L. S., Qiao, D., Asbeck, P. M., Lau, S. S., Sullivan, G. J., Boutros, K. S., & Redwing, J. M.** (1998). Schottky barrier engineering in III-V nitrides via the piezoelectric effect. *Applied Physics Letters*, Vol. 73, No. 13, pp. 1880-1882. <https://doi.org/10.1063/1.122312>
- [2] **Ambacher, O., Foutz, B., Smart, J., Shealy, J. R., & Weimann, N. G.** (2000). Two-dimensional electron gas induced by spontaneous and piezoelectric polarization charges in undoped and doped AlGa<sub>N</sub>/Ga<sub>N</sub> hetero-structures. *Journal of Applied Physics*, Vol. 87, No. 34, pp. 334-344. <https://doi.org/10.1063/1.371866>
- [3] **O. Ambacher, J. Majewski, C. Miskys, A. Link, M. Hermann, M. Eickhoff, M. Stutzmann, F. Bernardini, V. Fiorentini, V. Tilak, B. Schaff & L.F. Eastman** (2001). Pyroelectric properties of Al(In)Ga<sub>N</sub>/Ga<sub>N</sub> hetero- and quantum well structures. *Journal of Physics: Condensed Matter* 14, p. 2299. <https://doi.org/10.1088/0953-8984/14/13/302>
- [4] **O. Ambacher, J. Smart, J.R. Shealy, N.G. Weimann, K. Chu & M. Murphy** (1999). Two-dimensional electron gas induced by spontaneous and piezoelectric polarization charges in N-face and Ga-face AlGa<sub>N</sub>/Ga<sub>N</sub> hetero-structures. *Journal of Applied Physics*, Vol. 85, No. 6, pp. 3222-3233. <https://doi.org/10.1063/1.369664>
- [5] **S. Arulkumaran, Takashi Egawa, & Hiroyasu Ishikawa** (2005). Studies on the influences of i-GaN, n-GaN, p-GaN and InGa<sub>N</sub> cap layers in AlGa<sub>N</sub>/Ga<sub>N</sub> High-Electron-Mobility Transistors. *Journal of Applied Physics*, 44, p. 2953. <https://doi.org/10.1143/JJAP.44.2953>
- [6] **Snider.** <http://www.nd.edu/gsnider/>, University of Notre Dame.

- [7] U.K. Mishra, Likun Shen, Thomas E. Kazior & Yi-Feng Wu** (2008). GaN-based power devices and Amplifiers. IEEE Proceedings, 96(2), pp. 287-305. <https://doi.org/10.1109/JPROC.2007.911060>

# **ESTIMATION OF HEMOGLOBIN USING COLOR IMAGE PROCESSING TECHNIQUE**

**Karkuzhali S.**

*Assistant Professor, Department of Computer Science and Engineering, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India.*

Email ID: vijikarkuzhali@gmail.com, XXXXX

**Sushma M.**

*III Year B.Tech Computer Science and Engineering, Kalasalingam Academy of Research and Education, Tamilnadu, India.*

Email ID: medasushma4@gmail.com , XXXXXXXXXX

## **ABSTRACT**

In the fastest running medical field estimation of hemoglobin is important test before blood donation, and for confirmation of anemia. Many methods have been used for estimating the hemoglobin level. They are Hemoglobincyanide (HiCN) Method, Sahli's method, sensor based methods, Hemo Cue method. Among them Sahli's method is mostly preferred method. This method is based on the principle of converting hemoglobin into haematin and then visually matching the color of haematin with the color of a standard glass tube. Nowadays this method is done manually hence takes more time. The readings depend upon the judgment of human eye only. This leads to improper color matching and readings may go wrong. The proposed idea of this paper is about smart hemoglobin meter. It is an automated device in which the acid haematin is matched against the color in the standard glass using color image processing techniques either in MATLAB or LabVIEW platform. The inclusion and stirring of hydrochloric acid with the acid hematin in the test tube are programmed to operate in automatic manner by the use of DC motor. When the test tube color is matched with the standard color, estimated hemoglobin level is displayed as output. As a product this device will provide the output accurately as well as faster than conventional Sahli,s method.

**Keywords:** Hemoglobin detector, color image processing, haematin, Sahli's method.

## **1. INTRODUCTION**

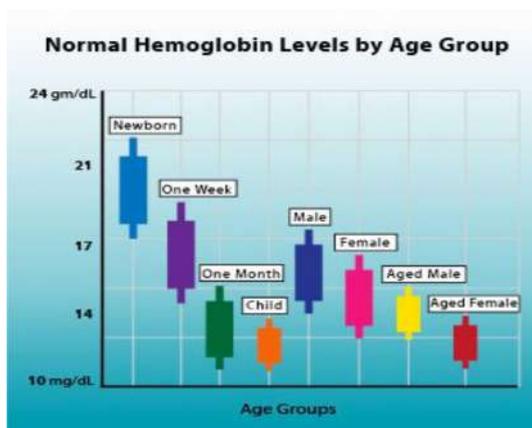
EMOGLOBIN is a protein molecule. It is presented in the Red Blood Cell (RBC) which carries the oxygen from the lungs to the cells/ tissues throughout the circulatory system and returns the carbon-di-oxide from all the tissues to the lung. Hemoglobin is also maintaining the shape of the red blood cells. Every hemoglobin molecule is

through up of four heme groups adjoining a globin group. Heme holds iron and provides a red color to the molecule. Globin consists of two linked pairs of polypeptide chains. The development of each chain is controlled at a separate genetic locus. The amount of hemoglobin level in the body should be maintained in a particular range. The normal hemoglobin level in the human blood is as followed by [1] is mentioned in Table 1.

**Table 1:** Normal hemoglobin level

S.No	SUBJECT CATEGORY	HEMOGLOBIN LEVEL (g/100ML BLOOD)
1.	Women	12-16
2.	Men	14-18
3.	Newborn	14-20

The normal hemoglobin level by age group is followed by [2] is mentioned in Table 2.



**Figure 1.** Normal Hemoglobin level by age group

**Source:** <https://www.healthyandnaturalworld.com/hemoglobin-hgbnormal-range-low-high/>

**Table 2:** level of hemoglobin for different age group.

AGE	HEMOGLOBIN LEVEL (gm/dL)
Newborn	17-22
One week of age	15- 20
One month of age	11- 15
Children	11-13
Adult males	14-18
Adult women	12-16
Men after middle age	12.4- 14.9
Women after middle age	11.7 – 13.8

**Source:** <https://www.disabled-world.com/calculatorscharts/hemoglobin-iron.php>

The condition in which the level of hemoglobin is lower than the normal level is called as anemia [3]. This is the cause of low iron level, VitaminB12 or folic acid. Symptoms of anemia include feeling of unhealthy, fatigue, hairless, shortness of breathing. In order to identify the abnormality in hemoglobin level it has to be estimated and further treatment has to be done. The measurement of hemoglobin level exists in several methods. They are Hemoglobinocyanide (HiCN) method, Hemo cue, sensor based method and Sahli's method.

In Hemoglobinocyanide method the free hemoglobin is allowed to expose to cyanide that fastens fixedly with the hemoglobin molecule. This will form cyanomethemoglobin. Then a light is allowed to pass through the solution. By measuring light absorbance of the solution specifically at a wavelength of 540 nanometers, the quantity of hemoglobin is estimated [4].

In Hemocue method the lysis of red blood cell is done by inserting chemicals that shatter the blood cell wall. The chemicals are combined with Hemoglobin and then they are measured by photometric method [5].

In sensor based method pulse oximetry principle is used. It is a non invasive method of Hemoglobin estimation. Red and IR LEDs are used. Oxygenated and deoxygenated blood absorbs different wavelength of light. Then the pulsation ratio is used to estimate the Hemoglobin level [6].

In Sahli's method anti coagulated blood is added to the 0.1N Hydrochloric Acid and allowed to keep for 5-7 minutes in order to the formation of acid haematin. The color of this acid haematin should be matched with the solution, present in the calibration tube. Distilled water is added to the acid haematin until the color matches and the final reading is directly noted from the graduation in the calibration tube [7].

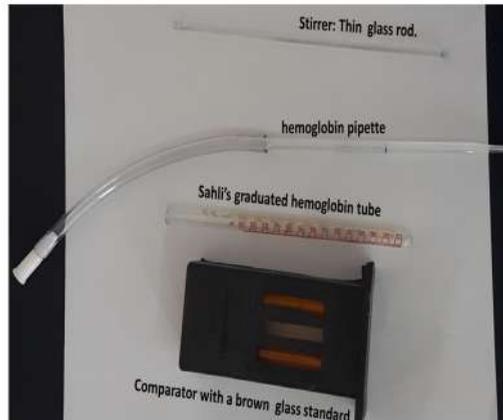
For this Sahli's method visual color matching is done human eye. Hence there is a chance of getting inaccurate Hemoglobin level. In order to obtain accurate output, the visual color matching is done by using color image processing (color matching) algorithm in MATLAB or LABVIEW. Also the addition of distilled water is done automatically by the use of motor pump.

## 2. MATERIALS AND METHOD

### A. Sahli's hemoglobin meter

The parts of hemoglobin meter are Sahli's graduated hemoglobin tube, comparator, hemoglobin pipette and stirrer. In hemoglobin tube marked hemoglobin levels are available from 2 to 24 in grams percent. The comparator consists of a brown glass standard and an opaque white glass presented at the back to provide uniform illumination. The hemoglobin pipette is marked as 20 $\mu$ l or 0.02 ml and it has no bulb. Here a thin glass rod is used as stirrer. These are the following procedures has to be done for Sahli's hemoglobin estimation:

1. Make ensure that the hemoglobin pipette and tube are not wet and then add N/10 HCl (HydroChloric acid) into the tube upto the mark 2g%
2. Stir the EDTA tenderly and pack the pipette with 0.02ml blood. Create certain that there is no air bubbles in the pipette. If the bubble enters into the tube, discard and pipette again.
3. Add the blood into the tube which contains HCl. Clean the hemoglobin pipette.
4. Then allow it to stand for 5-7 minutes without any disturbance in order to convert the hemoglobin into acid Haematin.
5. In the comparator box fix the hemoglobin tube and then drop by drop add the distilled water with the solution.
6. With the use of glass rod stir the solution till the color of haematin solution counterparts with that of the standard glass.
7. After counter parting the color, the level of hemoglobin is estimated based on the total amount of solution in the hemoglobin tube. Express the hemoglobin content as g%.



**Figure 2:** Sahli's Hemoglobin meter

Since the visual color matching through the naked human eye leads to get inaccurate output, the color matching algorithm in color image processing is preferred. This will give the accurate output than that of the above mentioned method.

### B. Proposed methodology

1. After the addition of HCL to the blood in the Hemoglobin tube the distilled water is added drop by drop by the use of pump motor and then it is stirred automatically by the rotation of dc motor.
2. The image of the Sahli's hemoglobin meter is taken by 8MP camera continuously.
3. The Database image is taken on the standard class tube in the comparator equipment.
4. These two images are then uploaded to the system.
5. In the system the color image processing technique is done by MATLAB or LABVIEW software by Color Histogram method
6. If the color is matched, the output of the hemoglobin level can be obtained in the display and then the whole system will be shut off. Because of that the hemoglobin levels are also predefined with respect to the solution level in the Hemoglobin tube.
7. Thus this paper consists of 3 new developed ideas such as (1) automatic distilled water addition (2) automatic stirring system (3) automatic color matching

### C. Automatic Distilled water addition

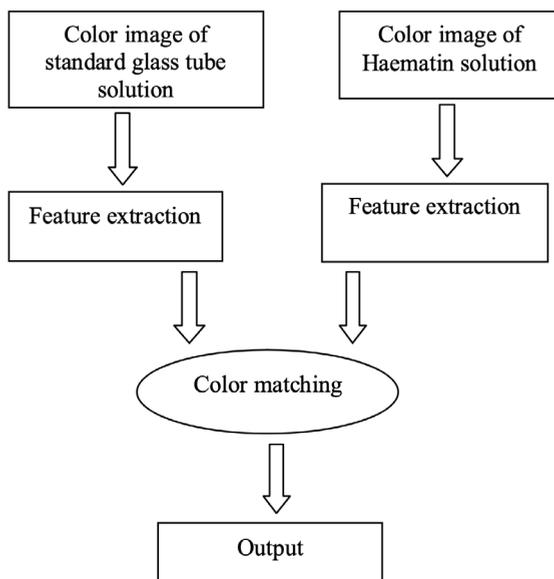
Normally in Sahli's method the distilled water is continuously added to the solution in the Hemoglobin tube until the color matching has to be done. Here the distilled water addition is done by automatically. For that motorized micropipette system can be used.

### D. Automatic stirring system

The stirrer is a glass thin rod which is used to mix the distilled water with the solution (Hematin) in the Hemoglobin tube. But in this idea, the stirring system is working automatically until the color matches. The one end of the rod is connected to the rotor of a dc motor and another end is inside the Hemoglobin tube. Both automatic distilled water addition and automatic stirring system are working alternatively until the color matching. After color matching both the systems are shut off.

### E. Color image processing

The visual color matching of the hemoglobin tube can be done in color image processing by the use of MATLAB or LABVIEW coding. [8]



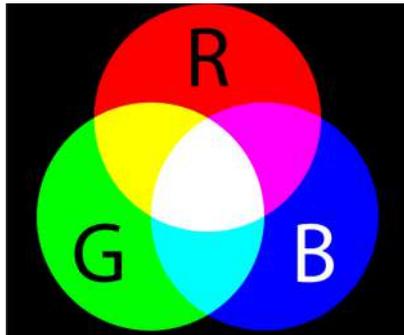
**Figure 3:** Block Diagram of color image processing

The color image processing classified into three major areas: (1) color conversions also called color mapping (2) spatial dispensation of entity color planes and (3) color

vectors processing. Among which we are going to match the color of the Hemoglobin tube with standard color by using color transformation method.

### F. RGB color model

The RGB color model is an preservative color model in which red, green and blue colors are appended together in a variety of ways to make a replica a extensive collection of colors. The given name of the replica draws closers from the preliminaries of the three preservative chief colors, red, green, and blue [9].

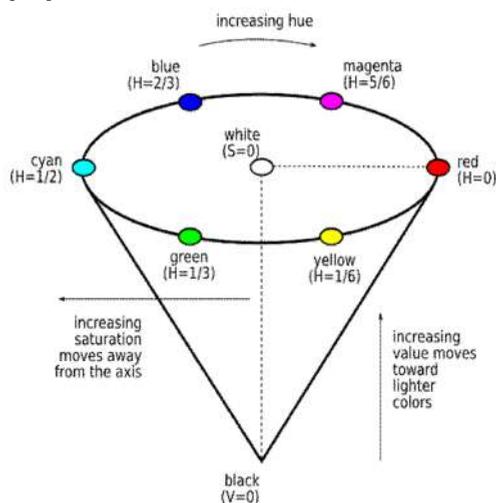


**Figure 4:** RGB Color Model

**Source:** <https://www.hisour.com/rgb-color-model-24867/>

### G. HSV color model

HSV (Hue, Saturation and Value) describes a category of color space. It is analogous to the term RGB and CMYK models. The HSV color space has three constituents: hue, saturation and value [10].



**Figure 5:** HSV model

**Source:** [http://www.justinliang.com/tutorials/hsv\\_color\\_extraction/](http://www.justinliang.com/tutorials/hsv_color_extraction/)

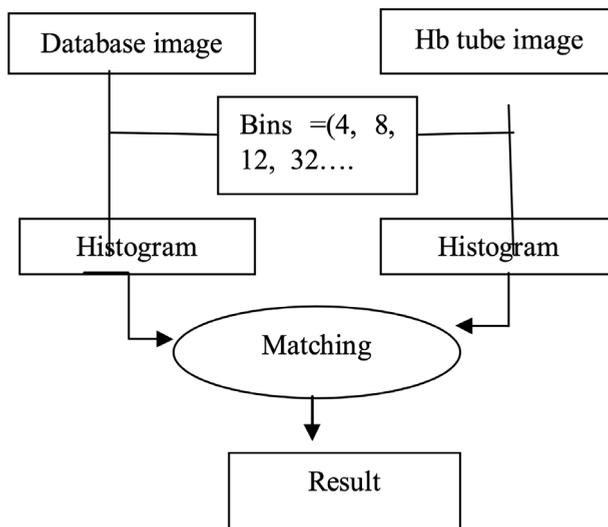
### H. Color Histogram of the images

Histogram is defined as the distribution of grey level in a particular image. Color histogram is the graphical demonstration of the pixels that have particular color in an image. The number of pixels for each 256 scales in each of the RGB channel is counted. The histogram of the image is calculated by plotting the pixel values in the bar graph [11]. The value of histogram of standard database image is previously calculated. But the histogram of the Hemoglobin tube image is calculated during the experiment. To find the color image histogram

$$H = \sum [\sum \{ \sum (vg1 * vg2) \}]$$

Where H is similarity value between two color image histogram, g1 is the haematin image histogram and g2 is the standard image histogram.

#### I. Algorithm for color matching:



**Figure 6:** Algorithm for color matching

These following algorithms are used for color matching of image of Hemoglobin tube solution color and the standard database image color [13],

1. Read the standard image and Haematin image and both image are RGB color images.
2. Convert these images into HSV images.

3. Plot the color histogram of the images.
4. Extract a color histogram from each image  $g_1$  and  $g_2$ . Bins = {4, 8, 12, 32 ...}
5. Compare their histogram, similarity ( $h_1, h_2$ ).  $H = \frac{\sum \{ \sum (V_{g1} * V_{g2}) \}}{\sum \{ \sum (V_{g1}^2 + V_{g2}^2) \}}$

$H = 0$ , similarity is very Low

$H = 0.9$ , similarity is Good

$H = 1$ , Similarity is Excellent

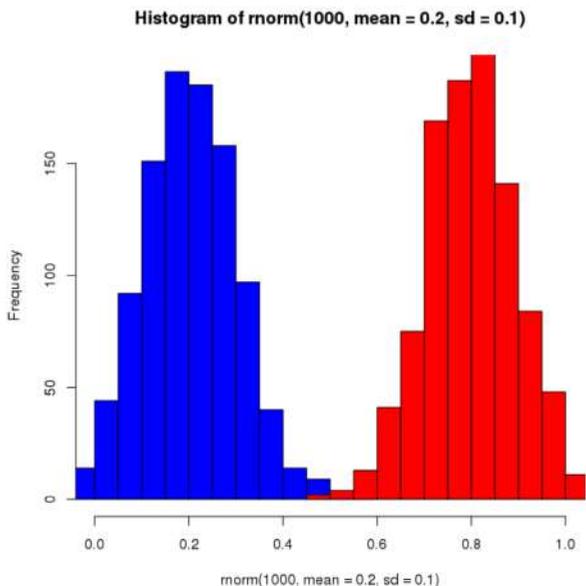
### J. Hemoglobin estimation

When the histogram of the two images is similar to each other the hemoglobin level is displayed at the LCD display. The hemoglobin level is preprogrammed with respect to the amount of solution in the Hemoglobin tube. For that the image of the Hemoglobin tube solution is converted into 2D array. From the size of the row of the array the hemoglobin level is calculated.

## 3. RESULTS AND DISCUSSION

In order to get the faster results, they are presented in LCD display and the graphical user interface is developed to provide user. As told before the result has 2 main conditions. Both the histograms of the images are compared. If the result is 0, there is no color matching. If the result is 1, there is color matching. If the color matching has been occurred the result will be displayed at the user interface.

The histogram comparison for both images are followed by,



**Figure 7:** Histogram comparison

The output results of the hemoglobin level estimation by conventional Sahli’s method and color matching technique in image processing are compared for different subjects as followed is mentioned in Table 3.

**Table 3:** hemoglobin level comparison between color image processing method and conventional sahli's method

S.No	SUBJECT NAME	HEMOGLOBIN VALUE BY COLOR IMAGE PROCESSING	HEMOGLOBIN VALUE BY CONVENTIONAL SAHLI’S METHOD
1.	A	13	12.5
2.	B	12	12
3.	C	10	10

#### 4. CONCLUSION

As a result of this research successfully utilizes color image processing technique and estimate the amount of hemoglobin. This proposed method is simulated in MATLAB or LABVIEW. As it is an automated system it requires power supply. As a product this method of hemoglobin estimation is more accurate and faster than conventional Sahli’s method. In healthcare industries it will be more helpful for hemoglobin estimation for blood donation, anemia confirmation test. The error due to human visual system can be rectified by using this new developed technology. We also have tried to do the same research by using color spatiogram method. The output was more-

over similar to that of color histogram method. In Future work we can develop a medical image analysis system and health care system.

## **5. REFERENCES**

- [1] <http://en.wikipedia.org/wiki/Hemoglobin>.
- [2] [https://www.medicinenet.com/hemoglobin/article.htm#what\\_are\\_normal\\_hemoglobin\\_values](https://www.medicinenet.com/hemoglobin/article.htm#what_are_normal_hemoglobin_values).
- [3] **Balarajan, Y., Ramakrishnan, U., Özaltın, E., Shankar, A. H., & Subramanian, S. V.** (2011). Anaemia in low-income and middleincome countries. *The lancet*, 378(9809), 2123-2135.
- [4] **Cook, J. D., Bothwell, T. H., & Covell, A. M.** (1985). Measurement of iron status. International Nutritional Anemia Consultative Group.
- [5] **Bhaskaram, P., Balakrishna, N., Radhakrishna, K. V., & Krishnaswamy, K.** (2003). Validation of hemoglobin estimation using Hemocue. *The Indian Journal of Pediatrics*, 70(1), 25-28.
- [6] **Doshi, R., & Panditrao, A.** (2013). Optical sensor system for hemoglobin measurement. *International Journal of Computational Engineering Research*, 3(7), 41-5.
- [7] **Wintrobe, M. M.** (1962). Clinical hematology. *Academic Medicine*, 37(1), 78.
- [8] **Pandey, K. K., Mishra, N., & Sharma, H. K.** (2011). Enhanced of color matching algorithm for image retrieval. *International Journal of Computer Science Issues (IJCSI)*, 8(3), 529.
- [9] **Gonzalez, R. C., & Woods, R. E.** AN INTRODUCTION TO MATRIX MANIPULATION IN MATLAB.
- [10] **Weisheng, L., Wang, W., & Liu, M.** (2009, November). New color cluster algorithm for image retrieval. In 2009 Third International Symposium on Intelligent Information Technology Application (Vol. 3, pp. 561-564). IEEE.
- [11] **Dou, J. J., Wen, J., & Liu, C. Q.** (2005). Histogram-based color image retrieval. *Infrared and Laser Engineering*, 34, 84-87.

**[12]** <https://in.mathworks.com/matlabcentral/answers/181624-how-to-get-color-histogram-of-an-image>.

**[13]** **Krishnan, A., Srikanth, A., Sanjay Robin, K. B., & Kulkarni, S.** (2017). Digitized estimation of haemoglobin using image processing. *International Journal of Engineering Research and General Science*,

# AN EMBEDDED ALERT SYSTEM AS ANTI-THEFT

**Josephine Selle Jeyanathan**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: josephine@klu.ac.in, <https://orcid.org/0000-0003-2219-6748>

**Duvvuru Abhiram Reddy**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: abhiramabhi1009@gmail.com, XXXXXXXXXX

**Manchikanti Anand**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: anandaakash345@gmail.com, XXXXXXXXXX

**Allampati Raviteja**

*Dept. of ECE, Kalasalingam Academy of Research and Education, Krishnankoil, India.*

Email ID: ravitejareddy30@gmail.com, XXXXXXXXXX

## ABSTRACT

It is a significant risk to store one's possessions in a secure location when travelling. It is one's obligation to watch after and protect them. However, there will be times when human eyes fail, and safety is jeopardized since it is not always feasible to keep an eye on the luggage when walking or travelling in different locations. Bag snatching is a severe crime that has spread throughout numerous cities. This study describes the design of an implanted framework that can prevent bag snatching. This system includes an alarm circuit that makes a buzzer sound to warn the bag user when a theft attempt is made on the bag. The circuit includes the following components: an operational amplifier designed as a comparator, a 555Timer-IC utilised as a monostable multi-vibrator, and UM3561 for sound alerting the passenger.

**Keywords:** Embedded system, anti-bag, comparator, 555 timers, multivibrator.

## 1. INTRODUCTION

This project talks about anti-bag snatching alarm, used in the bag in order to prevent it from being snatched [1]. The sound produced by the alarm is amplified through the buzzer sound to get the attention of people when there is a bag theft. Initially, the circuit will be in the locked mode but when a thief tries to snatch it, the circuit turns into unlocked mode thus simulating a buzzer horn. This circuit is comprised of three integrated units [2]. They are IC1 CA3140, that acts as a comparator, IC2 NE555 that acts as monostable multi-vibrator and third is IC3-UM3561 that could be an ad-

vanced read-only storage with the intrinsic generator. A single stage transistor BD139 acts as a loudspeaker that amplifies the buzzer sound to alert the co-passengers [4].

The output from pin6 of IC1 is fed to the pin2 of IC2 NE555 via a coupling capacitor. IC2 is configured as a mono-stable multi-vibrator [1]. Its trigger pin2 is mainly held high by resistor R4. Generally, the output of IC2 remains low and the alarm is in the off state. Resistor R6, along with capacitor C3 is connected to reset pin 4 of IC2, to prevent any false triggering [5]. Resistor R5 pre-set, VR (Variable resistor) and capacitor C2 are timing components. With these specified values, the output at the pin 3 of IC2 stays for about a minute, which can be increased by only increasing either the value of capacitor C2 or pre-set VR. When there is an attempt of theft, the plug connected to the circuit will be detached. At that moment, the voltage at the inverting input of IC1 exceeds the voltage at the non-inverting input terminal and subsequently its output goes very low [8]. This sends a low signal to trigger pin 2 of IC2 to make its output pin 3 high. Consequently, the alarm circuit built around IC UM3561 gets the voltage at its pin 5. IC UM3561 is a complex Read Only Memory (ROM) with an inbuilt oscillator which is formed by the resistor R8. The output is fed to the base of the single-stage transistor amplifier BD139 through resistor R9. In the standby mode, the electric circuit is locked by a plug and socket arrangement. When the burglar tries to snatch the bag, the plug is detached from the unit's socket to activate the alarm. The circuit is designed around operational amplifier IC CA3140, which is configured as the comparator. The non-inverting input of IC1 is kept at half the supply voltage by the potential divider comprising resistors R2 and R3 of 100K each [2]. The inverting input of IC1 is kept low through the shorted plug at the socket. As a result, the resistor R4 is activated to a high value.

## **2. MATERIALS AND METHODS**

Figure 1 depicts the overall arrangement of this work. In general, IC2 output remains low and the alarm is turned off. Resistor R6, together with capacitor C3, is connected to IC2's reset pin 4 to avoid erroneous triggering. Timing components are resistor R5, pre-sets VR, and capacitor C2 [5]. The output at pin 3 of IC2 takes roughly a minute with these settings, which may be enhanced by increasing the value of capacitor C2 or the pre-set VR [3]. When a snatching attempt is made, the connector attached to the circuit is disconnected. At that point, the voltage at IC1's inverting input terminal surpasses the voltage at the non-inverting input terminal, and the output becomes very low. This sends a low signal to IC2's trigger pin 2 to cause its output pin 3 to become high. As a result [6,] the alarm circuit constructed around IC UM3561 receives

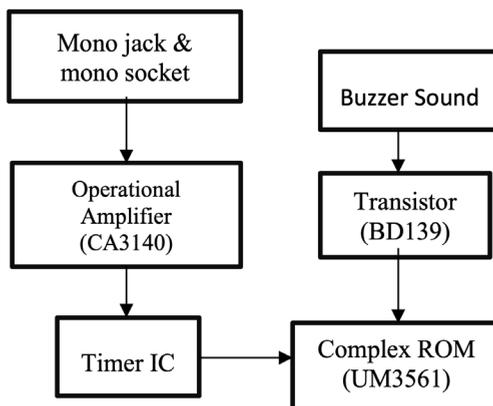
the supply voltage at pin 5. The IC UM3561 is a sophisticated Read Only Memory with an oscillator built in. The oscillator is formed by resistor R8. Its output is routed through R9 to the base of transistor BD139. The warning sound produced by IC3 is amplified by transistor T1. To generate the warning, a loudspeaker is attached to the collector of Transistor T1. The alarm may be turned off by reinserting the plug into the socket.

Because transistor T1 needs a heatsink, resistor R7 limits the current to IC3, and Zener diode ZD1 restricts the supply voltage to IC3 to a safe level of 3.3 volts. The current can be limited to the base of T1 by resistor R9. The circuit is simple to build on a NERO board or a general-purpose PCB board. A tiny box and a 9V battery are utilised to secure the circuit [8,9,10]. The speaker should be tiny in order for the device to be portable. A thin plastic wire is plugged to secure it in the hand, or it can be tied up someplace else so that the plug quickly detaches from the socket when the bag is tugged or grabbed [7,8].

#### *A. Hardware Components*

The following components are utilized for producing the anti-theft alarm system:

- 1.CA3140
- 2.NE555
- 3.UM3561
- 4.BD139
- 5.ZENER DIODE
- 6.SPEAKER



**Fig 1.** General block diagram

### *B. CA3140 (operational amplifier)*

As shown in fig. 2. the CA3140 is the integrated circuit op-amp that mainly combines the high voltage PMOS transistors with a very high voltage of BJT's on a monolithic chip for fabrication. The CA3140 is the Bi-MOS op-amp features gate protected MOSFET transistors in the input circuit to provide high input impedance, low input current, and very high-speed performance.

The CA3140 operates at supply voltages from 4Volts to 36Volts. The pin diagram of CA3140 is shown in the fig.2.

### *C.NE555 (Timer IC)*

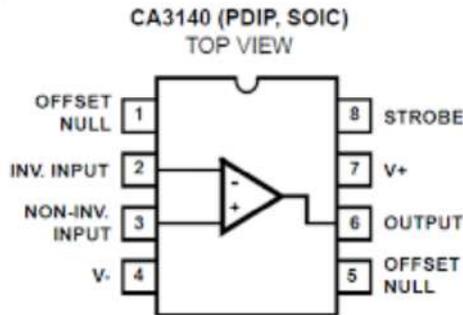
The 555 timer IC is an integral part of an electronics project. It simply involves a single 8-bit micro-controller as shown in the fig. 3 and some other peripherals or a complex one involving system on this type of chips. As an oscillator and as a flip-flop element these provide time delays among other applications. NE555 timer IC was introduced in 1971 by the US company Signetics, the NE555 timer IC is still in widespread use due to its low cost, ease of use and stability and some other major applications. It is made by major companies in the original bipolar and low power CMOS types.

### *D. UM3561 (complex ROM with an inbuilt oscillator)*

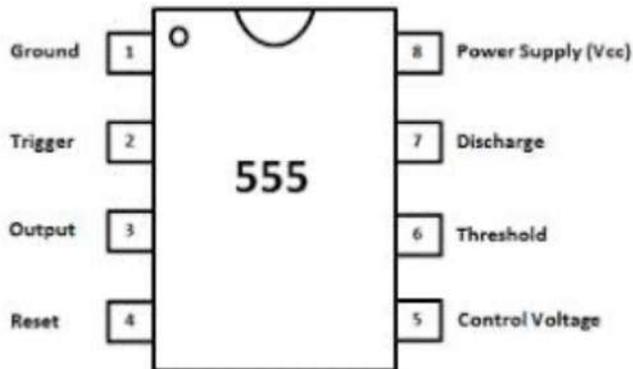
UM3561 is an excellent ROM IC that can produce Multi siren horns simulating Police horn, Fire brigade horn and Machine gun sound, Ambulance horn and some other sirens. The pin diagram is shown in the fig.4. where 8 pins low power IC can work down to 2.4Volts.The UM3561 is a low-cost sound generator designed for use in toy

applications or any other project-oriented applications. The IC has an inbuilt oscillator and siren selection pins. It is easy to make a tone generate with only a few external components like resistors and capacitors. Only one resistor and a speaker driver transistor are sufficient to make a simple horn generator.

### Pinout



**Fig. 2. Pin Diagram of CA3140**



**Fig 3.** Pin diagram of NE555

### E. BD139(transistor)

BD139 is the epitaxial planar transistor which is mounted in the SOT-32 plastic package. They are primarily designed for audio amplifiers and drivers utilizing the complementary or quasi-complementary circuits. The NPN types are mainly BD135 and BD139, and the PNP types are the BD136 and BD140. These are majorly used in Medium Power Linear and Switching Applications. BD135, BD137, and BD139 are inverse to BD136, BD138, and BD140 respectively.

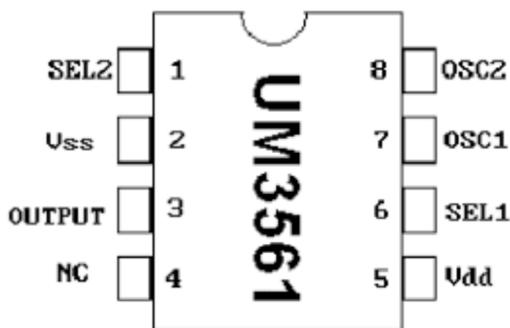


Fig 4. Pin diagram of UM3561

### F. Zener Diode

Zener Diode or “Breakdown voltage Diode”, as they're generally noted, area unit essentially identical because the normal PN junction diode however they're specially designed to own a very low and specified Reverse Breakdown Voltage which takes the advantage of any reverse voltage applied to it. The Zener diode behaves just like a general-purpose diode consist of a silicon PN junction diode is when biased in the forward direction, i.e., Anode is positive with respect to its Cathode, it behaves just like a normal signal diode passing mainly the rated current. However, unlike a conventional diode that blocks any flow of current through itself when reversing biased, that is the Cathode becomes positive than the Anode.

### G. Speaker

The speaker operates on the same basic principle as a normal microphone, but in reverse, to generate sound from an electrical signal. When a reverse current electrical audio signal is given to its voice coil, a coil of wire is suspended in a circular gap between poles of a permanent magnet, the coil is forced to move faster back and forth due to Faraday's law of induction, which causes a diaphragm that is attached to the coil to move back and forth, pushing on air to create sound waves. Besides this, the most common method is, there are several alternative technologies that can be used to convert an electrical signal into sound waves. The sound source must be amplified or strengthened with an audio amplifier before the electric signal is sent to the speaker.

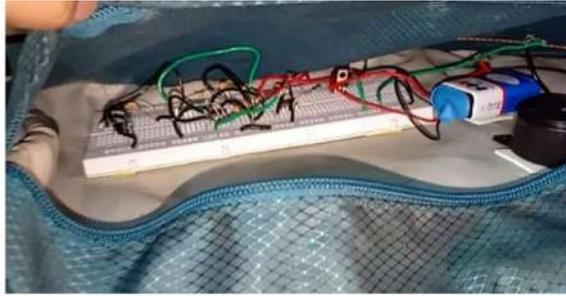


Fig 5. Prototype of anti-theft system

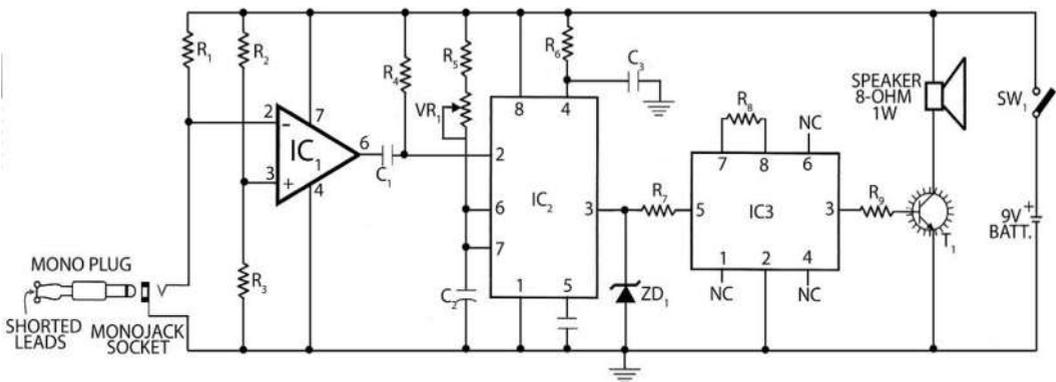


Fig 6. Circuit layout of the working model

## RESULTS

The circuit illustrated in fig. 6 was related to the security switch and was appropriately placed in the backpack. However, no other components were allowed to prevent the rear panel from snapping into place. If there was a problem sealing the case, it was checked to ensure that hot glue was not obstructing the closure and that a knife or scissors could be used to cut out the portion. Other steps were made in order to put the system safely within the bag. In addition, no transistors, diodes, or leads were taken out of the casing, which might prevent the enclosure from closing in the circuit. The slits were widened to make it easier to slip the components through the holes and fit the rear panel.

This gadget is designed to prevent bag snatching by mimicking the buzzer sound, which notifies the co-passengers and allows the thief to be quickly apprehended. By trading a little amount of money, anyone can utilise this gadget.

## **4. DISCUSSION AND/OR CONCLUSIONS**

As future work, the Bluetooth module can be made use as the RF receiver unit. The receiver part can be connected to the Arduino UNO as the microprocessor and to the buzzer as the output. The function of the circuit is to receive signals from the transmitter, and if the receiver stops to receive any signal, then the connection between them fails, then buzzer sound will be raised to alert the passenger and catch the thief.

## **REFERENCES**

- [1] Lee, C. H.** (1998). U.S. Patent No. 5,790,028. Washington, DC: U.S. Patent and Trademark Office.
- [2] Whitehead, S., Mailley, J., Storer, I., McCardle, J., Torrens, G., & Farrell, G.** (2008). In safe hands: a review of mobile phone anti-theft designs. *European Journal on Criminal Policy and Research*, 14(1), 39-60.
- [3] Gong, W., Lee, S., & Kim, B.** (2010). The comparison of pressure of the feet in stance and gait by the types of bags. *Journal of Physical Therapy Science*, 22(3), 255-258.
- [4] Blom, J.** (2015). Anti-Theft Bag for Elena Kihlman Design.
- [5] Postrel, V.** (2020). *The fabric of civilization: how textiles made the world*. Hachette UK.
- [6] Han, S., & Koo, H.** (2014, January). Anti-Theft Travel Bag Design: Perception and Design Factors. In *International Textile and Apparel Association Annual Conference Proceedings* (Vol. 71, No. 1). Iowa State University Digital Press.
- [7] Wang, L., Xu, F., & Wang, T.** (2018, October). Design of Multifunctional Anti-Theft Backpack Based on Microcomputer. In *8th International Conference on Management and Computer Science (ICMCS 2018)* (pp. 507-510). Atlantis Press.
- [8] Faroqi, A., Andhika, P. T., Ramdhani, M. A., & Lindra, I.** (2019, July). Design of Bag Monitoring Security System Based On Internet of Things. In *2019 IEEE 5th International Conference on Wireless and Telematics (ICWT)* (pp. 1-4). IEEE.
- [9] Ray, S., Puntambekar, T., & Singh, M.** (2020). Accessible and Secure Backpacks for Daily Use. *International Journal of Modern Agriculture*, 9(3), 1085-1093.

- [10] Whitehead, S., Mailley, J., Storer, I., McCardle, J., Torrens, G., & Farrell, G.** (2008). In safe hands: a review of mobile phone anti-theft designs. *European Journal on Criminal Policy and Research*, 14(1), 39-60.



# **WIRELESS MONITORING AND DECISION SUPPORT FOR WATER SAVING IN AGRICULTURE**

**Jenyfal Sampson**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: jenyfal.sampson@klu.ac.in, <https://orcid.org/0000-0001-8007-3995>

**Sivakumar Pothiraj**

*Professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: siva@klu.ac.in, <https://orcid.org/0000-0003-1328-8093>

**Velmurugan Subbiah Parvathy**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: s.p.velmurugan@klu.ac.in, <https://orcid.org/0000-0002-3314-1454>

## **ABSTRACT**

This paper suggests a resolution for the elevated water difficulties. These days for organization management industries require an enormous quantity of man power. We have start with an answer wherever we tend to use sensors to live the water level of storage system and learn concerning an equivalent saving human effort. Here sensors are slot in the tank at completely different levels. The sensors are further fixed to the microcontroller. The device senses the water level and notifies it to the microcontroller that exhibits the vessel standing on the liquid crystal display. A gate mechanism is additionally hooked up to the current system that is triggered once the water level reaches the brim of the storage system.

**Keywords:** Arduino UNO, Electrodes, Liquid Crystal Display (LCD), Motor.

## **1. INTRODUCTION**

Now a days, wastage of water and shortage of water are the major dilemma. The necessity of water is escalating because of the earth's residents expanding day by day. In a country like India shortage of water and consumption of water is a major problem. In this paper we have got tried to produce an aid to the present downside. Now a day's embedded system playing a significant role in engineering style method for economic analysis and effective operation. Due to time complexness in electronic phase embedded systems became a significant part of our existence. We have intended a project which can calculate the storage tank water level and demonstrate

it to the liquid crystal display with the help of the embedded system. Our project may be contribution towards the answer for water inadequacy problems. Also, the applying of embedded system decreases the likelihood of fault caused by human interference. In the earth water is the most significant for all the function, for agriculture. It is mandatory to store water consumption in agriculture [1]. In Problems throughout the state. Delhi Jai Board had taken a choice to penalize the shoppers for overflowing tanks. Water shoppers UN agency start their motors to fill overhead tanks then forget to change them off our life water is the most essential in our daily routine. To safeguard our surface water from contamination, we will check the value of water [2] This system is to check the quantity of water in urban places so that they help to finding the water wastage and procedures can be in use to shun spread out of water [3].

## **2. LITERATURE SURVEY**

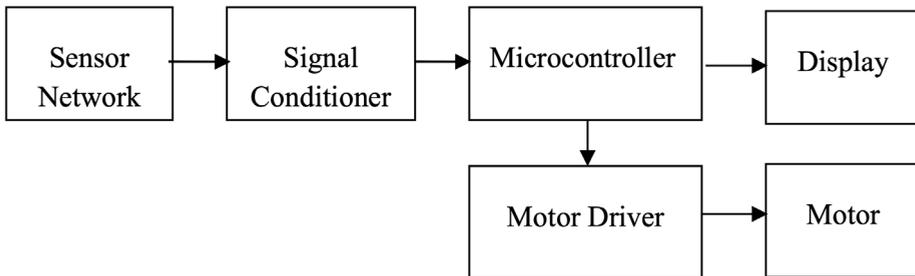
In associate degree analytically study handling by the Delhi committee of the associate chambers of commerce and trade of Asian country (ASSOCHAM), it's been discovered that there has been a significant raise within the wastage of water because of numerous reasons. Compared to preceding year the proportion of wastage of water has been accrued to forbidding four hundredth in associate with ASSOCHAM [4]

On Feb eleven, 2018 the BBC place Bangalore on a list of eleven major cities within the epoch having most water connected issues. The BBC blames a spike in population growth and new belongings growth, Bangalore's resist to handle its water and waste product systems and a huge waste of potable because of poor understanding. Also, several villages within the interior of geographic region and many different states face major water shortage due to deficiency and facility management. Our system is an initiative to assist curb or a minimum of cut back these water wastage and insufficiency need to pay the several penalties [5]

One of the simple methods to calculate the quantity of water for underwater use to force to convert and setup and preserve it [6].

### 3. PROPOSED MODEL

#### BLOCK DIAGRAM



**Figure 1:** Block diagram of water level monitoring and pump control system

**Source:** Own elaboration

The suggested scheme uses five sensors to detect many storage levels. At any time, the rise of water level and comes connected of any device then the circuit is complete and current flows because of that the corresponding electronic transistor controlling and the circuit is stopped. The microcontroller is triggered by the output of the sensing element circuit. At any time, the level of water increases on top of the very best level shrinks below rock bottom intensity level then the sensing element circuit activates the microcontroller. According to the code written and burnt it in the microcontroller it will run the dc motor. The motor driver is provided to run and management the motor. Associate LCD is offered to tell the user concerning the status of the water level within the tank. It has been manufactured by offering suitable forte by selecting material and geometry and decreasing the strength required to inject microneedles into skin by enhancing sharpness. They have been made-up using numerous materials [7].

#### WATER LEVEL SENSOR

There are five electrodes are used in this project. These five electrodes are used to sense the water in the tank. These sensors are placed in the tank 20%, 40%, 60%, 80% and the top of 100% up to tank level. In the given circuit connect a wire of 5v power supply in the bottom of the tank and the remaining wires will be placed different at an equal space in the tank. If the water is around 25% then 5v power supply wire and the 20% electrodes will be shorted out and circuit will be completed.

## SYSTEM FUNCTIONALITY

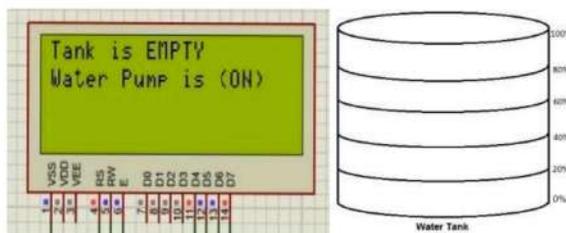
The proposed system is stimulated by using proteus and design suit software. In our project wires are used as sensor for understanding. These A1 to A5 sensor provide input to the Arduino. If the water gets reached its sensor level using this probs we can connect 5v dc supply to the respective branches with the help of the sensor the Arduino reads the input. Depending up on the water level the output (low, high) will be shown in the motor pin. The output of the motor pin is given to the motor driver. L293D is used to control the dc motor. Arduino is interface with LCD. In the screen the water level (low, high) and the percentage of the water in the storage system will be displayed. If the water reaches the high position the motor gets interfaced with LCD and it is turned off.

## ARDUINO UNO

Arduino is a combination of hardware as well as software that design and manufactured in a single board. In digital world these microcontroller kits produce the digital devices and interactive with object that can sense and control the object. Arduino UNO is a best one to start with electronics and coding. In Arduino family UNO is mostly used in a board. Arduino UNO is a microcontroller board based on ATMEGA 328. It has 14 digital inputs (output pins, 6 analog input and 16 MHz quartz crystal a USB connection and power jack and csp header and reset button). These all the pins are needed to support the microcontroller. These pins are connected to a computer with a USB cable or power to get start with an AC to DC adapted or battery. The Arduino board is very cheap, and we can implement the project very easily.

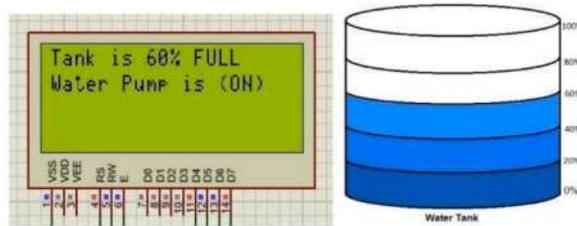
## 4. RESULTS

Thus, the analyzed data from various sensors has been displayed in the LCD by using the methodology mentioned above and we have proven that the system is squat in charge; trouble free to erect, less reliant upon network.



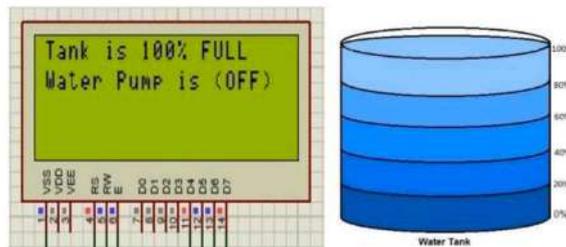
**Figure 2:** When tank is empty  
**Source:** Own elaboration

When the tank is empty, the level of water will be displayed in LCD as EMPTY.



**Figure 3:** When tank is 60% full  
**Source:** Own elaboration

When the tank is half filled with water, it displays as 60% of tank is FULL (MEDIUM).



**Figure 4:** When tank is full  
**Source:** Own elaboration

When the tank is filled with water, it displays as 100% of tank is FULL.



**Figure 5:** When tank is full  
**Source:** Own elaboration

This is the final outcome of our mechanism which has been analyzed and the concentration of irrigation has been exhibited in LCD.

## 5. CONCLUSION

In this paper we discussed and compared the result of water level. The planned mechanism of water wastage ensures economical use of obtainable water and generates a

lot of precise and correct results. There are no requirements of human working man for observance the extent, just one operator is comfortable for gap and shutting the gate according to device output. Because of the quantity of sensors being additional we will open or shut the gate whenever necessary knowing the correct level of water. Also, operation execution time is a smaller amount, and it attributes to its value potency. This system is often put in innumerable rural areas wherever the water issues are on an increase.

## 6. REFERENCES

- H. Navarro-Hellin, R. Torres-Sanchez, F. Soto-Valles, C. Albaladejo-Perez, J. A. Lopez-Riquelme, and R. Domingo-Miguel** "A wireless sensor architecture for efficient irrigation water management" *Agr. Water Manage.*, 2015.
- N. Harris, A. Cranny, M. Rivers, K. Smettem, and E. G. Barret-Lennard** "Application of distributed wireless chloride sensors to environmental monitoring: initial results," *IEEE Trans. Instrum. Meas.*, 2016.
- C. T. Kone, A. Hafid, and M. Boushaba** "Performance management of IEEE 802.15.4 wireless sensor network for precision agriculture," *IEEE Sensors J.*, 2015.
- M. Rivers, N. Coles, H. Zia, N. R. Harris, R. Yates** "How could sensor networks help with agricultural water management issues? Optimizing irrigation scheduling through networked soil-moisture sensors", *Proc. IEEE Sensors Appl. Symp.*, 2015.
- J. Gutierrez, J. F. Villa-Medina, A. Nieto-Garibay, M. A. Porta-Gandara** "Automated irrigation system using a wireless sensor network and GPRS module", *IEEE Trans. Instrum. Meas.*, 2014.
- F. Viani, A. Polo, M. Donelli, E. Giarola** "A relocable and resilient distributed measurement system for electromagnetic exposure assessment", *IEEE Sensors J.*, 2016.
- A. Massa, F. Robol, A. Polo, E. Giarola, F. Viani** "Localization strategies in WSNs as applied to landslide monitoring", *Proc. Amer. Geophys.*, 2013.
- F. Viani, F. Robol, A. Polo, P. Rocca, G. Oliveri, A. Massa** "Wireless architectures for heterogeneous sensing in smart home applications: Concepts and real implementation", *Proc. IEEE*, 2013.

# SMART BLIND STICK

**Dr. T. Senthil**

*T. Senthil completed his Ph.D. at Kalasalingam Academy of Research and Education (KARE) in the year 2017. He received his B.E and M.E degree from M.K University, India. Currently he is working as Associate Professor in the department of ECE, Kalasalingam Academy of Research and Education (KARE) Krishnankoil, Tamilnadu India.*

Email ID: [t.senthil@klu.ac.in](mailto:t.senthil@klu.ac.in), <https://orcid.org/0000-0002-0044-5371>

## ABSTRACT

The objective of this paper is to introduce user-friendly blind stick with added smartness using sensor module. For visually impaired persons a smart blind stick has been launched here to help them, assist in detecting obstacles without shaking and stretching the ordinary blind stick. The smart blind stick uses the ultrasonic sensors, accelerometer, GPS and GSM modules in the closed loop manner. With the help of these sensors actuated stick obstacles within distance of 3m can be detected easily using SONAR (Sound Navigation and Ranging) principle. In addition, to locate the position and navigation of the visually impaired person GPS module is used. Using the GSM module, the blind person can send the emergency message to his guardian or friends who is close to them by sending the notification if the blind person in any threatening condition. Our prototype model with Arduino Nano board connected with sensors and GSM/GPS module detected the obstacle and based on the threshold distance we set (1meter), the board warned the person with Buzzer sound.

**Keywords:** Smart stick, GPS module, GSM module, Ultrasonic sensors.

## 1. INTRODUCTION

The most important part of human physiology as 83% of information humans get from an environment is via sight. As the statistics done by the world health organization in 2011 states that there are 285 billion people in the world suffering from the visual impairment. The conventional ways the tool aiding the visually impaired people is the walking cane simply called as the white cane or stick. Some people will use the guide dogs. The person who is having the visual acuity of 20/200 or less is considered as a blind. In our project we have made a smart blind stick using ultrasonic sensors for obstacle detection and GPS, GSM module for detecting the location of the visually impaired person when he/she is in danger condition and alerting the closed ones of the visually impaired with the message using GSM module.

The previously existing system consists of a simple white cane which will be less use for a blind whenever he /she faces a critical situation like accident those white cane sticks cannot convey any information (Ref.1). In order to overcome those drawbacks, we came up with a smart blind stick with obstacle detection and alerting system. Here the ultrasonic sensors are preferred because of its cost effective and high resistivity against the noise over the surroundings. (Ref.2) Also ultrasound emitters and detectors are small enough to be carried without the need for complex circuitry (Ref 3-5).

In the conventional system there is no way to get alert the blind person's relatives. Here we have made a GSM and GPS module to make a alerting message in order to safeguard the life of the blind person. The smart blind stick is an embedded system consisting of the integral components such as ultrasonic sensors to detect the obstacles within the range of 2cm to 4cm. The real time data is collected by the sensors and it will be sent to the microprocessor. After the processed data output will be given to the buzzer to create a alerting sound as long as the obstacle is in front of the blind people. When the blind reaches his/her critical condition GPS system with user input interfacing get alert the blind person's relatives or closed ones with a alerting message with the location indicating their state of condition (Normal or Accident) with the help of GSM. The GSM creates a message with two main terms as Normal condition and Accident state. Once the message is received by the blind people's neighbor, he/she can take a step immediately in order to save the life of blind people.

## **2. MATERIALS AND METHODS**

The smart blind stick which we have developed consists of the following components which forms the overall proposed system.

### **A. Buzzer:**

A buzzer is a audio signal device. It can also be called as beeper. A buzzer can be piezoelectric, or electromechanical or mechanical buzzers. A transducer which converts an electrical energy into mechanical energy that typically operates a buzzer is in the lower portion of audible frequency range of 20Hz to 20 kHz. This is achieved by converting an electric oscillating signal in the audible range into mechanical energy in the form of audible waves. Buzzer is the research to warn the blind person against obstacle by generating sound proportional to distance from obstacle.

### **B.GSM/GPS 800L:**

The Global Positioning System consists of GPS receiver and the GPS antenna. The GPS unit receives the signal with the help of GPS antenna which helps in boosting the reception signal. GPS helps to obtain the latitude and longitude location of the blind persons. To keep track the address of the blind person they obtained data of latitude and longitude is essential one. Whenever the person makes a move, for each navigation the data of latitude and longitude are updated.

The Global System for Mobile Communication also called as General Packet Radio Service is an embedded hardware system which can be integrated in equipment. It set up the communication between a computer and GSM system. GSM module requires a Subscriber Identity Module (SIM) card to facilitate the sending and receiving of SMS messages through wireless communication. These GSM/GPRS module provides a great advantage for the visually impaired person's in critical condition. In GSM every operation is done by "AT" commands. Each command line starts with "AT" which indicates the command line starting. The commands are sent by the microcontroller.

### **C.ARDUINO NANO:**

Arduino Nano is based on Atmega 328 microcontroller. By receiving the input signals (analog/digital) Arduino can control the environment and can affect its surroundings by relay control, light control, and other devices control mechanism. Atmega 328 microcontroller on board is programmed using Arduino software. The Arduino Nano is the breadboard friendly, small and compact. Arduino Nano can be powered via the mini-B USB connection, 9V external power supply. Arduino Nano has 14 digital I/O pins and 8 analog input pins. Each 14 digital pins of ArduinoNano can be used as a input or output, using pin Mode (), digital Write (), digital Read() functions. Arduino Nano provides a great platform for the beginners. Due to its miniature size it perfectly suits for the compact project development. Arduino Nano will fit into the breadboard making the prototyping much easier.

### **D.ULTRASONIC SENSORS:**

Ultrasonic sensors are also called as acoustic sensor. The ultrasonic sensors are divided into three main categories as transmitters, receivers and transceivers. The function of transmitter is to convert the electrical signal into ultrasound and the receivers convert the ultrasound into the electrical signal and transceivers can transmit and

receive the ultrasound wave. Ultrasonic transducers are used in some system which can evaluate the target by interpreting the reflected signal.

By measuring the time between the sending a signal by receiving an echo the object distance is measured. Applications of Ultrasonic sensors include wireless charging non-destructive testing, medical ultrasonography, humidifiers etc., A transducer which generates the sound waves in the Ultrasonic range above 18kHz, by turning the electrical energy into the sound and then receiving the echo turns the sound waves into electrical energy which can be measured and displayed.

Ultrasound can be used to make a point to point distance measurement for transmitting and receiving the discrete bursts of ultrasound between the transducers.

#### **E. VIBRATING MOTOR:**

A vibrating motor is included in the smart blind stick to enhance the overall feedback for the person who receives the warning against obstacles closeness in different formats of vibration.

#### **F. ACCERELOMETERS:**

The measurement of proper acceleration is done by using a device called Accelerometer. Proper acceleration being the acceleration of a body in its own instantaneous rest frame is not the same as coordinate acceleration, being the acceleration in a fixed coordinate system. Accelerometers have multiple applications in science and industrial fields. Highly sensitive accelerometers are the components of inertial navigation systems for aircrafts and missiles.

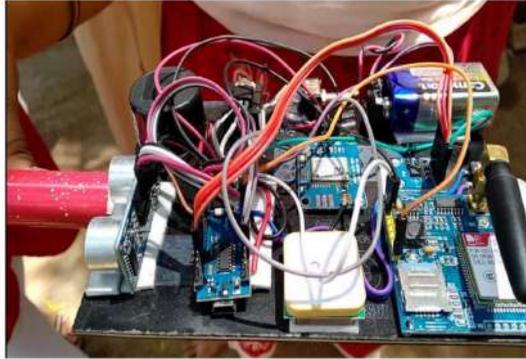
Accelerometers are used in detection and monitoring the vibration in rotating machinery. Accelerometers are used in tablet computers and in digital cameras so that the images on screen are always displayed upright. Single and multi-axis models of accelerometers are available to detect the magnitude and direction of proper acceleration as a vector quantity and can be used to sense the orientation because the direction of the weight changes, coordinate acceleration, vibration, shock and falling in resistive medium as in a case where the proper acceleration changes, since it starts at zero and then suddenly increases.

### **3. RESULTS**

Flow diagram for this project is given below:

Ultra-sonic sensor → ARDUINO → GSM&GPS system → buzzer & display. To ensure the safety of the visually impaired person, the future scope of the smart blind stick is to provide the great advantage in his/her navigation to be carried out in an independent manner. The following are some of the ideas which could be implemented on the smart blind stick in future technology.

- a) To increase the benefits of the smart stick by allowing one stick to communicate over the other smart blind stick or mobile, pc's nearby to utilize the functionality of other stick when one stick's functionality fails to communicate, by using the emerging technology of Internet Of Things(IOT).
- b) Another method is to implement the programmable wheels. It will help to steer the stick away from the obstacles and also leading the blind person to the destination.
- c) To provide the destination address for navigation the stick can be implanted with the Braille input device which could be the easiest method to convey the information to the blind stick.
- d) To run the integrated hardware, we can adopt to the solar panels as the alternative to the battery. The use of solar panels is more advantageous as it uses sunlight which could be the easily available renewable energy resource to get recharged.
- e) The prototype module detected any obstacle if we put within 1mter distance and Buzzer is ON for alerting the blind person about the obstacle in his path. The GSM/GPS module also send the person's location information to the selected persons via SMS.



**Graphic 1.** Hardware for smart blind stick

**Source:** Our Project

## 4. DISCUSSION AND/OR CONCLUSIONS

This paper implements the smart blind stick for the visually impaired person to help him/her in reaching the destination in a secured and safe way. We used sensors to detect the obstacles ahead and through a beep sound from the buzzer the blind person has been warned. Whenever the person moves near to the obstacle, the intensity of the sound increases. The benefits of GPS and GSM modules helps the blind person to navigate in a better way as they act as a good assist tool in detecting the position of the blind people and making an alerting message to his/her closed ones within a fraction of seconds. The smart blind stick makes the visually impaired persons self-reliant on his navigation. In future implementation the smart blind stick can be added with some additional features in which he/she can be able to make calls, or the messages generated by the gsm module can be given to the nearby hospital and the ambulance to safeguard the life of the visually impaired persons.

## 5. REFERENCES

- 1) A.Jose, G.George, M.R.Nair, M J Shilpa, M B Mathai** "Voice Enabled Walking Stick For Visually Impaired". International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering vol 5,pp.80-85, March 2016.
- 2) C.S.Kher, Y.A.Dabhade, S.K.Kadam, S.D.Dhamdhare and A.V.Deshpande.**"An Intelligent Walking Stick for the Blind". International Journal of Engineering, Research and general science, vol 3, number 1, pp.1057-1062, 2015.
- 3) G.Prasanthi and P.Tejaswitha** "Sensor Assisted Stick for the Blind People" Transactions on Engineering and Sciences, vol, 3, number 1, pp 12-16, 2015.

- 4) PunamR.PatilBhushan, V.Patil** "A Review in a visually impaired person: challenging in the future"[journal]- Shirpur, Maharashtra, India :IJSRSET,2016-2 :vol.2 – ISSN :2394-4099.
- 5) Thomas GonnotJafarSaniie** "Integrated machine vision and communication system for blind navigation and guidance" [conference]- Grand Forks,ND, USA :IEEE,08 August 2016.
- 6) Nadia Nowshin!!**", Sakib Shadman, Saha Joy, Sarker Aninda, Islam Md Minhajul "An Intelligent Walking Stick for the Visually-Impaired People" International Journal of Online and Biomedical Engineering (iJOE) Vol 13, No 11 (2017)
- 7) D.Sathya, S.Nithyaropa, P.Betty, 4G.Santhoshni, S.Sabharinath, M.J.Ahanaa** "Smart Walking Stick for Blind Person" International Journal of Pure and Applied Mathematics Volume 118 No. 20 2018, 4531-4536
- 8) Shafi Ullah, Shabir Ahmed,Waqas Ahmad, Latif Jan** "Sensor Based Smart Stick for Blind Person Navigation" International Journal of Scientific & Engineering Research Volume 9, Issue 12, December-2018



## SMART CROP PROTECTION SYSTEM

### **M. Sakthimohan**

*Assistant Professor, Department of ECE, Kalasalingam University Krishnankoil (India).*

Email ID: sakthimohan.m@klu.ac.in, <https://orcid.org/0000-0002-8151-4745>

### **G. Elizabeth Rani**

*Assistant Professor, Department of CSE, Kalasalingam University Krishnankoil (India).*

Email ID: g.elizabeth@klu.ac.in, <https://orcid.org/0000-0002-4513-2109>

### **Dr. J. Deny**

*Associate Professor, Department of ECE, Kalasalingam University Krishnankoil (India).*

Email ID: deny.j@klu.ac.in, <https://orcid.org/0000-0001-6515-3575>

### **Dr. R. Kannigadevi**

*Associate Professor, Department of CSE, Kalasalingam University Krishnankoil (India).*

Email ID: r.kannigadevi@klu.ac.in, <https://orcid.org/0000-0002-9251-4777>

### **Dr.R.Murugeswari**

*Associate Professor, Department of CSE, Kalasalingam University Krishnankoil (India).*

Email ID: r.murugeswari@klu.ac.in, <https://orcid.org/0000-0002-7851-4466>

## ABSTRACT

Farms have crops are numerous periods swing left by native animals like birds cows, goats, buffaloes, etc. This hints to vast sufferers for the agriculturalists. It is not conceivable for ranchers to street chunk whole field or halt over on field 24 hours and protector it. So here we derived up with automatic crop protection system (ACPS) from animals. This is a microcontroller stationed system by PIC microcontroller. This system customs a motion sensor to notice wild animals touching quicker nearby field. In such a case the PIR sensor sense it and directs a signal to the microcontroller to gross exploit. The microcontroller will start the buzzer which noises an alarm to woo the animals left from the field as well as refers SMS to the farmer so that he may see about the condition and originate to the field in case the faunae don't turn gone by the alarm. This guarantees broad security of crops from animals thus shielding the farmer's loss.

**Keywords:** Agriculture, farming, invest, profit sharing, help and tutorials.

## 1. INTRODUCTION

Harvests in farms are many times sweep away by local animals like buffaloes, cows, goats, birds etc. This leads to astronomically immense sufferers for the farmers. It is not probable for farmers to road hunk full field or break over on field 24 hours and sentinel it. So here we arisen up with automatic crop auspice system from creatures.

This is a microcontroller stationed system utilizing PIC microcontroller. This scheme utilizes a kineticism sensor to identify wild animals touching extra adjacent close the field. In such a case the PIR sensor sense it and directs a signal to the microcontroller to yield act. The microcontroller will activate the buzzer which echoes an alarm to woo the animals left from the field as well as leads SMS to the farmer so that he may ken about the condition and emanated to the field in case the natures don't digress by the alarm. This ascertains consummate safety of crops from animals thus bulwarking the farmer's loss.

## **RELATED WORK**

Bindu D *et al* [1] describes in this paper, the preservation of gather turf has been a main comfortable and an intricate issue. The animals from the bulwarked area [PAs] are perpetually assailing the crop field over the years and the auspice of this crop field has become a main concern. The techniques that already being used is ineffective, in this article we are giving a real-world procedure to ward them off, by engendering a system which studies the demeanor of the animal, detects the animal and stimulates the different sound that exasperates the animal and additionally alerts the sanctioned person by sending a message. We additionally provide a multi-class relegation by presenting zero mendacious alarm rate and precise species identification

Krishnamurthy *et al* [2] proposed the Agriculture meets victuals requisites of the people and engenders several raw materials for industries. But because of animal interference in agricultural lands, there will be immensely colossal loss of crops. Crops are vulnerably susceptible to wild animals. Consequently, it is very consequential to monitor the nearby occurrence of animals. Then the actuation of sundry contrivances should follow to repel the hazardous animals. We propose a method to bulwark farms from wild animals Operational amplifier circuits are utilized mainly for the recognition of animal intrusion from the outside of farms. The proposed monitoring scheme is to provide an early warning about possible intrusion and damage by wild animals. The Solar Electric Fence system is a modern day alternative to conventional methods of fencing to forfend your crops & property. Electric Fence is an efficacious way to reducing losses caused by animals.

Kshama s.Bhise [3] explained the project is utilized to track the location of Animal in the wildlife reserves or national parks. This project utilizes a RFID (Radio Frequency Identification Device) module and a GSM (Global System Mobile) modem for this purport. Forest officer or Regime ascendancy person will get these SMS containing

area in which that animals observe. Radio frequency identification (RFID) is utilized to describe a system that transmits the identity (in the form of a unique serial number) of an object or person wireless, utilizing radio waves. It's grouped under the broad 6 category of automatic identification technologies. This paper is utilized to track the location of Animal in the wildlife reserves or national parks. This paper utilizes a RFID module and zig bee for this purport. Forest officer or Regime ascendancy person will get these SMS containing area in which that animals observe

Prof. Abhinav V. Deshpande *et al* [4] proposed method to bulwark farms from wild animals via ubiquitous wired network contrivances, which is applied to farm along with traditional methods to amend the aegis performance. Operational amplifier circuits are utilized mainly for the exposure of animal interruption from the external of farms. The proposed monitoring scheme is to offer an early cautionary about likely invasion and harm by wild animals.

S. R. Chourey *et al* [5] described the paper provides review for consummate technical solution utilizing wireless sensor network (WSN) and Internet of Things (IOT) to the farmers to obviate their crops from wild animals. It comprises all the sorts of controller, sensors, actuator required for WSN and raspberry pi as a heart of the system

## **2. MATERIALS AND METHODS**

### **COMPONENTS**

- PIR Sensor
- PIC Microcontroller
- GSM SIM 800A Module
- 16\*2 LCD Display

#### PIR Sensor:

PIR sensors are more arduous than many of the other sensors expounded in these tutorials (like FSRs, photocells and tilt switches) because there are several variables that disturb the radars input and output.

The PIR sensor is having two apertures in it, each hole is made of a superior objective that is subtle to IR. The lens castoff now is not exploit plentiful and so we perceive that the two spaces can 'see' out past particular distance (mostly the sensitivity of the sensor). When the sensor is contrary, both slots distinguish the equal amount

of IR, the ambient quantity radiated from the room .When a body like a human or animal permits by, it main averts one half of the PIR sensor, which grounds a confident variance variation among the two splits. When the body leaves the knowing area, the inverse occurs, whereby the sensor replicates a negative differential conversion. These revolution pulses are which are spotted when an animal or human is approved.



**Fig 1:** PIR Sensor

#### PIC Microcontroller:

The PIC microcontroller PIC16f877a is one of the best well-known microcontrollers in the industry. This controller is exact user friendly to custom, the coding or programming of this controller is also calmer. One of the key benefits is that it can be write-erase as various times as potential because it habits FLASH memory skill. It is a 40 pin IC and in which 33 pins are castoff for input and output. PIC16F877A is recycled in countless PIC microcontroller projects. PIC16F877A also used in voluminous applications in digital electronics circuits.



**Fig 2:** PIC Microcontroller

#### GSM SIM Module:

GSM is a mobile communication modem, it is mentioned as global system for mobile communication (GSM). The knowledge of GSM was sophisticated at Bell Laboratories in 1970. It is commonly used mobile communication system in global. GSM is a digital cellular technology used for spreading mobile voice and data services activates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM sys-

tem was polished as a digital system which uses time division multiple access (TDMA) procedure for message tenacity. A GSM digitizes and bandage the data, then shows it downcast through a channel with two diverse channels of user records, each in its personal time slot. The digital system can transfer 64 kbps to 120 Mbps of data rates.



Fig 3: GSM SIM Module

### LCD Display:

The liquid-crystal exhibition has the exclusive gain of having a little power consumption than the LED. It is classically of the directive of microwatts for the exhibition when related to certain instruction of mill watts for LEDs. Low power consumption necessity has made it dependable with MOS joined logic circuit. It's some of the leads are its low charge, and moral divergence. The foremost drawbacks of LCDs are extra requirement of light source, an imperfect temperature range of procedure (between 0 and 60° C), low dependability, small working lifespan, deprived discernibility in short ambient lighting, squat speed and the need for an AC drive.

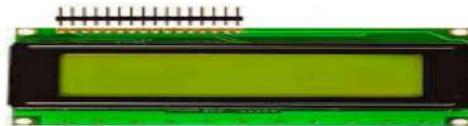


Fig 4: LCD Display

### 2.1 WORKING MODULE

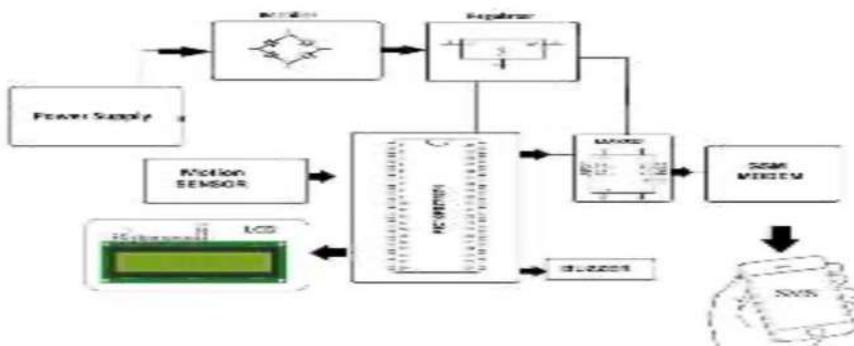


Fig 5: Block Diagram

Fig 5 shows the working modules for smart crop protection system.

## **2.2 WORKING DESCRIPTION**

### **PIR motion sensor:**

Passive infrared motion detectors (PIR) discover radiated infrared energy given by animals and humans in the system of heat. When there is a rapid growth in infrared energy, a buzzer which is connected in the circuit is announced. Small oscillations in infrared energy are not distinguished by the sensor.

### **PIC Microcontroller:**

Microcontroller will receive the input signal from the PIR sensor when an animal or human being is detected. Now the microcontroller will give an activation commands to GSM module and buzzer. GSM module which is connected to the microcontroller through MAX232 interfacing device, sends an SMS to the registered mobile numbered if animals won't run away even when alarm is sounded. So that farmer can understand that situation and come to the field to safeguard his crop.

### **Buzzer:**

Buzzer will generate sound signal when it receives activation command from the microcontroller.



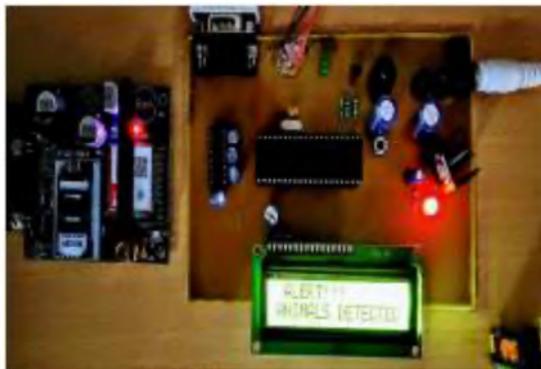
**Fig 6:** Buzzer

## **3. RESULTS**

When there is no animals and birds entered in to the farm, the LCD Display is displaying as follows. If any animal or bird is detected in the farm, the GSM module sends message to farmer as well as buzzer is ON.



**Fig. 7:** System Initializing



**Fig 8:** System output: Animal detected

## 4. CONCLUSIONS

In village parts of India, farmers meet severe threats such as harm done by animals. Hence, to overwhelm this problem we have designed a system in which sound is played by using buzzer. So that wild animals will not arrive the farm. It will route away. GSM module leads information to the farmer to aware them. From this it is determined that the design system is very beneficial and reasonable to the farmer. The design system will not be hazardous to animal and human being, and it guards farm.

### 4.1 FUTURE SCOPE

In the future, there will be identical huge scope, this task can be ready grounded on wireless networks. Wireless sensor network and sensors of different types are used to assemble the evidence of crop settings and environmental variations and this information is communicated through network to the agronomist that recruits remedial movements. Farmers are associated and attentive of the settings of the cultivated turf at any time and wherever in the sphere.

## 5. REFERENCES

- Harbouche, A., Noureddine, D., Mohammed, E., Ben-Othman, J., & Kobbane, A.** (2017). Model driven flexible design of a wireless body sensor network for health monitoring. *Computer Networks*, 129(5), 548-571. <http://thesis.univ-biskra.dz/3844/3/Article%20Elsevier%20-HARBOUCHE%20Ahmed.pdf>
- Jarchi, D., Salvi, D., Velardo, C., Mahdi, A., Tarassenko, L., & Clifton, D. A.** (2018). Estimation of HRV and SpO2 from Wrist-Worn Commercial Sensors for Clinical Settings. In *2018 IEEE 15th International Conference on Wearable and Implantable Body Sensor Networks (BSN)*, pp. 144-147. <https://doi.org/10.1109/BSN.2018.8329679>
- Jin, H., Tao, X., Dong, S., Qin, Y., Yu, L., Luo, J., & Deen, M. J.** (2017). Flexible surface acoustic wave respiration sensor for monitoring obstructive sleep apnea syndrome. *Journal of Micromechanics and Microengineering*, 27(11), 1–7. <https://iopscience.iop.org/article/10.1088/1361-6439/aa8ae0/meta>
- Kraitl, J., Klinger, D., Fricke, D., Timm, U., & Ewald, H.** (2013). Non-invasive. Measurement of Blood Components. In Mukhopadhyay, S., Jayasundera, K., & Fuchs, A. (eds) *Advancement in Sensing Technology. Smart Sensors, Measurement and Instrumentation*, vol 1. Springer, Berlin, Heidelberg. [https://doi.org/10.1007/978-3-642-32180-1\\_14](https://doi.org/10.1007/978-3-642-32180-1_14)
- Sakthimohan, M., & Deny, J.** (2020a). An Enhanced 8x8 Vedic Multiplier Design by Applying Urdhva-Tiryakbhyam Sutra. *International Journal of Advanced Science and Technology*, 29(05), 3348- 3358. <http://sersc.org/journals/index.php/IJAST/article/view/12015>
- Sakthimohan, M., & Deny, J.** (2020b). An Optimistic Design of 16-Tap FIR Filter with Radix-4 Booth Multiplier Using Improved Booth Recoding Algorithm. *Microprocessors and Microsystems*, 103453. <https://doi.org/10.1016/j.micropro.2020.103453>
- Sakthimohan, M., & Deny, J.** (2021). An Efficient Design of 8 \* 8 Wallace Tree Multiplier Using 2 and 3-Bit Adders. *Proceedings of International Conference on Sustainable Expert Systems. Lecture Notes in Networks and Systems*, vol. 176. Springer, Singapore. [https://doi.org/10.1007/978-981-33-4355-9\\_3](https://doi.org/10.1007/978-981-33-4355-9_3)

- Sakthimohan, M., Deny, J., Rani, G. E., Mahendran, J., Ahmed, J. A. J., & Azeem, M.** (2020). IOT based shrewd agronomy method. *Materials Today: Proceedings*. <https://doi.org/10.1016/j.matpr.2020.11.096>
- Yang, D., Zhu, J., & Zhu, P.** (2015). SpO2 and Heart Rate Measurement with Wearable Watch Based on PPG. In *2015 IET International Conference on Biomedical Image and Signal Processing (ICBISP 2015)*, 2015, pp. 1-5. <https://doi.org/10.1049/cp.2015.0784>
- Yu, C., Xu, W., Zhang, N., & Yu, C.** (2017). Non-invasive smart health monitoring system based on optical fiber interferometers. In *2017 16th International Conference on Optical Communications and Networks (ICO CN)*, pp. 1-3. <https://doi.org/10.1109/ICO CN.2017.8121526>.



# **AMELIORATING BANDWIDTH USING NEXT GENERATION SYNCHRONOUS DIGITAL HIERARCHY**

**M. Dhavanth**

*Final Year UG Student, Department of E.C.E, KARE – Tamil Nadu, India-626126*

Email ID: nani.mullangi97@gmail.com, <https://orcid.org/0000-0002-8232-3676>

**Dr. A. Lakshmi**

*Associate Professor, Department of E.C.E KARE – Tamil Nadu, India-626126*

Email ID: lakshmi@klu.ac.in, <http://orcid.org/0000-0002-6744-7048>

## **ABSTRACT**

The advancements in telecommunications has led the usage of Synchronous-Digital-Hierarchy (SDH) for inter-connection of networks. Synchronous Digital Hierarchy (SDH) is a standard International Telecommunication Union (ITU). It is deployed at all levels of network infrastructure including access network and long distance trunk network. It is based on synchronous multiplexed signal onto a light stream transmitted over optical fiber. The telecommunication has switched over from the traditional voice transport to data transport. Though digitized voice is still a very large contributor for bandwidth as well as for revenue. Therefore, instead of an evolution of the existing transport standard, a revolution is necessary to cope up additional data transport. This revolution is Next Generation SDH. Next Generation SDH enables new types of services with more efficient network usage to be easily implemented by utilizing existing infrastructure. Next Generation SDH, enables the simultaneous transport of heterogeneous services over one wavelength thereby saving network building and maintenance costs. Ability to reallocate dynamically bandwidth allows Bandwidth on Demand services. Next Generation SDH do not increase the bandwidth of SDH but they render the signals more flexible allowing a more efficient use of the available bandwidth. This project involves designing and implementation of 2Mbps bandwidth using SDH, 10Mbps bandwidth using Next Generation-SDH and providing protection for allocated channel. This captured the attention from worldwide towards it due to its flexible usage, automatic protection switching, standard for inter-connecting multiple manufactures and ease of multiplexing. But the use of SDH has become obsolete with the introduction of Next Generation SDH (NGSDH). This paper will address about both SDH and NGSDH, their features and deficiency of SDH that lead to NGSDH technology.

**Keywords:** Synchronous Digital Hierarchy, Next Generation Synchronous Digital Hierarchy, Virtual Container, Generic Framing Procedure, Link Capacity Adjustment Scheme, Virtual Concatenation, Performance.

## **1. INTRODUCTION**

In this technological era, the demand for new services like live streaming, higher communication speeds, voice and video calls, accessing huge amount of data has been increasing. These are demanding perfect 'Synchronization' during data transfer. In the late 1960s, the field of telecom services had chosen Pulse Code Modulation (PCM) which transports multiple signals in a single line using digital time domain multiplexing the sampled, quantized, encoded analog signal which demanded higher bit rates. In ITU-T, Plesiochronous Digital Hierarchy (PDH) was defined as G.702 [1] to meet the necessity of high speed data rate. But PDH has limitations like partially synchronous, inflexibility, complex multiplexing and de-multiplexing techniques, lack of interoperability among providers. SDH came into telecommunication field to overcome the disadvantages of PDH. Although SDH have the advantages of flexibility, automatic switching protection, high transmission rates, simplified multiplexing and de-multiplexing, interoperability among providers but it has the limitations of inefficiency in provision of bandwidth managements, hitless provision of bandwidth is not possible, can't map or integrate new type of data rate like Ethernet. Next Generation Synchronous Digital Hierarchy (NGSDH) came into existence to compensate the requirements that SDH cannot provide.

## **2. SDH**

Synchronous Digital Hierarchy (SDH) is a standard discipline for data transmission on optical media in a synchronous manner, also internationally in commensurate with SONET. Both disciplines deliver fast and economical way of network interconnection than conventional PDH equipment [1].

The features of SDH are:

- It incorporates optical and electrical specifications.
- It provides Network Management Service.
- It supports LAN interconnection.
- Uses simple add/drop multiplexing technique [3].

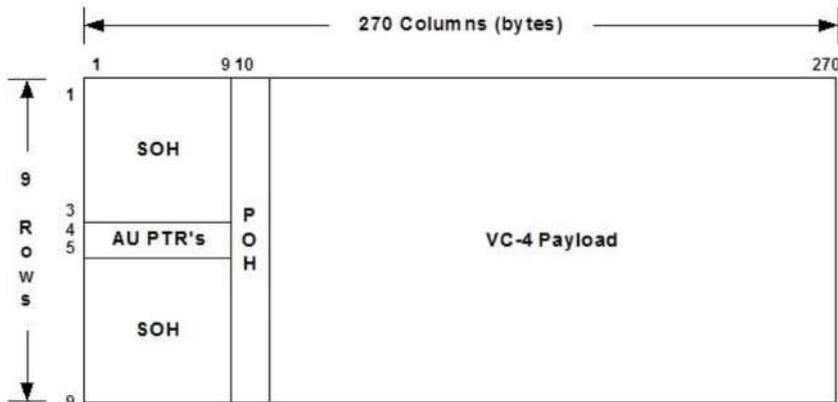
### **A. SDH Rates**

SDH depends on multiples of 155.52Mbps. The fundamental unit of SDH is Synchronous Transport Module-1 (STM-1). Types of SDH rates are as follows:

- STM-1 = 155.52 Mbps
- STM-4 = 622.08 Mbps
- STM-16 = 2488.32 Mbps
- STM-64 = 9953.28 Mbps

### B. STM-1 Frame Format

Any STM Frame [2] contains 9 rows and columns depend upon synchronous-transfer-module level. The number of rows is 9 and number of columns is 270 in STM-1 as shown in Figure1. The STM-1 frame is fundamental format for SDH and it takes 125microseconds. This frame is having 155.52Mbps bit rate and is defined in ITU-T standard as G.707. STM frame has Section Overhead, Payload Area, AU Pointer and Path Overhead.



**Figure 1.** STM-1 Frame Format

Calculation of bit rate in STM-1:

No of rows in each frame: 9

No of columns in each frame: 270

No of bytes in each frame:  $9 * 270 = 2430$

No of bits in each frame:  $9 * 270 * 8 = 199440$

Frame duration: 125 $\mu$ sec

No of bits transmitted in one second:  $(9 * 270 * 8) / 125\mu\text{sec} = 155.52 \text{ Mbps}$

### 1. Section Overhead (SOH)

In each of 9 rows, the first 9 bytes are called overhead. Section Overhead adds bytes in frame structure for providing normal and easy transmission of information payload. Management of network, running of network, and maintenance of network are the services provided by these bytes as shown in Figure2. In each frame, first three rows and last five rows are allocated to Section Overhead. 1-3 rows are called Regenerative Section Overhead (RSOH) and 5-9 rows are called Multiplex Section Overhead.

### 2. Payload Area

Information about different services is stored information payload area of SDH frame structure. Information payload area belongs to Horizontal rows  $10 \times (N-270) \times N$  and vertical columns (1-9).

### 3. Administrative Unit Pointer (AU-PTR) area

In order to indicate position of first byte of the information payload accurately, AU-PTR is used, which ensures correct decomposition of information at receiving end. Its position is fourth row in STM-N frame structure.

### 4. Path Overhead (POH)

For monitoring, managing and controlling of path performance, Path overhead (POH) bytes are used.

## *C. Network Elements of SDH*

Network Elements of SDH has Terminal Multiplexer(TM), Add/Drop multiplexer (ADM), Regenerator, and Digital Cross Connect(DXC).

### 1. Terminal Multiplexer

It is used to combine lower order and higher order input signals into higher rate STM signals.

### 2. Add-Drop Multiplexer (ADM)

It permits adding or dropping of lower order signals as shown in Figure2. Lower order signals can be added into or dropped from higher order SDH signal with the

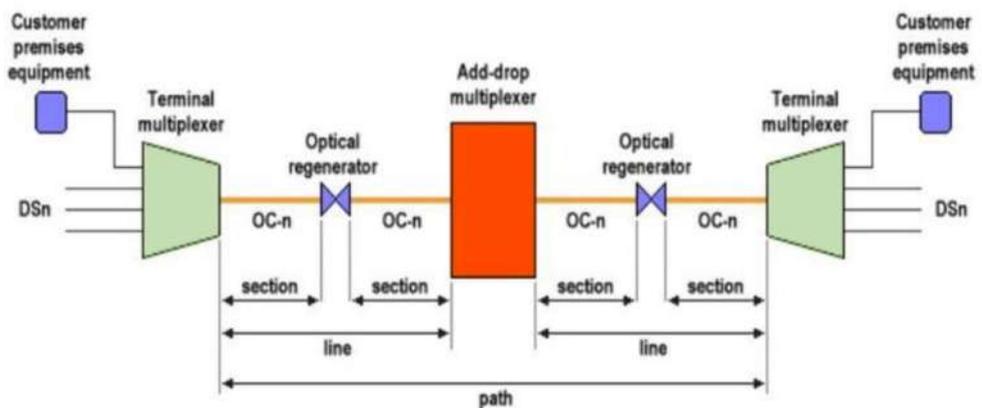
help of ADM [3]. Thus making it possible to form ring structure enabling automatic protection switching.

### 3. Regenerators

Its job is regenerating [3] the attenuated or distorted incoming data signals.

### 4. Digital Cross Connect

Digital Cross Connect will serve as circuit switch creating path between two networks.



**Figure 2.** Connection of Network Elements

## *D. SDH Network Topologies*

It refers to shape of network i.e., geometric arrangement of network nodes and transmission lines and reflects physical connectivity of network nodes.

### 1. Point-to-Point Topology

There exists only two terminal multiplexer network elements at both end of link in point-to-point links.

### 2. Linear Topology

If all nodes in a communication network are cascaded with first and last nodes open. A line topology is formed.

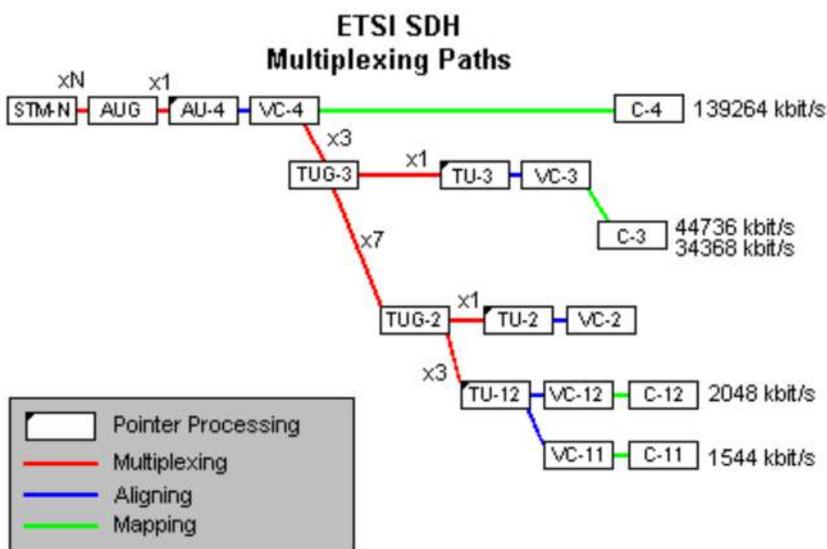
### 3. Star Topology

If a special node is connected with all other nodes and there is no direct connection between them a star topology structure is formed.

### 4. Ring Topology

If all nodes in a communication network are cascaded with no node open, a ring network is formed. If first and last open nodes of a line network are connected a ring-network is formed. The advantage of this topology is providing automatic switching protection mechanism.

### E. SDH Multiplexing Structure



**Figure 3.** SDH Multiplexing Structure

#### 1. Mapping

It is a method when tributaries are transformed into virtual-container by addition of justification bits along with Path overhead information as shown in Figure3 and Table1.

#### 2. Aligning

It takes place when pointer is included in tributary unit or administrative unit making sure that first byte of virtual container to be located as shown in Figure2.

### 3. Multiplexing

It is used when various lower-order signals are transformed to higher-order signal or when higher order signals are modified into multiplex section as shown in Figure 2.

**Table 1.** Combinations of signals

2MBPS	34MBPS	140MBPS
-	-	1
-	3	-
21	2	-
42	1	-
63	-	-

### 4. Container (C)

The first entry of signal is in to container. In container (C-12), the signal size increases from 32 bytes to 34 bytes. The additional bytes are stuffing bits and justification bytes.

### 5. Virtual Container (VC)

The path overhead fields are organized in virtual container.

### 6. Tributary Unit (TU)

It provides adaption between low level and high level path layer and consists of payload and tributary unit pointer. They are used for indicating offset of payload frame start that relates to virtual container frame start of higher order.

### 7. Tributary Unit Group (TUG)

A tributary unit group consists of one or more tributaries. A TUG-2 consists of identical Tributary-Unit-12s or Tributary-Unit-2. TUG-3 consists of identical Tributary-Unit-Group-2s or Tributary-Unit-3. TUG-2 consists of 3-Tributary-Unit-12s. TUG-3 consists of either 7 Tributary-Unit-Group-2 or 1 Tributary-Unit-3.

### 8. Pointer

A Pointer is an indicator which provides frame offset of Virtual Container regarding with the frame of transport entity.

### 9. Administrative Unit (AU)

It acts as information structure and also in provision of adaption between higher order and multiplex section layer. Administrative-Unit comprises of payload and Administrative-Unit pointer and also used in indicating the offset of the starting of payload frame that relates to the frame start of multiplex section. Administrative-Units are defined as (i) Administrative-Unit-4 which consists of Virtual Container-4 and Administrative-Unit pointer. (ii) Administrative-Unit-3 consisting of Virtual Container-3 and Administrative-Unit pointer.

### 10. Administrative Unit Group (AUG)

Administrative Unit Group consists of combination of Administrative-Unit-3 or Administrative-Unit-4.

#### **Advantages of SDH:**

- The transmission rate can reach up to 10 Gbps [3].
- It has auto backup and repair/restore mechanism in case of failure of a link in network.
- Simplified Add/Drop function using ADM [3].
- It provides interoperability among providers thus supporting different operators.
- Supports not only point-to-point but also multipoint networking.
- Ring topology offers switching protection to traffic.

#### **Limitations of SDH:**

- Difficulty in mapping newer services (Ethernet, ESCON, FICON, Fibre Channel) to existing network.
- Inefficiency in use of transport network.
- Inability to upgrade or downgrade available bandwidth during active traffic.

### **3. NEXT GENERATION SDH**

By adding new nodes at the edges known as Multi Service Provisioning Platforms (MSPP) / Multi Service Switching Platforms (MSSP), Next Generation SDH provides operators more services for transporting [4] the data such that the efficiency of conventional SDH will be increased. This specifies that it is not required to setup another network as a result reduces cost and makes new customers available for earlier services also. Also other protocols are setup on these edge nodes to achieve efficient data transport services. These nodes are interconnected with the existing equipment as shown in Figure4.

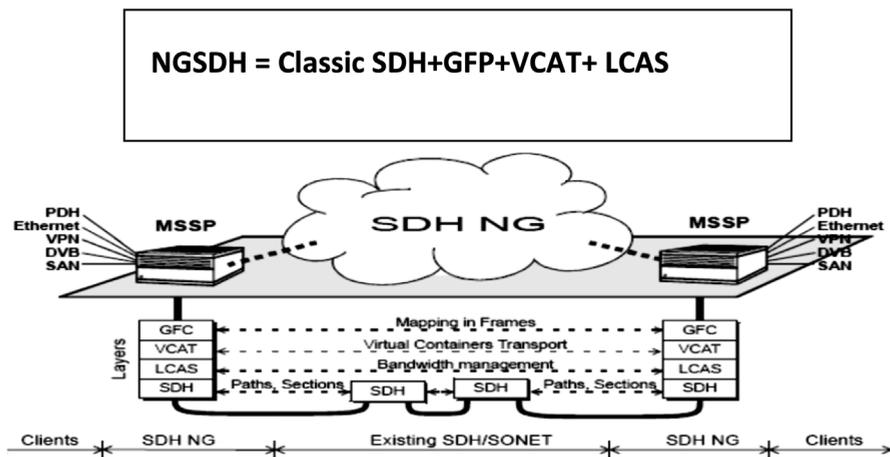
The limitations in SDH can be resolved by Next Generation SDH.

#### **Three major technologies or protocols in NGSDH are:**

- Generic Framing Procedure (GFP)
- Link Capacity Adjustment Scheme (LCAS)
- Virtual Concatenation (VCAT)

#### **They have the features of:**

- Integrated data transport services such as Ethernet [5], Fast Ethernet, ESCON, FICON----GFP
- Integrated combination of Virtual Containers (2Mb granularity) which provides efficient use of network in delivering the services----VCAT
- Allocating bandwidth dynamically, by bandwidth on demand and scheduling---  
-LCAS



**Figure 4.** Block diagram of NGSDH

### A. Generic Framing Procedure (GFP)

It is one of the protocols for packet [5] encapsulation packet data on SDH network. In ITU-T standards it is defined as G.7041. This protocol will add dynamism to conventional SDH thus making it one of the economical ways of incorporating data services in SDH networks.

Two types of GFP mechanisms are:

- a. Packet oriented data unit (PDU) [5]
- b. Block oriented

#### 1. GFP-F:

It is also known as Packet Data Unit [5]. Optimized and used in data packet protocols such as Point-to-Point (PPP), Ethernet/Fast Ethernet/ESCON/FICON/Gigabyte Ethernet, MPLS, etc. Adaptation and multiplexing at packet or frame level is supported by Frame mode which maps the complete frame of the customer into one GFP frame of a constant length. The frame is stored in buffer before being encapsulated for determining its length. It has variable frame size having more delay. It is used for Layer-2 encapsulation.

## 2. GFP-T:

It is also known as Block Code oriented [5]. It is useful for delay sensitive services. It has constant frame size having no delay. It is used for Layer-1 encapsulation.

Example: ESCON, FICON, FC, etc.

### B. Concatenation (C)

Concatenation involves linking of more than one Virtual Containers to each other in order to obtain a rate that cannot be achieved using standard rates. As the payloads do not fit into standard Virtual Containers efficiently, concatenation is used for efficient way of transport in Virtual Containers as shown in Figure 5.

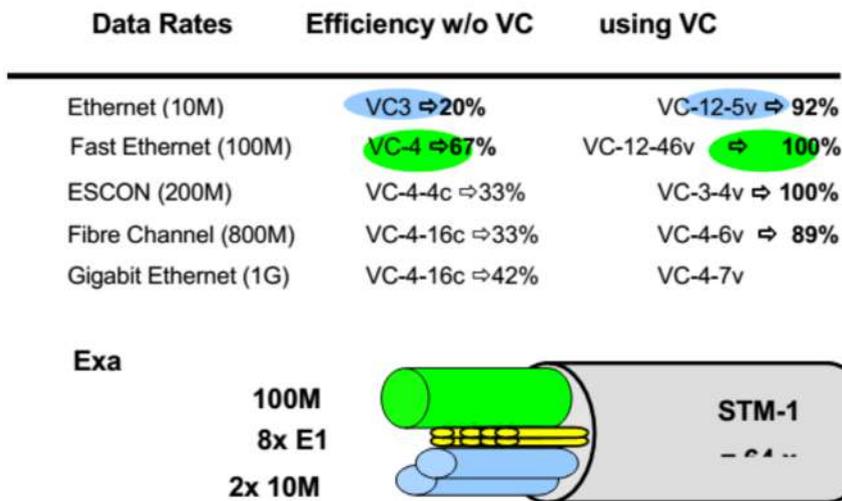


Figure 5. VCAT Efficiency

**Two types of concatenation are:**

1. Contiguous Concatenation
2. Virtual Concatenation

1. Contiguous Concatenation:

The conventional way of combining containers is called as contiguous. In contiguous concatenation only combination of adjacent containers is possible but not combination of lower virtual containers. Contiguous Concatenation depends on pointer. It includes linking of N number Virtual Containers of higher order that is Virtual Con-

tainer-4 but not the lower order as shown in Figure5. The disadvantage is that at every Network Element it requires functionality which adds cost and complexity. Concatenation of Lower order Virtual Containers (VC12, VC3) is not possible in contiguous concatenation.

## 2. Virtual Concatenation:

Mapping of individual Virtual Containers [4] to a virtual link is called Virtual Concatenation. Number of containers that can be grouped together is not limited, and also provides good bandwidth granularity compared to contiguous concatenation. It concatenates various lower and higher level Virtual Containers (VC12, VC3 & VC4) that form a virtual concatenation group. For example 20Mb Ethernet would be made of ten Virtual Container-12s, thus providing both data handling and scalability.

### **Benefits of VCAT:**

- Uses the same Network elements but modifies only the edge Network elements.
- Low investment with fast Return on investment.
- High efficiency and scalability.

### *C. Link Capacity Adjustment scheme (LCAS)*

LCAS is also a protocol of NGSDH which is stated in ITU-T standard as G.7042. It can also change the capacity of bandwidth [4] dynamically. It can dynamically change Virtual Concatenation path sizes and also to automatically recover from path failures. It can provide services for bandwidth as per customer requirements.

LCAS permits to adjust the size of payload of Virtual Concatenation Group in real time such that the bandwidth is upgraded or downgraded without incurring hits into active traffic.

Functioning of LCAS:

#### 1. Bandwidth based on Customer's-demand

##### **Customer:**

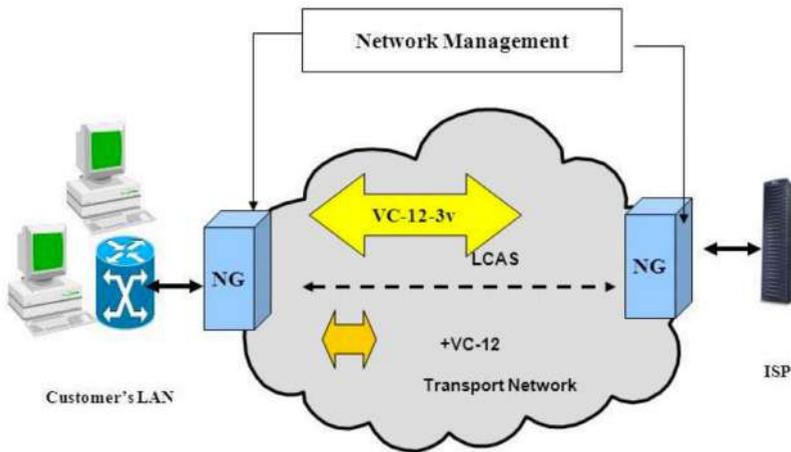
→ Demands certain capacity for connection.

→ Demands for additional 2Mb.

**Service Operator:**

→ Will provide it by adding another VC12.

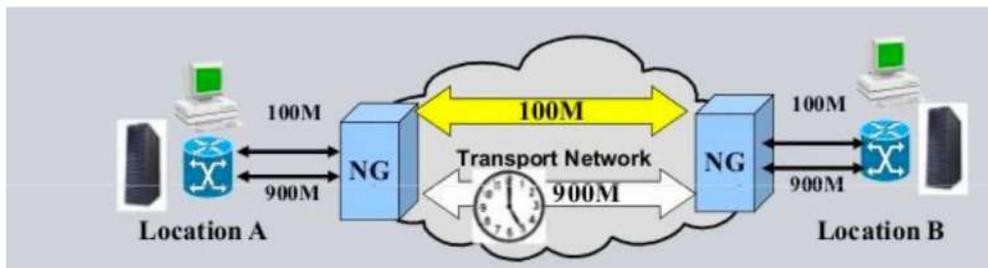
→ Without incurring hits into active traffic as shown in Figure6.



**Figure 6.** Bandwidth on Demand

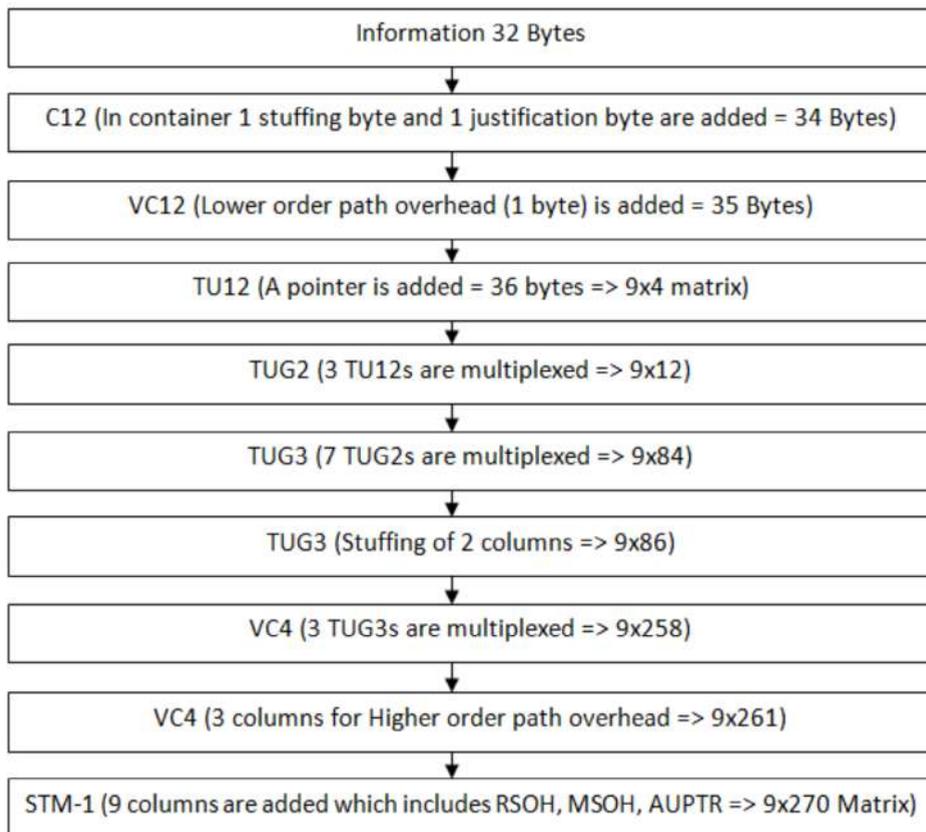
2. Bandwidth based on Customer's Schedule:

Customer demanded a bandwidth of 200Mb Ethernet, and it is provided with the help of 92 VC12s. Every night for an hour extra 900Mb ESCON service is provisioned by LCAS for data backup as shown in Figure7. New revenue is generated at low traffic hours.



**Figure 7.** Bandwidth on Schedule

The process of formation of STM-1 Frame is shown in Figure 8.



**Figure 8.** Formation of STM-1 Frame Structure

### 3. CONCLUSION

The demand for optical networks has been increasing with the availability of high speed networks. Even though SDH is lacking to meet those demands, by combining classical SDH with the three new technologies i.e. Next Generation SDH can provide performance which users are demanding and provide interoperability among different providers with good economical value. The advantage of NGSDH is allowing current operators to interface new services to conventional SDH services. Using GFP, mapping of different data interfaces to the conventional SONET/SDH infrastructure and then with the help of Virtual Concatenation granular bandwidth is provided by combining different virtual containers, later LCAS strengthens the value of VCAT by permitting providers to adjust bandwidth during active traffic hours to meet customer’s changing needs in an efficient way.

## **4. FUTURE WORK**

Due to fast data transfer, NG-SDH is used in live video conference and due to high accuracy, NG-SDH is used in regional network area.

Due to low data loss, NG-SDH uses ring topology thus providing protection to the path.

It is implemented in areas of bandwidth on demand and bandwidth on schedule

## **5. REFERENCES**

- Olabenjo Babatunde** (2014), A review of Plesiochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH), International Journal of Scientific Research Engineering & Technology (IJSRET)
- A. K. Kavitha** (2015), Performance Analysis of SDH Network Management System using DWDM Technique, International Journal of Engineering Technology Science and Research
- N. Jyothirmai, R. M. Valli, and A. R. Krishna** (2012), SDH and Its Future Trends, International Journal of Innovative Technology and Exploring Engineering.
- Dirceu Cavendish** (2002) NEC USA, Inc, New Transport Services for Next-Generation SONET/SDH Systems, IEEE Communications Magazine.
- Antonio Marcos Alberti** (2011), Ethernet-over-SDH: Technologies Review and Performance Evaluation, REVISTA TELECOMUNICACOES.



# MORPHOLOGY AND SEGMENTATION USED IN AUTOMATED SCREENING OF TUBERCULOSIS

**Balasubramani Perumal**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: palanimet@gmail.com, <https://orcid.org/0000-0003-4408-9396>

**Emil Molayil Paul**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: emilmpaul@gmail.com, <https://orcid.org/0000-0003-0563-4240>

## ABSTRACT

Tuberculosis(TB) is a necessary hazard in several areas of the globe. The multi-drug-resistant microorganism lines have exacerbated the matter, whereas diagnosing Tuberculosis even so stays a challenge.TB along with Covid- 19 brings prolonged adversary effects to the health of the affected person. Mortality rate will abruptly increase, if this disease is not diagnosed properly. In this paper, we deal with the morphological filters,for image enhancement(for the input chest images after the preprocessing). Both top hat and bot hat filters are used for the proper ROI (Region Of Interest) selection,which can be further proceeded for the segmentation part.Here,we have also compared different segmentation methodologies to analyse the performance of segmentation unit and found out that the marker based watershed segmentation excels the other segmentation methods such as Graph cut,KNN,Clustering methods,P-DE(Partial Differential Equation),Region Based Method,Thresholding Method.Variuos graphical methods are used for the performance comparison.It yields an accuracy of about 81%.

**Keywords:** Marker Based Watershed Segmentation, Graph cut, KNN(K Nearest Neighbour)segmentation,CannyEdge Detector, Morphological Filter,(Tophat,bothat filters).

## 1. INTRODUCTION

Tuberculosis is an infectious illness and is one amongst the foremost issues all round the world. Principally, growing nations suffer from T.B. because of dangerous fitness conditions. There are specific analog techniques for the screening of T.B. e.g. microscopy, Genexpert, culture checking and drug status test, line probe and several skin tests aids in analyzing the stage and state of tuberculosis.So distinctive automat-

ic methods had been developed for the detection of severity of sickness. Medical imaging technological know-how could be a facts managing an integrated system designed for the screening of T.B. patients. The tools consists of a magnifier, computer, digicam for taking photos of the affected area of the lungs of the victim and the software system also may be used for distinguishing the malady. However, for Chest Radio-graphs the X- ray pictures are used as enter to the algorithmic rule for the diagnosing purpose. The algorithms interpret the photograph. The machine-driven systems are accustomed reap higher effects in abundant less time. The statistics of those photos are often used because the scientific report back to measure and analyze the previous history of a patient. A machine-driven detection device races the procedure by manner of incrementing the majority of slides screened. The screening technique is extended with the help of creating the reviewing procedure faster via reducing eye fatigue. In this paper we tend to discuss, regarding the varied automatic approaches for sleuthing the TB. Here numerous techniques are tailored for preprocessing, segmentation, feature extraction techniques and various classifiers for sleuthing the similar.

## **2. RELATED WORKS**

Screening is widely used for detection of tuberculosis. It's hard for a radiologist to interpret the disease. It's viable to improve this task through the use of CAD system[18]. When compared to the existing methods, the proposed approach offers the fine result. This paper describes different chest radiography approaches used in the automated screening of tuberculosis patients When compared to the existing methods, the proposed approach offers the fine result. Initially, the input chest x-ray is pre-processed the use of Weiner filter and it is a kind of non-linear filter[19]. Then the local features are extracted the use of LBP and HOG in every block[1]. Lung Tuberculosis is induced via micro organism known as Mycobacterium Tuberculosis or tubercle bacillus. This research work strives to pick out techniques by means of which patients, who require the second opinion for an already recognized result, can save a lot of money. Once we get hold of X-ray image an input, pre- processing techniques like Gaussian filter, a median filter is applied. These filters help to do away with unwanted noise and resource to get high-quality textural features. The output acquired from this is taken as an input and applied to watershed segmentation and grey level segmentation which helps to focus on the lung location of the obtained results[2]. In this paper, the authors current a computerized TB approach with the aid of morphological features along with ellipse fitting. The input feed of the proposed method is the images of ZN-stained sputum smear which comprises of three phases[3][21].

The two formats for Watershed Segmentations are Watershed Distance Transform Segmentation and Marker Based Watershed Segmentation. However, it was found that Distance Transform Watershed Segmentation produces inaccurate results due to over segmentation[5]. This method realizes the computerized segmentation and classification of Mycobacterium tuberculosis with traditional mild microscopy. Here firstly, mycobacterium bacillus are segmented by means of the marker-based watershed transform with the aid of the adaptive scale Gaussian filter as preprocessing filter[6]. The lung segmentation process is modeled from the definition of feature extraction and computation. First, the system segments the lung using a graph cut optimization technique. Then a set of a pre-trained features are fed to the binary classifier and decides whether the person is affected with TB or not[7]. In TB Screening the use of CAD gadget is already available for improving the performance of a human expert. Even though the diagnosing TB Patients is a difficult mission, a new method called "conventional poster anterior chest radiographs" is introduced[8]. This paper deals with Deep Convolutional Networks. The three different approaches such as slice-wise lesion detection, semantic segmentation, and the slice-wise lesion detection uses the sliding window in 3D CT scans[9]. This method propose, an awesome combination of the facets of radiographs such as the surface of the image, decisive nature of the radiographs, and contour abnormality subsystems are mixed into one gadget to deal with the three one-of-a-kind abnormality aspects discovered in a variety of people. The supervised pixel classification is used to become aware of tuberculosis. The performance evaluation is based on TB screening and a TB suspect database using both an external and a reference standard[10]. The existing methodologies incorporates cavity detection, ribs and diaphragm elimination. Moreover, it challenges the chest radiographs studies. Here the lung area is extracted using registration primarily based segmentation methods to handle the confusions in segmentation[11].

### **3. VARIOUS SEGMENTATION METHODS**

#### **3.1. GRAPH CUT SEGMENTATION AND LHTGF FEATURE EXTRACTION METHODS WITH SVM CLASSIFIER**

Here, the input chest x-ray has been pre-processed with the usage of Weiner filter. Its being employed for restoring blurred and noise image and for filtering a gray scale image. Graph Cut segmentation technique is employed for segmenting the pictures. Segmentation is partitioning the image into areas equivalent to specific, evident objects on the image. Segmentation Algorithms: 1) Segmentation supported points, lines, edges and contours of objects and it's represented to be the difference in a

picture.2) Segmentation primarily based on the partition of the image into areas and then delineated to be the similarity in a picture. The changed LHTGF primarily based Feature Extraction is employed which contains the advantages of the subsequent feature extraction ways 1) LBP, 2) HOG primarily based Feature Extraction 3) Tamura Feature Extraction 4) Gabor Filter 5) Fusing the features:  $FLHT=f(LBP \cup HOG \cup TAMz)$ . The SVM maps input vectors to a bigger dimensional vector space [1]. In this work, the gain of LHTGF points for sleuthing TB is examined. The planned methodologies LBP, HOG and Tamura that once combined with Dennis Gabor options (LHTGF) offers confidential effects when put next with this ones. The take a glance at results show that LHTGF points find their basic position in TB detection functions allotted on the Montgomery and china databases. LHTGF options show an accuracy of 93.4% in detection of TB in Montgomery dataset and eighty nine accuracy in sleuthing TB in China dataset. The extension of the work is towards the detection of TB the employment of a neuro-fuzzy genetic formula.

### **3.2. KNN, SIMPLE LINEAR REGRESSION AND SMO CLASSIFIERS**

Here Median is employed. In a median filter, the noise gets reduced by exploitation the square of the amount of pixels that we tend for averaging. For segmentation, Watershed could be a morphological device is often used. It identifies the outputs instead of the utilization of input segmentation techniques. The output from the segmentation ways is consolidated to induce a neighborhood of Interest (ROI). From the ROI, the applied mathematics options like space, major axis, minor axis, eccentricity, mean, kurtosis, skewness, and entropy are extracted. Finally, we use KNN, sequential minimal optimization (SMO), simple regression classification techniques to observe respiratory organ infectious disease. The results got here this paper suggests KNN classifier performs nicely than the various 2 classifiers. Here, the division is performed on the groundwork of comparable attributes. Similarities are separated into one in every of a form teams. The K nearest neighbor (KNN) formula helps in deciding the closest neighbor of Associate in Nursing unknown info purpose. This formula works looking forward to the worth of k. If the value of  $k=n$ , then we are able to predict n nearest neighbor. during this analysis work, 2 categories are gift specifically, traditional categorification and peculiar class. A form of regression analysis model, it assumes the target variable is foreseeable, not chaotic or random. Sequential Minimal Optimisation (SMO) Classification is a way to clear up the SVM coaching drawback that's quite economical. SMO uses heuristics to partition the coaching bother into smaller issues that may be solved analytically. It quickens the coaching technique. A technique to look at respiratory organ infectious disease mistreatment pectoral x-ray is introduced during this analysis work. to induce eliminate undesirable noise from

a picture, median filtering technique is accomplished at the planning stage. For the next stage we tend to mixed 2 segmentation ways like watershed model and gray level thresholding model, and a consolidated image is generated that yields a passing correct consequence options like space, major axis, minor axis, eccentricity, mean, variance, skewness, kurtosis are extracted from ROI of consolidated image similar attributes. Similarities are separated into one of a kind groups. In future, numerous feature extraction/feature selection methods are often used for infectious disease segmentation classification.

### **3.3. HYBRID DYNAMIC PROGRAMMING MODEL AND IMAGE SEGMENTATION AND COARSE-TO-FINE DUAL SCALE METHOD BASED ON SUPPORT VECTOR MACHINES (SVM):**

Hybrid Dynamic Programming model could be a mixture of Dynamic programming, Active form model and component Classification ways in which in an exceedingly} terribly structured methodology. It is accustomed boost the results of individual algorithms. Active structure modeling (ASM) is employed to come back duplicate with realizable shapes and dynamic programming is employed to seek out the precise boundary. The hybrid dynamic programming mannequin includes Active shape model and pixel classification. The Coarse-to- fine twin scale technique supported Support Vector Machines (SVM): A CXR image is 1st divided into patches. In beginning, the modules accustomed seize the coarse aspects are Gaussian-model- based model matching (GTM), local binary sample (LBP) and histogram of familiarizing gradient (HOG) primarily based fully characteristic classification (LHFC). Secondly, contours of the chosen candidates are divided using : Hessian-matrix-based image sweetening (HIE) and Active contour-based segmentation (ACS). Thirdly, a contour based mostly altogether characteristic classification (CFC) module is applied. Fine points that has sort, edge, and section are extracted from the contours[9]. The future work is to layout associate intelligent mannequin for sleuthing pleural TB exploitation Active Learning frameworks.

### **3.4. GRAPH CUT SEGMENTATION USING SVM AND CBC TECHNIQUES.**

In this methodology, a region of the lung is extracted using graph cut segmentation. During this extracted phase, a collection of texture and structure options is computed. The situation below a roc curve for the primary time is referred with the help of (AUC) of 87 and second, set of 90%. TB is labeled by means of the threshold values[14]. Here, the SVM is employed for classification and is employed to investigate information and pattern. In addition, it's a learning model and formula used for clas-

sification and regression. SVM includes a one or completely different class of coaching formula having binary linear classifier. SVM mannequin may be a illustration of an element in area, that the example is obvious and wide as potential. By exploitation SVM and CBC techniques, TB detection is through with classification.



**Graphic 1.** a) The Segmented Image  
**Source:** own elaboration

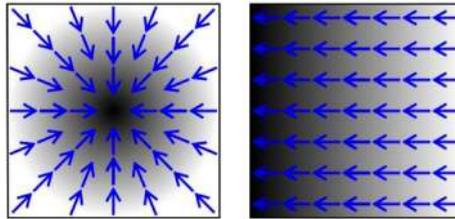
Finally in contrast to other structures in the literature and achieved better overall performance in contrast to other existing methods.

### 3.5 GRAPH CUT SEGMENTATION WITH GLCM FEATURES AND SVM CLASSIFIERS

The experiments and effects exhibit that the novel classification technique used is further correct once in distinction to the regular technique. In pre-processing step initial, follow a Gaussian filtering to our input image. The GLCM features endorse two situations for the implementation. It primarily based entirely Classifications within the initial state of affairs, the co-occurrence matrix immediately been used by ever-changing it into a column vector for each image within the recognition method. The SVM Classifier: SVM maps input vectors to a better dimensional vector area wherever an prime of the line hyperplane is made. This hyperplane that maximizes the margin is noted because the best isolating hyper plane and additionally the margin is printed as a result of the whole of distances of the hyper plane to the closest coaching job vectors of each category. This approach combines depth records with customized internal organ atlas models derived from the training job set. Then work out a collection of shape and texture aspects as stepping into a binary classifier, that then classifies the given input image into each traditional or abnormal. The dynamic programming route is calculated additional exactly if a couple of reference factors on the contour are clicked and therefore the direction is compelled to travel by through those points[10]. Providing over one reference is helpful for delicate cavities for specific boundary segmentation. Such a tool ought to be terribly helpful in remedy watching for TB[18].

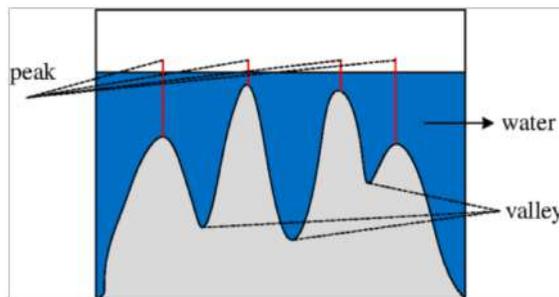
### 3.6 WATERSHED SEGMENTATION

Automatic investigation of TB microorganism algorithms have conjointly been tested to be less time , less human error and less man- power. The Watershed transformation is a powerful tool for image segmentation, it uses the region-based approach and searches for pixel and region similarities. The watershed concept was first applied by Beucher and Lantuejoul at 1979, they used it to segment images of bubbles and SEM metallographic pictures. An image gradient is a directional change in the intensity or color in an image. Image gradients may be used to extract information from images.



**Graphic 2.** Shows image gradient

**Source:** Google images



**Graphic 3.** Shows how watershed is built

**Source:** Google images

The approach consists of analyzing a picture, with the color thresholding segmentation before greyscale color. The excellence of the greyscale image has been increased, and binarization is performed. The Image Segmentation is intermeshed toward characteristic and differentiating between the being with the history image in order that the previous is detected and counted. Throughout this analysis, two methods are involved; on Watershed Segmentation The first methodology quickly makes use of Watershed Segmentation on the image, to boot known as Watershed Distance transform Segmentation methodology. The second methodology, Marker based Water-

shed Segmentation, which overcomes the over segmentation problem of the first method, limits the variability of regions through exploitation the inside markers to specify the ROI [5]. Unfortunately, most times the real watershed transform of the gradient present many catchment basins, Each one corresponds to a minimum of the gradient that is produced by small variations, mainly due to noise. This leads to the over segmentation problem, which yields inaccurate results. The over- segmentation could be reduced by appropriate filtering, but the best results is obtained by marking the patterns to be segmented before performing the watershed transformation of the gradient. This can be effectively reduced by using marker based watershed segmentation.

#### 4. PROPOSED METHOD

Our planned system contains the preprocessing followed by segmentation, feature extraction strategies, trained information sets and also the classifier.



**Graphic 1.** Flow Chart  
**Source:** own elaboration

The preprocessing technique includes median, wiener and morphological filters (Top hat and bot hat filters). The median filters out the salt and pepper noises, but once the impulse noise is larger than .4%, it filters out the helpful data within the chest pictures. It will bring an improbable loss in sleuthing the TB. Therefore, the filtered output from the median filter is then fed to the Weiner filter. This filter, in turn, smoothens and restores the required data of the chest pictures. This output is then fed to the image improvement filters say top hat and bot hat filters. Even once the background of the image and also the target color remains identical, the morpho-

logical filter analyses the same and identifies them as separate values even our eyes cannot determine. The output is then fed for segmentation. Here, marker based watershed segmentation is used to avoid the over segmentation from distance transform watershed segmentation. After the feature extraction, the chest X-ray images from the database is compared with the feature extracted image and is fed to a binary classifier for detecting the TB in its initial state depending upon certain features like speed, accuracy, sensitivity.

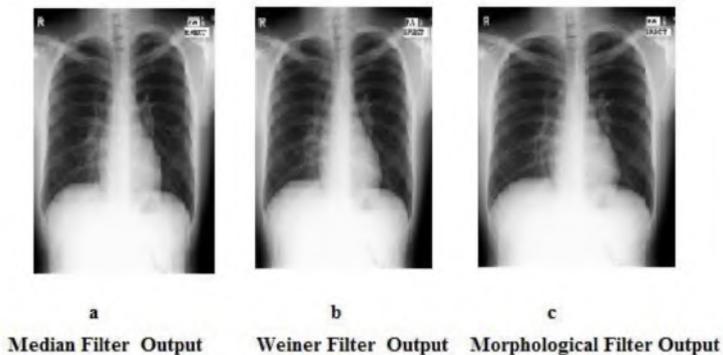
## 5. RESULTS

Let us analyze the output of the Median, Weiner, Morphological filters on the X-Ray chest images for detecting TB in its initial stage.



**Graphic 4.** Input Original Chest Images  
**Source:** own elaboration

The figure below shows the output after preprocessing of each filters output. It filters out the noises from the unblocked secondary radiations (speckle noise). The time taking for creating and copying the X-ray image (Gaussian Noise). Due to the digitization the noises are added up radiometrically and geographically (Salt and Pepper noise). These noises are been fairly well removed by the proposed preprocessing filters.



**Graphic 5.** shows the outputs of each preprocessing filters (individual stage output)  
**Source:** own elaboration

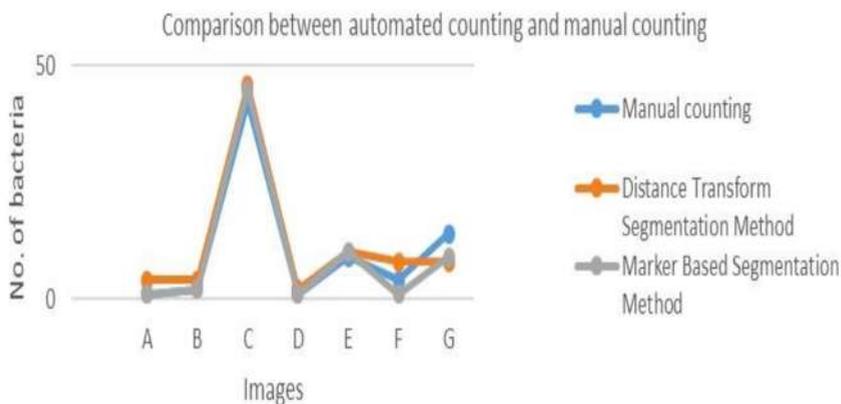
The final output of the preprocessing section is shown after it is fed through median, weiner and morphological filters. The median filter filters sort out the salt and pepper noise (due to dead pixels, ADC error). This signal is then filtered using weiner filter, which reduces the error rate mainly reduces the speckle noise occurs due to the back scattering of X-rays. For enhancing the ROI, it's then fed to morphological filters.



**The output of the proposed filter  
(After Pre Processing)**

**Graphic 6.** shows the final output of the preprocessed stage.  
**Source:** own elaboration

The graphical representation below shows the difference between the manual and automatic watershed counting with watershed and marker based watershed segmentation on the bacteria count is shown below:



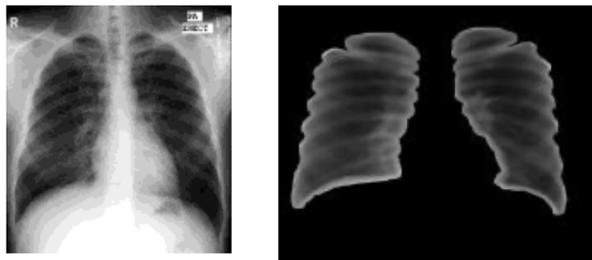
**Graphic 7.** This graph supports the advantages of using the marker based watershed segmentation when compared to the distance transform segmentation method.  
**Source:** own elaboration



**MARKER BASED WATERSHED SEGMENTATION (LUNG X-RAY IMAGE)**

**Graphic 8.** Shows how marker based watershed segmentation works well with chest images  
**Source:** own elaboration

The marker based segmentation utilizes both internal and external markers. The input lung image after the image enhancement is applied watershed, then applied markers to select the ROI. The above figure clearly explains how the marker shed works with lung chest image.

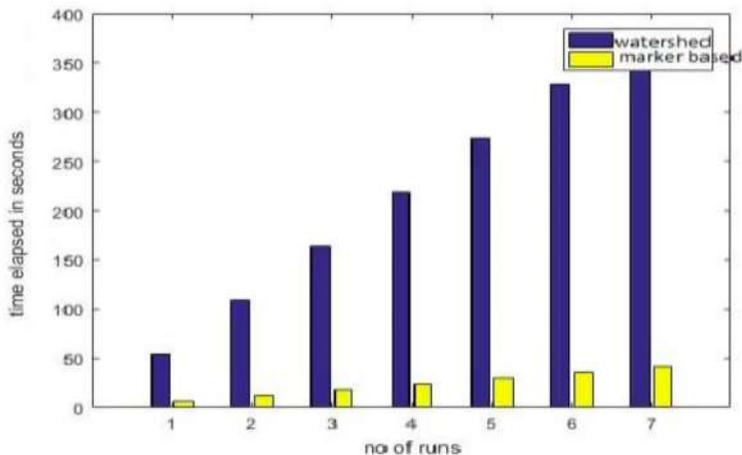


**Graphic 9. a)** Watershed segmented output **b)** Marker based segmentation (Here the ROI is obtained clearly).  
**Source:** own elaboration

Here from the figure it is clear that the marker based watershed segmentation yields a clear ROI (Region Of Interest) when compared to the distance transform watershed segmentation method and hence yields clear result for the feature extraction process. It also requires lesser running time when compared to the existing.

A graphical comparison between distance based watershed and marker based watershed segmentation is made between the time taken (which means the speed required to complete the execution) and number of runs. Our proposed system retains

its beneficiary with much less execution time when compared to the distance transform watershed segmentation. The representation is shown below:



**Graphic 10.** shows the graphical representation between distance transform segmentation and marker based segmentation

**Source:** own elaboration

## 6. CONCLUSION

This paper offers a clear-cut review of the assorted strategies adopted for preprocessing, thresholding, classifications and far a lot of. economical feature extraction methods are known like LBP, HOG based mostly Feature Extraction, Tamura Feature Extraction. For the fast and accurate segment analysis marker based watershed segmentation have been used, along with the morphological filters. In this paper after comparison with different segmentation methods, we found out that the accuracy is around 81%. In future this segmented image can be combined with K means clustering (after normalisation and gamma correction of the input image) for the accurate ROI, which then can be fed to feature extraction Process. The main advantage of this marker based watershed segmentation is that, it reduces the over segmentation explicitly by setting the internal and external markers for the lungs (X-ray chest images) image analysis.

## 7. COMPARIOSN BETWEEN DIFFERENT SEGMENTATION METHODS

Segmentation technique	Description	Advantages	Disadvantages
Thresholding Method	Works on the histogram peaks of the image. It finds out a particular Threshold	1) No need of previous information 2) Simplest method	1) Highly dependent on peaks, 2) Spatial details are not considered

Edge Based Method	Works on discontinuity detection	1) Good for images having better contrast between objects	1) Not suitable for wrong detected or too many edges
Region Based Method	Works on by partitioning image into homogeneous regions	1) More immune to noise 2) Useful when it is easy to define similarity criteria	1) Expensive method in terms of time and memory
Clustering Method	Works on by dividing the image into homogeneous clusters	1)Fuzzy uses partial membership, therefore useful for Real problems	1) Determining membership function is not easy
PDE based Method	Works on the differential equations	1) Fastest method, 2) Best for Real time applications	1) More computational complexity
Graph cut Method	Works by partitioning an undirected graph into disjoint sets. By associating energy term with every cut optimization is achieved.	1) It can be applied to low level vision problems by minimizing the energy in cut.	1) It has a very high time complexity
Watershed Segmentation	Works on topological interpretation	1) Results are more stable 2) Detected boundaries are continuous	1) Complex calculation of gradients. 2) Oversegmentation ,it can be reduced by using marker based watershed segmentation.

**Graphic 1.** Comparison Table**Source:** own elaboration

## 7. REFERENCES

- MS Vidya,M Krishnan,G Anirudh,**(2019). Local and global transformations to improve learning of medical images applied to chest radiographs, - Medical Imaging,- spiedigitalibrary.org. <https://doi.org/10.1117/12.2512717>
- Kumar S. N; Lenin Fred A; Muthukumar S; Kumar H., Ajay; Varghese P, Sebastian,** (2018). A Voyage On Medical Image Segmentation Algorithms, Biomedical Research (0970-938X) pS75-S87. 13p. <https://doi.org/10.4066/biomedicalresearch.29-16-1785>

- R. Beulah Jeyavathana, Dr. R. Balasubramanian & Mr. Anbarasa Pandian,**(2017). An Efficient Feature Extraction Method for Tuberculosis detection using Chest Radiographs, International Journal of Applied Environmental Sciences ISSN 0973-6077 Volume 12, Number 2 (2017), pp. 227-240. DOI:unavailable
- Reshma S R ,Rehannara Beegum T,**(2017).Microscope Image Processing for TB Diagnosis Using Shape Features and Ellipse Fitting”,IEEE SPICES 2017 1570365912. <https://doi.org/10.1109/spices.2017.8091342>
- Emil.M.Paul,B. Perumal,**(2018).Filters Used in X-Ray Chest Images for Initial Stage Tuberculosis Detection,IEEE Xplore2019. <https://doi.org/10.1109/ICIRCA.2018.8597334>
- M. K. Hassan, N. F. H. Eko and S. Shafie,** (2017)Tuberculosis Bacteria Counting Using Watershed Segmentation Technique, SCIENCE & TECHNOLOGY ,Pertanika J. Sci. & Technol. 25 (S): 275- 282 (2017) Journal of Science & Technology: ISSN 0128-7680 (Print); ISSN 2231-8526 (Online)
- ChaoXu, DongxiangZhou, YongpingZhai, Yunhui Liu**(2018),Automatic Segmentation and Classification of Mycobacterium Tuberculosis with Conventional Light Microscopy”, Proc. of SPIE Vol. 9814 981409-2, Parallel Processing of Images and Optimization; and Medical Imaging Processing, edited by Jianguo Liu, Proc. of SPIE Vol. 9814, 981409. <https://doi.org/10.1063/1.4917142>
- K Furutani, Y Hirano, S Kido,** (2019). Segmentation of lung region from chest x-ray images using U-net,Joint International Workshop on Advanced Image Technology (IWAIT) and International Forum on Medical Imaging in Asia (IFMIA). <https://doi.org/10.1117/12.2521594>
- Udayakumar E, Santhi S, Vetrivelan P,** (2017)TB screening using SVM and CBC techniques”, Curr Pediatr Res 2017 Volume 21 Issue 2 [10]Korsuk Sirinukunwattana, Shan E Ahmed Raza, Yee-Wah Tsang, David RJ Snead, Ian A Cree, and Nasir M Rajpoot. Locality sensitive deep learning for detection and classification of nuclei in routine colon cancer histology images. IEEE transactions on medical imaging, 35(5):1196–1206, 2016. DOI:unavailable.

- A.Kalinovsky, V. Liauchuk, A. Tarasau,** (2017)“Lesion Detection In Ct Images Using Deep Learning Semantic Segmentation Technique”, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XLII-2/W4, 2017 2nd International ISPRS Workshop on PSBB, 15–17 May 2017, Moscow, Russia. <https://doi.org/10.5194/isprs-archives-XLII-2-W4-13-2017>
- M. Raviglione and G. Sulis** (2016),“Tuberculosis Burden, Challenges and Strategy for Control and Elimination.”, *Infect. Dis.Rep.*, vol. 8, no. 2, p. 6570, Jun. 2016. <https://doi.org/10.4081/idr.2016.6570>
- S.J.Surya , S.Lakshmanan, Ji. Aldo Stalin,** (2017).“Automatic Tuberculosis Detection Using Chest Radiographs Using Its Features Abnormality Analysis”,*Journal of Recent Research in Engineering and Technology* ISSN (Online): 2349–2252,ISSN(Print):2349– 2260 Volume 4 Issue 9 Oct 2017. DOI:unavailable.
- R. A. Hoffman, S. Kothari, and M. D. Wang,** (2014). Comparison of normalization algorithms for cross-batch color segmentation of histopathological images, *Conf. Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. IEEE Eng. Med. Biol. Soc.* pp. 194–197.
- Poornimadevi. CS, Helen Sulochana.C,** (2016). Automatic Detection Of Pulmonary Tuberculosis Using Image Processing Techniques, *IEEE WISPNET conference.* <https://doi.org/10.1109/WISPNET.2016.7566243>
- Xiaodong Zhanga FucangJia, Suhuai Luo,, QingmaoHu,** (2013). A marker-based watershed method for X-ray image segmentation”, *Computer Methods and Programs in Biomedicine*Volume 113, Issue 3, Pages 894-903.<https://doi.org/10.1016/j.cmpb.2013.12.025>
- Mahreen Kiran, Imran Ahmed, Nazish Khan, Alavalapati Gouth Reddy,** (2019). Chest X-ray segmentation using Sauvola thresholding and Gaussian derivatives responses”, *Journal of Ambient Intelligence and Humanized Computing*,pp 1–17. <https://doi.org/10.1007/s12652-019@012-81-7>



# LABVIEW BASED INTELLIGENT HOME SAFETY AUTOMATION SYSTEM USING FACE RECOGNITION

**V.Muneeswaran**

*Assistant Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [munees.klu@gmail.com](mailto:munees.klu@gmail.com), <http://orcid.org/0000-0001-8061-8529>

**Dr.M.Pallikonda Rajasekaran**

*Professor, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [m.p.raja@klu.ac.in](mailto:m.p.raja@klu.ac.in), <https://orcid.org/0000-0001-6942-4512>

**P.Sundar**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [sundarrock1999@gmail.com](mailto:sundarrock1999@gmail.com), <http://orcid.org/0000-0002-8759-6550>

**S.B.Thirumanikandan**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [sbt180298@gmail.com](mailto:sbt180298@gmail.com), <http://orcid.org/0000-0002-4576-1378>

**D.Muthukumar**

*B.Tech Student, Department of ECE, Kalasalingam Academy of Research and Education.  
Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [muthukumarmds1999@gmail.com](mailto:muthukumarmds1999@gmail.com), <http://orcid.org/0000-00020201-1315>

## ABSTRACT

A rudimentary issue for a laborer is the argument at which he/she is gone from his/her workstation, and a adherent staff requires a few papers from that office, assume that there is just one duplicate of the key which the proprietor has. When even we have manifold keys, now a days as so numerous theft hitches occurs, so that in order to solve it, the objective of this study is to create a project for automatic intelligent home safety using face recognition, making it as an anti-theft system. To make for interconnect with mobile and digital camera, if stored in the template, the digital camera acquisition module and recognition algorithm in the MyRIO module will compare the input and dataset, if both image equal means door will be open or not open, as your home is safe. The template generation process is the key step in the anticipated methodology and it will be performing the major task in the face detection process. The proposed methodology identifies 16 faces accurately for the given 20 input images and this providing an accuracy of 80% and it is superior to the existing methods for face detection.

**Keywords:** Face recognition, Automation, LabVIEW.

## 1. INTRODUCTION

Image handling is a fast budding exploration area which has a wide assortment of submissions comprising computer aided identification [1], Image preprocessing systems [2-4], therapeutic imaging [5] and it can be also useful to other methods viz face recognition and other security based systems. Amendable door admission is a momentous characteristic concerning real-life complications and the exertion ascends as soon as specifically when keys are not accessible. This work suggests a LabVIEW based key authentication mechanism with the purpose of allowing access to an inaccessible door to a set of predefined users. The main objective of combining both software and hardware is the fact which conveniences can be attained once such schemes functionally castoff on the ground. The hardware prototypical of the proposed framework demonstrates that the presented one will be beneficial for the entities who are worried about complications of physical keys, will make life a lot meeker by applying it. Also the proposed system safeguards energy during the all-inclusive process being conceded through. The current energy crisis has required significant energy reduction in all areas. The energy consumption in home areas has increased as more home appliances are installed. Both energy consumption and generation should be simultaneously considered to save the energy cost. This work considers a device control module to handle networked home appliances; it does not consider the energy consumption.

## 2. LITERATURE REVIEW

Sunaryono *et.al.* [6] Proposed an intelligent attendance monitoring system to be practiced in an educational institution. The system developed by them utilizes linear discriminant system so as to easily classify the intrinsic discrimination availed in the input images. The system is capable of giving an efficiency upto the percentage of 97.29. The entire system is implemented in the smartphone based environment which necessitates the pre-requisite knowledge of using the same and this is the only reason that prevents the system to use by all societal communities. Vazquez-Fernandez and Gonzalez-Jimenez [7] provided their basic knowledge on usability and its key implications, security and their role in getting acceptance to any integrated environment and finally the third prime factor of availability on satisfying the fore mentioned usability and security. The authors concluded that a single registration must suffice for retrieving different architectures considering all the factors due to device optics. Using PXA270 chip as the processing hardware, Hong Ai and Cheng [8] pro-

posed an integrated environment to detect smoke, vibration, movements and face authentication mechanism to ensure the concept of security and reliability. In their system, the authors used AdaBoost-based theory to make choice of the features to hasten classification. The AdaBoost finding algorithm notices the face whereas PCA principal component analysis algorithm will recognize the face and the determined face identification rate stretched upto 88% in their system. Sajjad *et.al.* [9] used Raspberry Pi based embedded system to be utilized in hardware assisted face identification systems in smart cities. The SVM based face detection strategy for law enforcement activities gives a face classification accuracy upto 98.3%. A dual factor face authentication was proposed by Verma *et.al* [10] in which enhanced phase-retrieval and optimized chaotic structures were used to encode facial features and yielded a value of EER of 1.19. Areed [11] proposed a keyless door opening system in a remote environment system using Arduino system utilizing a use case mechanism.

### **3. COMPONENT INVOLVED**

The LabView program used here comprises of three inputs. They are,

#### **3.1. Data acquisition**

The sample image to measure the real time image then that image feature extraction. Two various aspects of images are visualized. The primary one is front side view image, here, the anterior side of the face is apprehended and patterns are shaped through pixel identification. The Right side view image contains the veracious side of the face is apprehended and templates are fashioned through pixel identification.

#### **3.2 Template generation**

The feature image for generation for gray scale image then that image compare to storing image.

#### **3.3 Digital image analysis**

A digital camera is positioned on the flap of the gate, this camera goes further down two visualization developments. In the first visualization, the camera is in active mode where the camera captures the real time images in greyscale, When a person is identified through the camera, the camera takes the real time image and compares it with the stored image, it is called as second visualization.

## **4. PATTERN RECOGNITION- FUZZY PATTERN MATCHING ALGORITHM**

Identification process does two processes, camera detection and template matching. First the camera detects pattern, and the features are extracted through various techniques and these features are used for comparing with the stored template. If the template and the real time image is not matched, then access is denied else access granted. The matching if the real time and dataset image is usually done using Fuzzy pattern matching algorithm. The template matching stores the high level image for input, If the pattern recognition identification for face pixel and shape compare the real image

### Feature identification

Step1: The camera take photo image pixel standard input sample

Step2: 24 bit real image convert into 8 bit grayscale image.

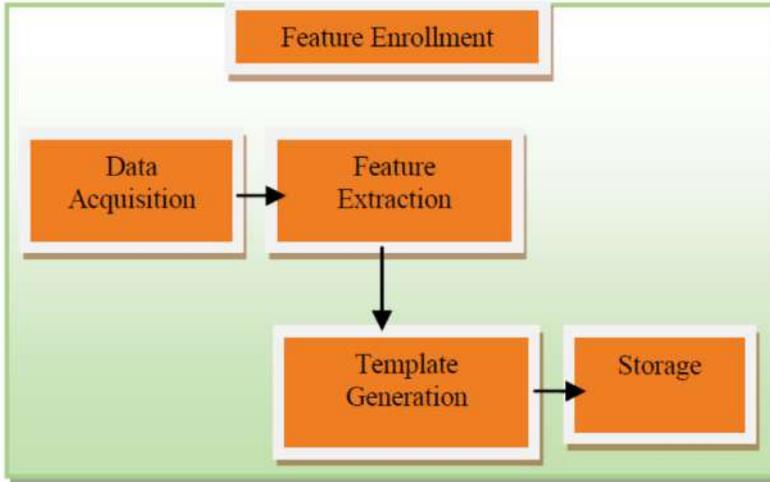
Step3: Compare the real time image (for give input) & storing image

Step4: Identification for correct person using Face recognition

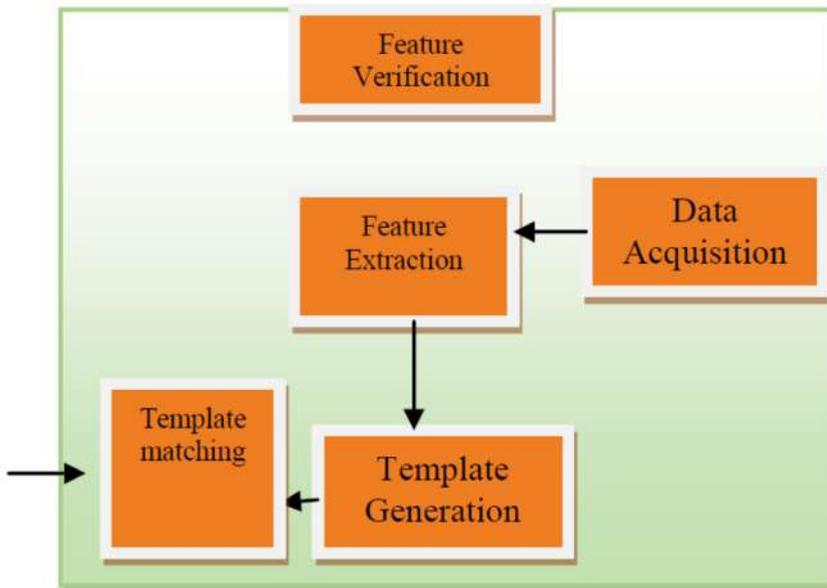
### IDENTIFICATION OF FACIAL IMAGE (PIXEL)

#### **A. Scanning facial process**

Initially the face is captured through a camera; these images are used as a template. For that, features are extracted from these images so that it can be used as a template. These templates are usually in greyscale images. These templates are then compared with the real time greyscale image obtained from the real time sensor (camera). If the compared image matches with the stored image, then the output produced will be a 1 else 0. The framework constituent is represented in Figure.1 and Figure 2.



**Figure 1.** Feature Enrollment  
**Source:** own elaboration.



**Figure 2.** Feature Verification  
**Source:** own elaboration.

If the feature enrolment prosing for collection of facial image and use the informa-tion to encoding then compare the image. Ex-eigen facial algorithm.

## B. Template matching

If the storing image and real time image both should be equal means the computer program to make decision for 1 to 1 door will be open. If the storing image and real time image both should be not equal means the computer program to make decision for 0 to 1 door will be not open. Template generation If the template generating for high level image then storage the hard disk Featuring verification The featuring verification for storing image pixel and real image pixel identification. The featuring verification for storing image pixel and real image pixel identification.

## 5. IMPLEMENTATION RESULTS

The simulated framework can be integrated with myRIO framework using LabVIEW environment and the results obtained are broadcasted using the table 1 and also sample framework result for both successful and unsuccessful events are described below in Figure 3 and Figure 4.

**Table 1.** Validation parameters

VALIDATION PARAMETERS	OUTPUTS	
Number of input samples	20 samples	
Number of face defined	2	
Number of face identified of 20 samples	16	
Accuracy of the face identification	FF_1	FF_2
	80%	80%



**Figure 3.** Front panel of successful trial

Source: own elaboration.



**Figure 4.** Front panel of unsuccessful trial  
**Source:** own elaboration.

## 6. CONCLUSION

There is a pervasive problem of the loss of keys in conservative key based padlocking schemes which affords access to homes or business residences far away or remotely to any of the other recognized members. For such instances, this investigation presented a real-world elucidation “Keyless Entry System for predefined users” for regulating the door admittance using face recognition in LabVIEW environment. The Keyless Entry System is mainly based on the use of the LabVIEW MyRIO circuit panel with the intention of grant admittance to a inaccessible door. The proposed system showed the research methodology used in the work serves as a facilitating tool to augment the system performance of door locking system. The future work of this work is to increase the efficiency of face detection by making algorithmic changes.

## 7. ACKNOWLEDGMENT

We thank the Department of Electronics and Communication Engineering of Kalasalingam University, Tamil Nadu, India for permitting to use the computational facilities available in Open Source Research Lab.

## 8. REFERENCES:

1. **Muneeswaran, V. and Rajasekaran, M.P.,** 2019. Automatic segmentation of gallbladder using bio-inspired algorithm based on a spider web construction model. *The Journal of Supercomputing*, 75(6), 3158-3183.

- 2. Muneeswaran, V., & Rajasekaran, M. P.** (2017, March). Beltrami-regularized denoising filter based on tree seed optimization algorithm: an ultrasound image application. In *International Conference on Information and Communication Technology for Intelligent Systems* (pp. 449-457). Springer, Cham.
- 3. Muneeswaran, V., & Rajasekaran, M. P.** (2016, December). Analysis of particle swarm optimization based 2D FIR filter for reduction of additive and multiplicative noise in images. In *International Conference on Theoretical Computer Science and Discrete Mathematics* (pp. 165-174). Springer, Cham.
- 4. Muneeswaran, V., & Rajasekaran, M. P.** (2019). Local contrast regularized contrast limited adaptive histogram equalization using tree seed algorithm— an aid for mammogram images enhancement. In *Smart intelligent computing and applications* (pp. 693-701). Springer, Singapore.
- 5. Muneeswaran, V., & Rajasekaran, M. P.** (2019). Automatic segmentation of gallbladder using intuitionistic fuzzy based active contour model. In *Microelectronics, Electromagnetics and Telecommunications* (pp. 651-658). Springer, Singapore.
- 6. Sunaryono, D., Siswanto, J., & Anggoro, R.** (2019). An android based course attendance system using face recognition. *Journal of King Saud University- Computer and Information Sciences*.
- 7. Vazquez-Fernandez, E., & Gonzalez-Jimenez, D.** (2016). Face recognition for authentication on mobile devices. *Image and Vision Computing*, 55, 31-33.
- 8. Ai, H., & Cheng, X.** (2018). Research on embedded access control security system and face recognition system. *Measurement*, 123, 309-322.
- 9. Sajjad, M., Nasir, M., Muhammad, K., Khan, S., Jan, Z., Sangaiah, A. K., Elhoseny, M., & Baik, S. W.** (2020). Raspberry Pi assisted face recognition framework for enhanced law-enforcement services in smart cities. *Future Generation Computer Systems*, 108, 995-1007.
- 10. Verma, G., Liao, M., Lu, D., He, W., & Peng, X.** (2019). A novel optical two-factor face authentication scheme. *Optics and Lasers in Engineering*, 123, 28-36.
- 11. Areed, M. F.** (2019). A keyless Entry System based on Arduino board with Wi-Fi technology. *Measurement*, 139, 34-39.

# **PERFORMANCE COMPARISON OF SVM, NB FOR MRI PANCREAS IMAGE CLASSIFICATION**

**Aruna Devi.B**

*Electronics and Communications engg, Kalasalingam Academy of research and Education, Krishnankoil, India.*

Email ID: b.arunadevi@klu.ac.in., XXXXX

**Pallikonda rajasekaran.M**

*Professor, Electronics and Communications engg, Kalasalingam Academy of research and Education, Krishnankoil, India.*

Email ID: m.p.raja@klu.ac.in, <https://orcid.org/0000-0001-6942-4512>

## **ABSTRACT**

Computer Aided Diagnosis (CAD) is an automatic route of diagnosing the tumour in medical field. Magnetic Resonance Imaging (MRI) has been normally applied in the identification of tumour in our body. MRI is used for soft tissue contrast and non invasiveness in medical image system. The troubles of MRI are incorrect diagnosis and large amount of time consuming by a radiologist. Programmed classifiers can mostly renew the detection process, in normal and abnormal images, naturally. This research work represents a smart, correct, and powerful approach to discriminate human pancreas magnetic resonance images (MRI) as normal or abnormal image. It presents the response of Naive bayes (NB) and Support vector machine (SVM) approaches on pancreas tumor classification. For that, we extract features from pancreas 165 MR images applying GLCM approach and analysed by two classification approaches such as NB and SVM. NB approach has high classification accuracy (98%) which is higher than SVM.

**Keywords:** SVM, NB, GLCM feature extraction, Image classification

## **1. INTRODUCTION**

CAD is mandatory to handle image-processing and data-handling approach for significant investigation of images. Accordingly, to upgrade a CAD for the diagnosis of pancreatic cancer, we have analyzed the extraction of features and classification using different classifiers. CAD can be used by the radiologists to cross analysis their investigation, lower their tasks at hand, and also improve inter observer changeability. Numerous features are discriminated from the pancreatic images adopting feature extraction techniques. The least possible number of best features is to be utilized for classification to crop the best accuracy by applying different classifiers. Thus, with

the advancement of CAD utilizing features of MR pancreas images, the analysis of cancer can be observed by a individual without much medical expertise. This is a necessary track in the advancement of CAD utilizing MR pancreatic images. Essential features can be discriminated from MR pancreas images and analyzed by classifier for automatic detection. In this research work, we have analyzed two classifiers such as SVM & NB.

**SVM:**

SVM is a classification approach for high-dimensional data which is presented by Vapnik *et al.*, (1995) to resolve the discrimination disputes of two issues. SVM has been broadly used in the fields of medical image processing, image retrieval, text analysis, and so on. SVM is based on the working principle that the data in the input space can be linear dividable in a higher dimensional feature space after a certain mapping.

**NB:**

The Naïve Bayes Classifier is one of the classification techniques that base on the statistics. It is generally noted that NB technique are ease to build with no complicate iterative parameter. Also its simplicity, the NB technique regularly outperforms than other refined classification methods (Ahmed *et al.*, 2007), (Vedala *et al.*, 2017). The previous research presented that the NB techniques strongly achieved in the many cases i.e., as a tool for public health surveillance from huge organizational databases, forecasting the medication and complexity for children, and as a tool for detecting the B-Chronic Lymphocytic Leukemia (Marucci-Wellman *et al.*, 2015, Paola *et al.*, 2013, Lakoumentas *et al.*, 2012). This work examined the performance of the image processing analysis at the MR image results and presented the Naïve Bayes Classifier technique to classify the pancreas tumour condition.

The first stage, describes with the feature extraction applying GLCM in MRI pancreas images. In the second stage, they are discriminated by the classification methods such as SVM & NB. The output displayed that NB classification method has the superior classification accuracy compared to SVM.

## 2. LITERATURE SURVEY

Tong *et al.*, (2017) presented investigation of wood defect images with an accuracy of 82%. The author described feature extraction by Gray level co occurrence matrix method, Selection by ranker and classified by Support vector machine polynomial classifier. In this work, accuracy should be improved. Yang *et al.*, (2017) presented combining multiple features for brodatz images using Gray level co occurrence matrix, Local binary pattern and Tamura, Feature reduction by principal component analysis and classified by Support vector machine. The author achieved 94.1% accuracy. In this work also, classification accuracy should be improved. Olufemi *et al.*, (2017) described detection of pancreatic cancer by set of symptoms and classified by artificial neural networks. The author gained an accuracy of 87%. Nitish Zulpe *et al.*, (2019), defined detection of tumor in brain MRI by speeded up robust feature extraction and classified by neural networks with an accuracy of 97.5%. Zhang *et al.*, (2017) presented glioma grading system using histogram feature extraction and classified by Support vector machine. The author obtained an accuracy of 94.5%. Pinamonti *et al.*, (1989) presented subjective and significant investigation of the myocardial wall and image texture in 2-D echocardiography to detect amyloid heart disorder. There was no important discrepancy in the mean values of first-order features. Skorton *et al.*, (1988) presented that intacted parts displayed an important reduction in kurtosis in subjective estimate of histogram shape by the three observers. Bae *et al.*, (2001) presented statistical texture approaches to identify perfused and nonperfused myocardium of dogs adopting contrast echocardiographic images. More inspections are needed to justify the capacity of the attributes to determine abnormal from normal myocardium, with area discrepancies in grey level. Aruna Devi *et al.*, (2018) applied GLCM features extraction method, and discriminated medical images as normal and abnormal by applying ANN and SVM methods. ANN method proves that it achieves 96% classification accuracy. Aruna Devi *et al.*, (2019) proposed tumour discrimination by GLCM feature extraction, JAFER feature selection and comparison between 5 types of classification methods, ANN BP technique achieves 98% classification accuracy. Based on the survey, the discrimination accuracy of classifiers is less and computations time is also high. Our proposed technique improves the classification accuracy as high (98%) that is superior to previous research techniques. In this research work, we are going to discriminate the 165 pancreas MR image by normal or abnormal using GLCM feature extraction and discriminated the same by two methods such as SVM and NB. Performance measures are classification accuracy; precision and recall are measured and compared between the two techniques.

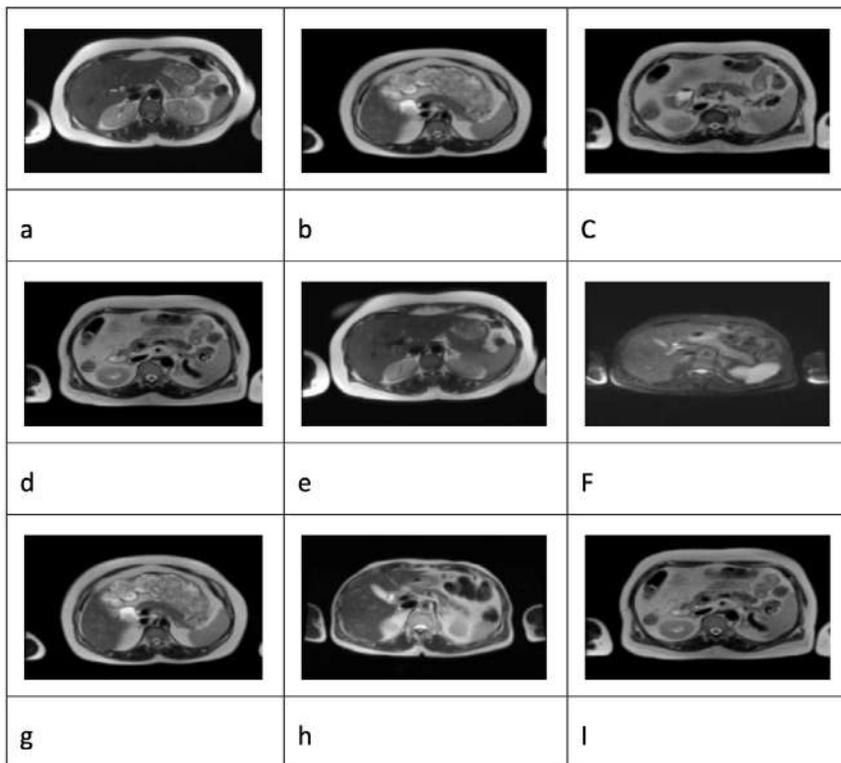
### 3. MATERIALS AND METHODS

#### Input data set:

The dataset used for predicting the performance of the proposed model in this research work is based on the MR pancreas medical images that are gathered from the KGS health care centres, Madurai in India. The numbers of medical pancreas images totally 165 of which 99 are normal and 66 are abnormal images. These 66 abnormal images denotes that the patients affected with, ductal adenocarcinoma, acinar cell carcinomas and pancreatic neuroendocrine tumor. Fig. 1 shows the normal pancreas images and Fig. 2 shows the abnormal pancreas images. Fig. 3 displays the flowchart.

### 4. FEATURES EXTRACTION

In this work, pancreas medical image features are extracted by GLCM. It is of second order statistics, so data with respects to pair pixels are made by GLCM. GLCM displays how the pixel brightness in an MR image appears. A matrix is made up at a distance  $d=1$  and at angles in degrees (0, 45, 90, 135).



**Fig 1.** Normal pancreas MR images

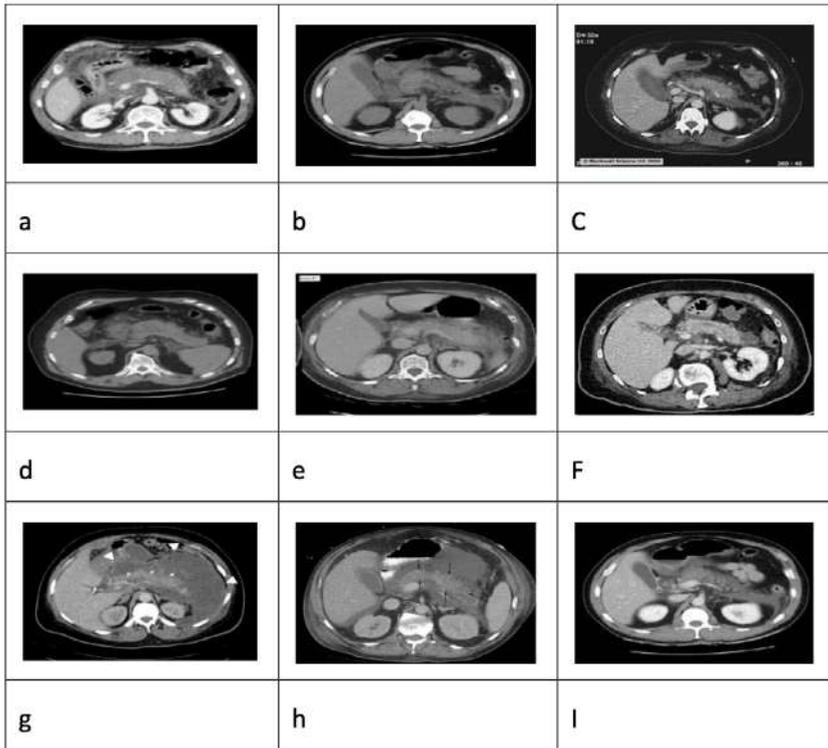


Fig 2. Abnormal pancreas MR images

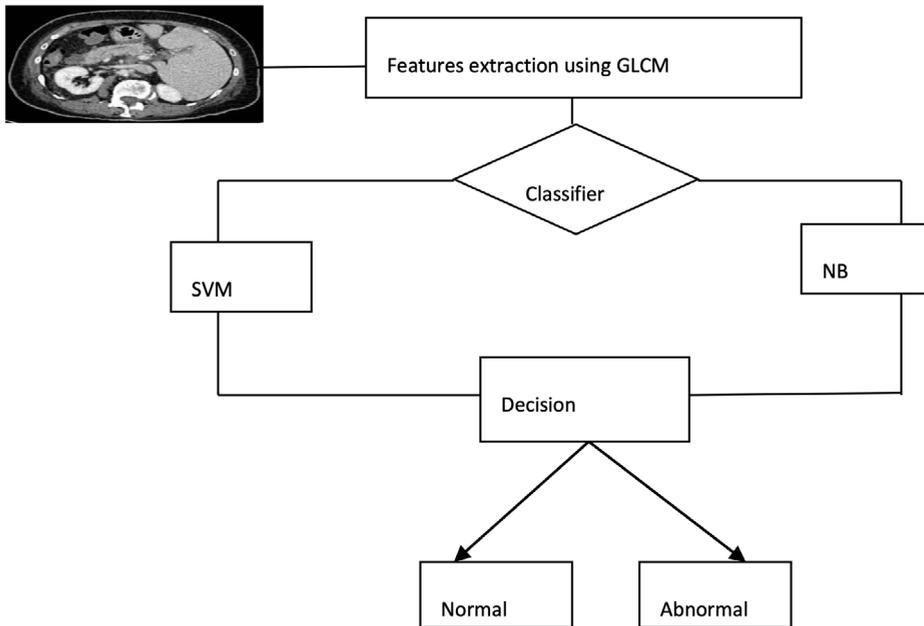


Fig 3. Flow chart

**Table 1:** GLCM features

<b>GLCM FEATURES:</b>	
Contrast: $\sum_i \sum_j (i - j)^2 g_{ij}$	(1)
Energy: $\sum_i \sum_j g_{ij}^2$	(2)
Entropy: $\sum_i \sum_j g_{ij} \log_2 g_{ij}$	(3)
Homogeneity: $\sum_i \sum_j (1/1 + (i - j)^2) g_{ij}$	(4)
Cluster prominence: It defines the inequality of an image.	
Cluster shade: It is exact to cluster prominence in that it also defines the loss of similarity in the image.	
Sumentropy: $-\sum_{i=2}^{2Ng} i g_{x+y}(i) \log \{g_{x+y}(i)\}$	(5)
Sumvariance: $\sum_{i=2}^{2Ng} (i - SUMENT)^2 \cdot g_{x+y}(i)$	(6)
Information measure of correlation: $HXY - HXY1 / \max\{HX, HY\};$ $(1 - \exp[-2.0(HXY2 - HXY)]^2)$	(7)

Haralick also provided distinct parameters i.e. entropy, energy, contrast, homogeneity, sum of variance, sum of entropy, cluster prominence, cluster shade, information measure of correlation etc. These parameters measured at distinct angles. GLCM features are tabulated in Table 1.

The feature dataset will be split into two categories and they are called as feature matrix and the response vector.

- The first category; the feature matrix influences each and every vector that is rows of the given dataset where each and every vector prevails the value of reliant features. In this dataset, features are entropy, energy, contrast, homogeneity, sum of variance, sum of entropy, cluster prominence, cluster shade and information measure of correlation.
- Response vector consist the value of class prediction or output for each row of feature matrix. Normal pancreas MR images are considered as 0 and abnormal pancreas MR images are considered as 1. In this research work, these parameters are calculated and discriminated by two classifiers namely SVM and naive bayes classifiers.

## 5. CLASSIFICATION

The determination of the favoured feature dataset granting to distinct classes have powerful role in medical analysis. Classifiers help in operation of computerized classification of feature dataset. The major aim is the automated classification performed to elect the good classifier.

### SVM

The classification of pancreas MR image is to classify the group items that have identical feature vectors into groups. Classifier obtains this by building a discrimination decision based on the value of the linear combination of the feature vectors. SVM is a binary technique that proceeds as labelled data input from two classes and outputs a model file for discriminating new unlabeled/labelled data into one of two classes. Support vector machines are mainly bi class classifiers that have be shown to be more organized to training linear or non-linear class boundaries. The benefit of SVM, like any other machine learning method, concerns two procedures namely learning and testing. Learning an SVM makes giving known data to the SVM forward with formerly known determined values, thus framing a finite training dataset. It is from the training dataset that an SVM brings its judgment to discriminate unknown data.

The SVM operates the training data that consists of  $n$  data points that are in format  $(x_1, y_1), (x_2, y_2) \dots (x_n, y_n) \forall i = 1, 2, \dots, n$ . Here  $x_i$  denotes the  $i$ th data point and is represented as a  $p$ -dimensional real vector that is generated by using the samples from the input dataset.  $y_i$  denotes the class to which the vector  $x_i$  belongs and this is represented as 0 and 1. The goal of SVM is to identify the hyperplane that separates the set of all vectors that belong to  $y_i = 0$  and  $y_i = 1$  that have the maximum distance between the hyperplane and the nearest point from both the groups. The hyperplane for a set of vectors  $x$  is expressed as given in Eqn. (8),

$$w \cdot x - b = 0 \quad (8)$$

Here  $w$  is the normalized vector to the hyper plane and  $b$  represents the bias value that is used to define the offset and angle of the hyper plane. For defining the offset  $b$  of the hyper plane with respect to the origin along the normal vector  $w$  the  $b/\|w\|$  parameter is used. RBF kernel function is used here. "Radial Bias Function –  $k(x_i, x_j) = \exp(-\gamma|x_i - x_j|^2)$ . Where  $K$  is the kernel function,  $x_i, x_j$  are  $n$  dimensional inputs

Naïve Bayes:

Naïve Bayes classifier is probabilistic classifiers. It uses Bayes' method to define the possibility of a sample to become a particular class. It predicts that all features of the samples in a definite class are separate of each other, given the background of the class. If  $x$  presents an input with  $m$  features such that:

$$x(n) = \{x_1, x_2, \dots, x_m\} \tag{9}$$

Then, according to Bayes' method, for a class  $C$   $P(x|C)$  is the posterior probability of  $C$  conditioned on  $x$ ,  $P(x)$  is the prior probability of  $x$  and  $P(C)$  is the prior probability of  $C$ . The probability of  $x$  becoming to class  $C$  is given by:

$$P(C|x) = P(x|C)P(C)P(x) \tag{10}$$

After measuring probability for each of the  $n$  classes the Bayes classifier classifies image  $x$  to a class  $C_i$ , if:

$$P(C_i|x) > P(C_j|x) \tag{11}$$

If  $\lambda(\alpha_i|C_j)$  is examined to be the loss interviewed for proceeding process  $\alpha_i$ , while the real class is  $C_j$ , the conditional risk for the Bayesian classifier for,  $m$  classes are expressed as:

$$R(\alpha_i|x) = \sum_{m,j=1}^m (\alpha_i|C_j)P(C_j|x) \tag{12}$$

If we examine zero-one loss function, then the conditional risk for the Bayesian classifier can be reduced as:

$$R(\alpha_i | x) = 1 - P(C_j | x) \quad (13)$$

## **6. TRAINING AND TESTING**

Feature dataset is classified by the classification such as SVM & NB techniques. To build up a superior model, we desire to approach a previously organized data set where we have all the inputs, forward with the target. This is termed as the training data set and it is activated to make a model. We also interest to scans the validity of the built model among new known data set called as the test data set. To shorten this process, the complete known data set can be separation into learning and a test data set. Out of 165 pancreas MR images, 70% Images were used for learning and 30% of images were used for testing. There are more classification techniques, where training dataset are favoured by random sampling with restoration for MR pancreas image classification.

Rapid Miner is mostly recognized and simple software for data and predicted test and we have elected it specifically for convenience of process using GUI and it is an open source data mining tool. Rapid Miner software (version 8.1) is used for this research work.

Basically, choosing the best feature election approach with its performance parameters, it was required for process of classification approaches. In continuity, the classification outcomes with parameters for each discrimination approach are followed. Performance parameters were employed for each discrimination approach and the best one was choose for tumour identification.

In SVM, there are 3 'kernel types': 1. Linear; 2. Polynomial; and 3. RBF. Here RBF kernel is used. Set the "split" to relative, "split ratio" to 0.7, and "sampling type" to stratify. The remaining parameters are default.

In NB approach, the “sampling type” is random and by default, Laplace correction is checked. The remaining parameters are default. At last, cross validation in stacking was 10. Next, the performance opinion parameters were used to check the two methods (SVM, NB). We measure the performance of the two approaches in terms of accuracy precision and recall.

Performance opinion parameters:

$$\text{Accuracy} = (\text{TP} + \text{TN}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN}) \text{ 100\%}$$

$$\text{Precision} = \text{TP} / (\text{TP} + \text{FN}) \text{ 100\%}$$

$$\text{Recall} = \text{TN} / (\text{TN} + \text{FN}) \text{ 100\%}$$

Where:

TP (True Positives) = perfectly discriminated positive cases, TN (True Negative) = perfectly discriminated negative cases, FP (False Positives) = imperfectly discriminated negative cases, FN (False Negative) = imperfectly discriminated positive cases.

Precision is the rate of perfectly discriminated positives, describes best performance of the approach in predicting positives. Recall measures how perform the system can predict the negatives. Accuracy confirms the whole correctness of the classifier in predicting both positive and negative cases in terms of tumour.

## **7. RESULT**

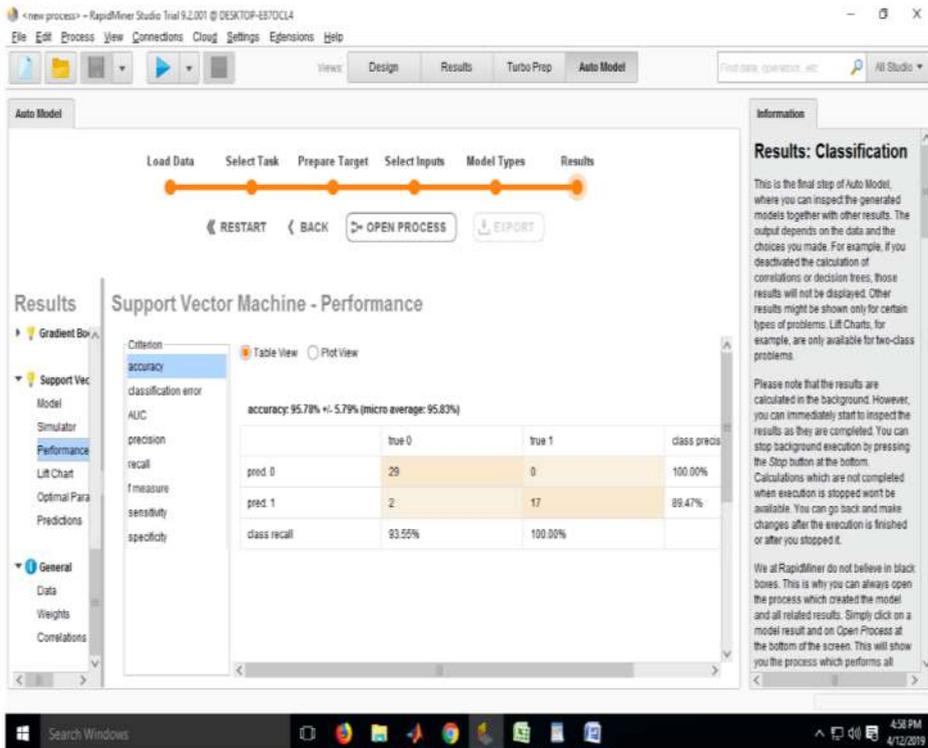
In this research, SVM and NB are learned by GLCM features and classify the pancreas MR image as affected or not affected (normal or abnormal). In this suggested model, we achieve the best feature dataset from GLCM which yields superior classification result. After electing the best feature dataset, the classification techniques with their performance parameters were processed and the good model for each classification method was select. Table 2 displays the values of classification accuracy, precision and recall for SVM and NB techniques.

**Table 2:** Comparative analysis of SVM and NB techniques.

CLASSIFICATION TECHNIQUES	SVM	NB
Classification accuracy	95.77	98
Precision	100	96
Recall	92	100

## 8. CONCLUSIONS

Among the two methods, NB is the best method which gives 98% classification accuracy. Fig 4, 5 are accuracy, precision, recall of NB and SVM methods respectively. Fig 6 represents comparative analysis of our proposed method with other previous research methods. It proves that our proposed NB method gives high classification accuracy of 98%, which is higher than SVM method. In the future, best features are selected from GLCM features and classified by evolutionary computation methods such as Genetic Algorithm with ANN and Fuzzy logic. This will increase the accuracy and decrease the complexity of the classification.

**Fig 4.** Support vector machine method.

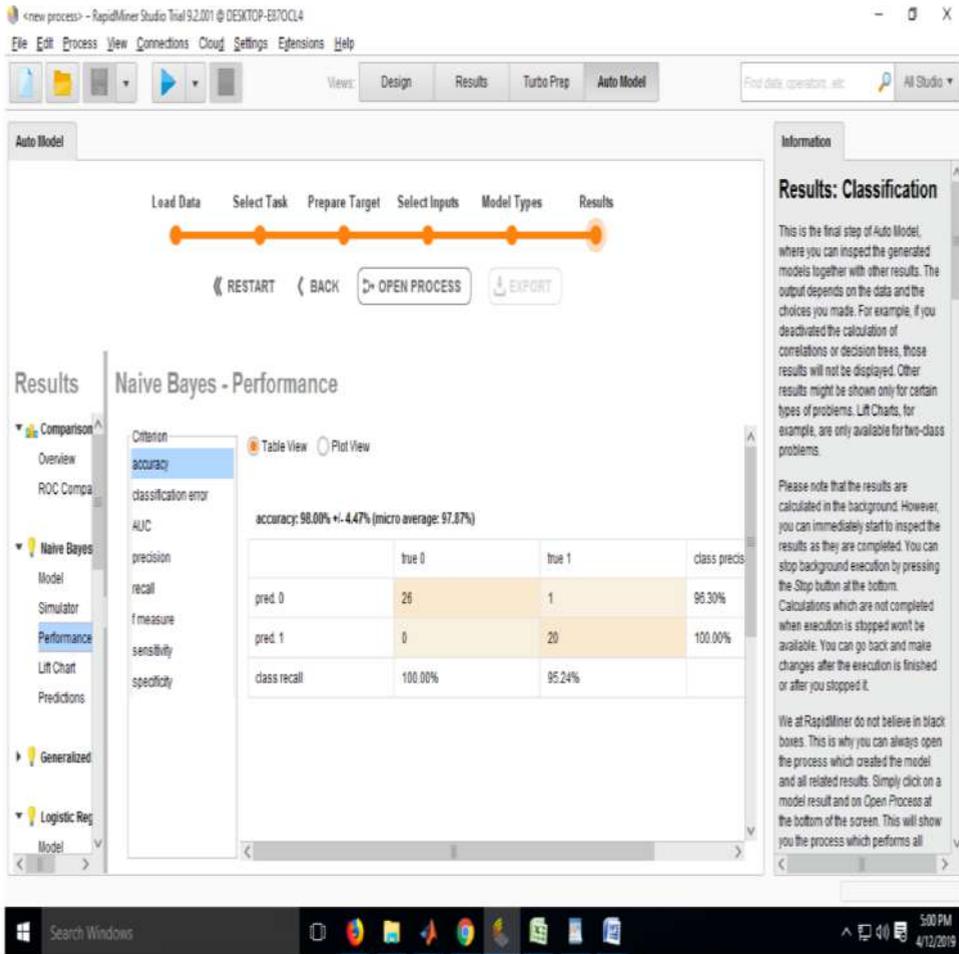
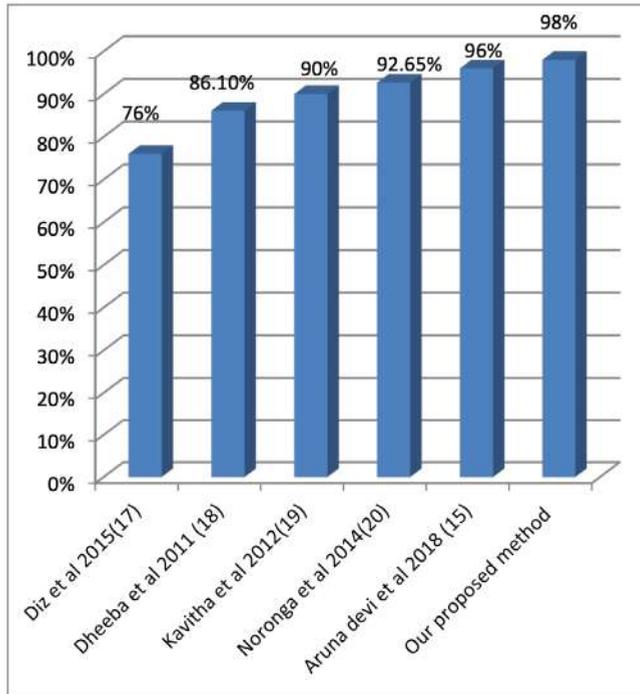


Fig 5. Naive Bayes method.



**Fig 6.** Comparative analysis of classification accuracy-our proposed method with previous methods.

## 9. ACKNOWLEDGEMENT

The authors thank the management of Kalasalingam Academy of research and education for granting financial assistance underside of University Research Fellowship (URF). Also, we thank the Department of Electronics and Communication Engineering, KARE for permitting to allow the NI lab. Also we thank KGS health care centre, Madurai for granting the pancreas MR image that is very useful for this research work.

## 10. REFERENCES

**Ahmed I. Saleh; Arwa E. Abulwafa; Mohammed F. Al Rahmawy.** (2017), A web page distillation strategy for efficient focused crawling based on optimized Naïve bayes (ONB) classifier, Applied Soft Computing, 53, pp.181-204. [https://www.researchgate.net/publication/312253595\\_A\\_Web\\_Page\\_Distillation\\_Strategy\\_for\\_Efficient\\_Focused\\_Crawling\\_Based\\_on\\_Optimized\\_Naive\\_Bayes\\_ONB\\_Classifier](https://www.researchgate.net/publication/312253595_A_Web_Page_Distillation_Strategy_for_Efficient_Focused_Crawling_Based_on_Optimized_Naive_Bayes_ONB_Classifier)

- Aruna devi, M.P.Rajaseker**, (2018), Performance evaluation of MRI pancreas image classification using Artificial Neural Networks (ANN), Springer smart intelligent computing and applications, Volume 104, pp 671-681. [https://link.springer.com/chapter/10.1007/978-981-13-1921-1\\_65](https://link.springer.com/chapter/10.1007/978-981-13-1921-1_65)
- Aruna devi, M.P.Rajaseker**, (2019), Analysis and classification of malignancy in pancreatic magnetic resonance images using neural network techniques, International journal of imaging systems and technology, DOI:10.1002/ima.22314. <https://onlinelibrary.wiley.com/doi/abs/10.1002/ima.22314>
- R.Y. Bae, M. Belohlavek, J.F. Greenleaf, J.B. Seward.** (2001), Myocardial contrast echocardiography: texture analysis for identification of nonperfused versus perfused myocardium. Echocardiography: A Jnl. Of CV Ultrasound and Allied Tech, 18, pp 665-672. <https://pubmed.ncbi.nlm.nih.gov/11801208/>
- Diz J, Marreiros G, Freitas A**, (2015), Using data mining techniques to support breast cancer diagnosis. N Contrib Info Sys Technol; pp 689-700. [https://link.springer.com/chapter/10.1007/978-3-319-16486-1\\_68](https://link.springer.com/chapter/10.1007/978-3-319-16486-1_68).
- Dheeba J, Selvi ST**, (2011), Classification of malignant and benign microcalcification using SVM classifier, International Conference on Emerging Trends in Electrical and Computer Technology; pp 686-690. <https://ieeexplore.ieee.org/document/5760205>
- Kavitha S, Thyagarajan KK**, (2012), Features based mammogram image classification using weighted feature support vector machine, Berlin, Heidelberg: Springer; pp 320-329. <https://arxiv.org/abs/2009.09300>
- Lakoumentas J.; Drakos J.; Karakantza M.; Sakellaropoulos G.; Megalooikonomou V.; Nikiforidis G.** (2012), Optimizations of the naive-Bayes classifier for the prognosis of B-Chronic Lymphocytic Leukemia incorporating flow cytometry data, Computer methods and programs in biomedicine, 108(1), pp 158-67, <https://pubmed.ncbi.nlm.nih.gov/22429720/>
- Marucci-Wellman HR; Lehto MR; Corns HL.** (2015). A practical tool for public health surveillance: Semiautomated coding of short injury narratives from large administrative databases using Naive Bayes algorithms. Accident; analysis and prevention, 84, pp. 165-76. <https://www.sciencedirect.com/science/article/pii/S0001457515300099>

- Nitish Zulpe and Vaijinath V. Bhosle** (2019), SURF serves better results for Brain Tumor Classification, IJRECE, VOL 7, ISSUE 1 [https://www.researchgate.net/publication/332321246\\_SURF\\_serves\\_better\\_results\\_for\\_Brain\\_Tumor\\_Classification](https://www.researchgate.net/publication/332321246_SURF_serves_better_results_for_Brain_Tumor_Classification)
- K. P. Noronha, U. R. Acharya, K. P. Nayak, R. J. Martis, and S. V. Bhandary** (2014) Automated classification of glaucoma stages using higher order cumulant features, Biomed. Signal Process. Control, vol. 10, pp.174–183. <https://www.sciencedirect.com/science/article/abs/pii/S1746809413001699>
- A.S.Olufemi,G.Oluleye,O.M.Oyeleke,E.E.Theophilus**(2017)DetectionandDiagnosis of Pancreatic Cancer using Neuro-Fuzzy Techniques. International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887 Volume 5 Issue VII, [https://www.semanticscholar.org/paper/Detection-and-Diagnosis-of-Pancreatic-Cancer-using-Olufemi Oluleye/191ebb0a0df235787576437ed18be0d7d5b1e39c](https://www.semanticscholar.org/paper/Detection-and-Diagnosis-of-Pancreatic-Cancer-using-Olufemi%20Oluleye/191ebb0a0df235787576437ed18be0d7d5b1e39c)
- Paola Berchiolla; Francesca Foltran; Dario Gregori,** (2013), Naïve Bayes classifiers with feature selection to predict hospitalization and complications due to objects swallowing and ingestion among European children, Safety Science, 51, pp. 1–5. <https://www.sciencedirect.com/science/article/abs/pii/S0925753512001415>
- B. Pinamonti, E. Picano, E.M. Ferdeghini, F. Lattanzi, G. Slavich, L. Landini, F. Camerini, A. Benassi, A. Distante, A. L'Abbate.** Quantitative texture analysis in two-dimensional echocardiography: application to the diagnosis of myocardial amyloidosis, J Am Coll Cardiol, 14, pp 666-671, <https://pubmed.ncbi.nlm.nih.gov/2768715/>
- D.J. Skorton, H.E. Melton, N.G. Pandian, J. Nichols, S. Koyanagi, M.L. Marcus, S.M. Collins, R.E. Kerber,** Detection of acute myocardial infarction in closed-chest dogs by analysis of regional two-dimensional echocardiographic gray-level distributions, Circ Res, 52, pp 36-44, Jan, 1983, <https://pubmed.ncbi.nlm.nih.gov/6848208/>
- Tong, H. L., Ng, H., Yap, T. V. T., Ahmad, W. S. H. M. W., & Fauzi, M. F. A.** (2017), Evaluation of feature extraction and selection techniques for the classification of wood defect images, J. Eng. Appl. Sci, 12(3), 602-608. [https://www.researchgate.net/publication/316995603\\_Evaluation\\_of\\_feature\\_extraction\\_and\\_selection\\_techniques\\_for\\_the\\_classification\\_of\\_wood\\_defect\\_images](https://www.researchgate.net/publication/316995603_Evaluation_of_feature_extraction_and_selection_techniques_for_the_classification_of_wood_defect_images)

- Vapnik V**, The Nature of Statistical Learning Theory, New York: Springer, 1995, <https://www.springer.com/gp/book/9780387987804>
- R. Vedala; B. R. Kumar**, (2012), An application of Naive Bayes classification for credit scoring in elending platform. International Conference on Data Science & Engineering (ICDSE), Cochin, Kerala. pp. 81-84. [https://www.researchgate.net/publication/261483697\\_An\\_application\\_of\\_Naive\\_Bayes\\_classification\\_for\\_credit\\_scoring\\_in\\_e-lending\\_platform](https://www.researchgate.net/publication/261483697_An_application_of_Naive_Bayes_classification_for_credit_scoring_in_e-lending_platform)
- Yang, T., Shi, G., Yang, N., & Wang, L** ,(2017), Combining multiple feature for texture image classification, In 2017 10th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI) (pp. 1-5). IEEE <https://ieeexplore.ieee.org/document/8301967>
- X. Zhang** (2017) Optimizing a machine learning based glioma grading system using multi-parametric MRI histogram and texture features Oncotarget, vol. 8, pp. 47816-47830. <https://pubmed.ncbi.nlm.nih.gov/28599282/>

# **AUTOMATIC IRRIGATION SYSTEM USING SINGLE PHASE MOTOR CONTROL IN GSM**

**Mrs. N.Bhuvaneshwary**

*Assistant Professor Department of ECE KARE*

Email ID: [bhuvaneshwary.n@klu.ac.in](mailto:bhuvaneshwary.n@klu.ac.in), <https://orcid.org/0000-0001-6400-6602>

**S.Vasudevan**

*UG Student Department of ECE KARE*

Email ID: [vasudevan777762@gmail.com](mailto:vasudevan777762@gmail.com), XXXXX

**M.Yuvaraj**

*UG Student Department of ECE KARE*

Email ID: [yuvaraj8565@gmail.com](mailto:yuvaraj8565@gmail.com), XXXXX

**S.Kathir kaamesh**

*UG Student Department of ECE KARE*

Email ID: [kathirkaamesh28@gmail.com](mailto:kathirkaamesh28@gmail.com), XXXXX

## **ABSTRACT**

Agriculture is the backbone of Indian Economy. Because Without agriculture living is impossible since agriculture produces the main sources of food for us. But in today's situation the availability of labor for carrying out agricultural activities is rare. The automation in all kind of industries leads to industrial growth. Here agricultural process is automated and aims in providing a user friendly, reliable and automated water pumping system. In this proposed system all the components to work on its own with the help of inputs received from the sensor which are monitoring the agricultural land round the clock and a single person is enough to monitor whether everything going normal. The entire process is controlled by ARDUINO and monitored by IOT and Specialised Android app. This system which is capable of detecting moisture level in the soil and correspondingly taking the decision of switching ON/OFF water pump. Above process is transmitted to the user using GSM. The ARDUNIO forms the heart of the system and there are also temperature sensors and humidity sensors , which detects the temperature and humidity level in the atmosphere. The proposed technique can help in reducing human work at fields and also to ON/OFF the motor automatically by using soil moisture sensor and at fields which avoids the need of a human being.

**Keywords:** Sensors, wifi module, arduino, relay, single phase motor, GSM

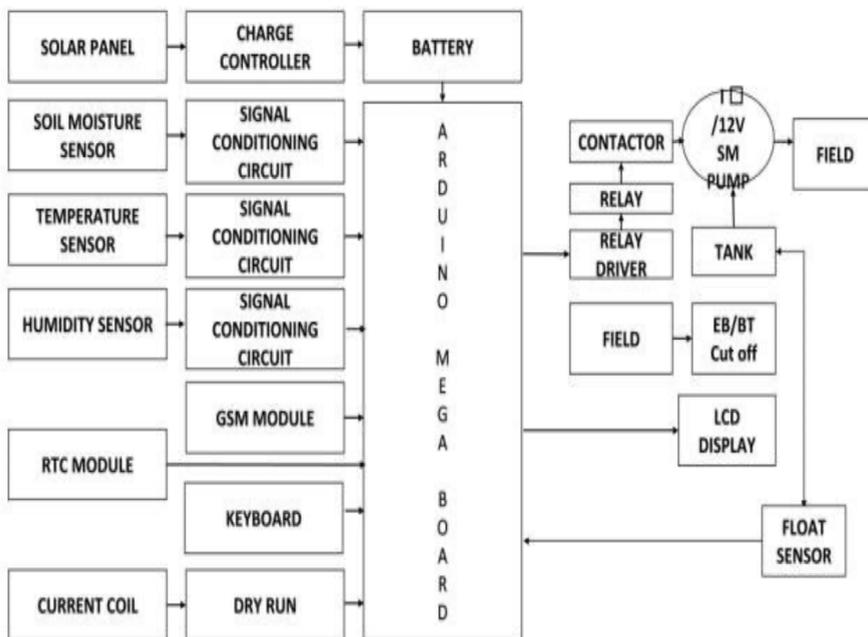
## 1. INTRODUCTION

The main aim of this project was to provide water to the crop fields are gardening automatically by using microcontroller (arduino mega). By this system we can automatically watering the plants while we are on vocation or out of our fields for some certain period of time. With the help of the sensors we are getting input from the field and information processed through the arduino mega board and the message is sent through the gsm module. Using the wifi module the system is connected through wifi hotspot and the system is monitored by the IOT. The status of the system is updated each and every day in the IOT web page. In additional we have android app we can also check the ststus of the system and we can also ON/OFF the system by using android app. Another mode for operation is cyclic process the ON and OFF condition is set accordingly. For that particular timing motor will be turned ON and it will be automatically turned OFF. [Agbetuyi ayoadé felix and Orovowode hope]

The system is backuiped by solar panel in case of power failure. This idea will lead to remarkable change in agricultural field in future. In our country like India, agriculture is the major back bone and where our climate conditions are isotropic.

## 2. PROPOSED METHODOLOGY

Represents Automatic irrigation system using Arduino



Graphic 1. Block Diagram  
Source: Own

In this section, proposed system ideology is given clearly. It is a friendly user and working in fast response. The signal from the environment is given to the sensing unit. The arduino which transfers the output to the input sensing unit. Sensing unit consists of temperature sensor, humidity sensor, float sensor and soil moisture sensor etc. In each sensor has three pins supply, ground and output pin to the Arduino. Float sensor will sense the amount of water in the tank and gives the signal back to the Arduino. If tank doesn't have require amount of water, then Arduino will turn on the well motor and it will fill the tank. All these data's is displayed in the LCD display and also it is send to the user through GSM technology. Based on the soil moisture the Arduino will decide whether to turn on/off the motor through relay. These whole system is powered by solar panel and gives the output value of 5V and 12V, 5V is given to the Arduino and 12V is for the sensor unit.

### **2.1 ARDUINO**

It is the main controller of project which performs 60 percentage of our controlling process. All information are processed and the conditions are checked with the help of the programming and the motor is switched ON by using relay circuit.

### **2.2 GSM MODULE**

It is the responsible for the communication part of our project. Whenever any other which occurs, the message will be sent to the user through the GSM.

### **2.3 MOTOR**

We are using 12v dc water pump. It is primary component of our project the motor control will be done by android app and sensing unit.

### **2.4 WIFI MODULE**

The system is connected through wifi hotspot in LAN network. The status of our sensors and the motor will be displayed in our own webpage by using think speak software with the help of IOT.

### **2.5 RELAY**

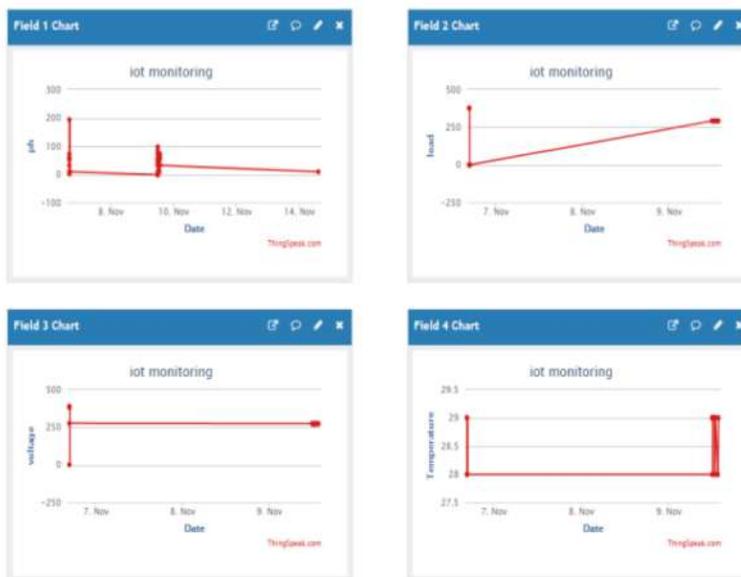
It acts as a switch which switches ON/OFF the motor according to our specification. It automatically changes the supply from EB to solar

### 3. WORKING

Our process starts with the soil moisture if detects the moisture content of the soil. And it sends it to through megs board and compare with the values which is already programmed in programming part. This information is passed as the text correspondingly temperature and humidity sensor parallel process takes place. Float sensor is fixed in the end of the tank on well to prevent the dry running of the motor. Once the water goes below the certain level the float switch will automatically turn of the motor with the help of our system. In additional the salinity of the water is also checked and monitored by the ph sensor [Kavita bhole and Dimple chaudhari]. This information is also sent through GSM to the user. By using wifi module we can inter-face our system with our portable devices. Once the motor is turned on the status of the each and every sensor is monitored by our own webpage and it is periodically updated in our webpage with the help of internet of things. Once when the over load or over current occurs the user will get a text message and the circuit will be tripped off. Controlling part is done by android app we can also check the status of our field and switching mechanism of the motor is also available in the app.

### 4. RESULT&DISCUSSION

From this result, the sensor values and the status of them a periodically monitored with the help of the IOT and the Arduino



Graphic 2: IOT

## 5. CONCLUSION

Since man has started agriculture irrigation is the challenging role. In this project we can control the flow of water by continuous monitor of soil. From this project we conclude these automatic irrigation systems which monitor and work automatically in the crop field which might be operate by the farmer in whatever place he does. In future up coming days we decided to elaborate more features to reduce the work burden of farmers. And we are taking this concept in robotics to reduce the workload of farmer. This design is low cost and highly versatile. By implementing this system water can be saved.

## 6. REFERENCES

- Agbetuyi ayoadé felix and Orovowode hope** (2015) "Design and Implementation of an Automatic Irrigation System Based on Monitoring Soil Moisture" Proceedings of the International Journal of Scientific & Technology.
- Kavita bhole and Dimple chaudhari** (2014) "Soil moisture sensor based automatic Irrigation system powered by solar energy" Proceedings of the international Journal of Scientific & Technology.
- M.Priyadharsini, V.Arunbalaji, T.Karthikaa** (2016) "GSM Based Motor Control for Irrigation System" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 5, Special Issue 1.
- Prof. U.R. Patole** (2017), "Android Application For Single Phase Motor Control Using IVRS & GSM System" IJARIE, Volume 3, Issue 3.
- Venkata Naga Rohit Gunturi** (2017) "Micro-controller based automatic plant irrigation System" International Journal of Advancement in Research and Technology.



# GAMING APPLICATION FOR ASSISTIVE TRAINING TO IMPROVE COGNITIVE AND MOTOR SKILLS OF CHILDREN WITH DYSPRAXIA

**Dr. Ponmozhi Chezhiyan**

*Assistant Professor, Department of Computer Applications,  
School of Computing Kalasalingam Academy of Research and Education  
Krishnankoil, Srivilliputhur, Tamil Nadu, India*  
Email ID: [chezhiyan71.p@gmail.com](mailto:chezhiyan71.p@gmail.com), <https://orcid.org/0000-0001-5039-4712>

**Dr. P. Deepalakshmi**

*Professor, Department of Computer Science and Engineering, School of Computing,  
Kalasalingam Academy of Research and Education, Krishnankovil, Srivilliputhur,  
Tamil Nadu, India*  
Email ID: [deepa.kumar@klu.ac.in](mailto:deepa.kumar@klu.ac.in), <https://orcid.org/0000-0002-1959-3657>

**Dr. K. Maheswari**

*Associate Professor, Department of Computer Applications,  
School of Computing, Kalasalingam Academy of Research and Education,  
Krishnankovil, Srivilliputhur, Tamil Nadu, India*  
Email ID: [maheswarisnr@gmail.com](mailto:maheswarisnr@gmail.com), <https://orcid.org/0000-0002-5407-2056>

**Dr. P. Sriramakrishnan**

*Assistant Professor, Department of Computer Applications,  
School of Computing Kalasalingam Academy of Research and Education  
Krishnankoil, Srivilliputhur, Tamil Nadu, India*  
Email ID: [sriram2010@gmail.com](mailto:sriram2010@gmail.com), <https://orcid.org/0000-0001-5339-673X>

## ABSTRACT

Assistive technologies can be used not only for the physical challenges but also for the skills like motor coordination and cognitive analysis. This paper designs a simple application which helps to improve the motor coordination such as eye hand coordination, and cognitive skill like identifying colors, same shaped objects. Evaluation is done on the facts that the performance of differently abled persons can be improved by two factors such as (i) assistance and (ii) practice. Participants considered for evaluation are of different IQ levels and age. Evaluation is conducted in two sessions. Session I participants are assisted if they face difficulty in completing the tasks. In session II, participants are asked to complete the task without assistance. Improvements in the skills are measured based on the number of screens the participants are able to complete, time taken to complete the tasks for each session. The results show that there is a 30% improvement in the participant's performance.

**Keywords:** Assistive technology , Cognitive skills , Disabled, Dyspraxia

## 1. INTRODUCTION

For most people, technology makes things easier. For people with disabilities, technology makes things possible as stated by Mary Pat Radabaugh [ Radabaugh MP (2004) ]. Disability of a person in any form will isolate them from society. Sustainable growth means the overall development of the society which includes those with disability too. The quality of life of disabled people can be improved by assistive technologies. Assistive technologies may be used to (i) give stimuli to do certain action [(Y. J. Chang *et. Al.* (2011), F. Ke and T. Im (2013), S. Parsons and S. Cobb. (2011) ] (ii) provide safe learning environment [L. Bartoli *et. Al.* (2013), F. A. Boujarwah *et. Al.* (2011)](iii) set personalized learning levels at different difficulty levels [E. Christinaki *et. A.*(2010), P. F. Ke and T. Im.(2013), J. Khakhar and S. Madhvanath (2010)] (iv) offer personalized repetition of learning activities[S. Parsons and S. Cobb.(2011) , T. D. Parsons *et. Al.* (2009)].

Any assistive technology is restricted or has limited access due to the technologies by the disabled due to economical as well as technical constraints. To have wide spread acceptance, the applications designed for the special people should be user-centered and be acceptable by the environment which includes the caregivers and therapist [F. A. Boujarwah (2011)].

Motor skill refers to the person's ability to move and do small things like writing, picking, placing an object [<http://en.wikipedia.org/wiki/Dexterity> ] which involves hand-eye coordination. Motor coordination can be improved by (i) strengthening the shoulder muscles (ii) strengthening the core (trunk) muscles (iii) Developing bilateral (right-left) coordination (iv) developing hand skills (v) developing balance and cognitive skills.

Cognitive skills are one's ability to perform various mental activities that are related with problem solving and learning [National Council on Measurement in Education [http://www.ncme.org/ncme/NCME/Resource\\_Center/Glossary/NCM](http://www.ncme.org/ncme/NCME/Resource_Center/Glossary/NCM)]. It mainly refers to the ability to remember things and learning new information. Cognitive skills include orientation, insight, attention, memory, problem solving, and organization. Deficit in cognitive skills affect daily life activities like communication, mobility, In general, any cognitive rehabilitation model has to use tasks in various positions, different activity movements, and in various environment [Abreu, Beatriz Colon and Joan P Toglia (1987) ]. Cognitive skills can be improved by doing activities

like [Samuel McNerney (2011)]: (i) identifying noises, (ii) practicing the alphabets, (iii) counting (iv) pointing out shapes and colors.

In this paper, an application is designed with set of games that focuses on activities which are relevant for the cognitive skills improvement and also for motor coordination development. Tasks that are focused are eye and hand coordination by the application of gesture sequence moving hands towards the color, dragging it to the matching one. Game has been designed for remembering colors, shapes and different objects.

## 2. MATERIALS AND METHODS

The assistive technology proposed in this paper aims to improve the motor coordination and cognitive skills. It uses the techniques of drag and drop gestures, and some kind of reasoning. The tasks used are matching color and a slight difficult sequence of gestures shown for selection. The participants are 15 children with dyspraxia. The improvement has been evaluated by measuring participants IQ scores. To measure IQ, Malin's Intelligence test [A. J. Malin(1966)] which is the Indian adaptation of Wechsler's intelligence scale for children [Wechsler David. (1949)] is used. Table 1 gives details related to participants of the evaluation. Data collected from the children are shown.

**Table 1.** Participants' details

PARTICIPANTS INFORMATION	NUMBERS
Number of participants	15
Age (in years)	Mean = 14, Std. Deviation = 5.2
Gender	Male = 10, Female = 5
IQ	Mean = 42; Std.dev. = 11

## 3. RELATED WORK

Many motion tracking technologies promote the use of gesture-based interactions in applications. Microsoft Kinect, NuiTrack, MotionBuilder etc. are of some of the technologies that influences the creation of gesture-based applications. They provide software tools which can be used to identify and track the movements of human body. These technologies were used in identifying facial expressions [E. Christinaki (2010)], games with hand-eye coordination [Alyssa Alcorn(2011)] and cognitive interventions [P. J. Standen and D. J. Brown (2005)].

Many applications such as SensoryPaint [K. E. Ringland *et. Al.* (2014)] use the whole body interactions. It also used in therapeutic interventions to motivate social interactions in children.

Application of gesture-based interaction for therapeutic and educational purpose has advanced in recent year [Samuel Mc Nerney (2011)]. Embodied cognition theory states that, the mind is not only connected to the body but that the body influences the mind. Thus learning occurs through the interaction of the body with the environment [R. Lindgren and M. Johnson-Glenberg (2013)], [M. Wilson (2002)] . In human-computer interaction [P. Dourish(2004)] field also, this embodied learning is used.

In the developing countries like India, there are limitations in adapting assistive technologies. The main and foremost reason is limited access which includes both access to resources like electricity and infrastructure. Some people in India do not have access to vast majority of beneficial technologies. This may be due to unawareness and economic conditions.

Based on the World Bank's report [D. Filmer (2008)] conducted in 14 developing countries, it is evident that low schooling attainment and subsequent poverty are common especially with disabled persons. Technology is too expensive for them.

To make Assistive technology to be suitable in developing countries like India, the cost of emerging technological developments has to be (i) affordable and the assistive devices should be (ii) shareable i.e. possibility of customizing one device to be used by many users. By keeping this in mind, we have gone for this study

## **4. APPLICATION DESIGN**

### **4.1 Design overview**

The concepts of matching shapes, colors and objects, numbers and alphabets are used in order to improve motor coordination and cognitive skills and also implicitly for the improvement of the memory and spatial skills. Application presented in this paper addressed two challenges that exist in the case of technology usage among disabled. They are:

Availability of diverse technology, i.e. some users may have old technology whereas some may have devices with latest technology. For example, application has to allow

the users to interact with any type of interaction mechanism such as touch screen; mouse or sensors may get universal acceptability.

Flexible learning i.e. it allows the participants to select the level of difficulty depending upon their ability, so that everybody who all needed can use this application effectively based on personal needs and capability.

Proposed application focuses on two tasks a namely matching and gesture interaction. Matching consists of shapes, colors and different objects. 10 different screens have been used for each matching activity. For example, for the task color identification, three same shaped objects are considered but only one with different color as shown in Fig. 1; in the subsequent screen, number of shapes along with colors is changed. In the last screen as shown in Fig. 2, there are three differently shaped objects, each of them are with varying color and the task to find as particular color.



**Fig 1:** color identification screen 1 & screen 2



**Fig 2:** color identification last screen

Similarly, in the case of shapes matching, same colored shapes are used in the initial screen as shown in Fig. 3, but later one among them is made as differently shaped. The difficulty level will be increased gradually, by using varying colors and increased

number of shapes. Finally, in the last screen as shown in Fig. 4, it is expected to find out the small change in the smiley faces itself. Many participants struggled slightly in this screen.



**Fig 3:** shape identification screen 1 and screen 5



**Fig 4:** shape identification last screen

Matching tasks include the interaction of gestures for (i) Dragging the object and (ii) dropping on to the correctly matched item. Similarly they have to point out the matching ones for some of the screens.

Audio and Visual appreciation is given for every correct response.



**Fig 5:** Appreciation symbols used

## 5. RESULTS AND EVALUATION

After completion of every screen, Star symbol will be shown and after the final screen completion balloons will be shown along with clapping sound as shown in Fig. 5.

Two sessions of evaluation were conducted. In the first session, verbal and oral guidance were given to the participants. In the second session, no guidance was given. Instructions for the gesture usage and practice session were given before displaying the first screen of the game. It is designed to have 10 screen for color and 10 for matching shapes. The time taken to complete every screen, total time for every session, number screen for which assistance required is measured. As there are three colors and three shapes, data has been gathered for every color and shape separately

Percentages of completion for each participant for the two sessions are calculated separately. Next measurement made is time required to complete the sessions with and without assistance.

### (i) Percentage of completion (PC)

This number defines the number of times the participants completed correctly in percentage. Number of times the participants completed the tasks without assistance, added with number of times completed with assistances calculated, and 0.5 weight age was given for completion of tasks with assistance, and this is divided by total number of attempts made.

Following formula is used for this calculation

Let us assume  $C_n$  represents number of screens completed without assistance,  $C_w$  represents number of screens completed with assistance, and  $TC$  represents total number of screens completed. Now, the percentage of completion,  $PC$  is calculated using formula given in Eq. (1)

$$PC = \frac{C_n + 0.5 * C_w}{TC} * 100 \quad (1)$$

For the first session, percentage of completion is around 45 to 60 without assistance. So, they need assistance to complete the tasks. In the second session, the same group is able to complete session up to 80 percentages without assistance and scored 100 with assistance. This implies that by practice they can improve themselves in completing the tasks in a better manner.

Percentage of completion in session I am given in Fig. 6. Chart gives the values only for participants with IQ 8, IQ 10, and IQ 13. As the IQ level increases the number of completion without assistance increases starting from 40. But, if they are provided assistance, their ability to complete screens increases from 40% to 70% with the IQ level of 8.

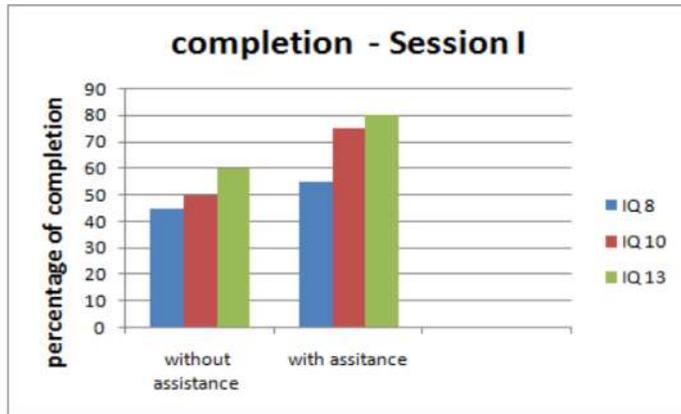


Fig 6: Percent of completion in Session I

Fig. 7 compares the performance of the two sessions. As expected in the second session they performed well due to the practice.

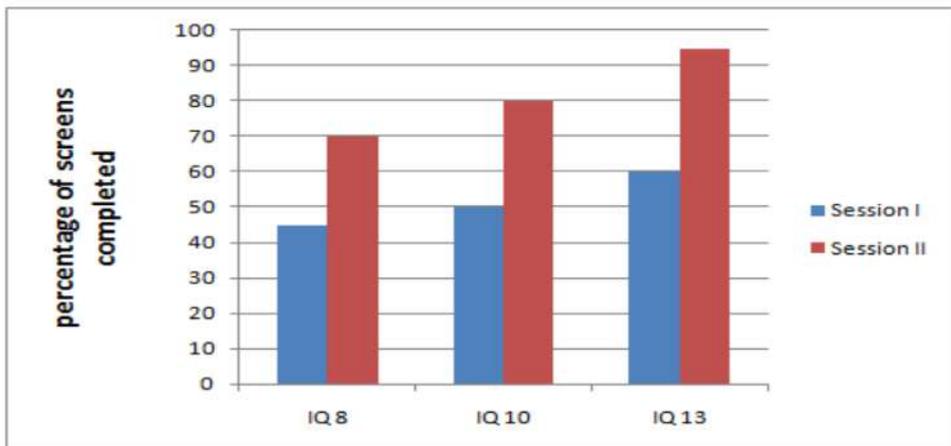


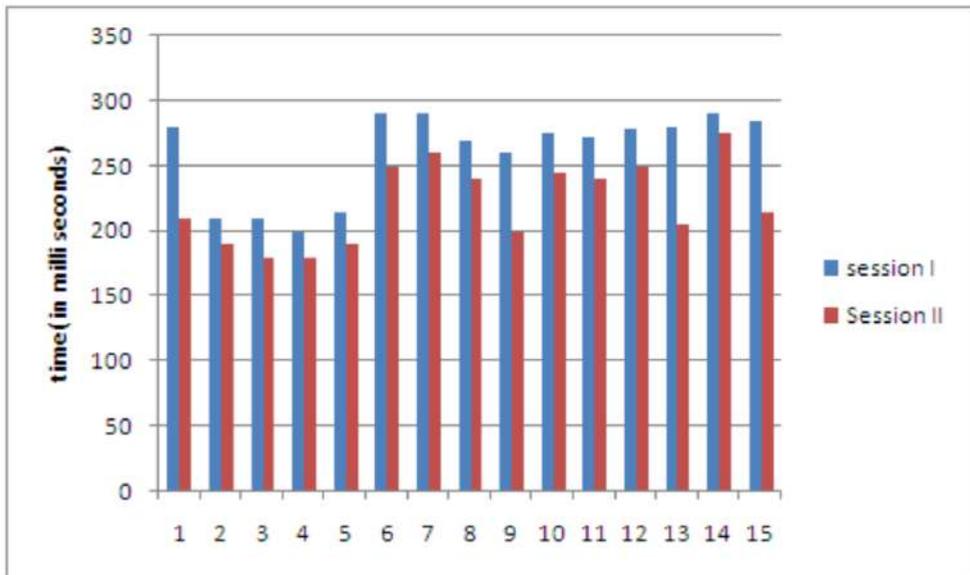
Fig 7: Comparison: percentage of number of screens completed (without assistance) in both the sessions

### (ii) Time taken for Completion

Time taken to complete every screen is collected over a period allotted for a session. It has been decided to allocate 30 sec for every screen. So, every session is allotted 300 sec.

Mean time required to finish the session by all participants is calculated, and compared. Comparisons between the two session's completion time with and without assistance are given in Fig.8 and Fig. 9 respectively.

From Fig. 9, it can be inferred that the practice helped them to reduce the time for some of the participants, but if additionally the assistance is given during session-I the time requirement is further reduced as shown in Fig. 8.



**Figure 8:** completion time of participants with assistance

Though the comparison brings out the difference, the Total number of screens completed by each participant is not constant, and thus the formula to find the completion time in relation with the number of screens the participants able to complete needs to be changed.

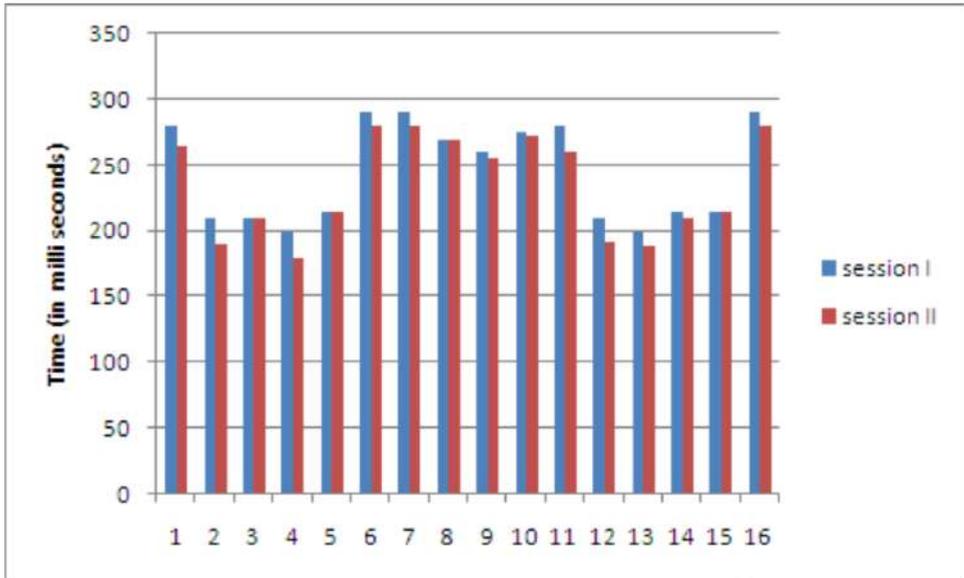


Fig 9: completion time of participants without assistance

Let  $T_t$  represents total time required to complete one full session.  $C_t$  represents total number of screens completed then Formula (2) is used to calculate the time taken to complete one screen by a participant the time taken for one screen by that participant can be calculated by Eq. 2 as given below.

$$Time\ per\ Screen = \frac{T_t}{C_t} \tag{2}$$

This calculation may give correct evaluation on the performance of every participant.

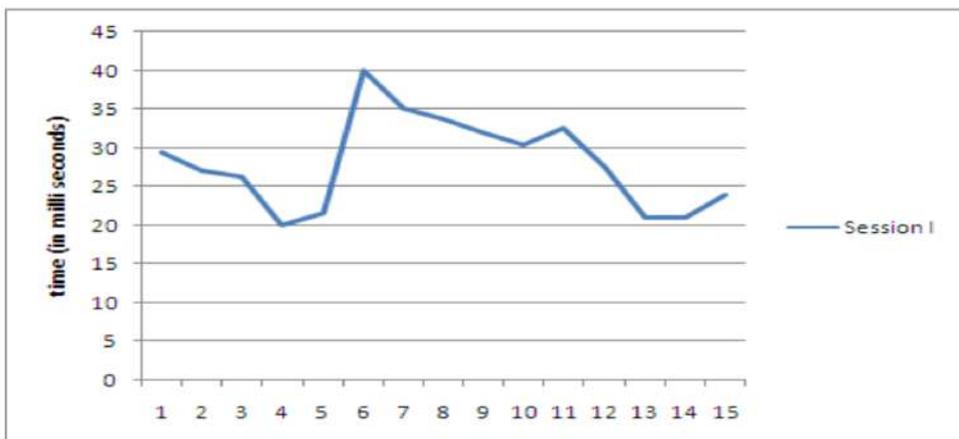


Fig 10. Time to complete Screen 9 of color matching

Fig 10 specifies the time required to complete screen 9 of color matching by each participant. Long time is taken to complete this screen are persons with low IQ level. Complexity of the screen, IQ level of the participant's practice of similar games earlier may also contributed to the earlier completion of some of the participants than others.

## 5. CONCLUSIONS

Lack in Cognitive and motor skills among children make them feel aloof and they cannot mingle with people. By practice, children with these two issues can improve their skills. So, we developed an application to improve these skills and through experiments we ensured that through practice and assistance, these people can also move along with the society within a stipulated period of time.

While evaluating, it is found that the participants felt difficulty in doing two things simultaneously i.e. the time taken to match same color shapes is easier for them than to match shapes with varying color. This component also varies depending upon assistance.

This work aimed to provide these benefits to the society: (i) the person with motor and cognitive disable person can start moving along with other people, which is one of the Sustainable Development goals. (ii) The society may use these people's experience and expertise when they overcome these two disabilities ultimately will lead to the realization of equality in employment. (iii) Giving assistance in improving the quality of life of them will be useful in attaining the Sustainable Development Goal 3, which states that countries should "Ensure healthy lives and promote well-being for all persons with disabilities".

In future, we plan to analyze the impact of color in recognition, female and male performance variations if any.

## 6. REFERENCES

**Abreu, Beatriz Colon and Joan P Togli.** (1987). "Cognitive rehabilitation: a model for occupational therapy." *The American journal of occupational therapy : official publication of the American Occupational Therapy Association* 41,7 (1987):439-48

- Alyssa Alcorn, Helen Pain, Gnanathusharan Rajendran, Tim Smith, Oliver Lemon, Kaska Porayska-Pomsta, Mary Ellen Foster, Katerina Avramides, Christopher Frauenberger, and Sara Bernardini.** (2011). Social communication between virtual characters and children with autism. In *Artificial Intelligence in Education*. Springer, Berlin, 7–14
- Aye Aye Myint and Chua Shuzhen**- Senior Physiotherapists Child Development: How to Improve Coordination and Motor Skills? <https://www.healthxchange.sg/children/childhood-conditions/child-development-coordination-motor-skills>
- Bartoli. L., Corradi.C, Garzotto.F, and Valoriani.M .** (2013), Exploring motion-based touchless games for autistic children’s learning. In *Proceedings of the Interaction Design and Children (IDC’13)*. ACM. 102–111.
- Boujarwah, F.A, Hong, H, Abowd G.D. and Arriaga. R.I.** (2011). Towards a framework to situate assistive technology design in the context of culture. In *Proceedings of the 13th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM. 19– 26.
- Chang Y. J., Chen S. F., and. Huang J. D** (2011). A kinect-based system for physical rehabilitation: A pilot study for young adults with motor disabilities. *Res. Dev. Disabil.* 32, 6 (2011), 2566–2570
- Christinaki. E, Triantafyllidis .G, and Vidakis.N.**(2010). Gesture- controlled serious game for teaching emotion recognition skills to preschoolers with autism. In *Proceedings of International Conference of the Foundations of Digital Games(FDG’10)*. 417–418
- Dourish. P**(2004). *Where the Action Is: The Foundations of Embodied Interaction*. MIT Press.
- Filmer. D.** (2008). Disability, poverty, and schooling in developing countries: Results from 14 household surveys. *World Bank Econ. Rev.* 22, 1 (2008), 141–163
- Ke F. and Im. T.** (2013). Virtual-reality-based social interaction training for children with high-functioning autism. *J Educ. Res.* 106, 6 (2013), 441–461
- Khakhar.J. and Madhvanath.S.** (2010). Jollymate: Assistive Technology for young children with dyslexia. In *Proceedings of the 2010 International Conference on Frontiers in Handwriting Recognition (ICFHR’10)*. IEEE, 576–580

**Lindgren. R and Johnson-Glenberg. M.** ( 2013). Emboldened by embodiment six precepts for research on embodied learning and mixed reality. *Educ. Res.*42, 8 (2013), 445–452

**Malin.A.J.** (1966). Indian Adaptation of Wechsler’s Intelligence Scale for Children. *Indian Psychological Corporation,Lucknow.*

**Parsons. S. and Cobb. S.** (2011). State-of-the-art of virtual reality technologies for children on the autism spectrum. *Eur. J. Special Needs Educ.*26, 3 (2011), 355–366.

**Parsons.T.D., Rizzo. A.A., Rogers. S, and York. P.**(2009). Virtual reality in paediatric rehabilitation: A review. *Dev.Neurorehabil.*12, 4 (2009), 224–238.

**Radabaugh MP.** (2014), Assistive Technology: Independent Living Centre NSW; [May 27, 2014]. Available from: [http://www.ilcnsw.asn.au/home/assistive\\_technology/](http://www.ilcnsw.asn.au/home/assistive_technology/).

**Ringland K.E., Zalapa R, Neal. M, Escobedo .L., Tentori .M, and Hayes.** (2014). SensoryPaint:A multimodalsensory intervention for children with neurodevelopmental disorders. *In Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing. ACM,* 873–884

**Samuel Mc Nerney** on November 4, (2011). A Brief Guide to Embodied Cognition: Why You Are Not Your Brain

**Standen P.J. and Brown.D. J** (2005). Virtual reality in the rehabilitation of people with intellectual disabilities: Review. *Cyberpsychol. Behav.*8, 3 (2005), 272–282.

**Wechsler David.**(1949). Wechsler Intelligence Scale for Children.

**Wilson. M** (2002). Six views of embodied cognition. *Psychonom. Bull. Rev.*9, 4 (2002), 625–636.

### **Web Reference**

National Council on Measurement in Education [http://www.ncme.org/ncme/NCME/Resource\\_Center/Glossary/NCME/Resource\\_Center/Glossary1.aspx?hkey=4bb87415-44dc-4088-9ed9-e8515326a061#anchorC](http://www.ncme.org/ncme/NCME/Resource_Center/Glossary/NCME/Resource_Center/Glossary1.aspx?hkey=4bb87415-44dc-4088-9ed9-e8515326a061#anchorC)

<http://en.wikipedia.org/wiki/Dexterity>



# A COMPREHENSIVE ANALYSIS ON DIFFERENT MACHINE LEARNING AND DATA MINING TECHNIQUES FOR ANOMALY INTRUSION DETECTION

**V. Sandeep**

*Research Scholar, Centre for VLSI Design, Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Virudhunagar, (India).*

Email ID: sandeep.vuud404@gmail.com, <https://orcid.org/0000-0002-0425-8688>

**K. Saravanan**

*Associate Professor, Department of Electronics and Communication Engineering, Saintgits College of Engineering, Kottayam, (India).*

Email ID: saravanantlf@gmail.com , XXXXXXXXXX

## ABSTRACT

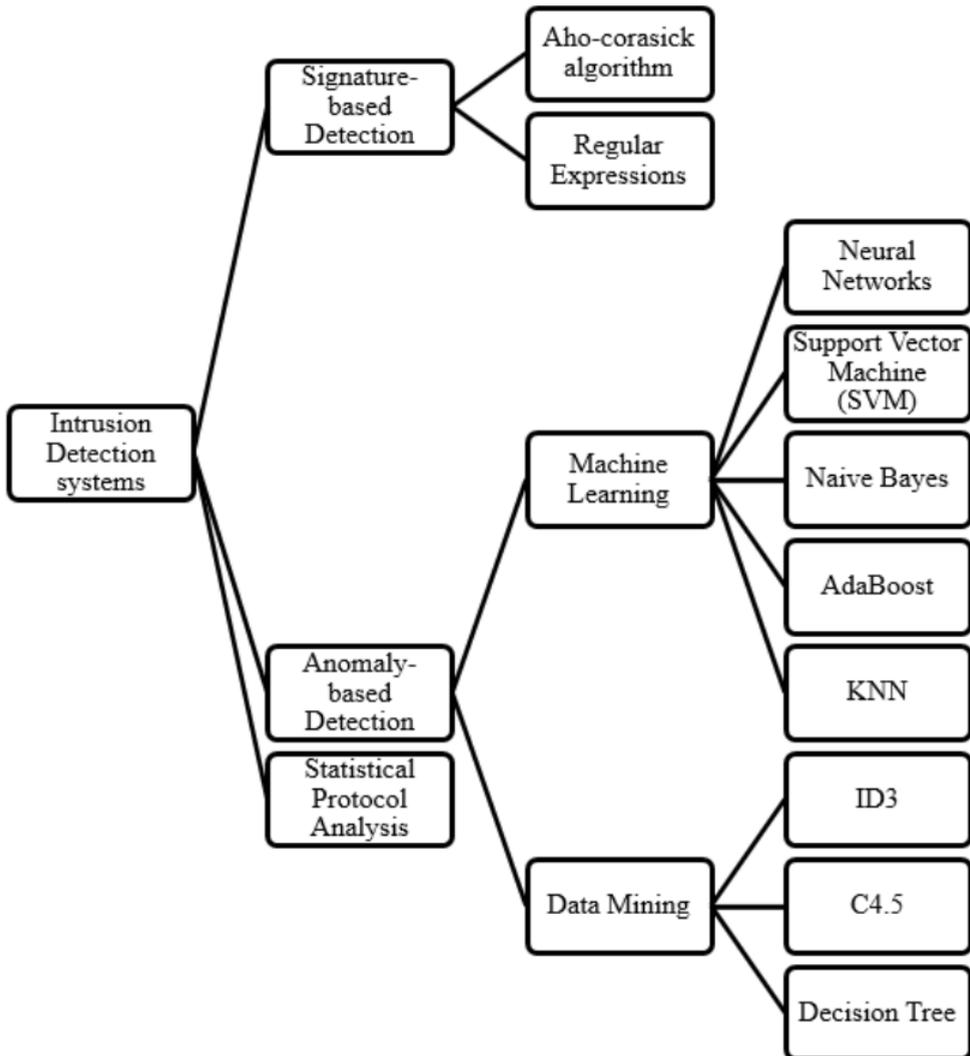
In this modern era, Network security draws a major attention in all areas across the world. Over the past decade, due to the high amount of internet usage and a quick development of internet, the weakness in network security have become major issues in every growing concern. Therefore, to detect unauthorized usage and unexpected attacks over the network security, Intrusion detection system (IDS) is used. There has been a vast amount of study done by many researchers in Intrusion Detection Systems in the last few years. Hence, this paper focuses on framing a survey on various IDS techniques that have been made use of over several years, which has not been mentioned previously. This paper does a short assessment on the various functions and detection strategies present in the anomaly intrusion detection system. It also includes a numerical comparison of several classification algorithms, the datasets used for processing and considering feature selection as an essential step for detection before classifying. This main objective here is to carry out an entire study of the importance and description of anomaly intrusion of detection, various types of anomaly intrusion of detection techniques, work done previously by different people, their outcomes and comparison, and the future work proposed by them.

**Keywords:** Anomaly Intrusion Detection, Machine Learning and Data Mining.

## 1. INTRODUCTION

Network Technology is termed as the integration of both the computer and communication technologies. Internet plays a vital task in all the areas of the society in recent days. It also changed the life style of individuals and for the endeavors to change the marketing models and their operational system. Network security pro-

protects the network software, hardware and system data from unexpected and malevolent destruction of reasons, disclosure, and changes, system operated consequently and accurately. Though network and information technologies have shown remarkable developments over the years, various kinds of problems continue to arise. The constant emergence of advanced internet services like online banking, e-commerce, digital currency etc has created higher requirements of network security [2]. A Network-based Intrusion detection system consists of three different detection methods. They are named based on Signature detection, based on Anomaly detection and analysis on Stateful protocol. Signature detection has a collection of signatures that characterizes the profile of each threat that has occurred, and checks the network for attacks using the known database. Intrusion Detection Systems are effective security systems which has various types to secure the applications more efficiently. To avoid intrusion and threats they add a defense line over inside and outside the system instead of replacing specific security tool just like immune system. Among the different kinds of ways IDS could be classified, they could be categorized on the basis of known and unknown attacks, called the detection on Signature-based (or) detection on Misuse, and detection on Anomaly- based. The main principle of Misuse IDS is detecting intrusion by pattern representations and it is also called as knowledge-based or signature-based. To find the possible intrusion comparison is made between these signatures or patterns to captured events. The type of Anomaly IDS is called as behavior based, which is used to monitor the activities regularly that depends on creating a profile of a normal behavior system [23].



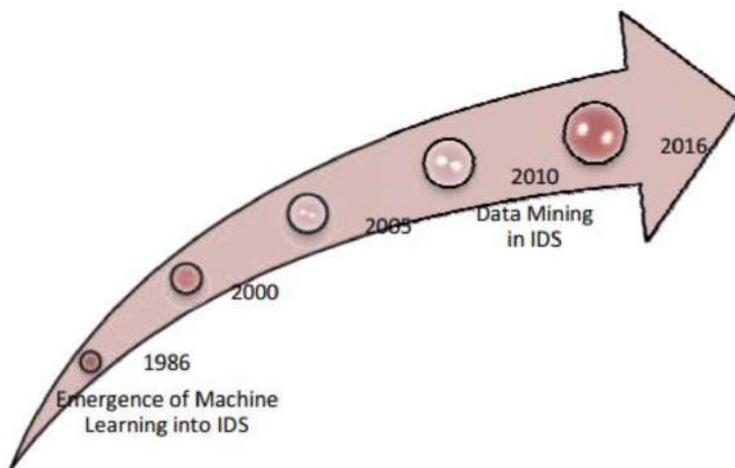
**Fig 1.** Various techniques of IDS

Fig.1. shows the various techniques involved in IDS. The significant aim of this paper is survey on Data mining (DM) and machine learning (ML) in IDS.

Many researchers are attracted towards Anomaly based IDS because it has great capability for representing novel attacks. Detection of a new or unknown data is the novelty detection which ML system is not conscious during the period of training. Anomaly based IDS have two major merits more than signature-based detection of intrusion systems. The capability of descry unknown attacks or zero-day attacks is the first merit of the ABIDS due to its ability to design the simple network operation

and to descry various departures. Secondly, the vital merit is that ABIDS makes it impossible for an attacker to identify the activities from the application or network [1]. ABIDS is categorized into two main types they are Machine Learning (ML) [1] and Data Mining (DM) [17].

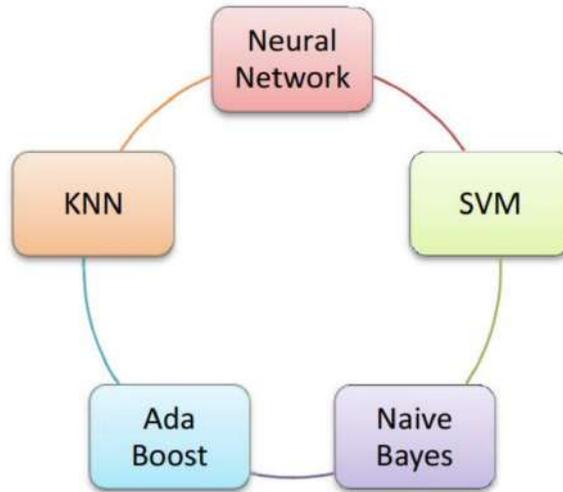
The paper is structured as follows: Section II gives the complete view of various Machine Learning techniques which are involved in ABIDS. Section III presents the several Data Mining techniques which are involved in ABIDS. Section IV concludes the overall report of the survey on ABIDS. Fig.2. shows the emergence of machine learning and data mining techniques used over the years for building supervised as well as anomaly intrusion detection systems. The data collected was from [7], [12], [17] and [18].



**Fig 2.** Survey of several years of ML and DM techniques in ABIDS

## 2. ABIDS BASED MACHINE LEARNING

The definition of ML is the capability of a system or program to study and enhance their execution on a particular task or a cluster of tasks at a time. The main aim of ML is to develop a system which enhances the performances over the previous results. The main functions of ML techniques have the capability to modify their computation technique based on newly acquired data [1]. In ML based IDSs, precise or inherent of design the analyzed patterns are caused. These designs are updated regularly, to develop the detection of intrusion that accomplishment on the basis of previous computation.



**Fig 3.** Different kinds of machine learning techniques in ABIDS

### 2.1 SUMMARY OF VARIOUS MACHINE LEARNING TECHNIQUES

In [15], Faraoun *et al.* in 2007 developed a machine learning algorithm for intrusion detection using K- means clustering and Neural networks, which showed a detection rate of an average of all attacks to 91.9% with a false alarm rate of only 3.36%. Azeem *et al.* defined a macro and micro-level classifier for classifying normal and attack data into categories. C4.5 feature selection was used [4]. [27] showed a Regular Expression matching architecture using Non-deterministic Finite Automata (NFA) approach, upon FPGA. They extracted a Perl Compatible RE (PCRE) achieving 46 % reduction in area. A Hybrid SVM and C4.5 classifier algorithm was developed in [12], with an accuracy for C4.5 achieving about 99.95% and 99.8% for SVM. Swamy *et al.* in 2012 developed a decision tree algorithm using an Improved C4.5 and it achieved a TPR of 96.75% in comparison with the existing C4.5's TPR of 95.76%. the False Positive Rate (FPR) was reduced from 4.23% to 3.25% [16].

CFS, IG, GR is used for feature reduction. Feature Vitality (FVBRM) reduction is done every time after classifying with Naïve bayes algorithm [24]. 41 features were selected, 24 reduced by FVBRM, achieving an average FPR of 0.005 and TPR of 97%. Ahmad *et al.* in 2013 built a PCA algorithm for feature transformation and SVM for classifying data in which the PCA-38 was able to achieve 100% TPR during training phase, and 98.66% during testing. Meanwhile SVM with GPC achieved a Detection Rate (DR) of 99.96% [10]. A Hybrid of C4.5 and SVM algorithm was achieved in [24] where C4.5 achieved a DR of 99.36% with a FPR of 9.46% and SVM obtained a DR of 87.65% and

an FPR of 6.12. an efficient intrusion detection algorithm was developed in [20] with K-means clustering, Neuro-fuzzy models and SVM and C4.5. Performance analysis was carried out the five measures: TPR, FPR, precision, total accuracy, F-measures. It provides an impressive DR. BadrHsina *et al.* in 2014 performed a comparative study on ID3 and C4.5 algorithm and the result were compared with C5.0 and CART. The ID3 and C4.5 was able to achieve an accuracy percentage of 94% and 96% respectively. C4.5 possessing less execution time proves that it is better when compared with other decision tree algorithms.

Sahu *et al.* in 2015 developed a J48 algorithm for the Kyoto 2006+ dataset. Using Weka, the J48 algorithm obtained 99.7% TPR for both normal and attacks, and 7.2 percent FPR with 99% F-measure for normal and attack packets. Omar *et al.* built a Principal Component Neural Network – a TDNN structure, which could detect various kinds of attacks, both through neural networks and Snort, namely ICMP Host sweep, TCP ECHO, UDP ECHO, TCP SYN etc. [22]. A novel intrusion detection system was built using the K-means and RBF kernel function for classification in [28]. Accuracy has been achieved at around 95% for an average of all attacks for a hybrid KMSVM, and around 86% for KM alone. Detection rate has been achieved around 97% for an average of all attacks for KMSVM, thus proving better than KM which is 90%. Linear canonical correlation and feature association impact scale are considered for feature optimization. With the total records tested and run, the entire TPR on average for all attacks is found to be 90.4%, with a FPR of about 9.6%. A hybrid model of SVM and extreme learning machine was built in [30]. Modified K-means was used for building high quality datasets. Detection rate for multi-level SVM and ELM has been achieved as 95.57% and 93.83% respectively, while for modified K-means it is achieved up to 95.75%.

In [25], the NSL-KDD datasets were filtered using Vote algorithm. The classification mechanisms consist of a hybrid fusion of the following algorithms: J48, RandomTree, Meta Paggging, DecisionStump, REPTree, AdaBoostMI, and Naïve Bayes. The hybrid algorithm achieved 99.81% in classifying instances. It shows 0.003 FPR and 99.7% TPR. [25] Uses K-means algorithm for clustering and Random forest algorithm for classification for the KDDCUP99 dataset.

The method of allotting a class of label to unclassified entity on the basis of features is called classification. Acquiring knowledge on representation of classes using a given sample is very important for any classifier. The classifier will work as predictor and descriptor for the unclassified and classified objects respectively. Various approach-

es exist such as Neural Networks, Bayesian Classifiers, Rule-based Approaches, SVM, decision Trees Genetic Classifiers and so on. The classifiers are assessed by it predict robustness, accuracy, speed, interpretability, scalability, domain dependent quality indicators and simplicity [8].

## **2.2 NEURAL NETWORKS**

The system taught to be predicting the next command on the basis of the sequences from the previous commands by a particular user in the neural network approach. Since neural network do not need any explicit user design, it can easily provide a way to any network trouble in modeling the behavior of the user to detect anomaly. The major alternate to statistical technique is neural networks in the IDEs. The basic of signature based matching system are comparably performed over the clean feed forward, well trained and back propagation neural network [11]. ABIDS uses several kinds of neural network such as Hopfield Networks, Radial Basis Function- Based and Multi layered Perceptions. IDS consist of three main phases to build a neural network [13].

To obtain the audit logs for every single used in a particular period of time, the collection trained data is required. A vector is essential and it is designed for every individual user which represents how often they use and execute each command. The command distribution vector is used to identify the trained neural network. An anomaly is signaled when the ideas of the network is varied from the original user.

## **2.3 SUPPORT VECTOR MACHINE (SVM)**

Initially, SVM maps the higher dimensional feature space from the input vector and then achieves advanced dimensional feature space from the optimal separating hyper-plane. Additionally, a decision boundary is created by it than quite the entire training samples and it tremendously sturdy to outliers. Basically, SVM classifier designed in the place of binary classification. Moreover, SVM also gives a penalty factor i.e. client specified parameter. It permits the user to exchange the width of the decision boundary and the number of misclassified samples. Added to the clustering methods, SVM is used for unsupervised learning [6, 13]. The achieved performance comparably provides better results than the clustering methods.

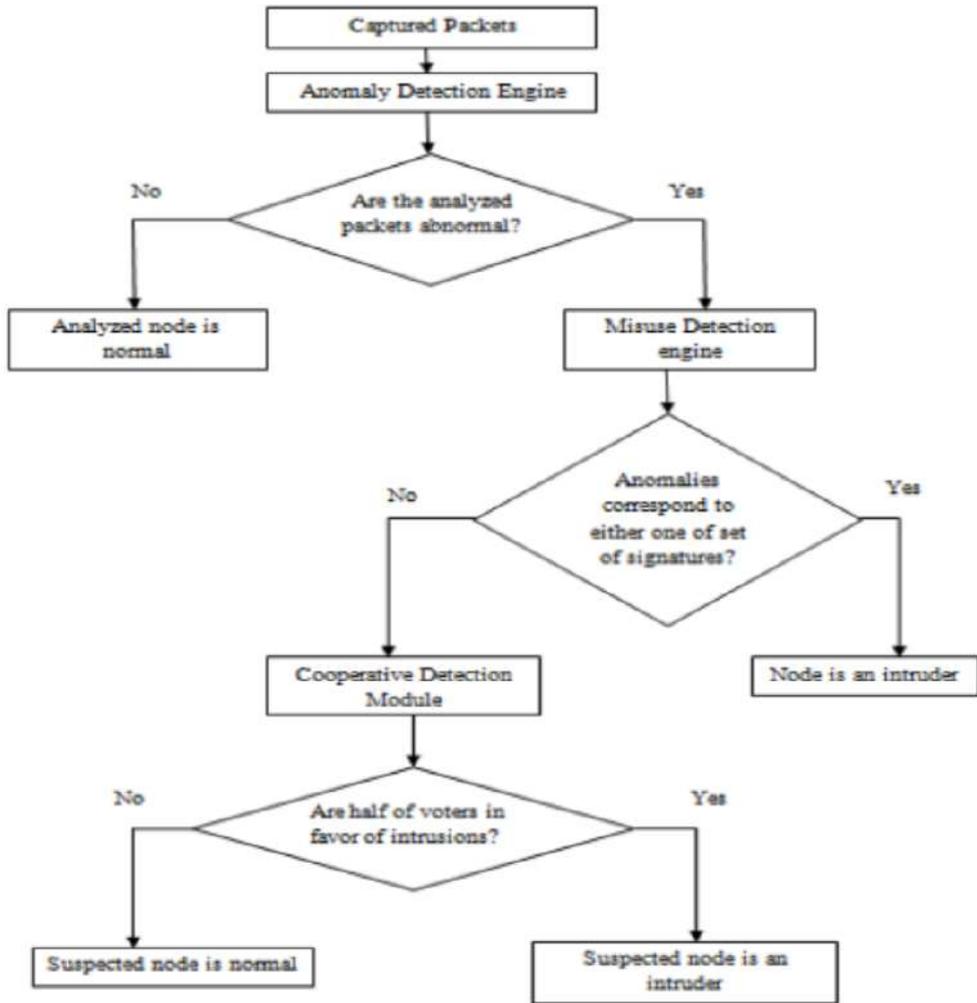


Fig 4. SVM flow for IDS [20].

In [3] were used more conventional SVM methods. Five SVMs methods were used to identify the normal traffic and to recognize the four types of abnormal activity KDD cup datasets. The above mentioned five SVMs work with the 99% accuracy though seven different variations of features set were used. Finally, it is concluded that SVMs are the ultimate method in neural network in terms of accuracy and speed.

### 2.4 NAÏVE BAYES

A main supervised learning method for classification is the Naïve Bayes (NB) classifier. It is easy to train and test the data in NB. The evaluation of conditional probability distribution of every feature in the class is dealt by the training of the classifier. This algorithm is used in many research areas, such as Spam filtering, online applications

and Text classification. It is the major booming learning algorithm for categorizing text documents. A simple probabilistic classifier is applied by the Bayes theorem with strong unique assumptions. It is easy, most favorable, and simple to apply. The major merit is that it takes very less time for training [9, 11].

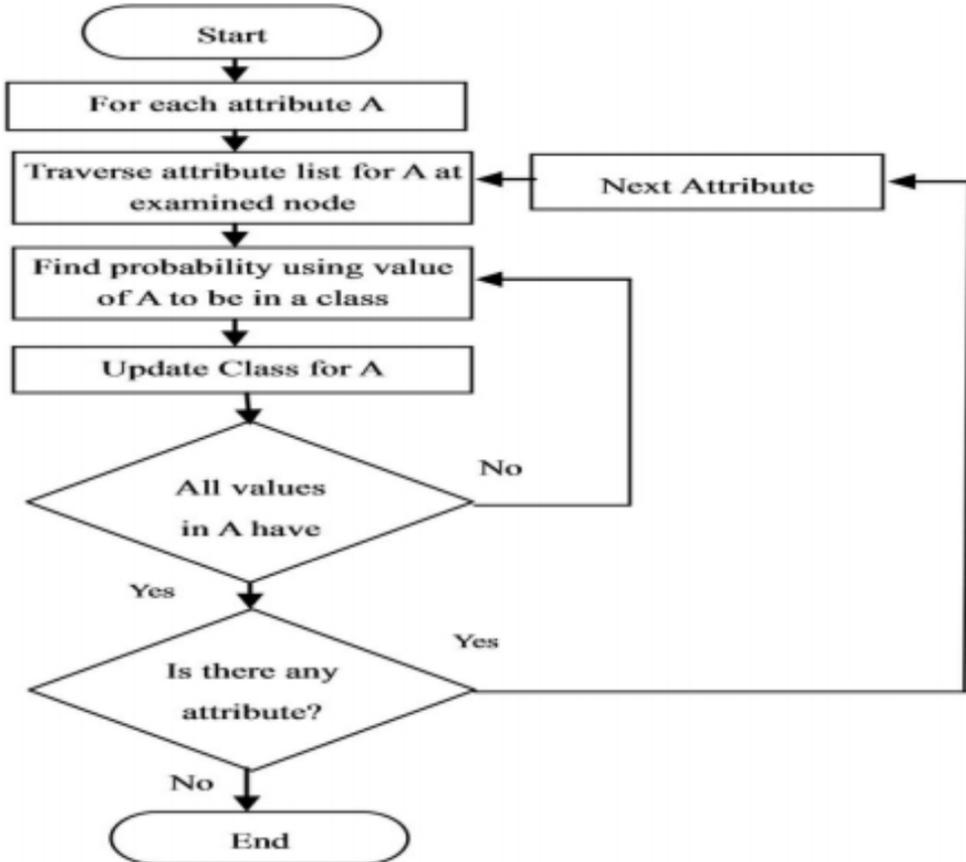


Fig 5. General workflow of Naive Bayes algorithm [30]

### 2.5 ADA BOOST

Ada Boost (Adaptive Boosting) is relatively well- organized, straightforward, and simple to program learning strategy. It has great in build a poor model and joining them relatively into an improved model. This algorithm is very straightforward to use, it begins by developing a basic form from the prepared datasets. It also verifies the records in the training data even the form is incapable to capture. To boost the significance of these difficult records in the prepared process a new form is built. This process is continued till the particular generated design starts to perform better.

## 2.6 KNN

KNN is a Neural Network classification technique and called as one of the easiest machine learning classifiers. It measures the distance among various data points on the input vectors and allots the undescribed data point to its nearest neighbor class. K is a significant factor. The data point allotted to the class of nearest neighbor when k is equal to 1. If k is greater than 1, it takes a long time to predict and influence the accuracy by reducing the noise effect. Based on the distance metric, it begins with a k arbitrary cluster which centers in space and partitions the group of given entity into k subsets. The optimization of an objective function is used to update the centers of groups iteratively.

This is one of the most commonly used clustering techniques, which is used world-wide because it is very simple to implement efficiently with less time complexity [23]. The fundamental aim of using k means grouping scheme is separating the collection of simple data and attacking the data which behaves similar to several parts that is known as K means clustering. Otherwise K-means measures a specific number of K, the finest cluster centroid showing information with same performance. In both normal and abnormal behavior, activities or data are similar. For classification and regression, a non-parametric method called k-NN. [3] In both cases the characteristic space has examples of k nearest preparation as an input. Whether the KNN algorithm will be required for either classification or for regression will be determined by the output. An entity (or) object could be categorized with the help of a best vote from its neighbors, with the entity to be allotted to the most common class in KNN. The k-NN is a based on instance learning, in which the process are approximately local and every outputs are overdue till classified it. The k-NN is one of the simplest algorithms among all the machine learning algorithms.

## **3. DATA MINING IN ABIDS**

The method of analyzing information from different perspectives and summarizing it into utilized data is known as data mining, also called as knowledge discovery that helps in making various decision. It helps in finding patterns or correlations between various fields which are presented in database. The significant disadvantage of signature-based and other detection techniques is that it detects only the known attacks and attack behaviors. For the above problem can be overcome with a data mining technique called Pattern Finding. It is defined as the function of attack models currently being used and before unobserved forms or patterns from bulky information stores. The data-mining process is proposed to minimize the sum of information that

is retaining for comparisons of systems activity; developing information that is huge would be wrathful to anomaly detection [11, 9].



**Fig 6.** Various Data Mining techniques in IDS

### 3.1. A SURVEY OF DIFFERENT DATA MINING ALGORITHMS

Lindell2014 in 2009 proposed an algorithm for developing an intrusion detection system with the use of an ID3 algorithm. It was able to determine the fitness level of the dataset and also provided much enhanced outputs than the previous ones. [6] proposes a hybrid model than puts together an Anomaly based Intrusion detection technique with a Signature based Intrusion detection method which is divided into two stages. The first stage includes generating alert for the anomaly data by the Signature detection SNORT. The second stage entails K-means and CART are used to classify normal and abnormal activities. CART algorithm achieved an accuracy of 99.41% whereas C4.5 achieved 96.43% accuracy. [13] presents a process for implementing the decision tree method on a small network data. With this process, the security model could collect data, build a decision tree and integrate the logic of the model into Snort signatures. The technique classified over 98% of the data and could be integrated into Snort, firewalls and for identifying malicious activity.

#### 3.2. C4.5

The C4.5 algorithm uses the data to gain ratio, as an extension of ID3 algorithm which uses the default criteria to select the better splitting attributes. The information gain ratios efficiently stay away from the basis of choosing feature with several values that come about in the ID3 algorithm. The C4.5 algorithm makes better improvements than the ID3, such as handling the information with mathematical and supposed characteristic, trading with the information of missing attribute values, and snip trees later than creation. The major difficulty of the C4.5 algorithm is that it

needs huge amount of time for CPU and memory as the samples enlarge. The trees were constructed by C4.5 algorithm in a top to down recursive way as presented in algorithm. In tree every node, the algorithm chooses the characteristics information are most efficiently divides the set of easy into detachment improved in one class or more. The characteristics with the highest normalized data achieve are selects to develop the decision [24]. The C4.5 is also a new variant of ID3 algorithm.

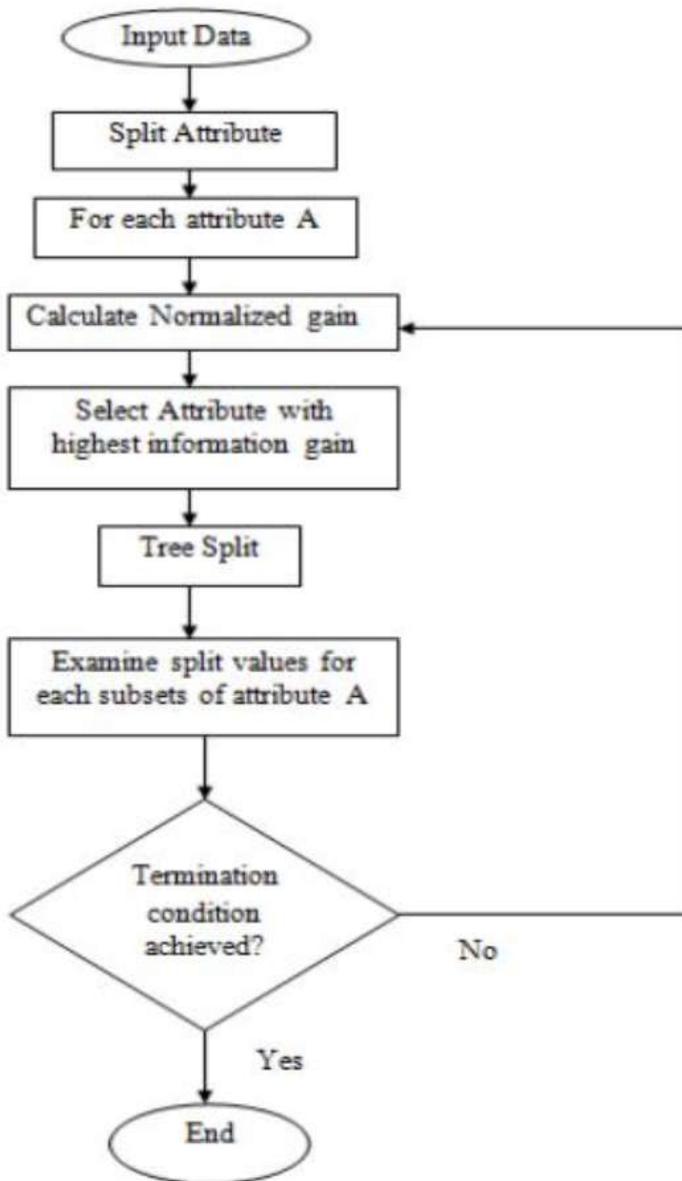


Fig 7. General workflow description of C4.5 algorithm: [30]

### **3.3. INTERACTIVE DICHOTOMIZER 3 (ID3)**

ID3 algorithm [5] has been utilized to create the classification rules as a form of DT. In every decision node, every characteristic is verified to choose, how best it categorizes the examples. The suitable characteristic is then selected even as the remaining example is paneled by it [7]. The advantage of data increase is introduced to choose the suitable characteristics for the classification function. Next to diving the examples associated to this characteristic, entropy decrease is guaranteed, it is also called as the data gain. Being a supervised learning algorithm, ID3 uses a set of examples for building a decision tree [11]. The algorithm also grows a tree based on different training instances where data could be acquired and use it for classification purposes.

### **3.4. DECISION TREE**

Decision trees can investigate the information and categorize significant attributes in the network that indicate malevolent activities. It can include worth to several real-time of protection networks through investigating bulky intrusion detection information. It can identify trends and patterns that sustain further analysis, the progress of attack signatures, and other activities of verifying. The major merits of utilizing decision trees as an alternative to other classification methods is that they give a rich set of rules that are simple to comprehend, and can be effortlessly integrated with real-time technologies [9]. A decision in a tree is marked using a node from various alternatives, with each terminal node possessing a different function. Decision trees provide reasonable performance and are fast, proving it a powerful tool. The Naïve Bayes tree also called the NBTree arranges high-dimensional by a mapping function. So, that worth can be structured and utilized after the resulting one-dimensional structure. It could be termed as a supervised learning algorithm which learns the process of mapping samples known and unknown samples from attributes to classes. This is completed using arbitrarily preferred predictors for every split in each tree [5].

### **3.5. C5.0**

C5.0 algorithm is similar to its predecessor C4.5. Like C4.5, this algorithm uses the decision tree for classification of both known and unknown data, before first being tested by the decision tree itself [19]. Some of its features are that it has a large decision tree that is easily comprehensible. And C5.0 also solves some problems previously present in C4.5, like over fitting and error pruning, through its acknowledgement action for missing data [19].

## 4. CONCLUSION

Intrusion detection at present attracts a lot of interest from various research communities and several commercial companies. The major purpose of this survey is that nowadays IDS have become an essential feature all over the world. Many studies had been conducted in the area of Intrusion detection to producing this paper. The major aim of this paper is to present an overview of the essential and functions of various techniques which involved in IDS. This paper clearly talks about the Motivation of IDS, problem beyond exclusion of IDS, and even the Challenges of IDS which are not mentioned in the previous studies. Many techniques have been handled by using IDS technology and it is proved to be an effective technology in detecting various intrusion attacks in the networks. Based on the survey done in this paper, the best-case criterion for constructing an Intrusion Detection system using significant methodology would be the Support Vector Machine (SVM) for machine learning and the C4.5 decision tree algorithm for data mining. The Particle Swarm Optimization (PSO) is also an efficient technique for performing feature extraction for the dataset. Though the proposed work carries out a review on the various contemporary machine learning and data mining techniques, the ability to manage massive data flows in real-time should be enhanced, and this issue will be addressed in future study. An Improved Particle Swarm Optimization (I-PSO) with SVM and C4.5 classification will be utilized over a NSL-KDD dataset to efficiently build an Anomaly Detection model.

## 5. REFERENCES

- [1] **Patcha, A., & Park, J. M.** (2007). An overview of anomaly detection techniques: Existing solutions and latest technological trends. *Computer networks*, 51(12), 3448-3470. <https://doi.org/10.1016/j.comnet.2007.02.001>
- [2] **Jones, A. K., & Sielken, R. S.** (2010). Computer System Intrusion Detection A Survey. *International Journal of Computer Theory and Engineering*, Vol.2, No.6. [https://www.princeton.edu/~rblee/ELE572Papers/Fall04Readings/IntrusionDetection\\_jones-sielken-survey-v11.pdf](https://www.princeton.edu/~rblee/ELE572Papers/Fall04Readings/IntrusionDetection_jones-sielken-survey-v11.pdf)
- [3] **Buczak, A. L., & Guven, E.** (2016). A Survey of Data Mining and Machine learning methods for Cyber security intrusion Detection. *IEEE Communications Surveys and Tutorials*. <https://doi.org/10.1109/COMST.2015.2494502>
- [4] **Khan, A., & Khan, S.** (2008). Two Level Anomaly Detection Classifier. *International Conference on Computer and Electrical Engineering, ICCEE*. <https://doi.org/10.1109/ICCEE.2008.138>

- [5] **Hssina, B., Merbouha, A. K., Ezzikouri, H., & Erritali, M.** (2014). A Comparative Study of decision tree ID3 and C4.5. *International Journal of Advanced Computer Science and Applications*, Vol. 4, Issue 2. [https://saiconference.com/Downloads/SpecialIssueNo10/Paper\\_3-A\\_comparative\\_study\\_of\\_decision\\_tree\\_ID3\\_and\\_C4.5.pdf](https://saiconference.com/Downloads/SpecialIssueNo10/Paper_3-A_comparative_study_of_decision_tree_ID3_and_C4.5.pdf)
- [6] **Eskin E, Arnold, A., Preraua, M., Portnoy, L., & Stolfo, S.** (2002). A Geometric Framework for Unsupervised Anomaly Detection: Detecting Intrusions in Unlabeled Data. *Applications of data mining in computer security*, pp. 77-101. [https://link.springer.com/chapter/10.1007/978-1-4615-0953-0\\_4](https://link.springer.com/chapter/10.1007/978-1-4615-0953-0_4)
- [7] **Ghosh A., Schwartzbard, K. A. & Schatz, M.** (1999). Learning program behavior profiles for intrusion Detection. In *Proceeding of 1st USENIX*, pp. 9-12. [https://www.usenix.org/legacy/event/detection99/full\\_papers/ghosh/ghosh.pdf](https://www.usenix.org/legacy/event/detection99/full_papers/ghosh/ghosh.pdf)
- [8] **Liao, H. J., Tung, K. Y., Lin, C. H. R. & Lin, C. Y.** (2012). Intrusion detection system: a comprehensive Review. *Journal of Network and Computer Applications* 36, pp. 16–24. <https://doi.org/10.1016/j.jnca.2012.09.004>
- [9] **Honig, A., Howard, A., Eskin, E., & Stolfo, S. J.** (2002). Adaptive model generation: An architecture for the deployment of data mining based intrusion detection Systems. In D. Barbar and S. Jajodia (Eds.), *Data Mining for Security Applications*. Boston, Kluwer Academic Publishers. [https://link.springer.com/chapter/10.1007/978-1-4615-0953-0\\_7](https://link.springer.com/chapter/10.1007/978-1-4615-0953-0_7)
- [10] **Ahmad, I., Hussain, M., Alghamdi, A., & Alelaiwi, A.** (2014) Enhancing SVM performance in intrusion detection using optimal feature subset selection based on genetic principal components. *Neural Computing and Applications*, Vol. 24, Issue 7-8, pp. 1671-1682. <https://doi.org/10.1007/s00521-013-1370-6>
- [11] **Patel, J., & Panchal, K.** (2015). Effective Intrusion Detection System using Data Mining Technique. *Journal of Emerging Technologies and Innovative Research (JETIR)*, Volume 2, Issue Vol. 6, pp. 1869- 1878. <https://www.jetir.org/papers/JETIR1506034.pdf>
- [12] **Koshal, J., & Bag, M.** (2012). Cascading of C4.5 Decision Tree and Support Vector Machine for Rule Based Intrusion Detection System. *International Journal of Computer Network and Information Security*, Vol. 8, pp. 8-20. <https://doi.org/10.5815/IJCNIS.2012.08.02>

- [13] **Vijayanand, R., Devaraj, D., & Kannapiran, B.** (2018). Intrusion Detection System for Wireless mesh network using multiple support vector machine classifiers with genetic-algorithm-based feature selection. *Computers & Security*, Vol. 77, pp. 304-314. <https://doi.org/10.1016/j.cose.2018.04.010>
- [14] **Jyothsna, V., & Prasad, V. V. R.** (2016). FCAAIS: Anomaly based Network Intrusion Detection through feature correlation analysis and association impact scale. *ICT Express* (2), pp. 103-116. <https://doi.org/10.1016/j.icte.2016.08.003>
- [15] **Faraoun, K. M., & Boukelif, A.** (2007). Neural Networks Learning Improvement using the K-Means Clustering Algorithm to Detect Network Intrusions. *International Journal of Computer and Information Technology*, Vol. 1, No. 10. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.99.971&rep=rep1&type=pdf>
- [16] **Swamy, K. V. R., & Lakshmi, K. S. V.** (2012). Network Intrusion Detection Using Improved Decision Tree Algorithm. (*IJCSIT*) *International Journal of Computer Science and Information Technologies*, Vol. 3 (5). <http://ijcsit.com/docs/Volume%203/vol3issue5/ijcsit2012030505.pdf>
- [17] **Lindell, Y., & Pinkas, B.** (2009). Secure multiparty computation for privacy-preserving data Mining. *The Journal of Privacy and Confidentiality*; Vol. 1, pp. 59–98. <https://doi.org/10.29012/JPC.V1I1.566>
- [18] **Vanitha, I., & Mary, M. S.** (2016). A comparative study of Classification algorithms used in Network Intrusion Detection Systems (NIDS). *ARS- Journal of Applied Research and Social Sciences*, Vol. 3, Issues 23. [https://www.researchgate.net/publication/314245651\\_A\\_comparative\\_study\\_of\\_Classification\\_algorithms\\_used\\_in\\_Network\\_Intrusion\\_Detection\\_Systems\\_NIDS](https://www.researchgate.net/publication/314245651_A_comparative_study_of_Classification_algorithms_used_in_Network_Intrusion_Detection_Systems_NIDS)
- [19] **Karim, M., & Rahman, R. M.** (2013). Decision Tree and Naïve Bayes Algorithm for classification and generation of actionable knowledge for direct marketing. *Journal of Software Engineering and Applications*, Vol. 6, No. 4, pp. 196-206. <http://dx.doi.org/10.4236/jsea.2013.64025>
- [20] **Solanki, M., & Dhamdhare, V.** (2014). Intrusion Detection System by using K-Means clustering, C 4.5, FNN, SVM classifier. *International Journal of Emerging Trends and Technology in Computer Science (IJETTCS)*, Vol. 3, Issues 6. <https://www.ijettcs.org/Volume3Issue6/IJETTCS-2014-11-02-10.pdf>

- [21] **Mukkamala, S. & Sung, A. H.** (2013). Identifying significant features for network forensic analysis using artificial intelligent techniques. *International Journal of Digital Evidence*, Vol. 1, No. 4, pp. 1-17. <https://www.utica.edu/academic/institutes/ecii/publications/articles/A04CCCB9-D778-B3D4-3C9A98DB4B0F99D1.pdf>
- [22] **Al-Jarrah, O., & Arafat, A.** (2015). Network Intrusion Detection System Using Neural Network Classification of Attack behavior. *Journal of Advances in Information Technology*, Vol. 6, No. 1. <https://doi.org/10.1109/IACS.2014.6841978>
- [23] **Caruana, R., & Niculescu-mizil, A.** (2006). An empirical comparison of supervised learning algorithms. *Proceedings of the 23rd International Conference on Machine Learning*, ACM, pp.161–168. <https://doi.org/10.1145/1143844.1143865>
- [24] **Mukherjee, S., & Sharma, N.** (2012). Intrusion Detection using Naive Bayes Classifier with Feature Reduction. *Procedia Technology* 4, pp. 119 – 128. <https://doi.org/10.1016/j.protcy.2012.05.017>
- [25] **Aljawarneh, S., Aldwairi, M., & Yasin, M. B.** (2017). Anomaly-based intrusion detection system through feature selection analysis and building hybrid efficient model. *Journal of Computational Science*. <https://doi.org/10.1016/j.jocs.2017.03.006>
- [26] **Sahu, S., & Mehtre, M. B.** (2015). Network Intrusion Detection System Using J48 Decision Tree. *International Conference on Advances in Computing, Communication and Informatics*. <https://doi.org/10.1109/ICACCI.2015.7275914>
- [27] **Hieu, T. T., Thinh, T. N., Vu, T. H., & Tomiyama, S.** (2011). Optimization of Regular Expression processing circuits for NIDS on FPGA. *Second International Conference on Networking and Computing*. <https://doi.org/10.1109/ICNC.2011.23>
- [28] **Ravale, U., Marathe, N. & Padiya, P.** (2015). Feature Selection Based Hybrid Anomaly Intrusion Detection System Using K Means and RBF Kernel Function. *International Conference on Advanced Computing Technologies and Applications (ICACTA)*. <https://doi.org/10.1016/j.procs.2015.03.174>

- [29] **Kosamkar, V., & Chaudhari, S. S.** (2014). Improved Intrusion Detection System using C4.5 Decision Tree and Support Vector Machine. *International Journal of Computer Science and Information Technologies (IJCSIT)*, Vol. 5(2). <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.658.3012&rep=rep1&type=pdf>
- [30] **Al-Yaseen, W. L., Othman, Z. A., & Nazri, M. Z. A.** (2017). Multi- Level Hybrid Support Vector Machine and Extreme Learning Machine Based on Modified K-means for Intrusion Detection System. *Expert systems with Applications*, Vol. 67, pp. 296-303. <https://doi.org/10.1016/j.eswa.2016.09.041>
- [31] **Aung, Y. Y., & Min, M. M.** (2017). An Analysis of Random Forest Algorithm based Network Intrusion Detection System. *IEEE/ACIS International Conference on Software Engineering, Artificial Intelligence, Network and Parallel/Distributed Computing (SNPD)*. <https://doi.org/10.1109/SNPD.2017.8022711>

# **EDGE COMPUTING WITH CLOUD BASED MACHINE LEARNING WITH IOT INFRASTRUCTURE SECURITY ISSUE**

**P. Velmurugadass**

*Assistant Professor, Department of CSE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [dass.spv@gmail.com](mailto:dass.spv@gmail.com), <http://orcid.org/0000-0002-4036-0532>

**Dr. S. Dhanasekaran**

*Associate Professor, Department of CSE, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [srividhans@gmail.com](mailto:srividhans@gmail.com), <https://orcid.org/0000-0002-5409-2057>

**Dr. D. Gnanasekaran**

*University Library, Department of Library and Information Science, Kalasalingam Academy of Research and Education. Krishnankoil, Virudhunagar (Dt) (India).*

Email ID: [gsekard@gmail.com](mailto:gsekard@gmail.com), <http://orcid.org/000-0003-4999-3210>

## **ABSTRACT**

This paper represents the exponential growth of the internet of things (IoT) and present cloud services have more traffic for managing the resource and delivering the services of end-to end. The new idea behind cloud computing is to push the cloud services to closer the edge of the networks, edge computing has able to do the concerns service for smart clients, smart city, smart hospital, smart mobiles, smart grid, smart factory, smart transport, smart wind, and edge computing manage networks traffic, reducing transmission latency, low bandwidth occupation, save energy consumption and security data transfer of IoT devices. This paper analyzes and represents the edge cloud computing extensively survey of ongoing research for the Internet of Things (IoT). Finally, we represent several features and evaluating the availability, integrity of the edge computing and more flexible service of IoT applications then blend into the scenery cloud computing architectures.

**Keywords:** Cloud computing, IoT, Edge Computing, Smart Vehicle, Smart Home and Machine Learning.

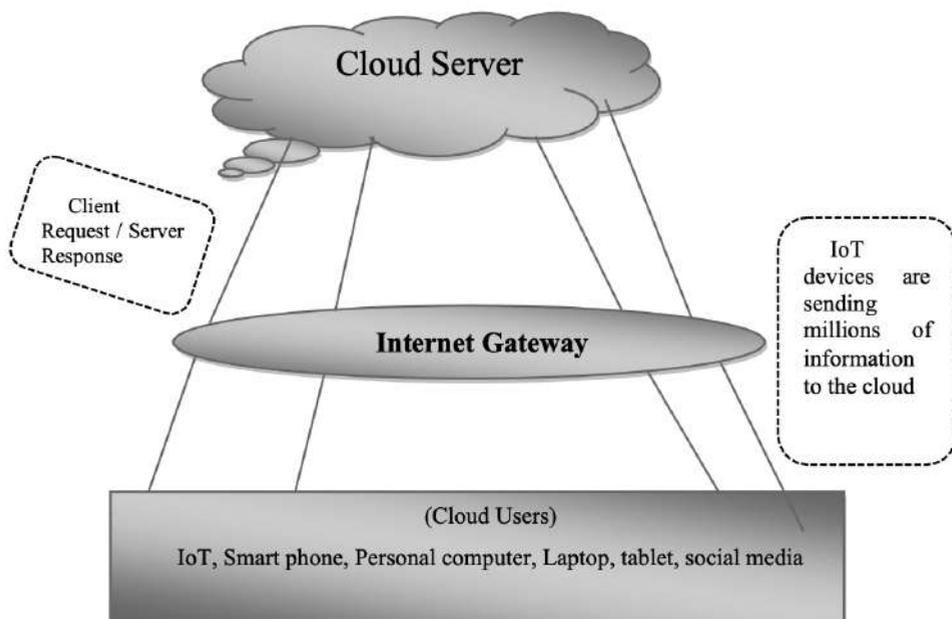
## **1. INTRODUCTION**

The Internet of Things (IoT) is a new computing prototype and architecture that is a speedy development application with the improvement of wireless communication technologies [1]. The edge computing architecture basically intelligent of the edge

of the networks and supporting to the smart devices of IoT application environment. The internet of everything now we have just thousands and thousands of millions and billions of devices try to send all the data back to a cloud server. The server's themselves would get overloaded, it would be a big problem a few years ago there was the idea of pushing the intelligence to edge computing. The edge devices do computational stuff and then only send the results back to the cloud server. Edge computing is a reduce the cloud server works, Edge with Cloud computing architecture by processing and services at the edge of the distributed networks and edge computing services extensively decrease the cumulative of data that have to be travelled to the cloud server, reduce the networks traffic and the remoteness of data travelling [2]-[3].

### 1.1 Cloud to the Edge Computing

Cloud plus edge computing now cloud we already known what cloud is it offers services like platform and storage and other resources through the internet from a remote data centres, the cloud allows us access to our resources anywhere and anytime. It gives us benefits like saving cost on physical resources efficiency gives us. Cloud has some of the limitations- High latency, limited bandwidth, data protection mechanisms and Internet connectivity.



**Figure 1:** Cloud computing service architecture.

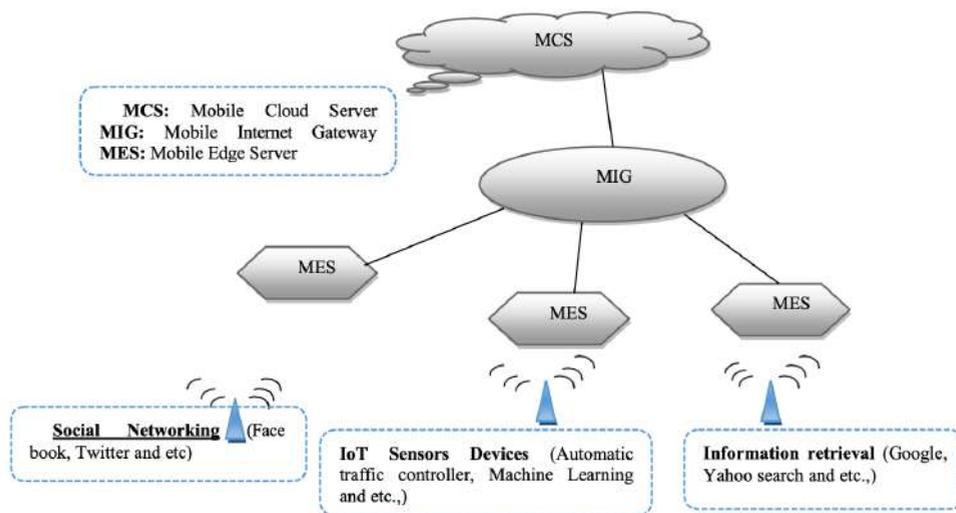
In this architecture, we discuss the cloud computing functionalities, resource pooling at the data centre, cloud big data analysis and scalability access. Now a day's internet usage and IoT application growth are increasing such as Smartphone, personal computer, sensor devices, Google apps, Twitter, Face book, Linked In and several social media. These devices and IoT applications are widely used in our daily life. Moreover, all the sources of the data have to be stored in the centralized cloud, so that the data streams transmit to the cloud and end-user. In this case, cloud computing has a high demand for real-time data analysis of this reason some of the service latency problems accrued in the present cloud and security issues due to failing data protection mechanisms than a requirement of high-speed internet connectivity. Hence we need intelligence and dedicated service infrastructure to process the real-time data that name is edge computing.

## **2. AN OVERVIEW OF CLOUD WITH EDGE COMPUTING-BASED IOT APPLICATIONS**

The pictorial representation of cloud with edge computing major objective is could server push the service to the nearest edge server. The edge server provides better Quality of Service ( QoS) of IoT devices such as smart Home, Smart Mobile, Smart City, smart Healthcare, and Smart Transport, Smart Grid and etc.,. Edge computing reducing latency problem, minimum bandwidth usage, power consumption saving and high security. Even though edge computing has significantly more advantages when compared with cloud services, it cannot completely replace the cloud [3]. For the current cloud computing and application infrastructure, it is very common that these large amounts of edge devices need to work closely with the application servers located at a small number of distributed large-size data canter because most of the computation, storage and networking resources are owned by the application service providers (ASPs) such as Google, Amazon, Microsoft, Facebook and Apple[5]. Edge computing architecture is also implementing several IoT applications for example mobile edge computing a new option for network operators. It is used for improved coverage and providing more bandwidth to data usage consumers. A major advantage of edge computing is that action is taken action and reduces response time down to milliseconds, while also securing network resources. The main purpose of edge computing is not likely to replace Cloud computing and such as edge computing ability to reduce latency and network bottlenecks, security challenges.

### 2.1 An overview of cloud with edge computing-based IoT Applications

Mobile edge computing provides seamless integration of multiple application service providers and vendors towards mobile subscribers, enterprises and other vertical segments [6]. Mobile edge computing (MEC) is an important future of cloud mobile computing (CMC). In the future smart mobile and IoT application users will be increased billions and billions such as current mobile communications networks architecture and the spectrum there are many obstacles. For example user’s mobile behaviour change users need more the capability of high order image processing so that the demand for high computation power of comfortable devices increase therefore mobile edge network cloud that offloads from centralized mobile cloud is needed in future changes. Next challenges users expect low latency, high speed and everywhere increased reality and numbers of smart devices will be increased after that mobile traffic bursts will cause network congestion in the future 4g/5g network services. Cloud Mobile Computing push the CMC services to closer the MEC of the networks, MEC has able to do the concerns service such as (mobile games applications, mobile software applications, Mobile network tracking/location, mobile big data analytics and etc.). The overall framework is given in Figure 2.



**Figure 2:** Overall framework of MCS, MIG, MES

**Source:** Own diagram

The Pictorial representation of MEC distributed Architecture major objective is Mobile Cloud Service push the concerns service to the nearest MEC server. The mobile edge server provides better Quality of Service (QoS) of Social Networking’s, IoT Sensors devices and Information retrieval. Smart object request sent to the mobile

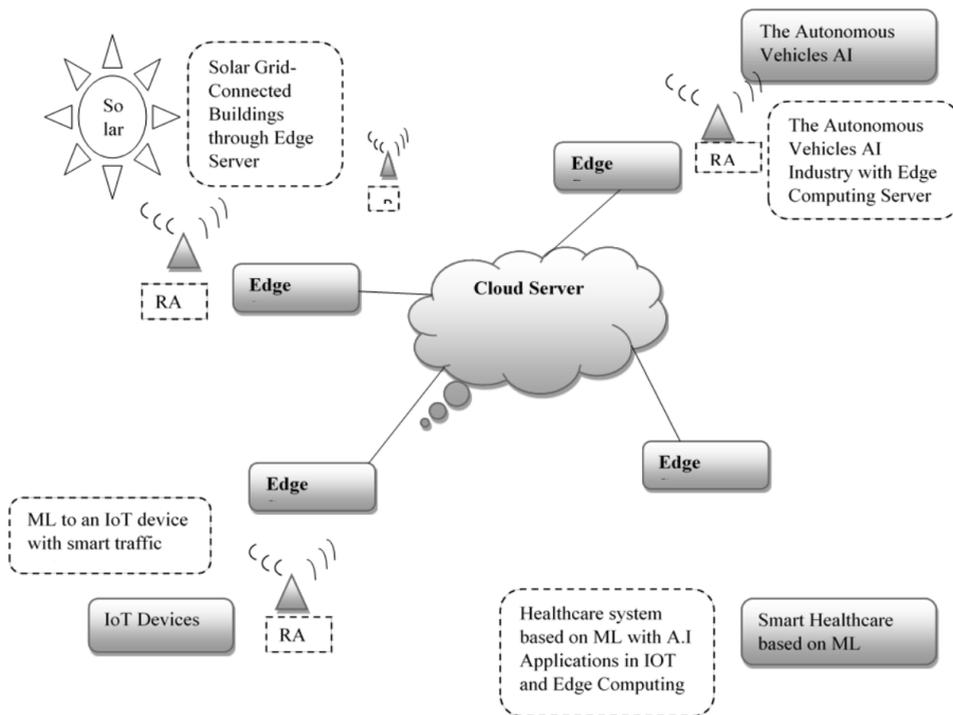
edge server after that mobile edge server was taken intelligence service for particular request then services reports sent to the mobile cloud server. In the Radio Access Networks are signals broadcasted for smart objects. Even though MEC has significantly more advantages when compared with mobile cloud services, it cannot completely replace the cloud. It is used for improved coverage, fast response and providing more bandwidth to data usage consumers.

### **2.3 Merit of mobile edge computing:**

- The high bandwidth of 4g, 5g and above mobile technology.
- Server's power consumption cost is low.
- Low latency.
- Networking congestion control management.
- Improved user Quality of Service (QoS) and Quality of Experiences (QoE).
- Video caching and security is improved on Edge Mobile Computing.

## **3. MACHINE LEARNING WITH EDGE COMPUTING**

The sparkle of the idea is machine learning plus edge computing compares to better than the cloud service and Edge computing can enable real-time analytics and execute the process-based algorithms to keep Artificial Intelligence (A.I). We can't replace the cloud server; Edge computing is extended to the cloud server and intelligent services given through the edge server after that client objects service details forwarded to the Cloud server. However, most of the A.I and machine learning algorithm specification and deployments are also very rich such as IoT device have service latency problems due to processing, computing and analytics through the cloud server. The quickness of cloud computing is great but the present situation is not enough. In this world most industry, government sectors, public sectors and IoT device users increasing million and millions such as IoT device, machine learning and A.I are interact with cloud server because of all the algorithms and process deployed only cloud data centre. However, IoT devices have faced big data problems for AI-based approaches – high response time required of real-time analytics. It overall framework is given in Figure 3.



**Figure 3:** Distributed cloud based ML with Edge computing on IoT

**Source:** Own diagram

Edge computing with machine learning is to be deployed at the edge of the networks. This approach is that for scalability, reliability, and security reasons, data will be analytics at the edge in the IoT industry.

#### Machine Learning with Edge Computing Advantages

- Edge based Machine Learning is rapid verification about ML- Algorithms and specification then analyze Pattern recognition.
- Edge based Machine Learning is superior security, data verification and access points location accuracy detection.
- Edge based Machine Learning has self-learning time, problem solving methods, IoT device behaviours detection, and intelligent decision making is very fast and optimize.

### 3.1 Edge and Cloud characteristics different

Table 1 shows the characteristics difference of Edge Computing and cloud Computing.

CHARACTERISTICS	CLOUD	EDGE
Processing Speed	Slower	Faster
Bandwidth Usage	High	Low
Real time data processing	Millisecond	Microsecond
Storage	Centralized	Decentralized
Deployment cost	High	Low
Multi Environment	Support	Support
IoT device identification	More time required	Less timer required

**Table 1:** Characteristics difference of Edge and cloud.

## 4. EDGE-BASED AUTONOMOUS VEHICLES

Autonomous vehicles and these technologies are used for self driving cars and not need human drivers, autonomous vehicles must be proficient for deriving on the road in real-time but data information transfer in real-time is essential. Transport rules and driving methods are deployed at the cloud data centers and autonomous vehicles and sensors are connected to the cloud server then the cloud server has given instruction and sent the data to particular autonomous vehicles about the transport and driving rules. In these stipulations for cloud to autonomous vehicles, significant impact on the self-driving vehicles' decision-making time will be delayed.

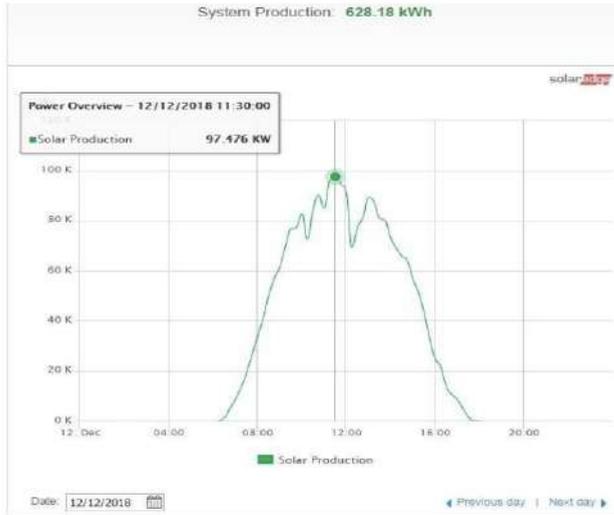
In case network traffic in the cloud data center that time autonomous vehicles have some of the problems for self-driving. In these circumstances Artificial Intelligence and IoT devices is driving the data processing from the cloud to the edge computing with mobile sensor, platforms are interconnected of the autonomous vehicle and algorithm specification and deployment closer to the intelligence edge of the networks in the appearance of distributed radio frequency identification. In this technology will be capable of greater data aggregation and processing while maintaining high-speed data transmission between autonomous vehicles and RFID communication towers then AI-based edge computing facilitates intelligent decision-making capabilities in real-time, allowing Autonomous Vehicles to react faster than humans in response to unexpected changes in traffic flows.

#### *4.1 Edge-based Smart Health Home*

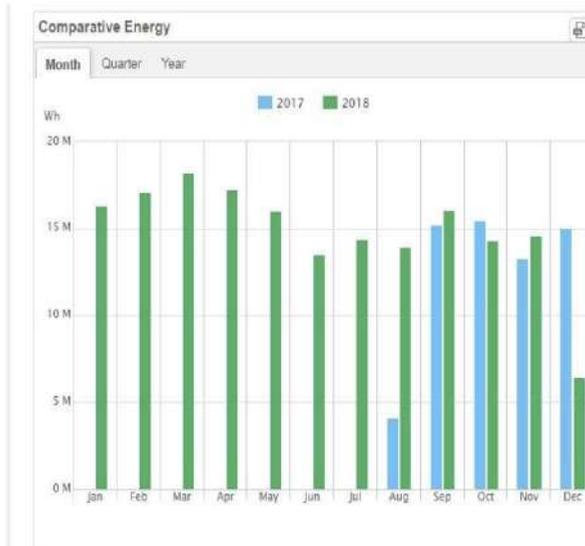
Nowadays, digital trade infrastructure developing for all the public and government sectors for example smart health home service collecting data from patients, doctors and nurses. The very big amount of healthcare data collected from human health details, online medicine suggestion and information is also available in the digital health care system then these prescription details, previous treatment details report are stored in cloud server. In this case large amount of services are handling the cloud server because of cloud is a centralized storage due to huge amount of request sent to the cloud that time cloud has some of the problems such as response time, high bandwidth cost and etc., In this situation Edge Based Health Care Monitoring (EBH-CM) system is very important to handle the request priorities for different types of schedule, efficiency and improve the Quality of Service (QoS) on these services are run in a local edge server due to reduce data processing time and efficiency security also provided for smart health care monitoring system

#### *4.2 Solar Grid Power System (SGPS)*

IoT devices are connecting to the solar grid power system wirelessly or directly through network devices. Solar panels and sensors recording data in real-time every second or minute then data collection is enormous from the solar plant. Service latency can be a big problem whilst real-time data and report need to be prepared also big challenges such as Solar panel has multiplied solar cells and each cell is sent the huge amount of data to the cloud server. All the data are stored centralized cloud server and the cloud server has to monitor unlimited resources. However, cloud server facing some of the problems – bandwidth limitation, Quality of Service (QoS), more cost. Recent technology is Solar Edge computing extends the processing capabilities into the solar edge of the networks and it is a decentralized data collection center for IoT aided Solar Grid Power System (SGPS). Figure 4 and 5,6 shows the processing of energy per day for sample.



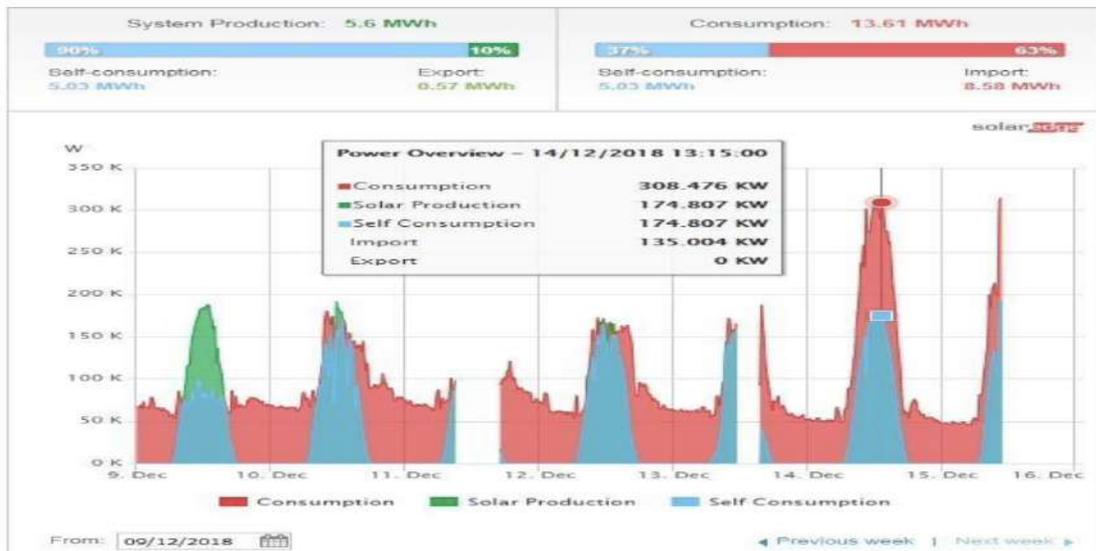
**Figure 4:** Total processing time per day.  
**Source:** own elaboration.



**Figure 5:** Total processing energy data on 2017-18.  
**Source:** own elaboration.

Figure 4. represents solar energy data consumption in a real-time manner on 12th December 2018. This data was taken from the in-house solar plant of Kalasalingam Academy of Research and Education.

Figure 5. represents energy consumption data of 2017 and 2018. These complete solar energy consumption details are sent to the central storage server i.e. cloud data center every minute. The implementation of this solar power production may increase multifold in the future and it will lead to the service latency of cloud server. Hence, real-time analytics is more important in the application of IoT technology.



**Figure 6:** comparison between System production and consumption weekly base report generation.

**Source:** own elaboration.

## 5. RESEARCH VIEW OF EDGE COMPUTING

In this section, we discuss the research gap of the edge computing architecture and services for the IoT environment. The internet of everything now we have just thousands and thousands of millions and billions of IoT devices usage will be increased and try to send the entire request to an edge server. In this case, Edge computing has some the problems in future such as communication overhead, resource allocation problems, process performance, scheduling priority problems, and security privacy challenges. Next challenges of Cloud Edge computing is not yet essential classification and clustering algorithms for machine learning approach. Nowadays we have different type of Hardware, Software infrastructure, message-passing techniques, and communication networking protocols in this reason Edge computing has issues of Quality of Service and Challenges.

## 6. CONCLUSIONS

Now a day's different types of vendors introduced new protocol standards and deployment for IoT applications. Cloud computing is the best resource pooling and services to IoT applications through the wired and wireless technologies and more and more client object services are pushed from the cloud server in this due to cloud server upgraded service to IoT Applications. Edge computing in recent times developed and deployed for successful function by pushing cloud services to the edge of the network. The present edge computing is a decentralized architecture and provides a reliable, intelligence, quality of services are improved to IoT smart applications compared with cloud computing. To conclude, Edge computing and IoT device has a great perspective to be the future of providing and offering service in the filled with networking technologies such as Mobile networking, Machine learning, and IoT smart applications. Edge-based networking technology offering low bandwidth usage, QoS (Quality of Services), more secure encryption algorithms, and user friendly. In this survey paper, we have presented an overview of offloading storage, client service load balancing, intelligent decision making, scheduling priority, and security and privacy challenges. In summary, the main aim of this edge computing survey is to summarize the research gap in the edge-based IoT smart application environment and to outline future research direction to solve dissimilar challenges in Quality of Service (QoS) and security in edge computing.

## REFERENCES:

1. **Bmc Blogs** - (2018). "What is Edge Computing? Edge Computing Explained with Examples" [ online] . Available <https://www.bmc.com/blogs/edge-computing>.
2. **Intelligent Internet of Things** (2018). : Google Cloud's IoT Vision (Cloud Next '18). Available: [https://www.youtube.com/watch?v=8kGdis2-\\_YI&t=1226s](https://www.youtube.com/watch?v=8kGdis2-_YI&t=1226s).
3. "Channels Where Client-Side Marketers Worldwide Have Experienced an Increase in Conversion Rates Since Implementing Personalization, Sep 2015," Conversion Rate Optimization Report 2015, Econsultancy in association with RedEye, 11 November 2015, as cited by eMarketer.
4. Gartner Says 6.4 Billion Connected 'Things' Will Be in Use in 2016, Up 30 Percent From 2015," Gartner website, 10 November 2015, <http://www.gartner.com/newsroom/id/3165317>.

5. IDC's New Global IoT Decision Maker Survey Quantifies the IoT Opportunity, International Data Corporation (IDC) website, 22 September 2015, <https://www.idc.com/getdoc.jsp?containerId=prUS25923515>.
6. Primary Attitude Toward Personalized Ads Among Internet Users in Select Countries in North America and Western Europe, July 2015, "Marketing Channels," as presented at dmexco, Adobe Digital Index, 17 September 2015.
7. BuddeComm, BuddeComm Intelligence Report – M2M, IoT and Big Data – Key Global Trends, 14 September 2015, via ThomsonOne © Copyright Paul Budde Communication Pty Ltd, 2015.
8. Data Analytics, So Hot Right Now," eMarketer, 19 January 2015, [emarketer.com](http://emarketer.com); "Data Driven and Digitally Savvy: The Rise of the New Marketing Organization," Forbes Insights in association with Turn, 8 January, 2015 as cited by eMarketer in "Data Analytics, So Hot Right Now," January 19, 2015.
9. **Dr S. Mohan Kumar and Darpan Majumder**, " Healthcare Solution based on Machine Learning Applications in IOT and Edge Computing" International Journal of Pure and Applied Mathematics., Volume 119 No. 16 2018, 1473-1484.
10. **Fatemeh Jalali, Arun Vishwanath, Julian de Hoog, Frank Suits**- IBM Research Melbourne, Australia, "Interconnecting Fog Computing and Microgrids for Greening IoT", 2016\_ISGTAAsia.
11. **Hesham El-Sayed , Sharmi Sankar, Mukesh Prasad , Deepak Puthal, Akshansh Gupta, Manoranjan Mohanty, And Chin-Teng Lin**, "Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a Distributed Computing Environment", Received October 24, 2017, accepted November 19, 2017, date of publication December 6, 2017, date of current version February 14, 2018.
12. Internet of Things: The Complete Reimaginative Force, conducted by Research Now, Tata Consultancy Services, 22 July 2015, as cited by eMarketer.
13. **Jie Yuan , And Xiaoyong Li**, "A Reliable and Lightweight Trust Computing Mechanism for IoT Edge Devices Based on Multi-Source Feedback Information Fusion", 2169-3536 2018 IEEE Received February 28, 2018, accepted April 18, 2018, date of publication April 30, 2018, date of current version May 16, 2018.

14. **MacGillivray, Carrie**, Worldwide Internet of Things Forecast Update, 2015-2019, International Data Corporation (IDC), February 2016.
15. **Margaret Rouse**. Internet of things (IoT). <https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT>. Access on 15th November 2018.
16. **MATT BURGESS**. What is the Internet of Things? WIRED explains. <https://www.wired.co.uk/article/internet-of-things-what-is-explained-iot>. Accessed on 20th November 2018.
17. **Mohammad-Parsa Hosseini<sup>1</sup>, Tuyen X. Tran<sup>1</sup>, Dario Pompili<sup>1</sup>, Kost Elisevich<sup>2,3</sup>, and Hamid Soltanian-Zadeh<sup>4,5</sup>**, “ Deep Learning with Edge Computing for Localization of Epileptogenicity using Multimodal rs-fMRI and EEG Big Data”, 2017 IEEE International Conference on Autonomic Computing.
18. **Nasir Abbas, Yan Zhang, Amir Taherkordi , and Tor Skeie**, “Mobile Edge Computing: A Survey”, iee internet of things journal, vol. 5, no. 1, february 2018.
19. **Neeraj Kumar, Joel J. P. C. Rodrigues, Mohsen Guizani, Kim-Kwang, Raymond Choo, Rongxing Lu, Christos Verikoukis, Zhimeng Zhong**, “ACHIEVING ENERGY EFFICIENCY AND SUSTAINABILITY IN EDGE/FOG DEPLOYMENT”, IEEE Communications Magazine May 2018.
20. **Quan Yuan, Haibo Zhou, Jinglin Li, Zhihan Liu, Fangchun Yang, and Xuemin (Sherman) Shen**, “Toward Efficient Content Delivery for Automated Driving Services: An Edge Computing Solution”, IEEE Network • January/February 2018.
21. **Sneha Sureddy, K. Rashmi, R. Gayathri and Archana S. Nadhan**, “Flexible Deep Learning in Edge Computing for IoT”, International Journal of Pure and Applied Mathematics Volume 119 No. 10 2018, 531-543.
22. **Tapper, David, U.S.** Consumer Requirements for Managed IoT and Home Automation Services and the Value Chain of Outsourced Opportunities from IoT to Business Process and IT, International Data Corporation (IDC), August 2015.
23. **Turner, Vernon**, “The Internet of Things: Getting Ready to Embrace Its Impact on the Digital Economy,” International Data Corporation (IDC), 2 March 2016, Directions 2016: San Jose, CA.

24. **Weisong Shi, Jie Cao, Quan Zhang, Youhuizi Li, and Lanyu Xu**, “Edge Computing: Vision and Challenges”, IEEE INTERNET OF THINGS JOURNAL, VOL. 3, NO. 5, OCTOBER 2016.

# SIMULATION OF COMBINED S BOX AND INVERSE S BOX IN AES

**K. Pandiaraj**

*Assistant professor, Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education, Krishnan koil, Tamilnadu, India.*

Email ID: pandiaraj@klu.ac.in, <https://orcid.org/0000-0001-9610-2172>

**P. Sivakumar**

*Professor, Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education, Krishnan koil, Tamilnadu, India.*

Email ID: siva@klu.ac.in, <https://orcid.org/0000-0003-1328-8093>

**M.C.Rahul Chowdari**

*Department of Electronics and Communication Engineering Kalasalingam Academy of  
Research and Education Krishnan koil, Tamilnadu, India*

Email ID: rahulchowdarymuppuri@gmail.com, <https://orcid.org/0000-0001-5639-5302>

**P.Sai Krishna**

*Department of Electronics and Communication Engineering Kalasalingam  
Academy of Research and Education Krishnan koil, Tamilnadu, India*

Email ID: skitturoy@gmail.com, <https://orcid.org/0000-0003-1432-2177>

## ABSTRACT

From last 10 years there was great change in technology, everyday new gadgets are rising up for all these technologies in return we need to provide security. We have many algorithms for security but here I am going to discuss on advanced encryption standards. The main aim of any security methods is to prevent data from third party. lookup tables are used for AES algorithms to implement substitute box and inverse substitute box separately. By using these it occupies large memory, consumes more power and slower. For that reason, we are merging both s box and inverse s box operation into single operation by using multiplicative inverses. Simulation of a combined s box and inverse s box are available in a same hardware. This is the part of combinational architecture of encryption standard in which both the ciphering and deciphering can be carried out with one enabled pin.

**Keywords:** S box, Inverse S box, AEs.

## 1. INTRODUCTION

To maintain the data transmission secure, at the initial stages in 1970 DES was used for the purpose of encryption and decryption.

It is developed by the IBM for the U.S Government until 1998. The DES is limited to the key size of 56 bits. This size of key is not enough for the secure transmission due to the advancements in the technology. The security level of DES had decreased.

As size of the key increased, as compared to DES algorithm NIST had laid eye on it for further improvement in security. The key size is 256,192 and 128. Due to this larger key size the AES algorithm is difficult to crack and thus gives more security. The AES has 14, 12 and 10 rounds of encryption. The count of the rounds is depended on the size of the keys used in the encryption technique.

The AES mainly consists of four steps. They are Byte substitution, mixing of columns, shifting rows and addition of the round key. Out of these four different steps the byte substitution has more importance. AES offers more physical security when implemented in hardware than that of implementation in the software. AES does not include the Feistel structure, hence it is more advantageous.

We can also implement sum of product (sop) decomposition is possible but it acquires more than 400 gates, that cause increase in area and power. Moreover, the above-mentioned method is fast but effective in cost. Our main method approach on same hardware for both encryption and decryption as both functions are implementing on the same hardware by using an enable pin EN/DN.

## **2.RELATED WORKS**

An high efficient Memory-less byte substitute box is designed, it is quite faster in an LUT based substitute box .A box with Xilinx implementation using Gal Field  $GF(2^8)$  is represented in a combined stream pipe line in S-Box on Xilinx based on the above paper. In this paper the combined a-box that consist of a single method that is used for both enciphering and deciphering on the same component by using en/dn pin. The model can be better synthesized using Verilog and easily converted to ASCII conversion. As a result, a speed and area effective implementation of streaming pipelined s-box is done using Xilinx.

By the scientific composite field approach, , the computer memory unit sub modification is decided by the employment of the multiplicative inverse to plain content in Gal Field and relative modification is applied thereto .At decryption , the inverse computer memory unit sub transformation is calculated by the appliance of the inverse transformation to cipher text before applying the multiplicative inverse. Here

the multiplicative inverse operation is concerned in each computer memory unit sub and its inverse transformation.

### PROBLEM FORMULATION

In the present technology network security plays a key role. The data that is to be transmitted from one node to another node is ensured that it is encrypted with a good and proper algorithm. This contains of both decryption and encryption. AS we need to do both decryption and the encryption in AES, two s boxes are required. One is for decryption and another one is for encryption. Therefore, different hardware and memory is required for these two s boxes. One more method used for applying the s box and the inverse s box is to use the field of composite for multiplicative calculation inverse in the GF. It is done next by an affine transformation in the digital extending field. This helps in the reduction of the power and area occupied by the hardware.

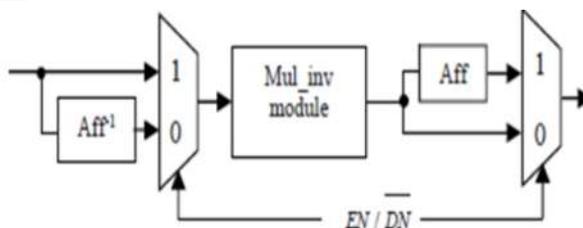
### OBJECTIVES

Composite field arithmetic approach is an analytical approach, which is also a low memory method. It overcomes disadvantages of Look up table approach, which are an unbreakable delay and low latency due to the fixed access time. In this paper, we are proposing a simulation of both S Box and inverse S box using analytical approach and mathematical, as both encryption and decryption algorithms are implementing on the same hardware by using an enable pin EN/DN.

### METHODOLOGY

B The S-Box and inverse S-Box are together simulated and enforced, using Composite field arithmetic approach is an analytical approach, within which each encryption and decryption are often performed with an enable pin, there's giant reduction in space.

#### A. Architecture



**Figure 1.** Architecture of S box and its inverse transformations  
**Source:** Own elaboration

By the analytical composite field approach, the computer memory unit substitution transformation may be calculated by implementing the multiplicative inverse to the plain text in GF ( $2^8$ ), and then transformation is applied to that.

During the decryption the substitution of the computer memory unit transformation takes place by the process of the encrypted text through the transformation.

The module of multiplicative inverse methodology is concerned in each the substitution of bytes and its inverse transformations. As this paper is concerning the combined design, one inverse increasing module will use in each transformation as shown in figure on top of. Affine transform is that the vital transformation that's needed to implement a s box and an inverse s box.

The affine transformation is finished by multiplying the eight-bit segments of the info with the affine function containing affine matrix. The output of this product provides the affine transformation of the given binary text. Similarly, the inverse affine transform is employed within the decrypting the info. For this the transformation is finished before the operation of multiplicative inverse module. There are two distinctive functions for each affine and inverse affine transformations. The encryption and also the decryption techniques are combined using the multiplexer by the suggests that of one selection line. once the selection line is enabled the encryption is performed.

### B. Multiplicative Inverse Module

**$\delta$** : Isomorphic mapping to composite field

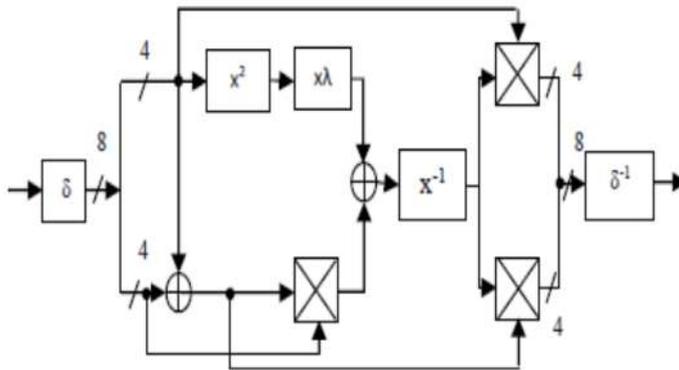
**$x^2$** : Squarer in Galois Fields (24)

**$x\lambda$** : Multiplication with constant  $\lambda$  in Galois Fields (24)

**$x^{-1}$** : Multiplicative inversion in Galois Fields (24)

**$x$** : Multiplicative operation in Galois Fields (24)

**$\delta^{-1}$** : Inverse isomorphic mapping to composite field

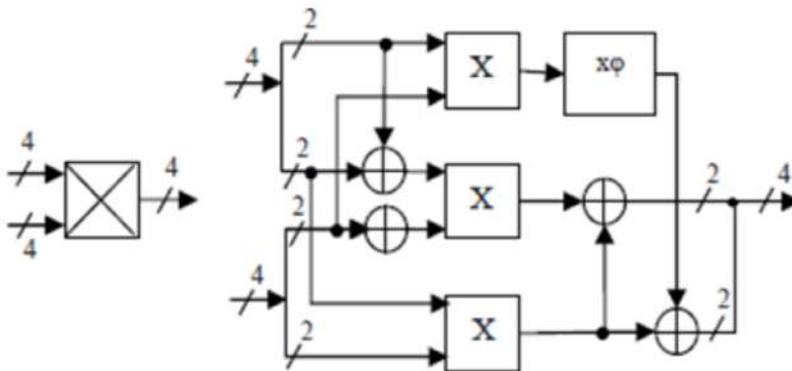


**Figure 2.** Multiplicative inverse module

**Source:** Own elaboration

The multiplicative inverse module is processed first and also the output data from the multiplicative inverse module is affine transformed. If the selection line is disabled or zero is chosen, the decryption takes place.

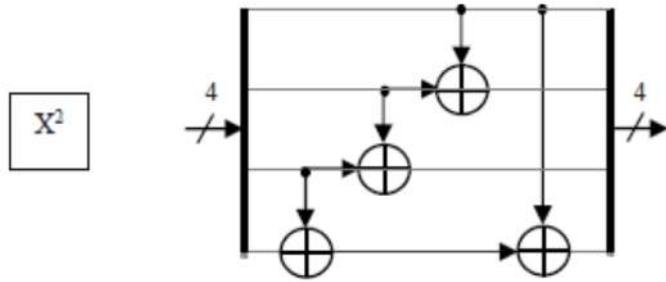
The inverse affine transform takes place first followed by the method in multiplicative inverse module. Here same selection line is employed for the 2 multiplexers. Here each the encryption and decryption is carried with enabling or disabling a pin.



**Figure 3.** Multiplicative Operation

**Source:** Own elaboration

In this Multiplicative Operation 8-bit data is divided into two 4bit or 2 nibbles. this perform internal operations and final four-bit output is obtained the operations carried in this are 2bit multiplexer is used and some XOR operations are done. Based on the above combined operation a final 4 bit is obtained.



**Figure 4.** Squaring in Galois Fields ( $2^4$ )

**Source:** Own elaboration

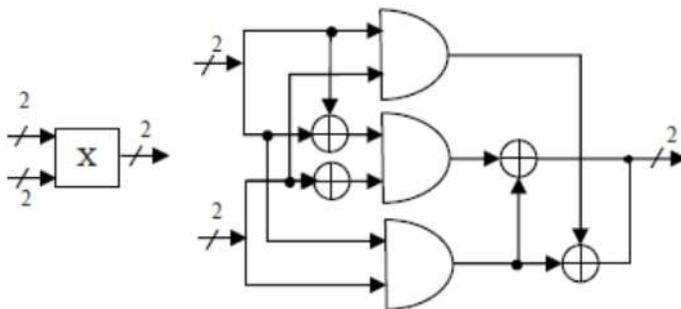
The squaring of the two 4-bit numbers is shown in the above figure.

$$k_3 = q_3$$

$$k_2 = q_2 \oplus q_3$$

$$k_1 = q_2 \oplus q_1$$

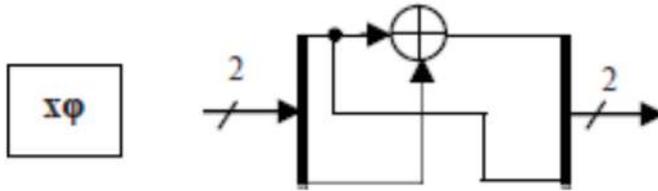
$$k_0 = q_3 \oplus q_1 \oplus q_0$$



**Figure 5.** Multiplication of Galois fields (2bit)

**Source:** Own elaboration

In this 2 bit multiplication operations it undergoes different operations that perform AND gate and XOR operations here after all this operation it will produce only 2bit output by using these two bits multiplication operators we can perform 4 bit multiplication operator and by using two 4bit we get 8 bit multiplexer that's continued.



**Figure 6.** Multiplication with the constant  $\phi$   
**Source:** Own elaboration

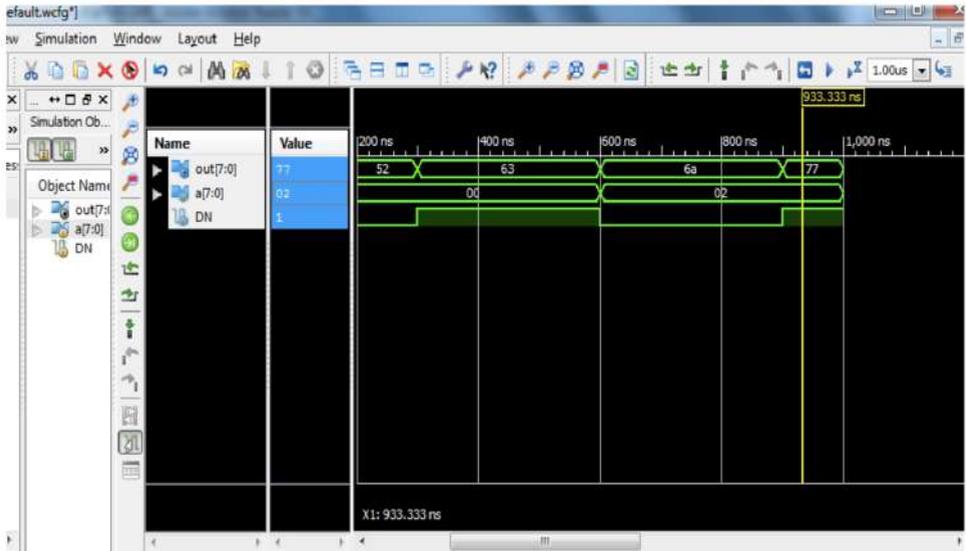
In the Multiplication with constant, operation is carried out in multiplicative inverse where 8 bit is divided into two 4 bit Or 2 nibbles that msn is passed to Squaring function followed by Lambda or constant function than 4 bit multiplication operation is carried out as input for this operation we take the 2 inputs as one from constant function output and the other one is feedback from 1118n the output is taken,

Lsn is the other one firstly, Xor operation is carried between msn and Lsn and that output is passed to 4bit multiplication operation.

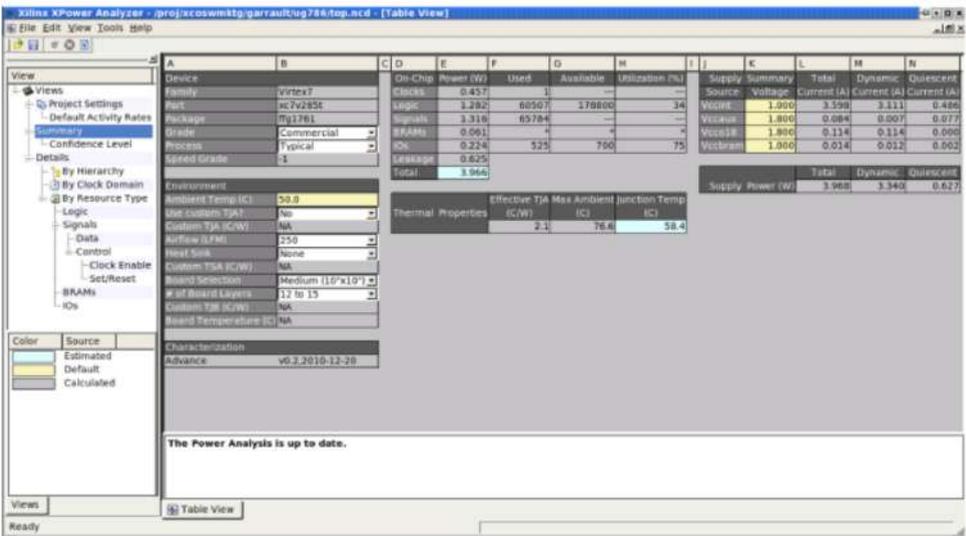
The output of both is Xor and that passed to, multiplicative inverse and that output is passed to both 4bit multiplication operation and those outputs are merged to get 8 bits. That is the output of multiplicative inverse module.

### 3. RESULTS

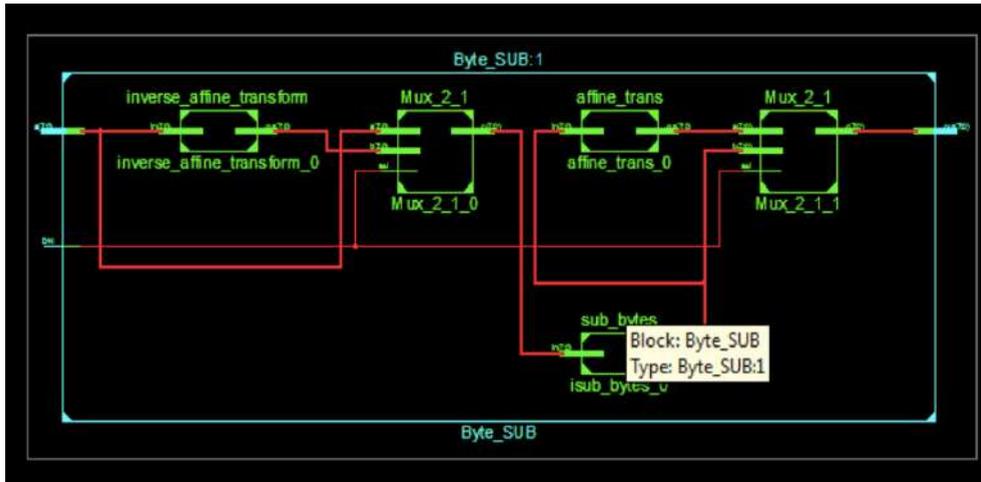
The S box is implemented in the Verilog using the Xilinx tool The RTL view of the s box is taken and explained briefly. The area and the power consumed by the combined S box is calculated and compared with the conventional models.



**Figure 7.** Simulated output of S Box  
**Source:** Own elaboration



**Figure 8.** The power and Area Consuming of the S box  
**Source:** Own elaboration



**Figure 9.** RTL View of the Combined S Box  
**Source:** Own elaboration

Slice Logic Utilization				
	Used	Available	Utilization	Note(s)
Number of Slice Registers	0	4,800	0%	
Number of Slice LUTs	66	2,400	2%	
Number used as logic	66	2,400	2%	
Number using O6 output only	55			
Number using O5 output only	0			
Number using O5 and O6	11			
Number used as ROM	0			
Number used as Memory	0	1,200	0%	
Number of occupied Slices	26	600	4%	
Number of MUXCYs used	0	1,200	0%	
Number of LUT Flip Flop pairs used	66			
Number with an unused Flip Flop	66	66	100%	
Number with an unused LUT	0	66	0%	
Number of fully used LUT-FF pairs	0	66	0%	
Number of slice register sites lost to control set restrictions	0	4,800	0%	
Number of bonded IOBs	17	102	16%	
Number of RAMB16BWERS	0	12	0%	
Number of RAMB8BWERS	0	24	0%	
Number of BUFIO2/BUFIO2_CLKs	0	32	0%	
Number of BUFIO2FB/BUFIO2FB_CLKs	0	32	0%	

**Figure 10.** Synthesis Report  
**Source:** Own elaboration

## 4. CONCLUSIONS

In this Paper, the architecture of combined S- Box and inverse S-Box is represented with good explanation. The architecture design is using the Finite Fields and their Composite fields, and the programming languages are implemented in Verilog HDL. The results of the simulation of s box and inverse s box using enable pin and disable pin, 1 for encryption and 0 for decryption. In this module the delay caused due to the logic implementation is very low, the power consumed by the circuit is reduced and the area occupied by the circuit is very less. As compared to the LUT and composite field, the S-Box resulted in smaller area with medium delay.

## 5. FUTURE WORK

Further this work will be carried out to apply the proposed design using ASIC implementation. This work is being carried out to apply these proposed techniques for inverse sub byte operation as well.

## 6. REFERENCES

- Xinmiao Zhang and Kishab K Parhi.** (2004). High-Speed VLSI Architectures for the AES Algorithm. *IEEE Transactions on Very Large-Scale Integration (VLSI) Systems*, Vol. 12., No. 9, September 2004. <https://doi.org/10.1109/TVLSI.2004.832943>
- M Sajadieh, A Mirzaei, H Mala, V Rijmen.** (2017) A new counting method to bound the number of active S-boxes in Rijndael and 3D. *Journal of Designs, Codes and Cryptography*, 8 (3), pp. 327-343. <https://doi.org/10.1007/s10623-016-0217-4>.
- Divya Sharma, Ankur Bhardwaj , Harshita Prasad.** (2016). Design of Low Power and Secure Implementation of SBox and Inverse-SBox for AES. *International Journal of Security and Its Applications*. Vol. 10, No. 7 (2016) pp.11-24. <http://dx.doi.org/10.14257/ijisia.2016.10.7.02>
- N. Ahmad, R. Hasan and W. M. Jubadi.** (2010). Design of AESS-Box using combinational logic optimization. *IEEE Symposium on Industrial Electronics & Applications*, (2010) Oct., pp. 696- 699. <https://doi.org/10.1109/ISIEA.2010.5679375>
- Wentao Zhang, Zhenzhen Bao, Vincent Rijmen, Meicheng Liu.** (2015). A New Classification of 4-bit Optimal S-boxes and Its Application to PRESENT, RECTANGLE and SPONGENT, *International Workshop on Fast Software Encryption*, pp. 494-515. [https://doi.org/10.1007/978-3-662-48116-5\\_24](https://doi.org/10.1007/978-3-662-48116-5_24)

- M. I. Soliman, G. Y. Abozaid** (2011). FPGA implementation and performance evaluation of a high throughput crypto coprocessor. *Journal of Parallel and Distributed Computing*, Vol. 71 (8), pp.1075-1084, Aug. 2011. <https://doi.org/10.1016/j.jpdc.2011.04.006>
- J. V. Dyken, J. G. Delgado-Frias** (2010). FPGA schemes for minimizing the power-throughput trade-off in executing the Advanced Encryption Standard algorithm. *Journal of Systems Architecture*, Vol.56(2–3), pp. 116-123, Mar. 2010. <https://doi.org/10.1016/j.sysarc.2009.12.001>
- N. Ahmad, R. Hasan, W. M. Jubadi** (2010). Design of AES S-Box using combinational logic optimization. *IEEE Symposium on Industrial Electronics & Applications*, pp.696-699, Oct. 2010. <https://doi.org/10.14257/ijisia.2016.10.7.02>



# **A HYBRID DISCRETE WAVELET TRANSFORM WITH NEURAL NETWORK RADIAL BASIS FUNCTION APPROACH FOR EFFICIENT MEDICAL IMAGE COMPRESSION**

**B.Perumal**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: palanimet@gmail.com., <https://orcid.org/0000-0003-4408-9396>

**M. Pallikonda Rajasekaran**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: m.p.raja@klu.ac.in, <https://orcid.org/0000-0001-6942-4512>

**J.Deny**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (DT), India*

Email ID: jdenysam@gmail.com, <https://orcid.org/0000-0001-6515-3575>

## **ABSTRACT**

For the most part, a larger than average amount of learning region unit expected to speak to advanced pictures wherever the transmission and capacity of such pictures territory unit time overpowering and undoable. Consequently, the pressure procedure is wont to downsize the capacity and transmission costs. To beat the challenges a Hybrid DWT with NNRBF pressure system is arranged. There are unit varying sorts of parameters, which joins CR, PSN, BPP) and MSE, Memory and Execution Time the standard of any packed picture is evaluated utilizing a lot of parameters. At that point, the exhibition Analysis of different pictures (512\*512) is dole out amid this paper. The outcomes unmistakably put forth a defense for that Hybrid DWT with Neural Network Radial Basis performs (HDWT- NNRBF) gives higher Compression size connection (CR).

**Keywords:** Image compression, Hybrid, DWT, NNRBF1.

## **1. INTRODUCTION**

Picture process is that the field of sign procedure wherever each the information and yield signals are pictures. Pictures might be thought of as two-dimensional sign through a network outline. Picture process discovers applications together with medicinal imaging photography, satellite, and pressure, and option prior picture process

was to a great extent circulated exploitation simple gadgets. As of now, pictures are prepared in the advanced area. Computerized picture process defeats issues like the rigidity of the framework to change, clamor, twisting all through the procedure, and the issue of execution. Picture procedure might be a method that improves unique pictures got from camera/sensors put on satellites, region tests and airplane or photographs of customary life. Very surprising strategies are produced for picture process all through the only remaining century. Strategies are created for improving pictures got from fluctuated sources. Picture process frameworks are getting across the board because of the simple handiness of incredible PCs, gadgets of colossal memory handiness of designs PC code and so forth. Utilization of Image process includes. 1. Remote detecting 2. Therapeutic Imaging 3. Non-damaging 4. Evaluation 5. Measurable Studies 6. Materials 7. Material Science 8. Military 9. Film industry 10. Document procedure 11. Realistic expressions 12. Printing business Normal advances followed in the picture procedure are 1. Image checking, 2. Storing, 3. Enhancing, and 4. Interpretation.

## **2. RELATED WORK**

Kai-Jen Cheng and Jeffrey Dill [1], the signs and extents of coefficients square measure encoded severally. The change based recipe has an or more of accomplishing lossless to lossy pressure by simple thresholding the bit plane pressure passes. Number juggling committal to composing guarantees higher execution for the committal to the composition of the sign bits with connection to lossless pressure, in some equation, the sizes of coefficients square measure encoded through the BEZW recipe upheld the 2 tree structures. Bit streams square measure so as of their significance. The reproduction constancy relies upon the number of bit planes that square measure recouped. The underlying limit  $T$  zero is the most noteworthy intensity of 2 littler than the most estimations of coefficients.

Ali Jian-Jiun chime *et al.* [2], a few calculations have practical experience in the pressure of direction mists, that square measure caught by little scale optical maser nearly weight reason mists caught by huge scale earthbound and enormous scanner has been given by the eye A little scale cloud contains no property data beside lattices, that produces it inconvenient to recognize the neighboring purposes for motivation behind anticipating and cryptography each point.

Anjanajianyu Lin *et al.* [3], the exhibition aftereffects of the half breed channels square measure higher than the 5/3 channels and taking after the 9/7 channels (or higher than the 9/7 for a couple of watchers). The PSNR for the café picture abuses

the 5/3 channels is 26x04, looked at 26x.36 for the Hybrid1 and 26x.63 for the Hybrid2. The 9/7 bi-symmetrical channels end in a PSNR of twenty-six .58. Shockingly, the number juggling nature of the crossbreed channels that is somewhat unobtrusive is a littler sum than that of the channels.

Anna Jemaah Islamiyah Shen, Qin Li and Gordon Erlebacher [4], right now the advanced cameras and along these lines the web have each turned out to be well-loved media. Different photographs square measure taken day by day. A quantitative part is meaning online. Advanced photographs have a huge fluctuation of value as they need to travel various mutilations, together with picture shooting, pressure, transmission, and post process. While snapping a picture utilizing a camera, off base center, low-quality focal point, or camera shake produce obscure picture paying little respect to the nature of the camera. At long last, software's, as one with de-noising, de-obscuring, super goals, and so on square measure utilized for picture process inside the 3 projections higher than, the picture is changed homogeneously, i.e., the standard debasement is factually uniform over the picture pressure could have entirely unexpected pressure greatness connection if the picture has a diverse quality dimension at various districts anyway the qualification is little or something bad might happen, bound sorts of picture improvement likely could be limited, for example, edge improvement could be a restricted improvement.

Kekre *et al.* [5], there as of late wide undulating changes are considered for his or her utilization in a few applications. Increased utilization of pictures has required the investigation of wavelets in pressure application. Rebuild essentially based committal to composing, a favored procedure, de-corresponds the pixels. This rebuilds changes over the sign into the recurrence area. This makes the procedure of sign simpler. Be that as it may, ever local information inside the sign cannot be distinguished. Gabor presented Short Time Fourier redesign (STFT) or windowed rebuild. That was later named as Gabor redesign. It gives local properties at the cost of overall properties.

Chakrapani and [6] design pressure strategy recognizes misuses likenesses in a few segments of the picture. An image is diagrammatical by fractals rather than pixels. The example is a plot by unmistakable Iterated performs System &#40; IFS&#41; comprising of a gaggle of relative changes. FIC utilizes an exceptional type of IFS known as parcelled off Iterated perform System &#40; PIFS&#41; also called local IFS. greyscale picture square measure encoded viably abuse arrangement hypothesis. The key reason for example committal to composing is to remove the fractals that square measure fitting for approximating the underlying picture and to speak to

the picture abuse these fractals square measure diagrammatical resource of relative changes. A man-made neural system (ANN), regularly essentially known as a Neural Network (NN), could be a numerical model or technique model bolstered BNNs. It comprises of an Associate in a nursing interconnected bunch of counterfeit neurons. It forms information utilizing a connectionist way to deal with calculation. ANN is Associate in Nursing versatile framework that changes its structure upheld outside or inside data that courses through the system all through the preparation part.

Alok Kumar Singh and Tripathi [7] the point of pressure is to decrease the excess and unconnectedness blessing inside the picture determined it winds up viable to store and exchange the packed picture is diagrammatical by less scope of. Capacity estimate required it diminished thus the most scope of the photos are regularly hang on and may be moved in the faster technique for sparing time and transmission biologic assault. Applications typify Health Industries, Retail Stores, Security Industries, Museums, and Galleries and so forth. In lossy pressure topic, the made picture contains corruption with respect to the underlying. As a rule, procedures give for bigger pressure proportions than lossless systems in various words. Lossless pressure gives reasonable quality.

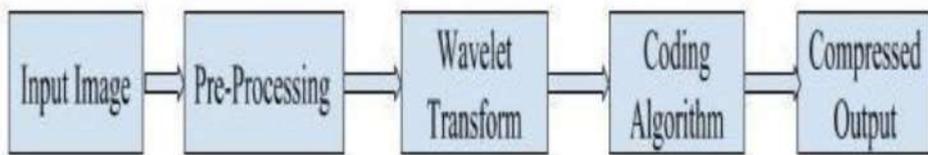
Venkata Subbarao *et al.* [8] the pressure methodologies square measure created to pack huge data documents like pictures. data pressure in transmission applications need for putting away a lot of picture data is required by advancement of innovation and wish for prudent methodologies emerge for pressure while not loss of value wavelets complete a more grounded activity of taking care of discontinuities in data, Therefore, it's higher to have a framework that may affirm Associate in Nursing ideal pressure extent connection once met with an image. Pressure abuse undulating rebuild and a NN has been quick as of late

Sandhya Sharma and Urvashi Bhat [9] EEG undulating redesign give different Intriguing properties like multi-goals portrayal; quantifiability and dynamic transmission the amount of data made by X-beam and CT filter procedures are huge. There could likewise be a tangle once causation the data over a system. To beat this disadvantage, pressure has been presented inside the field of medications. To understand a higher level of pressure one will pick the crossover subject of DWT, DCT and Huffman cryptography pressure system. Partner in nursing approach is arranged by another to support the presentation of therapeutic pressure just in the event of drug pictures the loss of corner to corner strength of the picture isn't middle of the road.

AmitaRakshit and TapaswiniPattnaik [10] it's made that the standard of the recreated pictures is debased by the "false forming" sway for explicit pictures having a tiny bit at a time shaded zones. In lossless pressure subject, for example, DWT the reproduced picture is like the underlying picture. A similar examination of 3 rebuilds committal to composing methods, especially DCT, DWT, Hybrid DCT-DWT are connected bolstered execution estimates like Peak Signal to Noise greatness connection (PSNR), Bits Per pel (BPP) and Compression extent connection (CR).

### 3. METHODOLOGY

The unmistakable undulating redesign is handled severally for various parts of the time-space signal at various frequencies. Multi-assurance examination: breaks down the sign at various frequencies giving different goals [11]. It's useful for the sign having high-recurrence parts for transient lengths and low-recurrence sections for an extensive stretch. For example pictures and video outlines. The undulating change is made out



**Figure 1.** Block diagram of DWT  
**Source:** own elaboration.

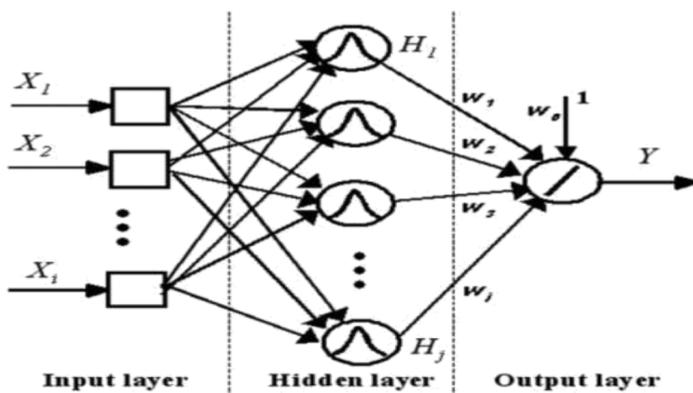
In the higher than Figure one, the picture is given as A contribution to prompt packed and it experiences some of the pre-preparing steps and it's trailed by some composition principle of moving edge revamp. For more pressure, the number juggling pressure is utilized then at last remaking is finished to instigate the remade picture.

Wavelets are signs that are close-by in time and scale and for the most part, have an unpredictable structure. A moving edge might be a waveform of the adequately committed term that includes a regular estimation of zero. The articulation "wavelet" begins from the implies that they consolidate to zero. There are 2 systems of pressure. They're lossy and lossless. Here, DWT is one among the calculations in the lossless method. DWT is considered joined of the crucial techniques for pressure, wherever there's no loss of learning all through the pressure of the picture. Wavelets have plenty of endowments over the weight signals.

DWT might be connected to the technique for pressure by abusing the edge worth. Applying DWT will encourage the North American nation to instigate totally various dimensions of groups. When choosing the edge worth, these qualities can disregard the bound moving edge coefficients. In moving edge correction, the decay of a chose picture incorporates 2 segments, one is that the lower return or estimate of an image (scaling limit) and another is that the higher return or reason by reason a piece of a picture (wavelet limit).

### 3.1 Radial Basis Function Neural Network (RBFNN) for Image Compression

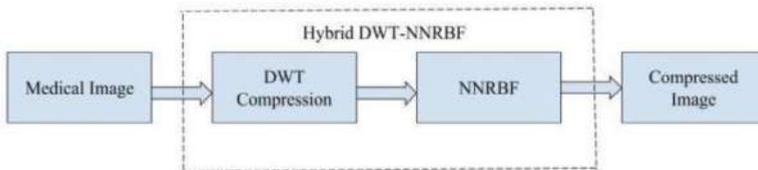
ANN each nerve cell in an exceedingly MLP (Multilayer Perception) holds a weighted include of its info esteems[13].That is, each information worth is expanded by a consistent and everybody the results square measure summed up. One MLP nerve cell could be a plain straight classifier; be that as it may, the intense non-direct classifiers are regularly made by bringing these neurons into a system. RBFN method is a great deal of unconstrained than the MLP. To group a piece of ongoing information, each nerve cell assesses the geometrician separate between the model and furthermore the info. Fig.2 demonstrates the last structure of NNRBF equation. Partner input vector  $x$  is used as a contribution to all or any spiral premise capacities with very surprising properties[14].Each RBF nerve cell looks at the info vector to its model and yields a cost in shift  $[0, 1]$  that estimates the similitude. On the off chance that the information is like the model, at that point the RBF neuron's yield is one. Since the separation between the model and info will expand, the yield tumbles off exponentially towards zero. RBF neuron's yield looks like a ringer bend.



**Figure 2.** General structure of NNRBF  
**Source:** own elaboration.

The yield of the system comprises of a gathering of hubs [15]. Each yield hub figures a score for the joined class. The score is determined by taking a weighted aggregate of the initiation esteems from each RBF nerve cell. By we have an inclination endured complete we imply that partner yield hub interfaces a weight worth with each RBF nerve cell, and increases the neuron's initiation by this weight before adding it to the full yield.

### 3.2 Hybrid image compression



**Figure 3.** Hybrid image compression using DWT-NNRBF method  
**Source:** own elaboration.

NNRBF method

Fig. 3 shows the proposed Hybrid image compression using DWT-NNRBF. The NNRBF algorithm is used to improve the transformation process, which increases the edge threshold. At the same time, the DWT coding and NNRBF algorithm are combined to obtain hybrid DWT-NNRBF coding, in order to get better quality in image compression

## 4. PERFORMANCE PARAMETER

The quality of the compressed image can be measured by many parameters. The most commonly used parameters are Compression Ratio (CR), Mean Square Error (MSE), and Peak Signal to Noise Ratio Error (PSNR), Bits per pixel (Bpp), Elapsed Time and Memory.

### A. Compression Ratio (CR)

It is defined as the ratio of the size of the original image to the size of the compressed image.

Where the  $n_1$  and  $n_2$  are defined as the input and output of the given input image.

### B. Mean Square Error (MSE)

MSE is utilized to appraise the nature of the compacted image. The lesser the estimation of MSE is the higher the nature of the packed image.

Where  $f(x,y)$  is the original image and  $g(x,y)$  is the reconstructed image and  $M, N$  is the rows and columns of the input image.

### C. Peak Signal to Noise Ratio (PSNR)

$$PSNR(f, g) = 20 \log(\max N) / (\sqrt{MSE}) \quad (4.2)$$

It is characterized as the measure of the data image to the MSE. If PSNR is high, then the quality of the reconstructed image is also increased.

### D. Bits per pixel (Bpp)

The number of bits used to encode each pixel value is termed as Bpp. Thus for the purpose of compression, Bpp should be minimized to reduce the storage on the Memory.

### E. Elapsed Time

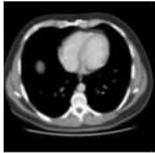
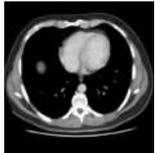
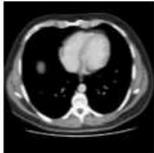
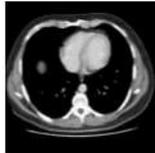
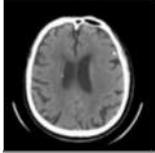
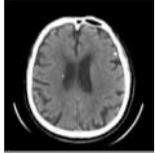
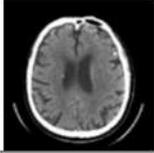
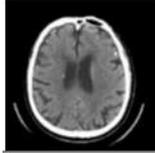
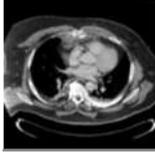
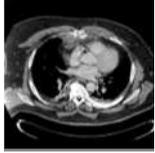
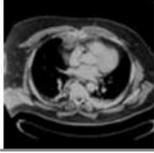
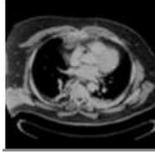
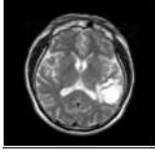
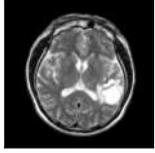
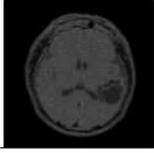
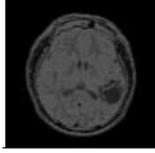
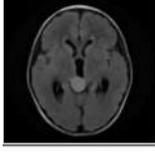
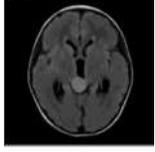
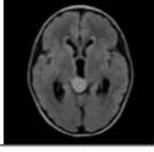
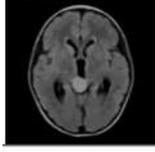
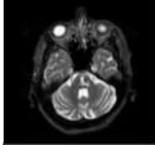
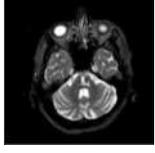
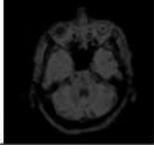
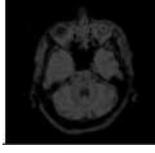
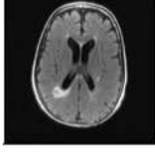
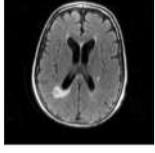
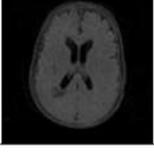
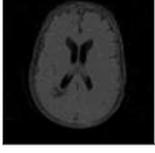
The compressed time gives the value of elapsed time in seconds from the process of an input image to the compressed image. It is characterized as the measure of the data image to the MSE. If PSNR is high, then the quality of the reconstructed image is also increased.

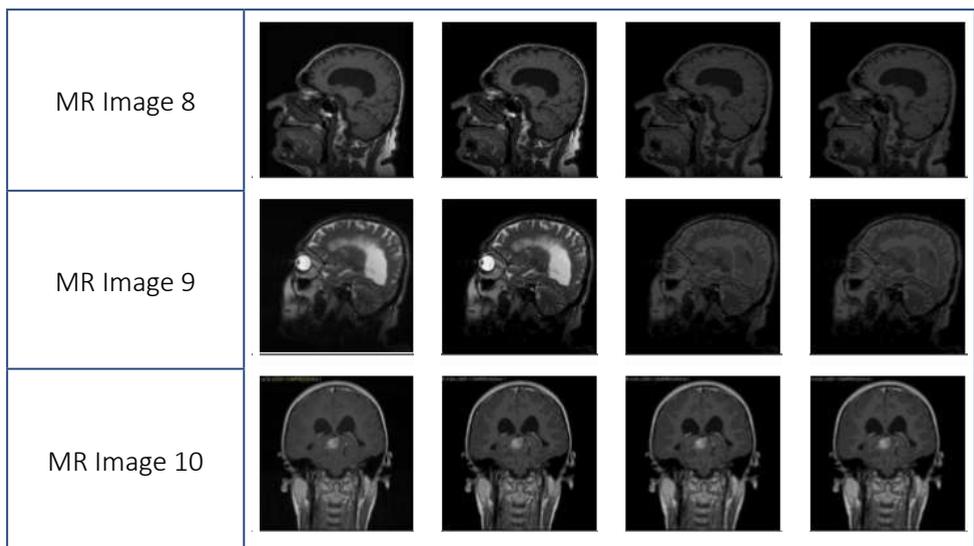
## 5. RESULTS

IMAGES	DWT	NNRBF	HYBRID
CT Image 1	1.1848	1.0204	0.9995
CT Image 2	1.7058	0.7558	0.815
CT Image 3	1.4748	1.0632	1.0296
CT Image 4	0.9987	1.1665	0.9959
MR Image 5	0.4753	0.9678	0.8316
MR Image 6	0.4112	1.1854	1.0884
MR Image 7	6.0786	1.2086	1.1155

MR Image 8	0.649	1.117	1.0407
MR Image 9	4.2551	1.1403	1.0442
MR Image 10	2.113	1.032	0.9715

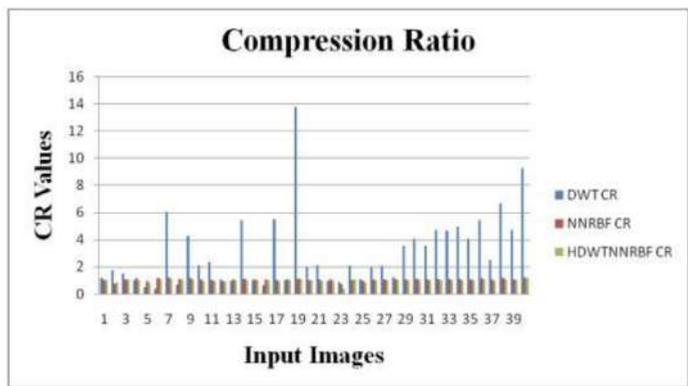
**Table 1.** shows CR obtained using DWT, NNRBF and Hybrid DWT-NNRBF

Images	a	b	c	d
CT Image 1				
CT Image 2				
CT Image 3				
CT Image 4				
MR Image 5				
MR Image 6				
MR Image 7				



**Fig.4.** (a) Input images (b) output obtained from DWT (c) output obtained from NNRBF and (d) output obtained from Hybrid DWT & NNRBF compression algorithms.

**Source:** own elaboration.



**Fig .5.** Compression Ratios expressed in percentage

**Source:** own elaboration.

## 6. CONCLUSION AND FUTURE WORK

In this paper, we tend to referenced concerning the correlation of pressure methods bolstered DWT standard, NNRBF, and a half and half DWT-NNRBF. The information picture of size 512×512 is given wherever the compacted picture is acquired by these higher than calculations. Contrasting sorts of parameters region unit determined to comprehend the standard of the compacted picture. The correlation diagram is accommodated Compression quantitative connection (CR) and Peak Signal to Noise

quantitative connection (PSNR). By examination of the presentation parameters of the compacted picture for these 3 calculations, we will, in general, presume that half breed DWT-NNRBF is a practical method for pressure. Amid this paper, we will in general assess and talk about the 3 contrasting kinds of calculations which may be utilized for pressure. We will in general also audit and examine these 3 calculations for weight pictures for each lossless and lossy Technique. As on future work pressure procedures might be finished by elective methodologies like Neural Networks mixture strategies and formal rationale.

## REFERENCES

- Cheng, K. J., & Dill, J.** (2014). Lossless to lossy dual-tree BEZW compression for hyperspectral images. *IEEE transactions on geoscience and remote sensing*, 52(9), 5765-5770.
- Ahn, J. K., Lee, K. Y., Sim, J. Y., & Kim, C. S.** (2014). Large-scale 3D point cloud compression using adaptive radial distance prediction in hybrid coordinate domains. *IEEE Journal of Selected Topics in Signal Processing*, 9(3), 422-434.
- Lin, J., & Smith, M. J.** (2011). Two-Band Hybrid FIR–IIR Filters for Image Compression, *IEEE Transactions on Image Processing*, 20(11) 3063-3072. DOI: 10.1109/TIP.2011.2134860
- Shen, J., Li, Q., & Erlebacher, G.** (2011). Hybrid No-Reference Natural Image Quality Assessment of Noisy, Blurry, JPEG2000 and JPEG Images *IEEE Transactions on Image Processing*, 20(8) 2089-2098. DOI: 10.1109/TIP.2011.2108661
- Kekre, H. B., Sarode, T. K., & Natu, P.** (2015). Performance Comparison of Hybrid Wavelet Transform Formed by Combination of Different Base Transform with DCT on Image Compression, *International Journal of Image, Graphics, and Signal Processing*, 6(4) 39-45.
- Chakrapani, Y., & Rajan, K. S.** (2009). Implementation of Fractal Image Compression Employing Hybrid Genetic-Neural Approach, *International Journal Of Computational Cognition*, 7(3) 33-39.
- Singh, A. K., & Tripathi, G. S.** (2014). A Comparative Study of DCT, DWT & Hybrid (DCT-DWT) Transform, *GJESR Review Paper*, 1(4) 2349-2355.

- Subbarao, M. V., Khasim, N. S., Thati, J., & Sastry, M. H. H.** (2013). Hybrid Image Compression using DWT and Neural Networks, *International Journal of Advanced Science and Technology*, 53(1) 31-40.
- Sharma, S., & Bhat, U.** (2013). Image Compression using an efficient hybrid algorithm, *The Open Medical Imaging Journal*, 1(1) 45-50.
- Rakshit, A., & Pattnaik, T.** (2014). A Hybrid JPEG & JPEG 2000 Image Compression Scheme for Gray Images, *International Journal of Scientific Engineering and Technology*, 3(6) 771-774.
- Mukhi, C., Nayyar, P., Saini, M.S.** (2014). Improved Image Compression using Hybrid Transform, *International Journal of Science and Research*, 2(1) (2013), 316-319.
- Pareek, P., & Shrivastava, M.** (2014). An Image Compression Using Multilayer Wavelet Transform with 2DTCWT: A Review, *International Journal of Computer Applications*, 102(1) 13-17. DOI: 10.5120/17779-8552
- Rawat, C., & Meher, S.** (2013). A Hybrid Image Compression Scheme using DCT and Fractal Image Compression, *The International Arab Journal of Information Technology*, 10(6) 553-562.
- Mohan, M. M. S. D. P., & Satyanarayana, P.** (2014). Noise and Performance Analysis of Image compression by Hybrid technique, *International Journal of Research in Advent Technology*, 2(2) 98-106.
- Kekre, H. B., Sarode, T., & Natu, P.** (2014). Image Compression Based on Hybrid Wavelet Transform Generated using Orthogonal Component Transforms of Different Sizes, *International Journal of Soft Computing and Engineering*, 3(3) 53-57.

# **ENHANCED BUILT IN SELF TESTING WITH REDUCED TIME AND POWER CONSUMPTION USING MINIMUM SPANNING TREE**

**H. Sribhuvaneshwari**

*Research scholar, ECE Department, Kalasalingam Academy of Research and Education, Krishnankoil, Tamilnadu, India*

Email ID: [havisriec@gmail.com](mailto:havisriec@gmail.com), <https://orcid.org/0000-0002-4804-4171>

**K.Suthendran**

*HoD/IT Department, Kalasalingam Academy of Research and Education, Krishnankoil, Tamilnadu, India*

Email ID: [k.suthendran@klu.ac.in](mailto:k.suthendran@klu.ac.in), <https://orcid.org/0000-0002-7030-4398>

## **ABSTRACT**

In today's multi-million gate ICs, testing and verification are too expensive procedure in the design flow. For huge memory capacity, the testing process becomes more complex and further it cannot be monitored & controlled by an external environment or Automated Test Equipment (ATE). Therefore a built in mechanism is designed which allows a system or circuit to test by its own is called Built-In Self-Test (BIST), here patterns are formed using different algorithms, each algorithm is specifically focused to a particular type of circuitry or fault type. The main objective of BIST is to find the defect with minimal power consumption, time and obtaining 100% fault coverage. In this article an enhanced BIST method is proposed for Resistive Random Access Memory (RRAM) using minimum spanning tree which results in well optimized test complexity, time, power consumption with 100% fault coverage.

**Keywords:** BIST, Minimum Spanning Tree, RRAM, Power consumption ,Testing time.

## **1. INTRODUCTION**

The quantity of essential data required to check IC is quickly increasing in all new generation expertise. Expanding integration density leads to complex design with additional scan cells that result in a range of faults. Conventional exterior testing does store all the test vectors and their corresponding response is verified using ATE, therefore it results in slow speed, requirement of huge memory space and I/O channels. BIST is a best arrangement of well organized test procedures which is typically applied for memories, multipliers, and other embedded logic blocks for self testing of circuits. The test data bandwidth connecting the tester and the chip is moderately

small; in fact, it is often the bottleneck determining how fast it can test the chip. So recent VLSI testing field is mainly focused towards test data minimization, complexity and power optimization methods because the device proportions are shrinking considerably and most of them are made to be battery operant (portable devices). Current development in test pattern generation employs random pattern generator for example scan chain based pattern generators, counter based circuits and Linear Feedback Shift Registers (LFSR), in which LFSR found to be common. Testing time is constantly more prominent than the measure of time required to convey the information. BIST is promising cost valuable alternative way to test trending complex integrated circuits. Various testing techniques were analyzed and a novel graphical (Minimum Spanning Tree) approach is proposed to defeat the drawbacks of conventional testing method with reduced test complexity, time and power consumption. Rest of the article is organized as follow: BIST architecture, schemes for test pattern generation, test data compression, testing methods, methodology & results and conclusion.

## 2. BIST ARCHITECTURE

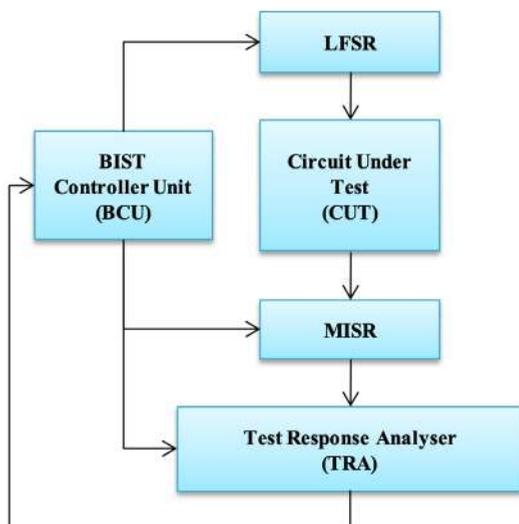


Fig: 1 BIST Architecture

Multiple input signature register (MISR): Signature register efficiently compares various input pattern with large signatures with least amount of alias. BIST architecture is shown in Fig.1 which deals with BIST Controller unit (BCU) manages all the components of BIST like TPG, MISR, ORA and reconfigures the CUT and effectively controls the test activity. It is activated by Normal/Test signal and generates Go/No signal, test is activated when Test or Go signal is enabled. Output response analyzer (ORA)

analyses the sequence of primary output from CUT (PO) and compares it with the expected value.

### **3. SCHEMES FOR TEST PATTERN GENERATION**

#### **3.1 Pseudo Exhaustive Testing (PET)**

PET divides the circuit to be tested into a number of minor secondary circuits and check its functional operation in detail. Every manifest flaw in the interior secondary circuits is easily detected. On the other hand PET require additional design venture to segregate the circuits that will distribute the generated test patterns and test responses.

#### **3.2 Pseudorandom Testing**

Test pattern is arranged in defined sequence with randomness property. Pattern contents are used to improve the fault coverage and test length.

#### **3.3 Weighted Pseudorandom Testing**

The test span is effectively optimized in weighted pseudorandom testing, where the random pattern resistant fault with certain 0s and 1s distribution that are undetectable by the pseudorandom testing are handled by pseudorandom patterns.

#### **3.4 Exhaustive Testing**

All feasible possible permutation of input are applied to CUT in exhaustive testing, here all the fault which is different from sequential behaviour are detected. These strategies are applicable for complex and small modules with well isolation such as PLAs.

#### **3.5 Stored Patterns**

The pre generated test patterns are tracked in stored pattern method to attain certain test target. To boost the system level testing, like Power on Self Test (POST) of microprocessor are used with micro programs.

### **4. TEST DATA COMPRESSION**

Test information compression is given in Fig.2 which is performed by supplementary on-chip hardware to the scan chain (either before or after the scan chain) the added hardware decode the out coming test stimulus from tester circuit. Compression unit is used to apply defined (ATPG-generated) test pattern to CUT. Testing cannot be

proceeded more rapidly than the total time requisite to convey the test information. Therefore the test data should be compressed in order to make effective testing in optimum time. Test data compression results in following two considerations (i) effectively squeeze the test information quantity stored in the tester that is used to expand the life span of tester which has inadequate memory. (ii) It reduces the test period for a prearranged set of test information bandwidth. Ever-increasing the amount of scan chains will condense every scan chain. Important aspect of test data compression is lossless compression i.e, the compression should reproduce all the bits during decompression. Numerous methods have been implemented to overcome the drawback of high power consumption in BIST-architectures.

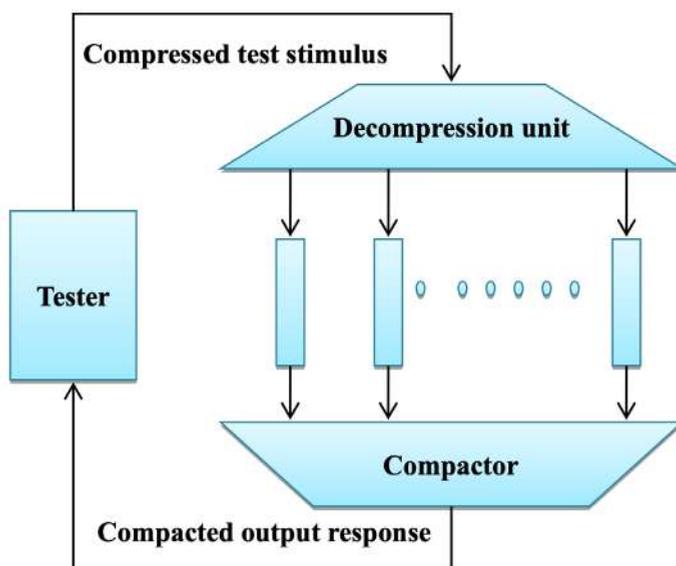


Fig:2 Test data compression

## 5. TESTING METHODS

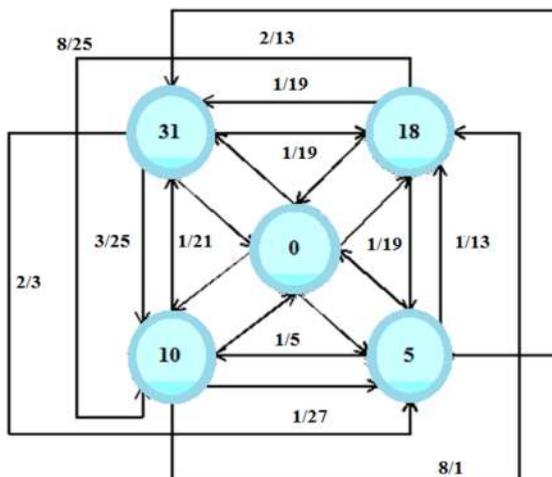
Low power initiator proposed in (Filipek, Mrugalski, Mukherjee, Nadeau-Dostie, Rajski, Solecki, & Tyszer, 2014) is proficient to turn out pseudorandom test sequence through preferred toggling range and improves the fault coverage grade which is highly efficient than traditional BIST oriented pseudorandom test sequence generators. This idea allows to powerfully merging the test compression data along with logic unit, hence both modules can work effectively to make worthy test.

Low power BIST design (Hussain, & Murthy, 2015) using a modified low transition test pattern generator by employing the combination of single input change (SIC)

with Bit Flipping linear feedback shift register and it is named as SIC-BF LFSR. It comprises of a seed generator (BF), a counter of n-bit, a gray code converter and an Ex-OR array. The proposed SIC-BF test sequence generator minimizes the switching action between the test sequences. In the design, a gray code generator and a m bit counter are Ex-OR by using the seed which is turn out by the Bit Flipping LFSR and it generates single input change patterns. This method is implemented with a digital circuit having 6-bit as input and 7-bit as output ISCAS'85 a 27-channel interrupt controller and the power consumed by CUT is reduced to 5.41% by effectively reducing the bit level transition in the test patterns.

An inventive test pattern generator (Liang, Zhang, Lei, Zhang, Gao, & Liang, 2012) which produces Multiple Single Input Change (MSIC) vectors, versatile Johnson counter and a adaptable SIC counter are designed in such a way to produce a class of bare minimum transition sequences. MSIC sequences have the complimentary feature of even circulation and low input transition density. The MSIC-TPG switch an SIC vector to low transition vectors in every scan chains of a test-per scan scheme. Experimental outcome and survey results authenticate that the MSIC-TPG is scalable to scan length, and has negligible impact on the test area overhead.

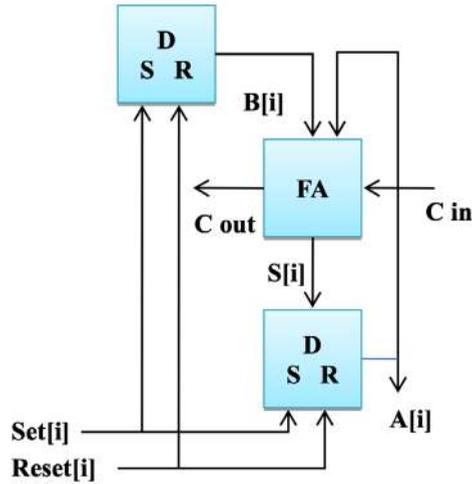
An innovative format to optimize the test time in accumulator-based TPG is proposed (Magos, Voyiatzis, & Tarnick, 2010) to produce test-patterns by detecting the shortest Hamiltonian path in the CUT's graph that results tremendously low demand for hardware. Main advance of this method is no storage requirement for the addend patterns which are generated based on a combination of decoder outputs. Further enhancement can be concentrated in terms of minimizing larger search space and the exact computation of the detecting shortest Hamiltonian path in the test-pattern graph and also revisiting nodes will reduce the test application time.



**Fig:3** Graphical representation of c17 benchmark circuit

The general pseudorandom BIST scheme needs more test sequence and it consumes more testing time in order to overcome this drawback (Rani, Meenakshi, & Marina, 2014). has introduced a new weighted pseudorandom BIST which drives behind the test vector quantity. Accumulators are one among the most significant element in VLSI chip, capable for minimizing the hardware e.g., data path architectures, digital signal processing chips or microprocessors that generally have arithmetic modules for functional operation [accumulators]. Therefore a weight pattern generation technique is implemented by using an accumulator (weights 0, 0.5, and 1) with low hardware overhead and optimized testing time with high fault coverage.

An accumulator is a register for provisional storage for test information and it performs arithmetic process which is a fraction of Arithmetic-Logic Unit (ALU). Full Adder (FA), Dff with asynchronous set and reset inputs are the elements of an accumulator cell Fig 4 shows an accumulator cell. Full adder has 3 inputs, where main 2 inputs are derived from Dff turn out, and Cin is given as the third input. Again the sum output S[i] and A[i] of full adder is applied as input to Dff. A[i] confer the mandatory bits for TPG. The design of accumulator oriented weighted pattern generation is implemented in C17 benchmark circuit (shown in Table.1).



**Fig:4** Accumulator cell

TEST VECTOR	INPUT
Ta	00101
Tb	01010
Tc	10010
Td	11111

**Table 1.** Test vector set of C17

Distinctive weight assignment procedure is maintained to separate the main test set into two subsets namely S1 and S2 where  $S1 = \{Ta, Td\}$  and  $S2 = \{Tb, Tc\}$ .  $W(S1) = \{-, -, 1, -, 1\}$  and  $W(S2) = \{-, -, 0, 1, 0\}$  are the weight allotments for subsets S1 and S2 where a “-” denotes a weight allotment of 0.5, a “1” denotes that the input is constantly driven by the logic “1” value, and “0” denotes that the input is driven by the logic “0” value. The essential condition to generate the required bits at the production of accumulator cell is “cin = cout” i.e, carry key in of the adder phase should equal to the carry turn out unaffectedly.

Novel LP BIST method under the concept of pseudorandom test pattern generation by weighted test-enable signal is proposed (Xiang, Wen, & Wang, 2016), where LP-BIST and reseeding mode are main two phases. The weights for test-enable signals of scan chains are determined in the primary phase by the activated sub circuits. This scheme is introduced to decide on the exact primitive polynomial with guaranteed LP function for every clock cycles that automatically leads to additional decrease in test information on chip.

A sequential fault (e.g., stuck-open) which takes place in current CMOS circuits and the exact circuit function at estimated clock speediness are assured by delay testing using two-pattern tests (Voyiatzis, Gizopoulos, & Paschalis, 2009) has accessible with two-pattern creation format, which is capable of generating both generic and recursive pseudo exhaustive test. The main advantage of this scheme is much number of circuits under test (CUT) with various sizes can be tested simultaneously.

A unique method for output bit selection is proposed by (Lien, Lee, Hsieh, Chakrabarty, & Wu, 2012). In this method counter and a multiplexer are used for the output selection. Here two efficient algorithms are introduced to achieve desired output response and enhance the optimization ratio of test response where single and more counters are used to achieve above states respectively. Here CUT consists of 3 scan chains hence there are 12 scan flip-flops in the counter based output bit selection. A control signal is generated from the counter at each scan cycle which is used to decide on an turn out reaction bit that is examine by the multiplexer. It will affect the single bit output response from n-bit wide output response.

An efficient scheme (Voyiatzis, Haniotakis, & Halatsis, 2006) is proposed to generate SIC pairs based on the decoder function that is named as DSG algorithm. Where all the SIC pairs were turn out by OR-ing the vector V with D sequence vectors. Whereas in (Voyiatzis, & Kavvadias, 2014) SIC pairs are generated based on T-transformation properties and gray sequence properties. In this proposed method all the SIC patterns with n bit's are generated in  $n \cdot 2^n$  time period with in less hardware an average of 18% and the main advantages of above mentioned test methods are shown in Table.2

REFERENCE PAPER.NO	PROPOSED METHOD	ADVANTAGE
1	Low-power (LP) programmable generator for pseudorandom test patterns	Good fault coverage than the conventional pseudorandom patterns
2	Accumulator-based test-pattern generation.	No storage requirement for the addend patterns
3	SIC-BF test pattern generator	5.41% of power consumed by minimizing the switching activity
4	Johnson counter and a adaptable SIC counter are designed for MSIC generation	Produces the bare minimum transition sequences
5	Weighted pseudorandom Built-In Self-Test (BIST) generators with accumulator	Low hardware overhead and optimized testing time with high fault coverage.
6	LP design with gating technique	Effective compression of test data

7	Pseudo-exhaustive pattern generators	Many numbers of circuits under test (CUT) with various cone sizes can be tested simultaneously with less hardware overhead.
8	Output bit selection	Test response compaction is achieved with less hardware
9	DSG algorithm	Minimum number of patterns are used to generate SIC pairs
10	T-transformation properties and	SIC patterns are generated with less hardware an average of 18%

**Table 2.**Conventional testing method

## 6. METHODOLOGY AND THE RESULTS

To overcome the drawbacks of conventional testing method, Minimum Spanning Tree (MST) is introduced in this paper. Data stored in the memory cell can be either '0' or else '1'. Here in MST, the stored data is considered as weight of the path, so that edge is drawn between logic zeros. Thus the connected edge in the pattern shows the presence of logic '0' in the particular memory cell. Consequently the unconnected (no edge) memory cells represent the presence of logic '1'. Once the MST is formed it is compared with the ideal fault free pattern, which effectively detects the faulty memory cell. Here 4\*4 RRAM (shown in fig.5a – with Bit Line (BL) , Word Line (WL) and Memristor (M) cells) is tested and the data stored in every memristor cell is verified by comparing the obtained pattern with stored ideal patterns (shown in fig.5b) of the fault free memory and the comparison results whether the RRAM is fault free or faulty. Here faults are detected in memristor cells M13 and M31 (shown in fig.5c – stuck at 1 fault) and also in M14, M24, M32 and M42 (shown in fig.5c- stuck at 0 fault). This method can find all kind of faults by comparing the obtained MST pattern with the fault free ideal pattern. Hence the proposed test method effectively reduces the test complexity, time, power consumption with 100% fault coverage.

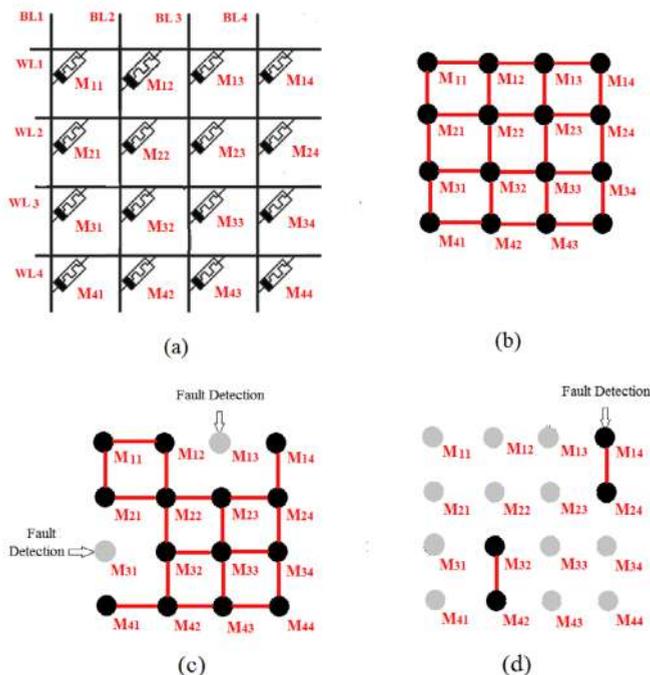


Fig.5. Minimum Spanning Tree for fault detection in RRAM

## 7. CONCLUSION

In deep submicron era optimization of test complexity, time and power consumption without compromising the test quality comes as major concern. In this paper various BIST methods are analyzed and a novel graphical test approach is introduced using minimum spanning tree here 4\*4 RRAM is tested and all the faults are detected (100% fault coverage) with reduced test complexity, time, power consumption. In future this method can be implemented for various nano memory application fields for testing.

## REFERENCES

- Filipek, M., Mrugalski, G., Mukherjee, N., Nadeau-Dostie, B., Rajski, J., Solecki, J., & Tyszer, J. (2014). Low-power programmable PRPG with test compression capabilities. *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, 23(6), 1063-1076.
- Hussain, S., & Murthy, P. H. S. T. (2015). An SIC Bit Flipping Linear Feedback Shift Register for Low Power BIST.

- Liang, F., Zhang, L., Lei, S., Zhang, G., Gao, K., & Liang, B.** (2012). Test patterns of multiple SIC vectors: Theory and application in BIST schemes. *IEEE transactions on very large scale integration (vlsi) systems*, 21(4), 614-623.
- Magos, D., Voyiatzis, I., & Tarnick, S.** (2010). An Accumulator—Based Test-Per-Clock Scheme. *IEEE transactions on very large scale integration (VLSI) systems*, 19(6), 1090-1094.
- Rani, D. G. N., Meenakshi, M. M., & Marina, S. A.** (2014, March). Low hardware overhead implementation of 3-weight pattern generation technique for VLSI testing. In *2014 2nd International Conference on Devices, Circuits and Systems (ICDCS)* (pp. 1-5). IEEE.
- Xiang, D., Wen, X., & Wang, L. T.** (2016). Low-power scan-based built-in self-test based on weighted pseudorandom test pattern generation and reseeding. *IEEE Transactions on Very Large Scale Integration (VLSI) Systems*, 25(3), 942-953.
- Voyiatzis, I., Gizopoulos, D., & Paschalis, A.** (2009). Recursive pseudo-exhaustive two-pattern generation. *IEEE transactions on very large scale integration (VLSI) systems*, 18(1), 142-152.
- Lien, W. C., Lee, K. J., Hsieh, T. Y., Chakrabarty, K., & Wu, Y. H.** (2012). Counter-based output selection for test response compaction. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 32(1), 152-164.
- Voyiatzis, I., Haniotakis, T., & Halatsis, C.** (2006). Algorithm for the generation of SIC pairs and its implementation in a BIST environment. *IEE Proceedings-Circuits, Devices and Systems*, 153(5), 427-432.
- Voyiatzis, I. K., & Kavvadias, D. J.** (2014). On the generation of SIC pairs in optimal time. *IEEE transactions on computers*, 64(10), 2891-2901.



# BENDING LOSS OF MULTIMODE FIBER WITH VARIOUS DIP DEPTHS AND ELEVATION HEIGHTS AT CORE REFRACTIVE INDEX

**Sumathy Raju**

*Assistant Professor, ECE, Kalasalingam Academy of Research and Education,  
Virudhunagar (Tamilnadu).*

Email ID: [sumathyraju1110@gmail.com](mailto:sumathyraju1110@gmail.com), <https://orcid.org/0000-0001-9871-1780>

**Muthukumar Arunachalam**

*Associate Professor, ECE, Kalasalingam Academy of Research and Education,  
Virudhunagar (Tamilnadu).*

Email ID: [muthuece.eng@gmail.com](mailto:muthuece.eng@gmail.com), <https://orcid.org/0000-0001-8070-3475>

## ABSTRACT

A 50 $\mu$ m Multimode Step Index (MSI) fiber is designed with the profile of inner core, outer core and the cladding. The objective of this work is to analyze bending loss for the change in Refractive Index (RI) profile of the fiber. The methodology of this work is RI profile design and varying refractive index difference using Optifiber software. RI at core centre is taken as 1.46399. The refractive index difference between centre of core and cladding is taken as 0.0377. Dips with five different depths are created at core centre by linearly decreasing its RI value from 1.46399 to 1.45899. This fiber is simulated for fundamental mode LP (0, 1) by Optifiber software and observed macro bending and micro bending loss characteristics for the wavelengths from 1200nm to 1600nm. Similarly, elevations with five different heights are created at core centre by linearly increasing its RI value from 1.46399 to 1.46899 and observed macro bending and micro bending loss characteristics. At result, zero macro bending loss is obtained from both the fiber with dip and fiber with elevation at refractive index of core. Average micro bending loss of 0.0255dB is obtained from fiber with elevated height of 0.005. From this, it is concluded that fiber core with elevated height of 0.005 has good bend forbearance for O-L wavelength bands of optical communication.

**Keywords:** Macro bending, Micro bending, Multimode Fiber, Refractive Index Profile.

## 1. INTRODUCTION

Depending on RI profile structure, optical fibers are classified as Step Index (SI) and Graded Index (GI) fiber. And depending upon the number of mode guided, again classified as single mode and multi mode fiber (Keiser, 2003). Multi Mode Fibers

(MMFs) are used in data centers and backbone cabling, because of its capability of supporting higher network speeds over longer distances while being more cost-effective to implement than single mode fiber. The transmission loss in optical fiber occurs due to two major reasons. They are attenuation and dispersion. Dispersion effect will broaden the light pulse and it can be reduced by various dispersion compensation techniques. Attenuation may arise from absorption loss, scattering loss and bending loss. Depending on the environment, weather condition and place of using optical fiber, the absorption loss and scattering loss are occurring and these are avoided by various loss compensation techniques. In this paper, attenuation due to bending loss is considered.

### 1.1 . BENDING LOSS

The bending loss is the main issue in optical communication and it is classified as macro bending loss and micro bending loss. Macro bending occurs whenever fiber is used around corner or turnings. Once if a fiber is bent around a corner with low radius, then severe Radiative loss will occur. Macro bend affects the performance of fiber severely. The number of modes decreased in case of bent fiber (Sokkar, Ramadan, MA Shams El-Din, Wahba & Aboleneen 2014). The Macro bending loss can be reduced if the values of refractive index difference between core and cladding are increased (Kingsta & Sivanantharaja, 2013). Micro bending occurs mostly during cabling or due to fiber axis perturbations which are randomly distributed. It reduces the optical power of signals which is a serious problem in optical communication. So both macro and micro bending loss are to be considered. Similar to macro bending loss, micro bending loss is also reduced by increasing refractive index difference (Wandel, Marie & Poul Kristensen, 2006). In General, Parabolic profile is insensitive to macro bending loss (Denis Donlagic, 2009). Structural imperfections of the guide also have the effect on micro bending which affects the spectral characteristics of W-type fiber (Tanaka, Yamada, Sumi & Mikoshiba, 1977). For fundamental mode propagation, the micro bending loss is lower for MMF than single mode fiber (Jin & Payne, 2016). Even small irregularities may lead to micro bending loss which causes notable transmission loss (Gardner, 1975). In order to reduce macro bending and micro bending loss, the idea of having large refractive index difference between core and cladding is proposed in this paper.

## 2. PROPOSED IDEA

### 2.1 REFRACTIVE INDEX PROFILE

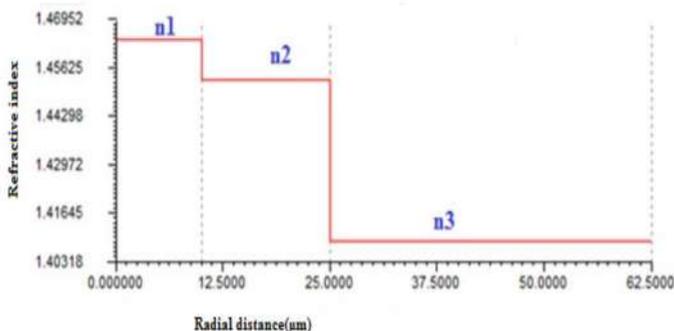
Even multimode GI profile has lower dispersion than SI profile, the manufacturing of SI profile is easier than GI profile. SI profiles in the inner core were the best choices for Raman Amplifier (RA) (Pramanik, Sanchita & Somenath Sarkar, 2013). With variation in core gap radius, even with dip or sinusoidal ripples in SI profile, the characteristics of RA are not affected (Bandyopadhyay, Pratap Kumar & Somenath Sarkar, 2013). So, the proposed work is done using SI profile. In profile analysis, dip in refractive index has a notable effect on the dispersion characteristics of the fiber (Khular, Enakshi, Arun Kumar, Ghatak & Pal, 1977). Differential Mode Delay (DMD) becomes high, because of dip in the central area of core. DMD depends on a structure and properties of defects of profile (Bourdine, Anton & Vladimir Burdin, 2018). Dispersion compensated fiber with central dip in refractive index is affected by loss for larger value of bend radii (Tewari, Basu & Acharya, 2000). Instead of using uniform index at core axis, the RI profile with smaller dip is considered in this paper. Additionally, the index at core centre is slightly elevated. Both the RI profiles are simulated using Optifiber software

### 2.2. PROPOSED MULTIMODE STEP INDEX FIBER

The proposed multimode fiber has total core diameter of 50 $\mu\text{m}$ , and cladding diameter of 125 $\mu\text{m}$ , RI of inner core  $n_1=1.46399$ , RI of outer core  $n_2=1.4529$ , refractive index of cladding  $n_3=1.40871$ . the RI profile is shown in Fig. 1. Now the refractive index difference is between centre of core and cladding is 0.0377 and is calculated from equation (1)

$$\Delta \approx \frac{n_1 - n_3}{n_1} \quad (1)$$

The suitable fiber materials corresponding to the proposed refractive indices are synthetic fused silica and fluorine doped material.

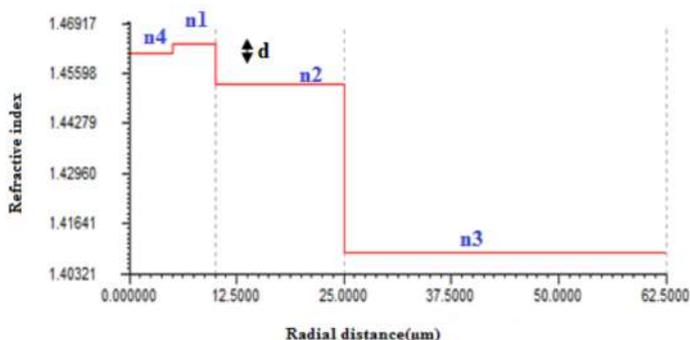


**Fig. 1.** RI Profile of proposed fiber without dip or elevation  
(Designed using OptiFiber simulation software)

Synthetic fused silica optical fibers have excellent tensile and bend strength performance (Heptonstall, Cagnoli, Hough & Rowan, 2006) which will be very suitable for core of the proposed fiber. Similarly, Fluorine doped material is suitable for the cladding of proposed fiber (Komachi, Yuichi & Katsuo Aizawa, 2004) which has lower refractive index than core. In the designed profile, fundamental mode LP (0, 1) is excited and simulated by Optifiber.

**2.3. MACRO BENDING AND MICRO BENDING LOSS ANALYSIS OF MSI FIBER WITH DIP AT CORE**

In the designed MSI fiber, dip is formed at the core centre by linearly reducing its index value from 1.46399(n1) to 1.45899(n4). Dip depths of  $d=0.001$ ,  $d=0.002$ ,  $d=0.003$ ,  $d=0.004$  &  $d=0.005$  are created as shown in Fig. 2.

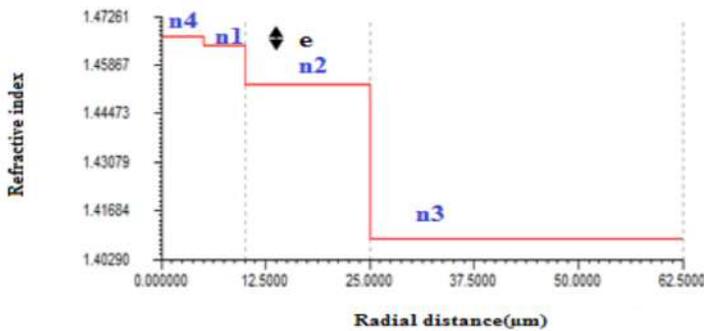


**Fig. 2.** Proposed fiber with dip (d) at the centre of core  
(Designed using OptiFiber simulation software)

In general, changing refractive index at core mostly affects the fundamental mode LP (0, 1) which is very essential in fiber communication. So in this simulation, LP (0, 1) mode is excited then, macro bending and micro bending loss characteristics are analyzed for wavelengths from 1.2μm to 1.6μm.

### 2.4. MACRO BENDING AND MICRO BENDING LOSS ANALYSIS OF MSI FIBER WITH ELEVATION AT CORE

Now, in the designed MSI fiber, elevation is formed at the core centre by linearly increasing its index value from 1.46399( $n_1$ ) to 1.46899( $n_4$ ). Elevation heights of  $e=0.001$ ,  $e=0.002$ ,  $e=0.003$ ,  $e=0.004$  &  $e=0.005$  are created as shown in Fig. 3.



**Fig. 3.** Proposed fiber with elevation (e) at the centre of core. (Designed using OptiFiber simulation software)

Then, LP (0, 1) mode is excited. Similar to dip case, macro bending and micro bending loss characteristics are analyzed for wavelengths from 1.2μm to 1.6μm.

## 3. RESULTS AND DISCUSSION

Macro bending loss coefficient ( $\gamma$ ) is calculated from Optifiber Simulation software as per equation (2)

$$\gamma = \frac{\sqrt{\pi} \left( \frac{P_{\text{clad}}}{P} \right) \exp\left( \frac{-4\Delta W^3}{3r_c V^2} R_b \right)}{2s r_c \left[ K_{v-1}(W) K_{v+1}(W) - K_v^2(W) \right] W \left( \frac{WR_b}{r_c} + \frac{V^2}{2\Delta W} \right)^{1/2}} \quad (2)$$

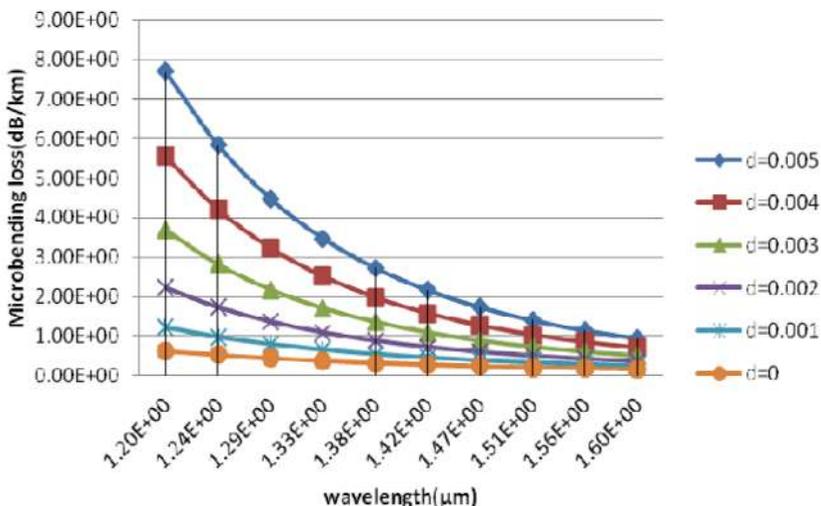
Where V is normalized frequency,  $P_{\text{clad}}$  is propagation power at cladding, P is the total power, W is normalized decay parameter in cladding,  $R_b$  is bending radius,  $r_c$  is fiber core radius, K is modified Bessel function and u is mode number where  $s=2$ , if  $u=0$

and  $s=1$ , if  $u \neq 0$ . Macro bending loss is nearly zero for the proposed profile with all dip depth values and elevated height values when  $R_b$  is 15mm. Since relative refractive index difference ( $\Delta$ ) is directly related to  $\gamma$ , RIP of fiber always impacts on macro bending loss.

Similar to Macro bending loss calculation, Micro bending loss coefficient ( $\alpha_{\text{micro}}$ ) is calculated from Optifiber Simulation software as per equation (3)

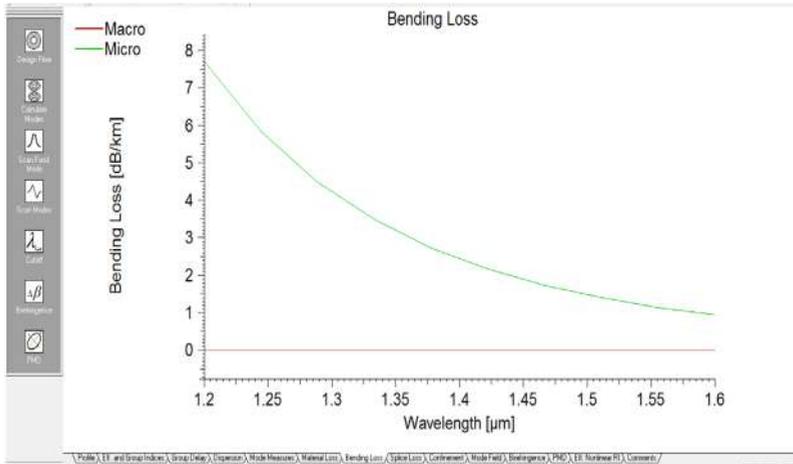
$$\alpha_{\text{micro}} = A(knd_n)^2 (knd_n^p)^{2p} \tag{3}$$

Where  $A$  is constant,  $k$  is free space wave number,  $n$  is refractive index of core,  $d_n$  is near field diameter and  $P$  is power. This micro bending loss is compared for the profile with all dip depths over the wavelength from  $1.2\mu\text{m}$  to  $1.6\mu\text{m}$  as shown in Fig. 4.



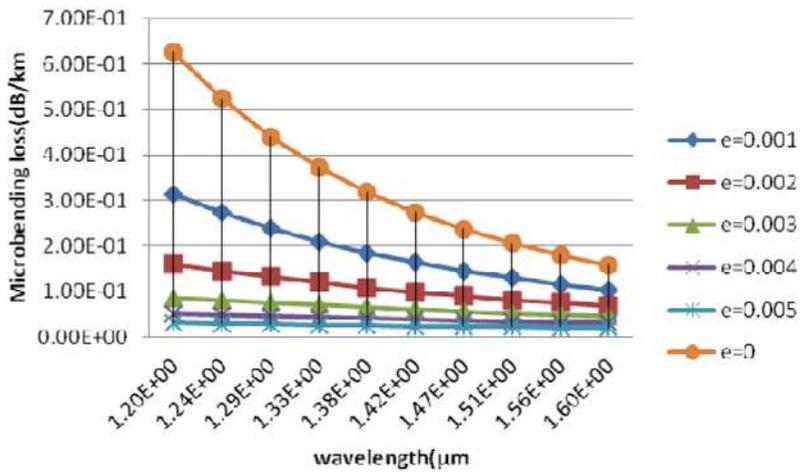
**Fig. 4.** Micro bending loss of fiber with all dip depths for wavelength from 1.2 to 1.6μm

From the comparison, it is observed that when dip depth is increased, micro bending loss also increases. But macro bending loss is zero. Among the dip profiles, profile with dip depth  $d=0.005$  has more micro bending loss as shown in Fig. 5.



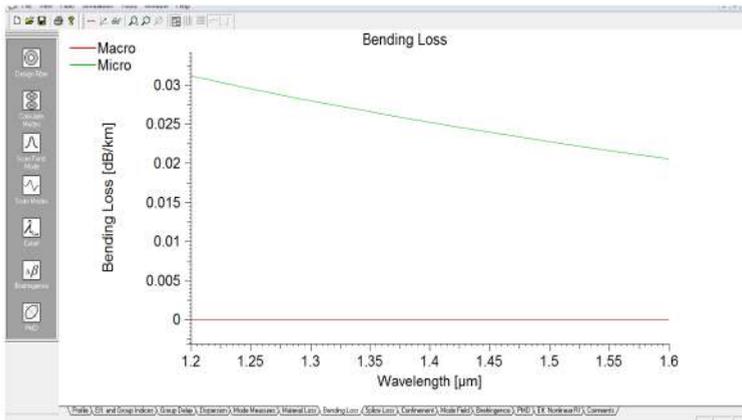
**Fig. 5.** Macro bending and Micro bending losses for profile with dip depth  $d=0.005$

Similar to profile with dip, macro bending loss becomes zero for the proposed profile with all elevated height values. And micro bending loss is compared for the profile with all elevation heights over the wavelength from  $1.2\mu\text{m}$  to  $1.6\mu\text{m}$  as shown in Fig. 6.



**Fig. 6.** Micro bending loss of fiber with elevated index for wavelength from  $1.2$  to  $1.6\mu\text{m}$

From the comparison graph, it is observed that when elevation height is increased, the value of micro bending loss is decreased gradually. Among elevation heights, when  $e=0.005$ , the micro bending loss is low and it is shown in Fig. 7.



**Fig. 7.** Macro bending and Micro bending losses for profile with elevation height  $e=0.005$

The overall comparison is done for the average bending loss from O to L wavelength band of optical communication. And it is tabulated in Table I.

**TABLE I.** Overall Comparison of Bending Loss for the wavelengths from  $1.2\mu\text{m}$  to  $1.6\mu\text{m}$

PROFILE TYPE	AVERAGE MACRO BENDING LOSS(DB/KM)	AVERAGE MICRO BENDING LOSS(DB/KM)
Without dip	0	0.334
With $d=0.001$	0	0.587
With $d=0.002$	0	0.987
With $d=0.003$	0	1.56
With $d=0.004$	0	2.30
With $d=0.005$	0	3.16
With $e =0.001$	0	0.188
With $e =0.002$	0	0.108
With $e =0.003$	0	0.0636
With $e =0.004$	0	0.0393
With $e =0.005$	0	0.0255

From the table, it is observed that the lowest average value of micro bending loss is obtained for fiber profile with  $e=0.005$ . But macro bending loss is zero for all the RI profiles with dip, without dip and elevation.

#### 4. CONCLUSION

The proposed work is for obtaining bend forbearance from a SI fiber. The core refractive index of SI fiber was varied for different dip depths and elevated heights. It was observed that macro bending loss is zero for RI profiles with dip and elevation. The minimum micro bending loss of 0.0255dB is obtained at elevation height of  $e=0.005$ . It is concluded that RI profile with elevation height  $e=0.005$  is best for obtaining bend forbearance and this is analyzed for the wavelength range from 1200nm to 1600nm. By this work, SI fiber can be used with better bend tolerance and can be applied at the fiber applications around corner. As the cost of SI fiber is lower than GI fiber, this work becomes a cost efficient approach. This work can be further extended by exporting this RI profile into optical communication system and can be analyzed with linear and non linear effects.

#### 5. REFERENCES

- Bandyopadhyay, P. K., & Sarkar, S.** (2013). Effect of variation of core gap radius on the performance of dual concentric core Raman fiber amplifier. *Optics Communications*, 300, 27-32. <https://doi.org/10.1016/j.optcom.2013.02.029>
- Bourdine, A., & Burdin, V.** (2018). Research on the influence of FMF refractive index profile deviation from the optimized form on DMD degradation. In 2018 Systems of Signals Generating and Processing in the Field of on Board Communications (pp. 1-3). IEEE. <https://doi.org/10.1109/sosg.2018.8350575>
- Donlagic, D.** (2009). A low bending loss multimode fiber transmission system. *Optics express*, 17(24), 22081-22095. <https://doi.org/10.1364/oe.17.022081>
- Gardner, W. B.** (1975). Microbending loss in optical fibers. *The bell system technical journal*, 54(2), 457-465. <https://doi.org/10.1002/j.1538-7305.1975.tb02848.x>
- Heptonstall, A., Cagnoli, G., Hough, J., & Rowan, S.** (2006). Characterisation of mechanical loss in synthetic fused silica ribbons. *Physics Letters A*, 354(5-6), 353-359. <https://doi.org/10.1016/j.physleta.2006.01.077>

- Jin, X., & Payne, F. P.** (2016). Numerical investigation of microbending loss in optical fibres. *Journal of Lightwave Technology*, 34(4), 1247-1253. <https://doi.org/10.1109/jlt.2015.2503560>
- Keiser, G.** (2003). Optical fiber communications. *Wiley Encyclopedia of Telecommunications*.
- Khular, E., Kumar, A., Ghatak, A. K., & Pal, B. P.** (1977). Effect of the refractive index dip on the propagation characteristics of step index and graded index fibers. *Optics Communications*, 23(2), 263-267. [https://doi.org/10.1016/0030-4018\(77\)90322-4](https://doi.org/10.1016/0030-4018(77)90322-4)
- Kingsta, R. M., & Sivanantharaja, A.** (2013). Numerical design and analysis of multimode fiber with high bend tolerance and bandwidth using refractive index optimization. *Optical Fiber Technology*, 19(6), 587-592. <https://doi.org/10.1016/j.yofte.2013.09.004>
- Komachi, Y., & Aizawa, K.** (2004). *U.S. Patent No. 6,735,369*. Washington, DC: U.S. Patent and Trademark Office.
- Pramanik, S., & Sarkar, S.** (2013). Step index profile coming out as the best choice for the inner core in fiber Raman gain amplifier under fixed phase matching condition. *Optics & Laser Technology*, 48, 206-209. <https://doi.org/10.1016/j.optlastec.2012.10.012>
- Sokkar, T. Z. N., Ramadan, W. A., El-Din, M. S., Wahba, H. H., & Aboleneen, S. S.** (2014). Bent induced refractive index profile variation and mode field distribution of step-index multimode optical fiber. *Optics and Lasers in Engineering*, 53, 133-141. <https://doi.org/10.1016/j.optlaseng.2013.09.002>
- Tanaka, T. P., Yamada, S., Sumi, M., & Mikoshiba, K.** (1977). Microbending losses of doubly clad (W-type) optical fibers. *Applied optics*, 16(9), 2391-2394. <https://doi.org/10.1364/ao.16.002391>
- Tewari, R., Basu, M., & Acharya, H. N.** (2000). Studying the effect of a central dip on the performance of a dispersion compensated fibre. *Optics Communications*, 174(5-6), 405-411. [https://doi.org/10.1016/s0030-4018\(99\)00658-6](https://doi.org/10.1016/s0030-4018(99)00658-6)
- Wandel, M., & Kristensen, P.** (2006). Fiber designs for high figure of merit and high slope dispersion compensating fibers. *Journal of Optical and Fiber Communications Reports*, 3(1), 25-60. [https://doi.org/10.1007/978-0-387-48948-3\\_2](https://doi.org/10.1007/978-0-387-48948-3_2)

# EFFICIENT DATA RETRIEVAL IN SOCIAL IOT WITH CUSTOMIZED RELATIONSHIPS

**R.Kanniga Devi**

*Received her Bachelor of Engineering in Computer Science and Engineering from Madurai Kamaraj University(2001) and Master of Engineering from Anna University(2008) and doctorate from Kalasalingam Academy of Research and Education(2018).*

*Area of interest includes Cloud Computing, Machine Learning and Internet of Things. Associate Professor, Department of Computer Science and Engineering, Kalasalingam Academy of Research and Education. Krishnankoil (India).*

Email ID: rkannigadevi@gmail.com, <https://orcid.org/0000-0001-6288-5607>

**K.Krishnaraja**

*Received Master of Computer Application degree from Madurai Kamaraj University (2009) and received Master of Technology in Computer & Information Technology from MS University (2013). Area of interests include Image Processing, Internet of Things.*

*Assistant Professor, Department Computer Science & Engineering, R.V.S. College of Engineering, Dindigul. (India).*

Email ID: kkrishnaraja@gmail.com, <https://orcid.org/0000-0003-2182-4239>

## ABSTRACT

With the advent of social media sites and web 3.0, there is a tremendous increase in the amount of data generated in web and other devices. Decision making based on these data is a tedious process. A priority-based model is proposed to address this problem. The proposed model is implemented in the Facebook environment and justified to be suitable for Social Internet of Things environment. The model retrieves the hotel reviews from the Facebook environment. The priority-based model is also enabled with a Machine Learning model, which classifies the reviews in to positive reviews and negative reviews from which a decision can be made. Three different machine learning models are employed, Naïve Bayes, Decision Tree and Random Forest. The pre processing step that is used before applying the machine learning model is natural language processing which includes the steps like removal of punctuations and removal of stop words and stemming. It has been inferred from the results that random forest classifier performs better than the other two models and it is used with the priority-based model for classifying the reviews of the individual hotels.

**Keywords:** Social-IoT, Machine Learning, Natural Language Processing, Classification.

## **1. INTRODUCTION**

Retrieving required data from huge amount of data and making a decision based on the retrieved data is certainly a problem that has to be addressed seriously. Though technologies such as Big Data and Machine Learning models address this issue, the problem is still an open issue for researchers in the contexts such as Social Internet of things, where data has to be retrieved from many devices. Making a decision on whether a hotel can be booked during a particular trip from the reviews available in the social media is a similar kind of problem.

Social-Internet of Things (S-IoT) is also known as third generation IoT. It merges the potential of social networks and Internet of Things. It provides more essential and sophisticated services to mankind. Internet of Things in its own sense can be viewed as a network of objects to do a specific task such as getting or providing a service as described in L. Atzori, A. Iera, G. Morabito, and M. Nitti (2012) and S. Sarma, D. Brock, and K. Ashton (1999) This is enabled with the specialized protocols, address resolution mechanism and specific architecture suitable for it.

[1] There are lot of studies and surveys, which forecast the number of IoT devices that would be in use in near future. Ericson has predicted that around 18 billion IoT devices will be in connection with each other by the year 2022(<https://www.ericsson.com/en/mobility-report/reports/november-2017/internet-of-things-outlook>). The current issue is to propose techniques in order to coordinate or handle these increasing number of devices and navigability associated with it as discussed by Saleem, Y., Crespi, N., Rehmani, M.H., Copeland, R., Hussein, D., & Bertin, E. (2016). Few of the works L. Atzori, A. Iera, G. Morabito, and M. Nitti (2012) and D. Guinard, M. Fischer, and V. Trifa (2010) which addresses the Social IoT research issues have referred J. Surowiecki, Te (2005), which presents the importance of collective intelligence in solving a problem.

Considering the scenario in which a user wishes to travel to a particular location and he looks for a hotel to stay. The social IoT scenario allows him to get the reviews from all the possible sources such as social media, Google+, hotel reviews that are available with related service providers such as Trip Advisor and other possible sources.

In order to address the problem of increasing number of devices to which the user's device should communicate, a priority-based model is proposed. The proposed model is demonstrated in the Facebook environment. It is observed that the same

model can also be applied to the Social Internet of things environment in future for the following reasons.

1. Though in case of the social Internet of Things environment, the user's device is about to communicate with the other devices without human intervention, the required data will reside only as a social media content or content provided by the related service providers such as Trip advisor.
2. The communication and other access controls in the Social Internet of things environment are based on the relationship between the devices. The various relationships that are in use are given in the following table 1.

**Table 1:** Relationship between objects in Social Internet of Things

SL. NO	TYPE OF RELATIONSHIP	OBJECTS POSSESSING THE RELATIONSHIP
1	Parental Object Relationship	Objects that are manufactured at the same time by the same manufacturer.
2	Co-location object relationship	Objects which are used in the same location.
3	Co-work Object relationship	Objects that are connected together to do a particular job.
4	Ownership object relationship	Objects which belongs to a same owner.
5	social object relationship	Objects which comes into close proximity often or at a specified interval of time.
6	Guardian object relationship.	Objects possessing a hierarchical relationship
7	Sibling object relationship	Devices that are owned by the members of same family.
8	Stranger object relationship	Devices of the owners who are not much familiar with each other.
9	Service object relationship.	Objects that are bounded together to service a request

The proposed priority-based model is built on classifying the friends in the Facebook in to relative, close friends and friends and assigning priorities to them. This model can easily be extended to Social IoT model, where the priority can be made based on the relationship between the devices.

The objectives of the proposed model are as follows:

- To design a priority-based model for retrieving the hotel reviews, that can also be used in the Social Internet of Things environment.

- Designing a Machine learning Model, which classifies the hotel reviews obtained through the priority-based model in to positive reviews and negative reviews and hence can make a decision.

## **2. MATERIALS AND METHODS**

### **2.1 Literature Review**

The literature includes the study of papers that have used different relationships in their implementation, state of art papers with respect to classification of hotel reviews and papers that speaks about the issues of the social – IoT.

The first and the foremost work that defines the various object relationships between the objects in social internet of things is L. Atzori, A. Iera, G. Morabito, and M. Nitti (2012). In addition to defining the various object relationships, the authors have also analysed the distance between the nodes in terms of probability distribution and observed that it varies with respect to the relationship between the objects. Though the authors has given theoretical example scenarios of different kind of relationships the implementation is made with small world in motion model (SWIM) in the works proposed by S. Kosta, A. Mei, and J. Stefa (2010) and A. Mei and J. Stefa (2009) and it is highly dependent on the movement of human beings.

Sajjad Ali, Muhammad Golam Kibria, Muhammad Aslam Jarwar, Hoon Ki Lee, and Ilyoung Chong (2018) has proposed some new relationships in addition to the one proposed by L. Atzori, A. Iera, G. Morabito, and M. Nitti(2012). They are as follows Guest Object relationship, Stranger Object Relationship, Service object relationship and Sibling object Relationship. The authors have demonstrated their work with a use case scenario of a person entering in to the museum and the following actions with respect to the IoT Devices. It includes the retrieval of user profile and friend's from the social media which was earlier demonstrated in the works of D. Guinard, M. Fischer, and V. Trifa (2010) and M. Kranz, L. Roalter, and F. Michahelles (2010) the authors have also created an architecture that is suitable for the development of microservices for social objects. An ontology model was also developed by the authors to facilitate the interoperable service operations.

Before the emergence of IoT, L. E. Holmquist, F. Mattern, B. Schiele, P. Alahutha, M. Beigl, and H. Gallersen (2001) described how social connections can be established between smart artefacts. It does not include the concept of social IoT. R. Girau, S. Martis, and L. Atzori (2017) Provides a platform called Lysis, which provides a Social

IoT platform based on cloud infrastructure. A. Pintus, D. Carboni, and A. Piras (2012) also provides a similar platform which connects the physical things based on the social relation between the humans. L. E. Holmquist, F. Mattern, B. Schiele, P. Alahutha, M. Beigl, and H. Gallersen (2001) speaks about temporary relationship between objects and necessity of connecting the objects in a more sensible means.

In addition to this K. M. Alam, M. Saini, and A. El Saddik (2015) have proposed a relationship called guardian relationship. This kind of relationship is established between the on board unit and road side units defined in VANET's by Karagiannis, Georgios & Altintas, Onur & Ekici, Eylem & Heijenk, Geert & Jarupan, Boangoat & Lin, Kenneth & Weil, Timothy (2011) the authors have defined an architecture suitable for Social Internet of Things and claims that social internet of vehicles would play a major role in social IoT in future.

Saleem, Y., Crespi, N., Rehmani, M.H., Copeland, R., Hussein, D., & Bertin, E. (2016). specifies that network navigability is one of the major concern that has to be addressed in future. The complexity increases with the increasing number of friends and the associated devices.

Nitti, Michele & Atzori, Luigi & Pletikosa, Irena. (2014) provides a solution for the network navigability. The authors proposed a model based on link selection which also promises efficiency in managing the friendships. Four strategies are followed and comparison of parameters such as average degree, average path length and local cluster coefficient is made.

With reference to the classification of the reviews of the hotel in to positive or negative various works have been made but they have not made any reference to Social IoT. T. Ghorpade and L. Ragha (2012) have made a study with reviews collected from 11 hotels. But the number of test and training dataset are very minimal. Yordanova, Stanimira & Kabakchieva, Dorina. (2017) provides a decision tree based model for classifying the hotel reviews. The authors have followed balanced and unbalanced training set which provides different kind of accuracies. Pei-Ju Lee, Ya-Han Hu, Kuan-Ting Lu (2018) Assessed the hotel reviews in terms of reviewer characteristics, review sentiment, and review quality and found that good predictors are the review characteristics whereas poor predictors are review quality and review sentiment. Yordanova, Stanimira & Kabakchieva, Dorina. (2017) made a sentimental analysis of the hotel reviews. The dataset is extracted from trip advisor. Naive bayes and support vector machine models are used for classification and the former found to produce better result than the later. P.Kalaivani, K.L.Shunmuganathan,( 2013) have used clas-

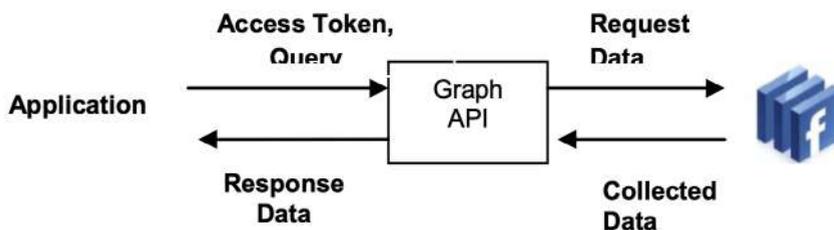
sification technologies for analysing the movie reviews. SVM, K-NN and naive bayes models are used. The results show that Support vector model performs well than the other two models.

A variant of convolutional neural network (CNN) called as recurrent CNN is proposed by Y. Jin, C. Luo, W. Guo, J. Xie, D. Wu and R. Wang (2019) Though the deep learning models generally perform well than the machine learning model, this is not the case with this, the results depends on the dataset. Another such model, the result of which depends on the number of reviews is given by J. Panthati, J. Bhaskar, T. K. Ranga and M. R. Challa (2018) and it also employs convolutional neural networks.

It has been observed from the study made that, there were many works pertaining to classification of reviews but they have not been used in the context of Social IoT. It has also been noted that no similar solution to priority-based approach has been provided for the issue of increasing number of devices in Social Internet of Things, which is very much similar to the increasing number of friends in Facebook.

## 2.2 Priority-based model

[2] In this model the posts are comments that are made by users of the Facebook on a particular hotel is retrieved. The data is retrieved from the Facebook database using the Facebook graph API <https://developers.facebook.com/docs/graph-api/overview>.the process is illustrated in the following figure 1.



**Figure 1:** Retrieving of Data from Facebook using Graph API

The friends in the Facebook is categorised in to following groups.

- Family
- Close Friends
- Friends
- Friend of Friends

The priority assigned to them is as follows, Family is assigned the first priority followed by close friends, friends and public.

There are totally 248 friends and the numbers in each category are as follows, the counts in family, close friends and friends are 12,48,188 respectively.

The system works by using the following algorithm:

Input: Hotel Name

For i in range (1,4):

    For every person in the group:

        If review on the particular input is available:

            Retrieve the reviews and exit

        Else

            Continue

From the given algorithm, it is observed that if the reviews of the particular hotel is found in the posts or comments of the people belonging to category 1, then it is collected and the system exit if not it moves to the next category. With this the best and worst case in terms of number of profiles visited is given in Table 2.

SI. No.	CATEGORY	BEST CASE	WORST CASE
1	Family	1	12
2	Close Friends	13	60
3	Friends	61	248
4	Public	>248 and the number of reviews to be collected is restricted to 1000	

**Table 2:** Number of profiles to visit (worst and best case)

After the reviews are collected, they are categorized in to positive reviews and negative reviews. The decision is made with the following strategy.

*If the reviews are retrieved from the category 1 and*

*If: number of positive reviews > number of negative reviews*

*Make a positive decision*

*Else if : number of positive reviews < number of negative reviews*

*Make a negative decision*

*Else if : number of positive reviews=number of negative reviews*

*Get the reviews from the second category. Continue this process till category three by accumulating the reviews with the already existing reviews of the previous category.*

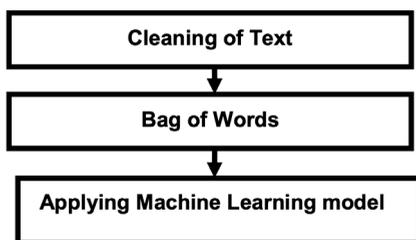
Applying priority-based method would solve the problem of navigability which is specified by Saleem, Y., Crespi, N., Rehmani, M.H., Copeland, R., Hussein, D., & Bertin, E. (2016).

In order to make this classification, a Machine Learning classifier is designed and tested. From the results it has been identified that Random Forest classifier yields better result when compared to Naive Bayes and Decision Tree classifiers.

### 2.3 Machine Learning Model

Natural Language Processing can be used in S-IoT as the interaction is only between the objects. The objects have to collect the reviews from other objects and provide a suggestion to its owner.

The core processes involved in Natural Language Processing are Text cleaning, creating Bag of Words and applying Machine Learning model. The flow of the core processes is denoted in Figure 2.



**Figure 2.** Steps in Natural Language Processing

#### **Text cleaning**

This is the process of cleaning the dataset to make it suitable for the Machine Learning models. The objective of the proposed model is to classify a new review into

positive or negative. The dataset used in the system is restaurant reviews which is obtained from the trip advisor website through web scrapping. The dataset contains 1000 reviews and in Tab Separated Value (TSV) file format. The training dataset contains both the positive and negative reviews. The positive reviews are marked with 1 and negative reviews are marked with 0. The Machine Learning model is trained by the training dataset and if a new review is input, it classifies the review into positive or negative. The text cleaning process is shown in Figure 3.

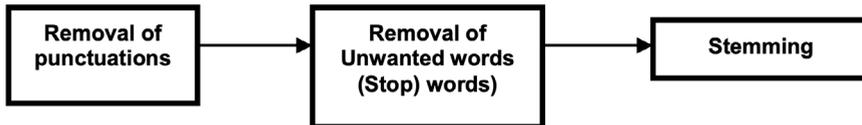


Figure 3. Text Cleaning

### Removal of punctuations

Punctuations such as comma are of no use in classifying the review. Hence, all the punctuations are removed. Removals of punctuations are made using regular expressions.

### Removal of unwanted words

Removal of unwanted words means removing of words that does not contribute in identifying the type of review either as positive or negative review. The unwanted words are removed with reference to the standard words in the English Language with appropriate libraries in the Python tool. The primary process in this module is to split the review into words and removing the stop words. The resulting lists of words are given as input to the stemming process.

### Stemming

Stemming can be understood with the following example. Consider a review,

“I Love this restaurant”

Consider the word love here; there can be variations of this word such as loved, loves etc. Stemming helps us to consolidate these words into a single word love. This in turn helps to reduce the total number of words. After stemming is applied to all the words, the resulting words are joined together to form the review back.

### Creating Bag of words

Bag of Word model considers all the words in all the reviews and all the unique words from all the reviews are extracted.

Example:

There are 1000 reviews

Set of reviews= {r0,r2,.....r999}

Set of unique words in all columns= {uw1,uw2,.....uwn}

A table is formed, where the rows denote the set of reviews and columns denote the set of unique words. Table 3 illustrates this idea.

	Uw1	Uw2		Uwn
Review 0				
Review 1				
.			...	
.				
Review 999				

**Table 3:** Creating Bag of Words

Each cell of the Table 3 is filled with either 0 or 1. For example, the cell {Review 0, Uw1} is filled with 1 if that particular word Uw1 occurs in review 0, else the cell is filled with 0. The resulting table will be a sparse matrix. The sparse matrix is the one which contains many zeroes. The bag of words and the resulting relation between each unique word and the individual reviews are the input to the classification model. With thousand reviews and numerous unique words, the sparsity of the matrix is high and it will increase tremendously when the dataset contains more number of reviews.

Another step is followed to reduce the number of unique words. Consider if the review contains any names such as “ABC recommends this restaurant”. The name ABC will not occur in any other reviews. These kind of words can be removed and only

the most frequent words can only be taken in to consideration. In this case 1500 such words from all the reviews were taken and the sparse matrix is generated. With the created matrix and the training dataset, the Machine Learning model is built.

Clearly, the problem considered is a classification problem. The given review should be classified into positive or negative. The system is tested with three types of classifiers.

- Naive Bayes
- Decision Tree
- Random Forest

The results are discussed in section V. From the results obtained it is observed that random forest classifier performs well than the other two models. So this model is chosen for implementing the priority-based approach.

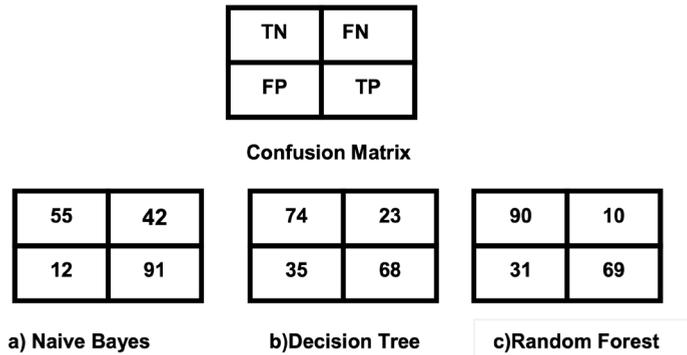
Test run for the proposed system is made for 10 hotels and the observed results are given in the next section.

The numerical results obtained, the accuracy of the system and other observations made are discussed in the next section.

### **3. RESULTS**

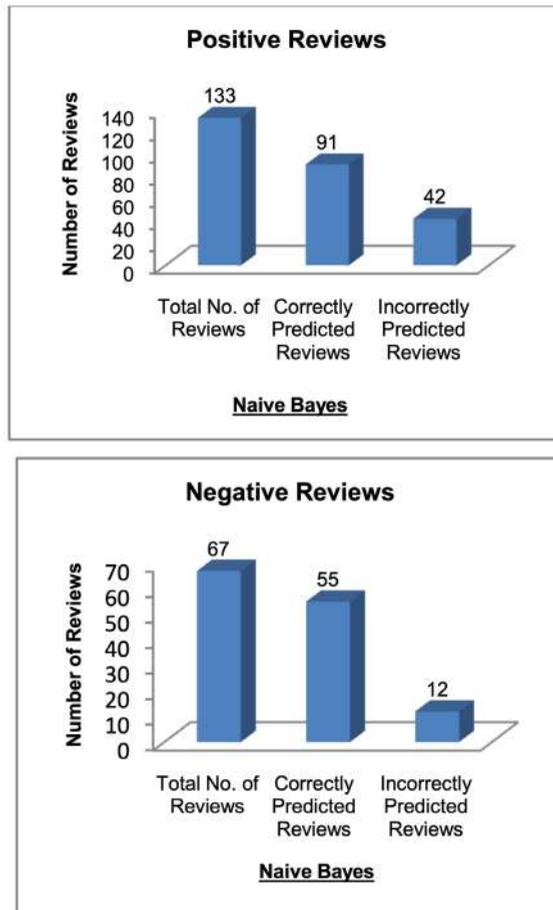
The Machine Learning model is designed in a system with 4 GB RAM and Intel i3 processor. The programming language used for building the Machine Learning model is Python. The test runs for the each classifier is made 5 times with varying training and test datasets .the best result achieved is given in the results.

The dataset contains 1000 reviews, out of which 800 reviews are considered as training dataset and the remaining 200 is considered as test dataset. The confusion matrices for the three classifiers are given in Figure 4. The confusion matrix is the one which shows the True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN) predictions. These are the parameters that are used for calculating the performance of the Machine Learning model.



**Figure 4.** Confusion Matrix of the Classifiers

The observations made from the confusion matrix in terms of the number of correct and incorrect predictions of both positive and negative review of each classifier are given in Figure 5, 6 and 7.



**Figure 5.** Naive Bayes Classifier

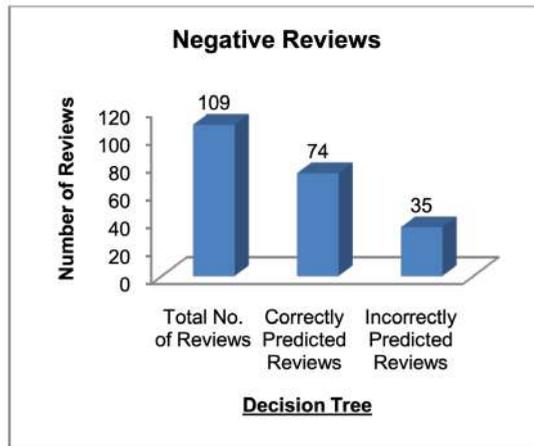
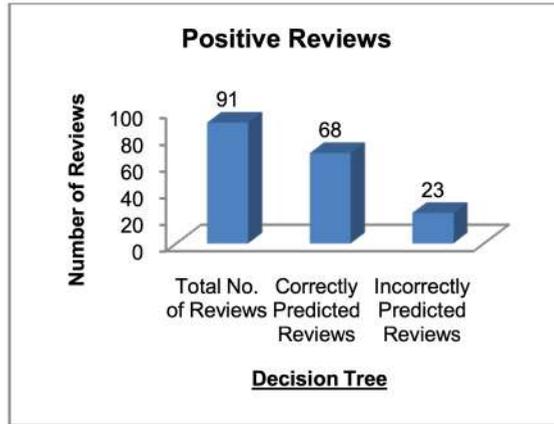
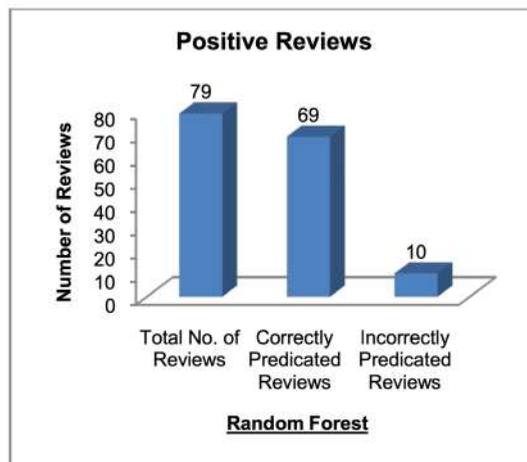
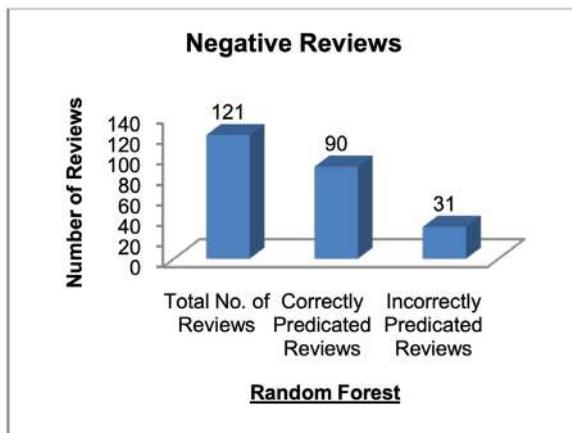


Figure 6. Decision Tree Classifier





**Figure 7.** Random Forest Classifier

From the results obtained the following parameters are calculated for both the classes.

- Precision(P)
- Recall(R)
- F1-score(F1)

True Positive rate

True positive rate is defined as

$$\text{True Positive Rate (TPR)} = \frac{TP}{TP + FP} \tag{1}$$

Where,

TP =True Positive, FP =False Positive

$$\text{False Positive Rate (FPR)} = \frac{FP}{FP + TN} \tag{2}$$

Where TN=True Negative

**Precision**

Precision defines the percentage of correctly classified class. In simple terms it can be defined as the ratio between the positive observations that are correctly predicted and actual number of positive observations.

$$\text{Precision} = \frac{TP}{TP + FN} \quad (3)$$

Where FN is False Negative

### Recall

Recall also known as sensitivity is the ratio between the correctly classified and total observations. It can be represented as follows

$$\text{Recall} = \frac{TP}{TP + FP} \quad (4)$$

### F-Measure

F-Measure is defined as the weighted average of precision and recall. F-Measure is most useful performance metric than accuracy when we have various distributions of classes. It is represented as

$$\text{F-Measure} = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \quad (5)$$

The resulting parameters are given in Table 4.

	NAIVE BAYES			DECISION TREE			RANDOM FOREST		
	P	R	F1	P	R	F1	P	R	F1
0	0.82	0.57	0.67	0.68	0.76	0.72	0.74	0.90	0.81
1	0.68	0.88	0.77	0.75	0.66	0.70	0.87	0.69	0.77
Avg	0.75	0.73	0.72	0.71	0.71	0.71	0.81	0.80	0.79

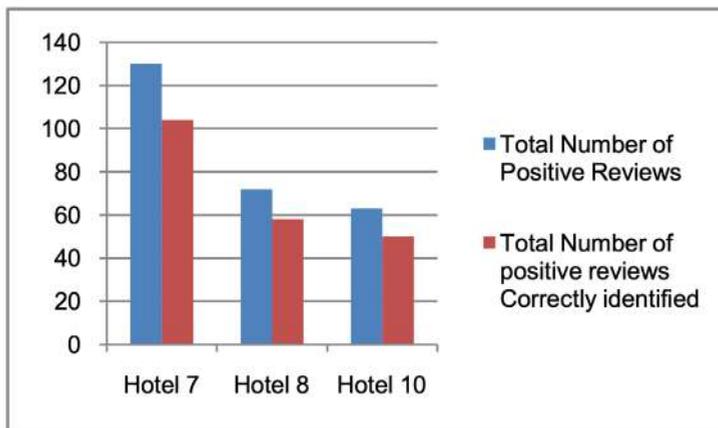
**Table 4.** Classification Parameters

It can be observed from the results that Random Forest classifier is better than Naive Bayes and Decision Tree. With this classifier, the test for the priority-based system produces the result, which is depicted in Table 5.

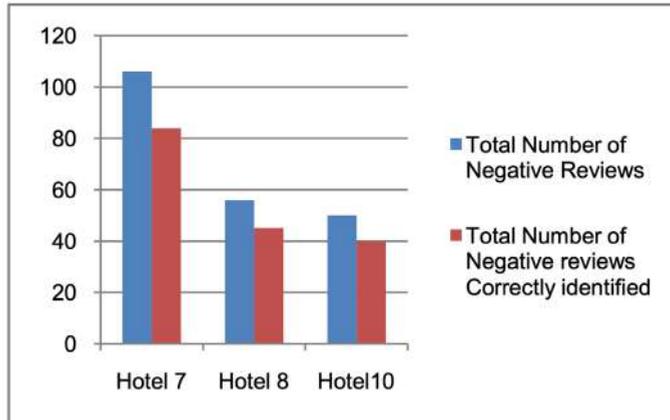
Sl. No	HOTEL	CATEGORY IN WHICH THE REVIEW IS FOUND	NUMBER OF REVIEWS FOUND	DECISION MADE
1	Hotel 1	Family	2	Positive
2	Hotel 2	Not Found	-	
3	Hotel 3	Family	1	Positive
4	Hotel 4	Close Friends	1	Positive
5	Hotel 5	Friends	7	Negative
6	Hotel 6	Family	3	Negative
7	Hotel 7	Public(Friend of Friends)	236	Positive
8	Hotel 8	Public(Friend of Friends)	128	Positive
9	Hotel 9	Not Found		
10	Hotel 10	Public(Friend of Friends)	113	positive

**Table 5.** Number of reviews retrieved for each hotel and decision made

The Figures 8, 9 and 10 shows the results with respect to the hotels 7,8 and 10.

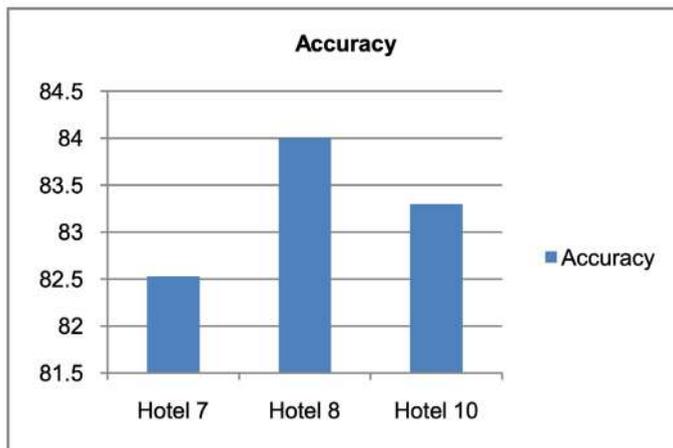


**Figure 8.** Comparison of total number of positive reviews and total number of positive reviews correctly predicted



**Figure 9.** Comparison of total number of positive reviews and total number of positive reviews correctly predicted

The accuracy in terms of percentage obtained for these three cases (hotel 7,8 and 10) are given in the following figure.



**Figure 10.** Percentage Accuracy

In order to test the accuracy of the system with lower number of reviews, the system is tested with 10 different single review and the result obtained shows that 7 times the reviews has been predicted correctly. It is also observed that for two hotels, the results cannot be obtained since no reviews are available with the persons defined in our category, in such cases web scrapping of a particular website is only applicable.

## **4 CONCLUSION AND FUTURE WORK**

This work develops a priority-based model to retrieve the required data from the huge amount of data, the model is based on the social behaviour of humans in making a decision based on the suggestion from the intimate persons. The model is demonstrated in the Facebook environment and justified to be suitable for using it in the environment of Social Internet of Things. A Natural Language Processing model is also designed enabled with a classifier. The system is tested with three different classifiers and the Random Forest classifier is found to provide better performance and is used in the priority-based model. The future work would include increasing the efficiency of the Machine Learning model and applying the system to real Social Internet of Things environment. This would be the stepping Stone towards the next generation recommendation systems where more personalized recommendation can be made.

## **5. REFERENCES**

- Alam. K. M., Saini. M, and Saddik. A. El**, "Toward social internet of vehicles: concept, architecture, and applications," *IEEE Access*, vol. 3, pp. 343–357, 2015. doi: 10.1109/ACCESS.2015.2416657.
- Atzori. L, Iera. A, Morabito. G, and Nitti. M**, "The social internet of things (SIoT) — when social networks meet the internet of things: concept, architecture and network characterization," *Computer Networks*, vol. 56, no. 16, pp. 35949 – 3608, 2012. <https://doi.org/10.1016/j.comnet.2012.07.010>
- Guinard. D, Fischer. M, and Trifa. V**, "Sharing using social networks in a composable Web of Things," in *Proceedings of the 8th IEEE International Conference on Pervasive Computing and Communications Workshops, PERCOM Workshops 2010*, pp.702–707, Germany, April 2010. doi: 10.1109/PERCOMW.2010.5470524.
- Ghorpade. T and Ragha. L**, "Featured based sentiment classification for hotel reviews using NLP and Bayesian classification," *2012 International Conference on Communication, Information & Computing Technology (ICCICT)*, Mumbai, 2012, pp. 1-5. doi: 10.1109/ICCICT.2012.6398136.
- Girau. R, Martis. S, and Atzori. L**, Lysis: "A platform for IoT distributed applications over socially connected objects," *IEEE Internet of Things Journal*, vol. 4, no.1, pp.40–51, 2017. doi: 10.1109/JIOT.2016.2616022.

- Holmquist. L. E., Mattern. F. B. Schiele, Alahutha. P, Beigl. M, and Gallersen. H.** Smart-its friends: A technique for users to easily establish connections between smart artefacts. Proc. of ACM UbiComp'01. September-October 2001. <https://dl.acm.org/doi/10.5555/647987.741340>
- Jin. Y, Luo. C, Guo. W, Xie. J, Wu. D and Wang. R,** "Text Classification Based on Conditional Reflection," in IEEE Access, vol. 7, pp. 76712-76719, 2019. doi: 10.1109/ACCESS.2019.2921976.
- Kalaivani. P, Shunmuganathan. K.L.,** 2013. Sentiment Classification of Movie Reviews by Supervised Machine Learning Approaches. Vol. 4 No.4 Aug-Sep 2013. Indian Journal of Computer Science and Engineering (IJCSE).
- Karagiannis, Georgios & Altintas, Onur & Ekici, Eylem & Heijenk, Geert & Jarupan, Boangoat & Lin, Kenneth & Weil, Timothy.,** "Vehicular networking: A survey and tutorial on requirements, architectures, challenges, standards and solutions," IEEE Commun. Surveys Tuts., vol. 13, no. 4, pp. 584–616, Nov. 2011. doi: 10.1109/SURV.2011.061411.00019.
- Kosta. S, Mei. A, and Stefa. J.** Small World in Motion (SWIM): Modelling Communities in Ad-Hoc Mobile Networking. Proc. of IEEE SECON 2010. June 2010. <http://dx.doi.org/10.1109/SECON.2010.5508278>
- Kranz. M, Roalter. L, and Michahelles. F,** "Things that twitter: social networks and the internet of things.' What can the Internet of Things do for the Citizen (CloT)," in Proceedings of the 8th International Conference on Pervasive Computing (Pervasive 2010), 2010.
- Mei. A and Stefa. J.** SWIM: A Simple Model to Generate Small Mobile Worlds. In Proc. of IEEE Infocom 2009. April 2009. doi: 10.1109/INFCOM.2009.5062134
- Nitti, Michele & Atzori, Luigi & Pletikosa, Irena.** (2014). "Network navigability in the social Internet of Things." *2014 IEEE World Forum on Internet of Things (WF-IoT) (2014)*: 405-410. doi: 10.1109/WF-IoT.2014.6803200
- Panthati. J, Bhaskar. J, Ranga. T. K. and Challa. M. R.,** "Sentiment Analysis of Product Reviews using Deep Learning," 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Bangalore, 2018, pp. 2408-2414. doi: 10.1109/ICACCI.2018.8554551

**Pei-Ju Lee, Ya-Han Hu, Kuan-Ting Lu,** Assessing the helpfulness of online hotel reviews: A classification based Approach. *Telematics and Informatics*, ISSN: 0736-5853, Vol: 35, Issue: 2, Page: 436-445 Publication Year: 2018. <https://doi.org/10.1016/j.tele.2018.01.001>

**Pintus. A, Carboni. D, and Piras. A,** "Paraimpu: A platform for a social Web of Things," in *Proceedings of the 21st Annual Conference on World Wide Web, WWW'12*, pp. 401– 404, France, April 2012. <https://doi.org/10.1145/2187980.2188059>

**Sarma. S, Brock. D, and Ashton. K.** The networked physical world: proposals for the next generation of computing commerce, and automatic identification. *AutoID Center White Paper*. 1999.

**Saleem, Y., Crespi, N., Rehmani, M.H., Copeland, R., Hussein, D., & Bertin, E.** (2016). Exploitation of social IoT for recommendation services. *2016 IEEE 3rd World Forum on Internet of Things (WF-IoT)*, 359-364. doi: 10.1109/WF-IoT.2016.7845500.

**Sajjad Ali, Muhammad Golam Kibria, Muhammad Aslam Jarwar, Hoon Ki Lee, and Ilyoung Chong,** "A Model of Socially Connected Web Objects for IoT Applications," *Wireless Communications and Mobile Computing*, vol. 2018, Article ID 6309509, 20 pages, 2018. <https://doi.org/10.1155/2018/6309509>

**Surowiecki. J,** *Te Wisdom of Crowds*, Anchor Books, 2005.

**Yordanova, Stanimira & Kabakchieva, Dorina.** (2017). Sentiment Classification of Hotel Reviews in Social Media with Decision Tree Learning. *International Journal of Computer Applications*. 158. 1-7. Doi: 10.5120/ijca2017912806.

# FLOOR CLEANING ROBOT USING BLUETOOTH AND ANDROID APPLICATION

**P. Manikandan**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Virudhunagar (India).*

Email ID: [maanip85@gmail.com](mailto:maanip85@gmail.com), <https://orcid.org/0000-0002-5737-0235>

**P. Sivakumar**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Virudhunagar (India).*

Email ID: [sivapothe@gmail.com](mailto:sivapothe@gmail.com), <https://orcid.org/0000-0003-1328-8093>

**T. Chenna Keshava Reddy**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Virudhunagar (India).*

Email ID: [keshavakeshu333@gmail.com](mailto:keshavakeshu333@gmail.com), <https://orcid.org/0000-0001-6694-3894>

**Ch. Nikhil Reddy**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Virudhunagar (India).*

Email ID: [nikhilreddy.jana@gmail.com](mailto:nikhilreddy.jana@gmail.com), <https://orcid.org/0000-0003-0268-9086>

**M. Hari Siva**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Virudhunagar (India),*

Email ID: [siv.hari148@gmail.com](mailto:siv.hari148@gmail.com), <https://orcid.org/0000-0003-1501-4635>

## ABSTRACT

Purity is next to godliness. For our wellbeing, we are deprived to keep the floor with more perfect dependably. For the most part sweepers are doing the floor cleaning by manually. but, for cleaning huge structures like complex, malls, course lobbies require more workers. this causes cleaning procedure are more expensive. In this paper we proposed the idea of floor cleaning robot to make the cleaning procedure as less expensive. This floor cleaning robot is planned utilizing Arduino Uno and constrained by versatile application through Bluetooth technology. It is a compact gadget and needs less working vitality. this gadget will improve the cleaning by the strategy for wet ground cleaning

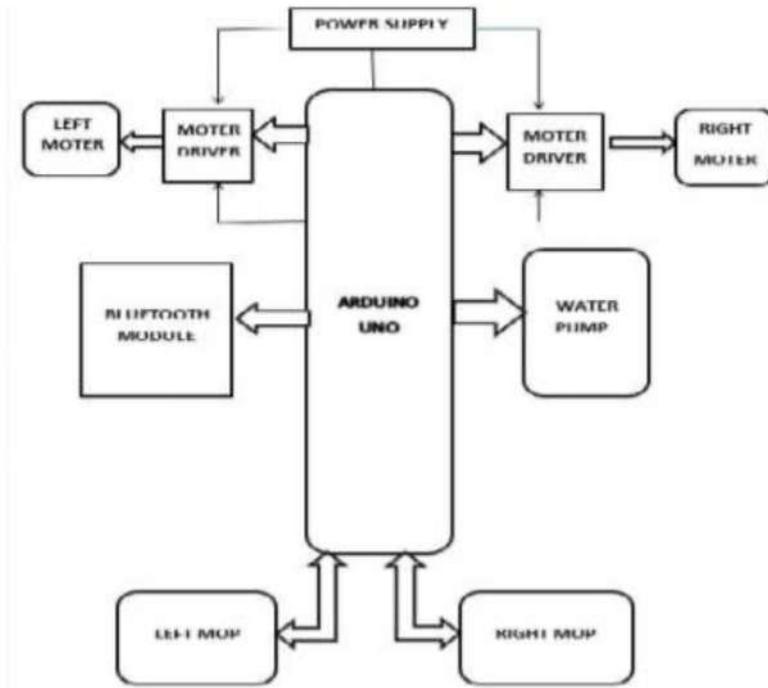
**Keywords:** Android application, Arduino Uno, Bluetooth module Floor Cleaning, L239D.

## 1. INTRODUCTION

For cleaning the floors like houses, seminar Halls, hospitals, offices, enterprises, and so forth., utilizing the sweeper by the workers. But manual floor brush- based cleaning won't perfect exactly.it causes some medical problem can happen like, asthma, skin hypersensitivity, Eye aggravation etc. so to guarantee the more cleanness, we have to utilize the phenyl, soap oil, water to horde in a steady progression ( Andersen *et al*, 2009). It likewise requires more humanity power and time. Henceforth now in present days as innovation is developing in each field, we wanted to propose a robot for cleaning reason (Schmidt *et al*, 1984). Vacuum and dry cleaners have unable to clean the bacteria and organic materials in the floors (Andersen *et al*, 2009). In India for houses cleaning robots are not utilized in light of the fact that a typical individual can't bear the cost of it because of surprising expense. In India, robots are utilized for road cleaning, railroad station and airplane terminal cleaning which are controlled physically. Vacuum cleaners have been used to clean the solids and weightless dust (Badde *et al*, 2018). But vacuum cleaners have not providing protection against the germs like bacteria, fungus, etc. Since in the wet cleaning process, soap oil, phenyl and chemicals can be used to kill the germs (Schmidt *et al*, 1984). So, in this paper, we have proposed a versatile control-based floor cleaner through Bluetooth innovation. which supports wet cleaning. In this venture, utilized the Arduino UNO microcontroller, Mobile Android application, Bluetooth module and arrangement for keeping water, cleanser oil and phenyl.

## 2. METHODS

The block diagram of our proposed system “Floor Cleaning Robot using Arduino controlled through Bluetooth module and android application” is shown in Figure 1. Arduino Uno microcontroller has been used in most of the hardware controlling applications (Manikandan *et al*, 2021). Since its cost is very cheap, easy to programme, easy to interface with I/O devices



**Figure 1.** Block Diagram of cleaning robot.

**Source:** own elaboration

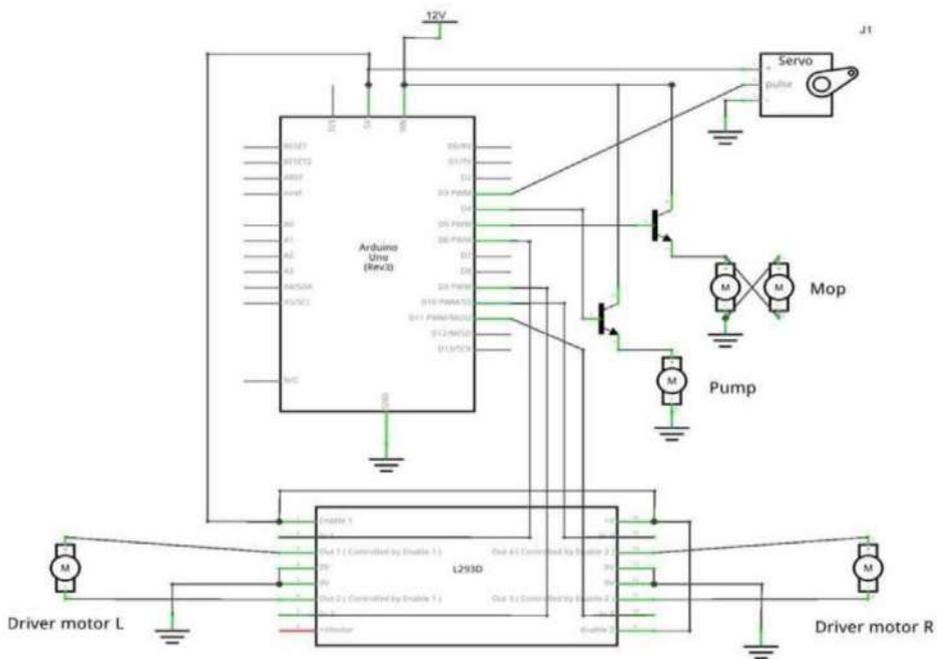
## 2.1 OVERVIEW OF THE SYSTEM

The robot for floor cleaning is working with the operating voltage of 12V battery, Arduino Uno microcontroller board, Bluetooth module (HC-05), two 300 rpm engines, L239D motor driver. The primary portion of this scheme that regulates all activities is the Bluetooth module (HC-05). Bluetooth module is utilized to convey remotely between android telephone and robot and its 10 m scope of activity. Two motors are used to drive the wheels. All the Arduino microcontroller monitored signals that require 12V battery to work.

To control the robot remotely, various wireless module has been used like Zigbee (Kumar et al,2015), Bluetooth, Wi-Fi, etc. In the proposed system, to obtain and transmit the signal, the Bluetooth module is used. Android Blue Control v2.0 is accessible free of charge on google through which user can control the machine remotely. Here we use the request to override. The proposed framework will comprise of following modules:

- a. Bluetooth Module
- b. Android based mobile phone
- c. Arduino Microcontroller
- d. Motor driver IC.
- e. DC Motors
- f. Water pump

The remote control of our robot is our advanced cell. Bluetooth module will go about as the association connect among robot and Smart telephone, microcontroller will go about as the mind of the robot and DC motors will move the robot. The Bluetooth transceiver, Motors for wheels and motor pumps and motor for mobs are interfaced with the microcontroller as shown in figure 2.



**Figure 2.** Interface between Arduino and motor drive.

**Source:** own elaboration

## 2.2 FUNCTIONALITY PROVIDED BY THE SYSTEM

A robot can be controlled and made to work and function as our wish. It became much easier with the involvement of the smartphone. In this scheme, the mobile phone will use a Bluetooth application in the smartphone to control the robot. With

the assistance of the Bluetooth module mounted on the Robot, this Bluetooth application in smartphone will connect to the robot.

The 12\*9-inch wooden board robot is mechanically altered to suit the Bluetooth and Arduino microcontroller module. A robot can be controlled and made to work and function as our wish. It became much easier with the involvement of the smartphone. The inputs are linked to the back motors. The link is accomplished between the driver and the Arduino. The transmitter and receiver pins of the Bluetooth module are now linked to the corresponding transmitter and receiver pins of Arduino and Vcc. The water pump input is linked to the corresponding Arduino pin. Front engines are linked straight to the 12v power supply they are attached in parallel in such a manner that the two engines rotate each other in opposite directions. In this the Arduino has only 5v supply as output. So, it can't operate the water pump and front engines at the same moment, so we use the TIP 122 power transistors to operate the front engines and water pump at the same moment. And the water pump is mounted in a rectangular box and the water pump outlet is linked to a vinyl pipe and divided into two sides. And by providing the instructions by Bluetooth the water is split accordingly it includes both the front mops and the mops that are the cleaning instruments are made of ancient cd's and cloth that is snapped like two rolling instruments that are used to dry the floors. Eventually all of these are governed using the Arduino code instructions through which all the parts receive the inputs and these features are regulated using a portable Bluetooth application known as Blu-Control version 2.0. The figure 3 explains the flow of operation of the cleaning system.

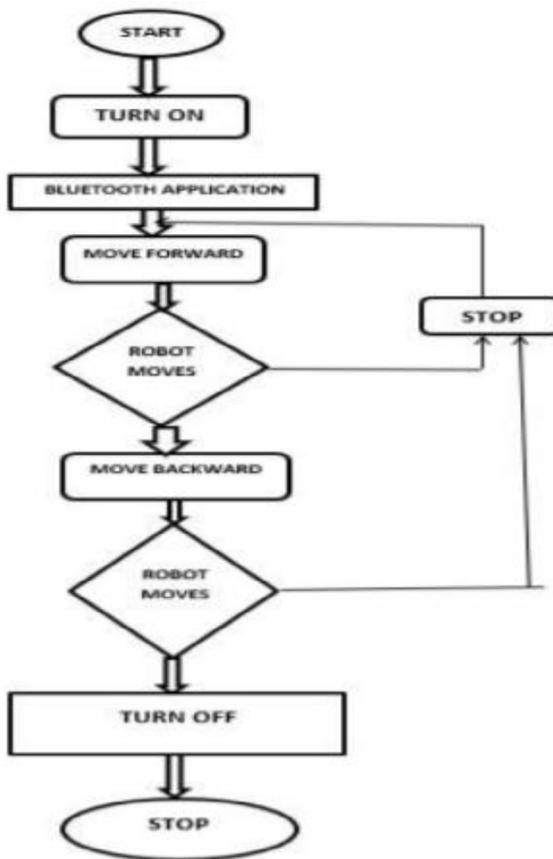


Figure 3. Flow chart for Operation.

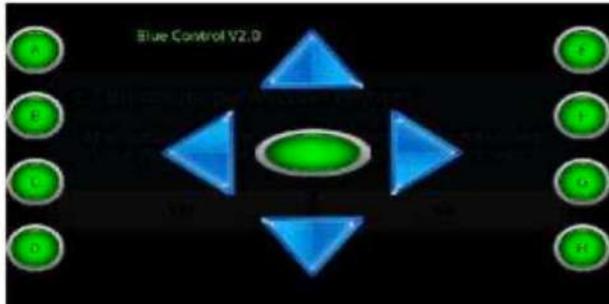
Source: own elaboration

### 2.3 SYSTEM INTERFACES, INPUTS AND OUTPUTS

The system interface comprises of the following entities: Smartphone, Android Application, Bluetooth module, Arduino Microcontroller, DC Motor and water pump. The smart phone functions as the medium on which an interface is played by the Android Application. The input is provided to the Arduino microcontroller through the Bluetooth application that is supplied to the Arduino on a wooden board via the Bluetooth module that transfers the instructions passed to the wooden board by the smartphone application. In order to get the necessary movement, the DC motor is also included in the circuit. And the 12v water pump is interfaced with the Arduino and the Bluetooth application controls it. The code will be sent to the port using Arduino There are following stages which should be considered while planning the robot.

### 2.3.1 Control Logic

The direction or movement of the robot is controlled by the microcontroller. For making it movable in all required directions we written code in Arduino Uno to do the Cleaning Operation. Our developed floor cleaning robot cleans the floor by making wet condition. The above-mentioned project is controlled by an android application blue control v2.0. The interface of the Application looks like in figure 4.



**Figure 4.** Blue Control Icon

**Source:** own elaboration

The arrows as mentioned are used to control the movement of the robot. The a and b buttons are used to control the water spilling and stopping by using water pump the controlling is much easier without any delay.

### 2.4 ADVANTAGES

1. Constrained expense.
2. Saving energy.
3. Reduces human exertion.
4. It can be utilized in residential purposes.
5. Medium size and low weight
6. Easy to utilize
7. Compact

## **3. RESULTS AND DISCUSSION**

The Bluetooth module floor cleaning robot project as shown in figure 6 was very helpful for indoor cleaning to wet and clean the dust on the ground. The systems price will be around Rs.4000 including all the project's parts used. In this we used the 12V rechargeable battery so it can be frequently recharged after use, it has another benefit of recharging the battery. The final price information will be around Rs.4250

for recharging. This system appears to be very tiny, but the job is merely helpful and inconceivable. The photo view of the proposed system is shown in figure 5.



**Figure 5.** Prototype of Floor cleaning Robot.

**Source:** own elaboration

#### 4. CONCLUSION AND FUTURE WORK

Our proposed system has been working properly like mobbing automatically and it can be controlled by mobile Application through Bluetooth module. This cleaning system removes the bacteria's, fungus and other organic dust. Since this system have the provisions to spray the Cleaning chemicals like soap oils, Phenyl. Cost of this system is very less. In future, many additional features can be extended for cleaning solid wastage with mini dustbin etc. this system can be more helpful and essential to clean the environment that is mandatory in this present culture.

#### 5. REFERENCES

- Andersen, B. M., Rasch, M., Kvist, J., Tollefsen, T., Lukkassen, R., Sandvik, L., & Welo, A.** (2009). Floor cleaning: effect on bacteria and organic materials in hospital rooms. *Journal of Hospital Infection*, 71(1), 57-65. <https://doi.org/10.1016/j.jhin.2008.09.014>
- A Kumar, GP Hanckle,** (2015). A Zigbee based animal health monitoring system. *IEEE sensor journal*. <https://doi.org/10.1109/JSEN.2014.2349073>
- Blackmore, S., Fountas, S., Tang, L., & Have, H.** (2004). Design specifications for a small autonomous tractor with behavioural control. *Journal of the International Commission of Agricultural Engineering (CIGR)*VI. <https://cigrjournal.org/index.php/Ejournal/article/download/525/519/0>

- Badde, A. R., Vichare, A., Shah, V., & Sharma, S.** (2018). Dustbuster: an autonomous vacuum cleaning robot. *International Journal of Advanced Research in Computer Science*, 9(2). <https://doi.org/10.26483/ijarcs.v9i2.5879>
- Manikandan, P., Ramesh, G., Likith, G., Sreekanth, D., & Prasad, G. D.** (2021, March). Smart Nursing Robot for COVID-19 Patients. In 2021 *International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)* (pp. 839-842). IEEE. <https://doi.org/10.1109/ICACITE51222.2021.9404698>
- Manikandan, P., Reddy, B. N. K., Bhanu, M. V., Ramesh, G., & Reddy, V. P.** (2021, July). IoT Based Air Quality Monitoring System with Email Notification. In 2021 6th *International Conference on Communication and Electronics Systems (ICCES)* (pp. 616-620). IEEE. <https://doi.org/10.1109/ICCES51350.2021.9489027>
- Manikandan, P., Reddy, M. R. S., Mehatab, S., & Sai, P. M.** (2021, July). Automobile Drivers Distraction Avoiding System Using Galvanic Skin Responses. In 2021 6th *International Conference on Communication and Electronics Systems (ICCES)* (pp. 1818-1821). IEEE. <https://doi.org/10.1109/ICCES51350.2021.9489076>
- Manikandan, P., Ramesh, G., Sai, K. P., Puneeth, G., Sudheer, M. S., & Kumar, K. H.** (2021, July). Automatic Accident Detector to Decrease the Death Rate in Highways and Remote Areas. In 2021 6th *International Conference on Communication and Electronics Systems (ICCES)* (pp. 1577-1581). IEEE. <https://doi.org/10.1109/ICCES51350.2021.9488942>
- Schmidt, E. A., Coleman, D. L., & Mallison, G. F.** (1984). Improved system for floor cleaning in health care facilities. *Applied and Environmental microbiology*, 47(5), 942-946. <https://doi.org/10.1128/aem.47.5.942-946.1984>



# **A STUDY ON VARIOUS ALGORITHMS FOR GLOBAL ROUTING IN VLSI**

**Pandiaraj Kadarkarai**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: pandiaraj@klu.ac.in, <https://orcid.org/0000-0001-9610-2172>

**Sivakumar Pothiraj**

*Professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: siva@klu.ac.in, <https://orcid.org/0000-0003-1328-8093>

## **ABSTRACT**

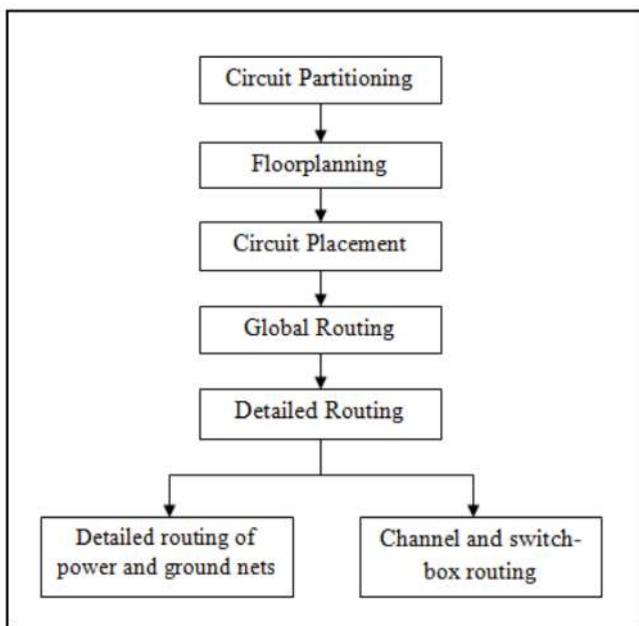
The monstrous burden of VLSI circuits has driven global routing to a NP-complete one all through late years. With the appearance of 3D ICs, this drawback has become far more complicated. Thermal dissipation will increase in 3D ICs because of close proximity of modules. several algorithms like minimum spanning trees, Steiner trees, integer linear programming are used for total wire length reduction. however, these techniques don't seem to be thermal and congestion aware and are of high quality. additionally, there's no benchmark out there for routing until currently covering 3D routing area with each multiple metal layers and multiple device layers. 3D IC technology relies on multi-layer formation. TSVs (Through Si Vias) are accustomed produce the interconnections between layers. during this work, a thermal and congestion aware formula are going to be developed to attenuate the amount of metal layers and thermal dissipation are often reduced by replacing the long metal layer interconnects in 2d ICs with TSVs (Through Si Vias) in 3D ICs during which optimization are often achieved by equalization design area and metal layer demand.

**Keywords:** Global Routing, thermal dissipation, NP completeness, 3D ICs, TSVs.

## **1. INTRODUCTION**

VLSI physical design is that the method of deciding the physical location of active devices and interconnecting them within the boundary of a VLSI chip. Physical design of a circuit is the part that precedes the fabrication of a circuit. Usually it refers to all or any synthesis steps succeeding logic design and preceding fabrication. The main aim of the physical design techniques is to provide layouts with a little space, high signal integrity, reduced delay, reduced power consumption and better yield. Physical design phases embody partitioning, floor planning, placement and routing.

Execution of VLSI circuits has been constrained by the interconnects considering decrease in the wire contribute and increase the pass on size. The hindrance is increasingly troublesome in 3D IC due to the very closeness of the modules. Toward the end, it will build the significance of worldwide directing impediment making it harder step by step. The hierarchic methodologies are utilized for global routing by and large. The fundamental target of the global routing is to improve totally extraordinary multi-target capacities related with execution and clog, warm issues (B. Goplen and S. S. Sapatnekar , 2005), obstruction (J. Minz, E. Wong, and S. K. Lim 2005), snag mindful directing (P. Ghosal *et al.*, 2012 and H. Rahaman *et al.*, 2011)and so on.



**Figure 1:** VLSI Physical Design phases

**Source:** Own elaboration

3D Integration offers assortment of focal points for future VLSI configuration, similar to 1) higher packing density and reduced footprint; 2) insignificant global interconnect because of the short length of through-silicon vias (TSVs) and furthermore the adaptability of vertical routing, winds up in higher execution and lower control utilization of interconnects; 3) Each and each and every kicks the bucket will have diverse kind of strategy because of heterogeneous mix. The main advantages of increment in performance by high-bandwidth and low-latency TSV structures(B. Goplen and S. S. Sapatnekar , 2005) is taken for the account due to the increased connectivity. For implementing the interconnectivity across the layer TSVs is very much important.

The increment in technology and demand for system on a chip (SOC) became heaps of inauspicious. This produces a huge challenge in Integrated Circuit design. The routing is especially required because it will assume a crucial job in physical design. The upgraded routing methodologies are led to better routing area of layout because it will reduce the number of interconnects. Minimization of wirelength between the modules is the main objective of VLSI Routing.

## **2.MATERIALS AND METHODS**

### **GLOBAL ROUTING**

The primary point of a global router is to deteriorate an outsized interconnect issue into decreased and reasonable sub-issues (detailed routing). This decomposition is needed for finding a difficult path for every net so as to reduce the chip size, to reduce the wire length and equally distribute the congestion over the routing area. A global router doesn't create any connections, it simply plans them. Generally, the total chip is global routed (or massive items if it's an outsized chip) before detail routing of the total chip (or the pieces) is dispensed. There are 2 kinds of areas to global route: i) within the modules and ii) between modules. The floorplan has been an input for the global router, because it has the locations of all the mounted modules; the placement info for flexible modules; and therefore, the locations of all the logic cells.

### **Goals and Objectives of Global Routing**

The objective of floor planning and placement is to attenuate the interconnect length. Thus, there's a necessity to seek out the reduced total interconnect length connecting terminals that is the MRST (Minimum rectilinear Steiner Tree). Straightforward approximations to length of MRST like half-perimeter measure are often used as an alternate for floor planning and placement. however floor planning and placement each assume that on an oblong grid interconnect is also put anyplace , as a result of nets wouldn't are assigned at this time to the channels, however to seek out the first path, the global router ought to use the wiring channels. A path that minimizes the delay between two terminals is noted by the global router—which is not a constant for calculating the entire shortest path length for a given set of terminals.

The aim of global routing is to supply entire info to the detailed router on wherever to route each interconnection. The following is the objectives of global routing

- Minimization of the wirelength.
- Minimization of critical path delay.
- Probability maximization that the detailed router can complete the routing.

Floor planning and placement would like fast and easier ways that to estimate the delay of interconnects to visualize every placement, which is commonly a predefined LUT (look-up table). The placement of the logic cells is fastened, and the global router will build use of higher estimation ways that of the interconnect delay. However, there's an accuracy limitation for estimating delay throughout global routing as a result of the global router doesn't have the routing information concerning on that of the layers routing is completed, or how many vias are going to be used, the kind of vias, or concerning width of the metal lines. But estimation of interconnects is going to be horizontal and the way much is vertical may be done. The global router considers a crucial distinction between a path and a net once it tries to reduce interconnect delay. The path that minimizes the delay between 2 terminals on a net might not be essentially an equivalent because the path that minimizes the total path length of the net.

### **Global Routing Methods**

Global Routing Methods: The interconnect-length approximations have not been used by the global routing as within the case of the half-perimeter measure that were utilized in placement. The disadvantages of tree on a graph networks are still supported by the global routing methods. Because it's used to decide the requirement of the actual path and not an approximated path length.

One approach to global routing is successive routing that considers each of the net and calculates the minimal path victimization tree-graph algorithms. As a sequential routing formula issue, some channels can bear a lot of congestion since they hold a lot of interconnections than the others.

There are 2 ways that during which a global router will handle this drawback. i) Order-independent routing ii) Order-dependent routing. victimization order-independent routing, a global router routes every internet, by not considering however engorged the channels are. The assignment of channel is a similar though the order of process nets is initial or last. In order-independent routing, all the channels are allotted by the interconnects, then global router returns to engorged channels and reassigns some interconnects to less engorged channels. In in a different way, a global router may also contemplate the quantity of interconnections already allotted in numerous channels because it takes. This method is order dependent however the routing continues to be serial and therefore the result is affected because the order of process the nets amendment. Iterative algorithms or simulated annealing has been applied to the solutions obtained from each order-dependent and order-independent algorithm. the answer that's created are in turn modified, one interconnection path at a time, by creating random moves in series.

In distinction to sequential global-routing ways that it processes the nets one at a time, gradable routing methods process the entire nets at a specific level at one amount of your time. Rather than taking care of the considerable number of nets on the chip all through a comparable time, global routing disadvantage is shaped extra adaptable by thinking about only one degree of pecking order at once. This lessens the size of the issue at each level. There are 2 levels of hierarchy is available. One is top down approach, and another one is bottom up approach.

## PROBLEM STATEMENT

Let  $P = \{p_1, p_2 \dots p_n\}$  be pins of a net allocated across  $n$  ( $n \geq 1$ ) device layers. Let  $N = \{n_1, n_2 \dots n_m\}$  be the set of all nets. Let  $M = \{m_1, m_2 \dots m_k\}$  be a group of modules meet the routing layer, wherever every  $m_i$  has its co-ordinates  $(x_i, y_i)$ . The congestion and wirelength are going to be determined consistent with the algorithmic rule. The main aim of the problem is to build an entire routing tree  $(T)$  covering the complete set  $(N)$  victimization planned congestion routing methodology. Routing regions are going to be established with reduced wire-length for all nets relying upon the algorithmic rule. The routing layer are going to be portrayed as a grid structure.

The quality factors which will be employed in this work to evaluate the specification of the routing result are:

- Wire length
- Number of vias.

### Wirelength Minimization

The main aim of the wire length minimization is given as follows:

The trivial boundary on the quantity of tracks is larger than the peak of a particular vertex  $v_i$  (corresponding to net  $n_i$ ) in vct i. e.

$$\text{Max}(d_{tmax}, v_{tmax}) > h_{tvi}$$

Then we will put over this assignment of  $n_i$  wherever

$d_{max}$  = channel density,

$VC = (V, A)$  is built to represent the vertical constraints

$h$  = height of the vertex

$t_{vi}$  = selected vertex

## Via Minimization

In general, for a given cell of  $n$  horizontal and  $m$  vertical tracks (referred to as an  $n \times m$  cell), there's a most variety of vias which will be allowed for every via placement restriction

Let  $m=m(k,r)$  is the maximal integer such that in any cell with  $k$  horizontal and  $r$  vertical tracks  $m(k,r)$  vias may always be realized. Then the values  $M(k,r)$  are determined as

$$M(k,r) = m(k,r) * C(n) \quad C(x) = x+1/2x.$$

## RELATED WORK

Many approaches are projected for the global routing drawback. They embody congestion aware global routing algorithmic rule, cooperative multi-objective global routing, genetic algorithm etc.

### i) Global Routing based on Fuzzy Logic Expert System:

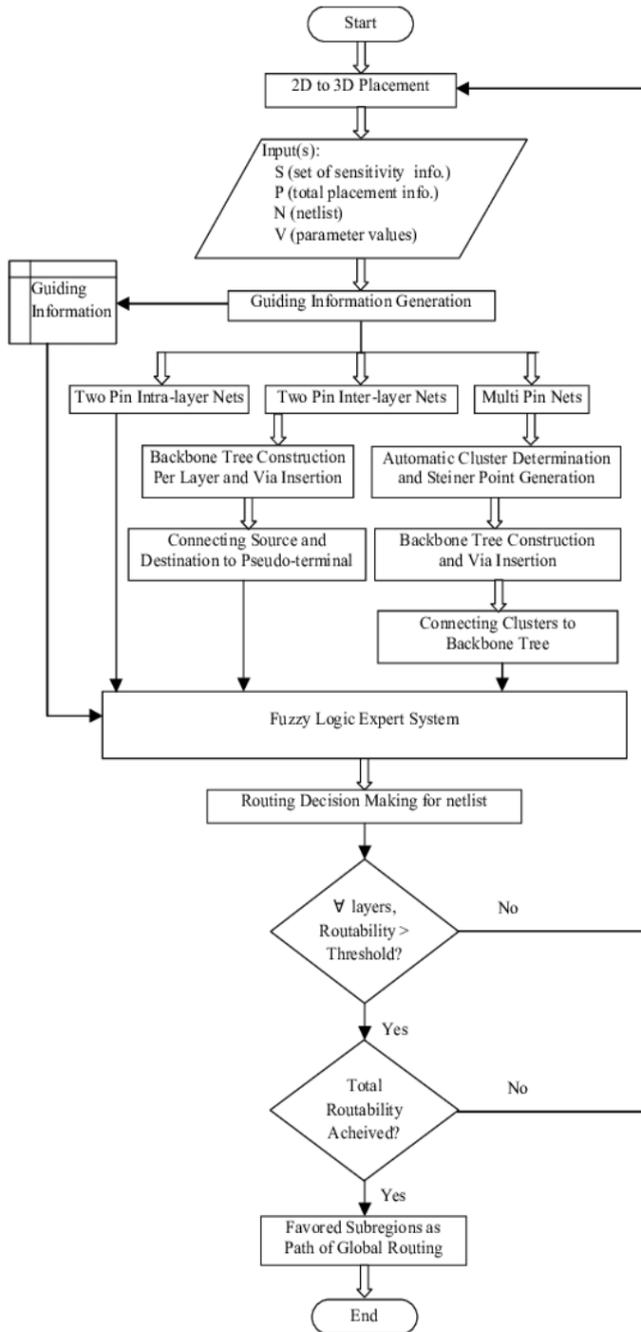
Because of the overstated multifaceted nature of the global routing disadvantage as of now, deterministic methodologies constantly cause NP-completeness. The issue is settled with a better than average level of dependableness exploitation fuzzy logic. Since fuzzy frameworks have just been perceived as general approximator the quest region is lessened for explicit goals exploitation fuzzified approach that scales back the time and plan intricacy.

The possibility of warm affectability is tweaked from (Debashri Roy *et al.*, 2014). One introductory methodology for two-pin global routing was reportable in . Fuzzified approach (D. Roy and P. Ghosal, 2013). was expanded for all the 2 stick nets in 3D ICs. All the multi-pin and huge nets might be deteriorated regarding the numerous two-pin nets. In this way, the development of two pin exclusively switch is a partner moderate advance towards the arranging of first fuzzified complete worldwide switch. This switch creates the grouping of global routing way regarding sub-regions for every one of the two pin intra and buries layer nets contained in one netlist for 3D IC.

Coming up next are the means for fuzzified directing:

- Fuzzified intra layer directing
- 2-pin net global routing
- Generation of spine tree development and assurance of pseudo-terminal

- Generation of obstacle avoidance plan during assurance of Pseudo-terminal
- Connection of source and goal to spine tree.



**Figure 2:** Flowchart of overall approach for routing nets in 3D ICs using a fuzzy logic expert system  
**Source:** (Debashri Roy *et al.*, 2014)

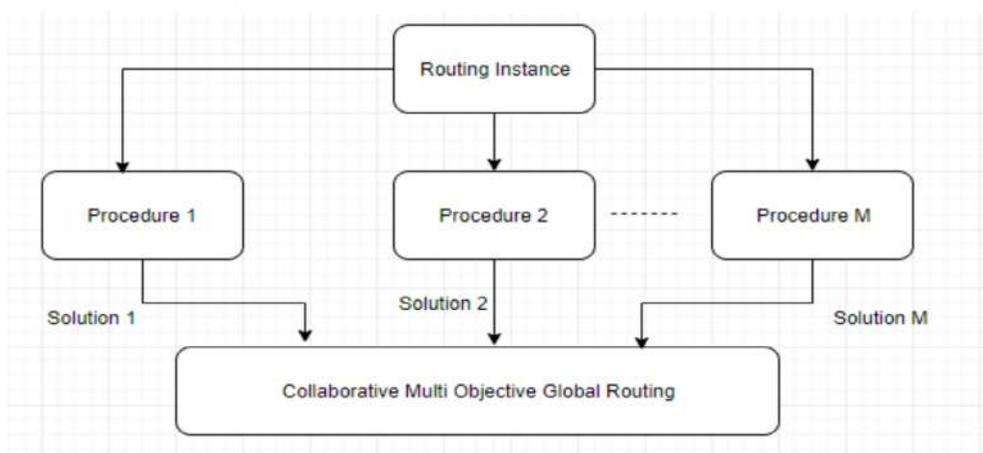
**ii) Multi-Objective Global Routing:**

Different global routing arrangements are taken by Multi-objective global routing technique, that is produced a few modes in the meantime as information. At that point multi objective improvement is done dependent on Pareto unadulterated arithmetic and rapidly produces various global routing arrangements with an exchange off between the idea of destinations. The measure of produced arrangements and the level of investigating the exchange off between them is constrained by the client by constrictive the most extreme permissible debasement in each target. It considers the ensuing 3 multi objective

- Reduction of interconnect wirelength and power.
- Reduction of congestion in routing
- reduction of wirelength in connection to the routing resources.

With some important enhancements in (Y. Xu and C. Chu, 2011) wirelength and runtime, a multi-level global router has been developed. The global routing processes is divided into 2 classes of concurrent and sequential procedures. The concurrent procedures think about coincident routing of all the nets (L. Behjat *et al.*, 2006).

whereas the sequential ones impose an ordering to route the nets (Y.-J. Chang *et al.*, 2010 and Y.-J. Chang *et al.*, (2008). Furthermore, the sequential techniques apply drastically totally different procedures for various steps like net ordering, layer assignment, and route generation.



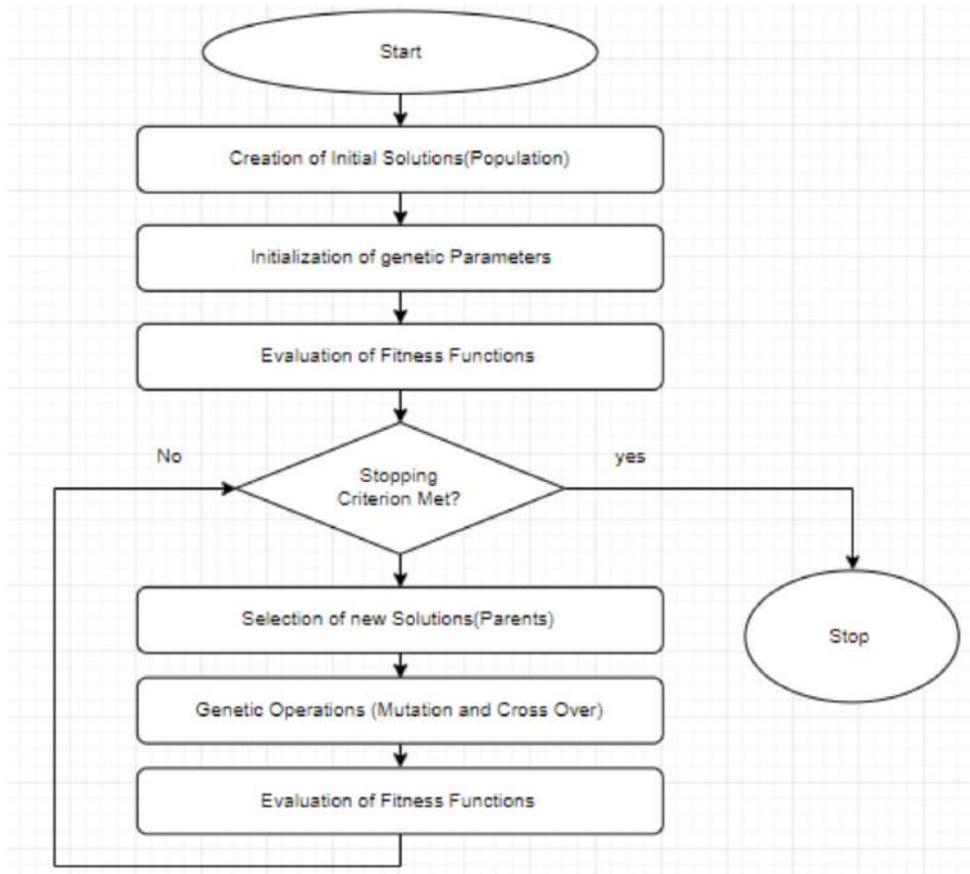
**Figure 3:** Flowchart for collaborative multi-objective global routing  
**Source:** Own elaboration

### iii) Genetic Algorithm:

Genetic Algorithms [GA's] (Pandiaraj K., *et al.* (2017). are search algorithms supported the ideas of natural selection and natural evolution. Genetic algorithm begins with a group of solutions known as initial population. Sensible initial population facilitates a GA's convergence to sensible solutions whereas poor initial population will hinder Genetic Algorithms (GA) convergence (Pandiaraj K., *et al.* (2017). The random initialization is default methodology of population generation. Genetic algorithm creates initial population by an iterative method. The algorithm stops once the population converges towards the best resolution. A population of people representing totally different drawback solutions is subjected to genetic operators like the selection, crossover and mutation. therefore, by applying genetic operators, the individuals are steady improved over several generations and eventually the most effective individual ensuing from this method is given because the best resolution to the problem.

#### Creation of initial population:

The initial population is built from randomly created routing structures, i.e. individuals. First, each of those individuals is allotted a random initial row number  $y_{ind}$ . Let  $S = \{s_1 \dots s_i \dots s_k\}$  be the set of all pins of the channel that are not connected yet and let  $T = \{t_1 \dots t_j \dots t_l\}$  be the set of all pins having minimum of one association to alternative pin. At first  $T = 0$ . A pin  $s_i \in S$  is chosen randomly among all components in  $S$ . If  $T$  contains pins  $\{t_u \dots t_j \dots t_v\}$  (with  $1 \leq u < v \leq l$ ) of the same net, a  $p$  in  $t_j$  is randomly selected. Else a second pin of the same net is randomly chosen from  $S$  and transferred into  $T$ . Both pins ( $s_i, t_j$ ) are connected with a generally called "random routing". Then  $s_i$  are transferred into  $T$ . This method continues with succeeding random selection of  $s_i \in S$  until  $S = 0$ . The creation of the initial population is finished once the quantity of completely routed channels is adequate to the population size  $|P_c|$ . As a result of this strategy, these generated initial individuals are quite completely different from one another and scattered everywhere the search space.



**Figure 4:** Flow chart for global routing using genetic algorithm  
**Source:** Own elaboration

**Calculation of fitness:**

The fitness  $F(p)$  of every individual  $p \in P$  is calculated to assess the standard of its routing structure relative to the remainder of the population  $P$ . The selection of the mates for crossover and the selection of individuals which are transferred into succeeding generation are based on these fitness values. First, two functions  $F1(p)$  and  $F2(p)$  are calculated for every individual  $p \in P$  according to equations (1) and (2)

$$F1(p) = 1/nrow \tag{1}$$

$$F2(p) = 1/ \sum_{nindi=1} (lacc(i) + a * lopp(i)) + b * vind \tag{2}$$

Where  $n_{row}$  = number of rows of  $p$  and  $l_{acc}(i)$  = net length of net  $i$  of net segments according to the preferred direction of the layer,  $l_{opp}(i)$  = net length of net  $i$  of net segments opposite to the preferred direction of the layer  $a$  = cost factor for the preferred direction,  $n_{ind}$  = number of nets of individual = cost factor for vias. The final fitness  $F(p)$  is derived from  $F_1(p)$  and  $F_2(p)$  in such a way that the area minimization, i.e. the number of rows, always predominates the net length and the number of vias. After the evaluation of  $F(p)$  for all individuals of the population  $P$  these values are scaled linearly as described in order to control the variance of the fitness in the population.

### **Selection strategy:**

The selection strategy is answerable for choosing the mates among the individuals of the population  $P_c$ . According to the terminology of our selection strategy is really stochastic sampling with replacement. That means any individual  $p_i \in P_c$  is chosen with a probability

$$F(p_i) / \sum_{p \in P_c} F(p) \quad (3)$$

The two mates required for one crossover are chosen of every different. An individual could also be selected any number of times severally within the same generation.

### **Crossover operator:**

During the crossover operation, two of the individuals are combined to form a descendant.

### **Reduction strategy:**

The reduction strategy merely chooses the fittest individuals of individuals of population to survive as fittest into the future generation

### **Mutation operator:**

Mutation operators perform random modifications on an individual. The aim is to beat native Optima and to use new regions of the search space.

### 3. RESULTS AND DISCUSSIONS

In C FastRoute3.0 (Y.-J. Chang *et al.*, 2008) was performed, and all the experiments were done on a 2.4 Ghz Intel processor with 4GB RAM. For RSMT generation FLUTE was utilized. FastRoute3.0's performance on running is demonstrated by three benchmark suites: ISPD98 benchmarks, 3D version of ISPD07 global routing contest benchmarks and 3D version of ISPD08 global routing contest benchmarks.

Comparison is done with published academic global routers: NTHU-R, Box Router 2.0, Archer, FGR, FastRoute2.0 and Box Router. The result shows that FastRoute3.0 is able to route through all the benchmarks without any overflow and achieves it in good runtime in this platform. Among all, FastRoute2.0 achieves fastest runtime.

### 4. CONCLUSIONS AND FUTURE WORK

In this article, a study on various global routing algorithmic programs like congestion aware global routing algorithm supported fuzzy logic skilled system, collaborative multi-objective global routing and genetic algorithms was done. i) Fuzzy system is recognized as universal approximator and the search area is reduced for a selected answer using fuzzified approach that helps to scale back the time and design quality. ii) CGR receives totally different routing solutions as input and optimizes objectives like wirelength and delay. In general, for tight resource constraints, the CGR procedure could fail to seek out a possible answer. Though, in practice, a possible answer is often gettable. iii) Genetic algorithms are optimization methods within which individuals are improved over several generations steady and eventually the most effective individual ensuing from this method is given because the best answer to the matter.

### 5. REFERENCES

- B. Goplen and S. S. Sapatnekar** (2005) Thermal Via Placement in 3D ICs in Proceedings of the *International Symposium on Physical Design*, pp. 167–174, 2005 <https://doi.org/10.1145/1055137.1055171>
- J. Minz, E. Wong, and S. K. Lim** (2005). Thermal and Crosstalk-Aware Physical Design for 3D System-On-Package. in Proceedings of *Electronic Components and Technology Conference*, pp. 824–831, 2005. <https://doi.org/10.1109/ECTC.2005.1441368>

- P. Ghosal, S. Das, and A. Das** (2012). A Novel Algorithm for Obstacle Aware RMST Construction during Routing in 3D ICs. in *Advances in Computing and Information Technology* (2), pp. 649–658, 2012. [https://doi.org/ 10.1007/978-3-642-31552-7\\_65](https://doi.org/10.1007/978-3-642-31552-7_65)
- P. Ghosal, A. Das, and S. Das.** (2012). Obstacle Aware RMST Generation Using Non-Manhattan Routing for 3D ICs. in *Advances in Computing and Information Technology* (3), pp. 657–666, 2012. [https://doi.org/10.1007/978-3-642-31600-5\\_64](https://doi.org/10.1007/978-3-642-31600-5_64)
- P. Ghosal, S. Das, and A. Das** (2012). A New Class of Obstacle Aware Steiner Routing in 3D Integrated Circuits. in *Advances in Computing and Information Technology* (3), pp. 697–706, 2012. [https://doi.org/10.1007/978-3-642-31600-5\\_68](https://doi.org/10.1007/978-3-642-31600-5_68)
- P. Ghosal, H. Rahaman, S. Das, A. Das, and P. Dasgupta** (2011). Obstacle Aware Routing in 3D Integrated Circuits. In *Advanced Computing, Networking and Security (ADCONS)*, pp. 451–460, 2011. [https://doi.org/10.1007/978-3-642-29280-4\\_53](https://doi.org/10.1007/978-3-642-29280-4_53)
- Debashri Roy, Prasun Ghosal, Nabanita Das** (2014). A Thermal and Congestion Driven Global Router For 3D Integrated Circuits. *Proceeding of the 2014 IEEE Students' Technology Symposium*, pp.303-308, 2014. [https://doi.org/ 10.1109/TechSym.2014.6808065](https://doi.org/10.1109/TechSym.2014.6808065)
- P. Ghosal, T. Samanta, H. Rahaman, and P. Dasgupta** (2008). Thermal-aware Placement of Standard Cells and Gate Arrays: Studies and Observations. *Symposiums on VLSI, ISVLSI '08, IEEE Computer Society Annual*, pp. 369 – 374, Apr 2008. <https://doi.org/10.1109/ISVLSI.2008.37>
- D. Roy and P. Ghosal.** (2013). A Fuzzified Approach Towards Global Routing in VLSI Layout Design in Proceedings of *IEEE International Conference on Fuzzy Systems, FUZZ IEEE 2013*, July 2013. [https://doi.org/ 10.1109/FUZZ-IEEE.2013.6622477](https://doi.org/10.1109/FUZZ-IEEE.2013.6622477)
- Y. Xu and C. Chu** (2011). MGR: Multi-level global router. in *Proc. Int. Conf. Comput.-Aided Design*, 2011, pp. 250–255. <https://doi.org/10.1109/ICCAD.2011.6105336>
- L. Behjat, A. Vannelli, and W. Rosehart** (2006). Integer linear programming models for global routing. *INFORMS J. Comput.*, vol. 18, no. 2, pp.137–150, 2006. <https://doi.org/10.1287/ijoc.1040.0127>

- Y.-J. Chang, T.-H. Lee, and T.-C. Wang** (2010). GLADE: A modern global router considering layer directives. in *Proc. Int. Conf. Computer Aided Design*, 2010, pp. 319–323. <https://doi.org/10.1109/ICCAD.2010.5654094>
- Y.-J. Chang, Y.-T. Lee, and T.-C. Wang** (2008). NTHU-route 2.0: A fast and stable global router. in *Proc. Int. Conf. Computer-Aided Design*, pp. 338–343.2008 <https://doi.org/10.1109/ICCAD.2008.4681595>
- Pandiaraj K., et al.** (2017). Minimization of wirelength in 3d IC routing by using differential evolution algorithm. In *2017 IEEE international conference on electrical, instrumentation and communication engineering (ICEICE)* (pp. 1–5). <https://doi.org/10.1109/ICEICE.2017.8191950>
- Pandiaraj, K et al.** (2017). Reduction of temperature rise in 3D IC routing. In *2017 IEEE international conference on electrical, instrumentation and communication engineering (ICEICE)* (pp.1–5). <https://doi.org/10.1109/ICEICE.2017.8191907>

# HOME AUTOMATION WITH FIREBASE USING RASPBERRY PI

**K Sathish Kumar**

*His area of interest in Embedded Systems. UG Student, Department of ECE, Kalasalingam Academy of Research And Education. Krishnankoil (India).*

Email ID: [sathish20898k@gmail.com](mailto:sathish20898k@gmail.com), <https://orcid.org/0000-0002-0328-4972>

**Radeep Krishna R**

*His area of interest in Embedded Systems and VLSI Physical Design. Assistant Professor, Department of ECE, Kalasalingam Academy of Research And Education. Krishnankoil (India).*

Email ID: [radeepkrishna@gmail.com](mailto:radeepkrishna@gmail.com), <https://orcid.org/0000-0003-3576-2032>

## ABSTRACT

Internet of factors is playing a exceptional good sized function in the connectivity of things such as home equipment, automobiles with some software's, sensors, actuators and so forth and makes the trade of information ease. Firebase is the mobile and net packages development platform. There are many challenges to firebase and home automation as an instance protection of appliances and provider safety, believe, information privacy, reliability. This paper includes the concept of raspberry pi in home automation system. In this project two programming languages are built. All sensor statistics are gathered through raspberry pi. All the connections regarding disputes are solved by Raspberry Pi. However, the practice which include the on/off mode of the home equipment are remotely managed through the person with the help of the Raspberry Pi server and the Firebase console even the user being at the very long distances from his home. Therefore in this project the home automation system is made simple and secured presenting the consumer with the benefit of having managed over the appliances even at the very lengthy distance.

**Keywords:** Internet of things, Firebase (console), Raspberry Pi.

## 1. INTRODUCTION

The Wireless structures can become a terrific assistance for automation structures. The advancement of wireless technology along with wireless, cloud networks inside the latest beyond, Wi-Fi systems are used each day and everywhere. The home automation procedure long gone via the subsequent level. Because firebase machine can speak the two different gadgets in extraordinary places. This home automation manner will be a wireless communiqué gadget. The Firebase offers a real-time database and backend as a Carrier as per Ibrahim *et.al* (2015).

## 2. MATERIALS AND METHODS

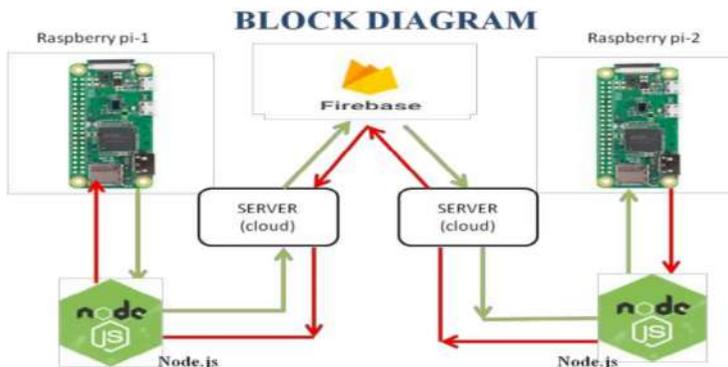
The main aim of the project is to create a home automation system using Raspberry pi platform with a Raspberry pi is a form of technique which has already been advanced. With the aid of the usage of the use of this technique most effective the user can have the manage over the house home equipment only at a few preferred distance.

The gain of including a firebase console to the system depart supports the user with easy module to govern the appliances through the internet at a wider connectivity range. The complete management of the device is done with a small raspberry pi. This automation system helps to showcase that the all home equipment machine can be computerized just with a card size computing device or a microchip and the related environment statistics may be viewed or monitored from firebase as discussed in Balasubramaniyan *et.al* (2016).

### Objective and related work

There are two objectives for this paper. The first one is to make awareness about raspberry usage for home automation for pi-pi peak level communication. The Second is to incorporate the advanced technology of firebase consoles the mobile application.

Here the work of FIREBASE is revealed using various steps. In Survey paper, system is based on raspberry pi which enables the cost-effective environment monitoring.



**Fig 1.** Firebase Platform  
**Source:** <https:// raspberrypi.org>

Following are the considerations made in the arrangement. Here each raspberry having the node.js coding for triggering the server. Here the Node.js can trigger the

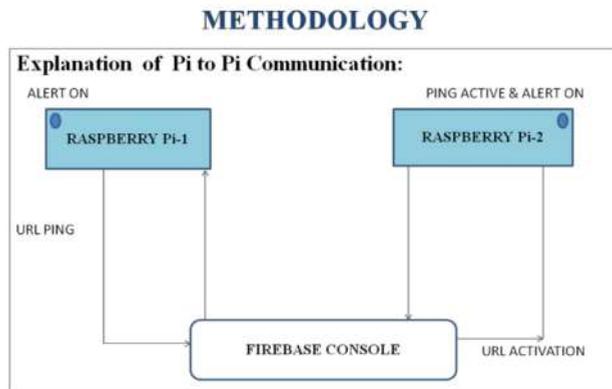
Server and activate the Fire base console. The Fire base can give wide range communications in between the Two raspberry pi's. Only then the automatic activation happens in home appliances. Each Raspberry pi's having separate Node.js codes for triggering other Raspberry using the Server.

### The Merits

The Firebase provides the Connecticut between the two pi's much differently and act as a cloud storage. The Usage of two Raspberry Pi to maintain the strong connectivity among the devices through wireless system. It also makes use of the Firebase Cloud Network for the IOT. It is much more secure and versatile.

The Proposed System has got the hardware which includes the Raspberry Pi (Zero w) and Resistor. The software includes the Python, HTML/CSS and Node Js.

The methodology is shown in the figure 2.



**Fig. 2.** Pi-Pi Communication  
Source: [https:// raspberrypi.org](https://raspberrypi.org)

The Raspberry pi is a miniature length computer that is able of performing all the capabilities as that of a computer. The home equipment may be connected to the Raspberry pi board with assist of relay motive force modules so one can facilitate the ON/OFF movements primarily based at the load given. The system may be connected to the internet through WIFI and a cloud interface could be created to manipulate the home equipment from a far off vicinity. The run mode: the vital processing unit (CPU) and all capability of the arm11 middle can be available at this mode and can be powered up as discussed in Raguvaran *et.al* (2015).

The standby mode: the main path clocks are shut down i.e. the components of the CPU that system instructions are now not walking in this mode. But the strength

circuits at the middle may be still lively. The middle may be quickly woken up by using a method producing a special name to the CPU known as an interrupt. In the shutdown mode, the board might be in a entire shutdown and not using a electricity. In the dormant mode, the middle could be powered down and all the caches are left powered on.

### **Real time data base – Firebase**

Firestore provides a real time database and backend as a service as discussed in Hans *et.al* (2013). The provider presents utility developers an-API that lets in software data to be synchronized across clients and stored on Firestore's Cloud. The organization favors the customers by providing libraries enabled with integration of various software developing languages and tools. The relaxation app uses the server- dispatched activities protocol, which is an API for growing. Developers making use of the real time database could comfort their facts with the aid of using the agency's server-side-enforced protection guidelines as discussed in Deshpande *et.al* (2016). Cloud fire store that's firestore's subsequent era of the real- time database turned into launched for beta use.

- Have to import the needed website in the FIREBASE console.
- The Raspberry Pi to Pi communication needs to happen within single command activation.
- If there is a system alert in any Raspberry pi connected Home Appliances.
- Then the automatic Alert action to be happen in another Raspberry pi.

### **3. RESULTS**

The connectivity between the two Raspberry Pi is achieved as the appliances connected to the each raspberry pi is controlled by itself and by the other raspberry pi which is also connected to same type of appliances that are located at the very long distance as the former and vice versa. Thus, the peak distance communication between the raspberry pi is achieved.

### **4. CONCLUSIONS**

The Study has shown that the controlling of the working appliances becomes easy even when the user is far away from home through Raspberry Pi controllers. It is presently important to bring the wireless connectivity with security. Therefore, it benefits the usage in wide area applications like home security, office security, stores security and industrial hazardous security etc. In future scopus with small change in the design the system can be further updated to measuring or monitoring and

controlling the power meters connected to homes. Also applications are available in automatic garbage cleaner systems etc.

## **5. REFERENCES**

**Ibrahim, M., Elgamri, A., Babiker, S., & Mohamed, A.** (2015, October). Internet of things based smart environmental monitoring using the Raspberry-Pi computer. In 2015 Fifth International Conference on Digital Information Processing and Communications (ICDIPC) (pp. 159-164). IEEE.

**Balasubramaniyan, M. C. and D. Manivannan,** IoT Enabled Air Quality Monitoring System (AQMS) using Raspberry Pi. Indian Journal of Science and Technology, 9(39).

**Raguvaran, K., & Thiyagarajan, J.** (2015, February). Raspberry PI based global industrial process monitoring through wireless communication. In 2015 International Conference on Robotics, Automation, Control and Embedded Systems (RACE) (pp. 1-6). IEEE.

**Han, S., Wei, Y. H., Mok, A. K., Chen, D., Nixon, M., & Rotvold, E.** (2013, November). Building wireless embedded internet for industrial automation. In IECON 2013-39th Annual Conference of the IEEE Industrial Electronics Society (pp. 5582-5587). IEEE.

**Deshpande, A., Pitale, P., & Sanap, S.** (2016). Industrial automation using Internet of Things (IOT). International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 5(2), 266-269.

**Raspberry Pi Foundation.** (2015). <https://raspberrypi.org>



# **ANALYSIS OF OSTEO ARTHIRITIS (OA) IN INDIA FROM 2008-2018**

**S.Murugeswari**

*Department of Electronics and Communication Engineering, School of Electronics and Electrical Technology, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [sudha.murugeswari@gmail.com](mailto:sudha.murugeswari@gmail.com), <https://orcid.org/0000-0002-5240-4360>

**Kalpana Murugan**

*Department of Electronics and Communication Engineering, School of Electronics and Electrical Technology, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [drmkalpanaee@gmail.com](mailto:drmkalpanaee@gmail.com), <https://orcid.org/0000-0002-5121-0468>

## **ABSTRACT**

Nowadays, Osteo Arthritis (OA) is the most common form of arthritis, affecting millions of people worldwide. In India, it might be there is no permeant solutions are available for Osteo arthritis. Knee joint is one of the strongest and most important joint in the human body. Knee pain is more common than back pain among this population and to increase in life expectancy in developed and developing countries, this is an epidemic which is destined to grow. Stem cell therapy is a new technology and does not come out of the blues in India. In fact, this has been successfully implemented in various countries. If proper technologies along with proper aid are given in the region, this can surely help a lot of people as it has been proven to be highly effective when compared with the existing conventional methods. The main aim of this survey is to analyze OA for past 10 years from 2008-2018. India need stem cell treatment for people who are suffering from Knee Osteoarthritis. This survey will be useful for the society.

**Keywords:** Clinical Trial, Osteo Arthritis, Patients, Stem cell therapy, Research design Review.

## **1. INTRODUCTION**

Knee pain causes due to heavy physical activities, lack of use, injuries such as sprains or strains, sitting in a constrained area or sitting on knees for a prolonged period. Although osteoarthritis can damage any joint in our body, the disorder most commonly affects joints in our hands, knees, hips and spine. In 2015 totally 18.6% of people are affected by Osteoarthritis (Male 15.0% and Female 19.7%) in Tamilnadu. At present, in [1,2] the survey is collected during the analysis of OA program, from

that survey 1127 females out of 1153 and 1052 males are out of 1706 are affected. Most of the geriatric population is troubled by chronic arthritis that has a major effect on their quality of life. Approximately one-third of people are suffering from musculoskeletal problems in this population [3]. High prevalence of OA was reported by various researches i.e. 46.7% among the 60 years and above and 40.7% among the 65 years and above. Undertreated or poorly managed OA can affect their physical, psychological, social, and emotional life. In [4,5] osteoarthritis, rheumatoid joint inflammation, septic joint inflammation, dysplasia (which are commonly hereditary) and post-horrendous joint. Inflammation are the different sorts of joint pain that can influence the knee with or without earlier extensions or medical procedures. There might be a past filled with extension or ligament technique. Ordinarily, there is a progressive increment in agony after some time with weight-bearing exercises, for example, strolling and standing. Joint indications can likewise have long winded flares where side effects intensify for a couple of days or weeks and after that resolve. These indications might be compounded with grades and decays and stairs. Knee braces made from neoprene or other types of elasticated material are widely available in high street sports shops and health stores in [5,6]. These braces stabilize our knee by supporting the natural action of our ligament and provide warm and compression to ease soreness and prevent swelling many braces has an opening around the knee cap to keep the bone in position. Special rehabilitative braces and hinged plastic or metal support braces are designed to limit certain types of movement while our knee is healing. In [7] braces should be used for supporting purpose only, the patient should not wear them during any activity that creates a risk of injuring the knee. Another solution for OA is Knee replacement surgery. It is one of the most common surgical procedures around the world. It is usually very successful in relieving knee pain around 90 percent of patients. Knee replacement surgery is not suitable for treating problems such as torn ligaments to menisci which can, in any case, often be repaired using much less invasive arthroscopic surgery. The principle of knee replacement operation is to remove the injured cartilage and some of the bone underneath it and apply an artificial cover over the remaining bone. Depending on the condition of the knee, the surgeon may perform total knee replacement or a half knee replacement in [8]. Half-knee replacement is used if only one side of the knee is damaged, and is usually a simple operation with quicker recovery time. Unfortunately, all artificial joints have a limited lifespan. Most Artificial knees will last 10 years or more, even in young, active patients, but every joint will need to be replaced eventually. Subsequent operations are often less successful than the original surgery. So, arthroplasty tends to be reserved for older patients who are less likely to require replacements. These are the methodologies which are used to relieve the knee pain for a temporary period [9]. Permanent solutions are not available in India. In Saudi Arabia, they did their research with stem cell therapy for osteoarthritis. This stem cell

therapy can create good welfare to people with improvements and new revolutions in science and technology. As of now, foundational microorganism treatment is being utilized in orthopedic conditions, for example,

- Chronic tendonitis: It inflames the elastic tissue that between bone to muscle
- Shoulders pain, Neck, Chronic back pain and Bone fractures .
- Osteoarthritis: It is a degenerative joint ailment

Using Stem Cells for Knee Osteoarthritis has the following merits:

- Stiffness and Pain are gone,
- There is no limitation in movement.
- Patients feel the reprieve,

This stem cell therapy is a new technology and does not come out of the blues. In fact, this has been successfully implemented in various areas and applications. If proper technologies along with proper aid are given in the region, this can surely help a lot of people as it has been proven to be highly effective when compared with the existing conventional methods. This can provide a high potential in unlocking newer healthcare domains and solutions for existing problems. In the future, our country is going to adopt this stem cell treatment for people who are suffering from Knee Osteoarthritis. This survey will be useful for the society.

In SECTION-II, related literature survey was discussed. In SECTION-III, has been discussed along with its proposed method. In SECTION-IV, the results have analyzed and discussed. Finally, this paper is concluded with a Conclusion in the SECTION-V.

## **2. RELATED WORK**

In general out of 320, 139 peoples are affected with joint pains and stiffness. Radio-graphic evidence of OA for 80% were estimated but symptomatically only 60% of peoples are affected. Cross sectional study in general prevalence has 62:38 female vs. male ratio. Affected peoples in OS for various states as shown in tab.2.1

STATE	TOTAL OA in(%)	MALE OA in(%)	FEMALE OA in(%)
Andrapradesh	68.0	72.0	59.5
Assam	43.0	26.8	54.1
Bangalore	17.0	15.5	18.8
Bihar	21.2	16.2	5.0
Delhi	47.3	-	-
Jammu Kashmir	24.9	-	-
Karnataka	41.3	20.6	57.0
Maharastra	10.2	7.0	11.0
Rajasthan	3.66	1.76	4.48
Tamilnadu	18.6	15.0	19.7
Uttra hand	21.2	12.8	14.0
Uttra Pradesh	78.27	-	-
West Bangal	49.8	-	-

**Table. 2.1.** Affected peoples in OS for various states.

In [10] gathering information from the Medical Expenditure Panel Survey (MEPS) for the years 1996–2005 were utilized. Data in the MEPS database is gathered by the Agency for Healthcare Research and Quality. The MEPS overviews have been led every year since 1996 and have accomplished reaction rates of 75%; all respondents were met face to face. Information gathered by over the age of 18 and tests of 84,647 ladies and 70,590 men were utilized in the calculated relapses to anticipate the likelihood of having positive human services consumptions, while perceptions for 74,603 ladies and 53,890 men were utilized in multivariable relapses foreseeing the measure of social insurance uses among the individuals who have positive medicinal services uses. Basic and programmed technique is received for division of articular ligament in [11]. The calculation ascertains the thickness of femur and tibia ligament together at joint area. Along these lines, debasement of ligament can be productively found. In view of the outcomes it is conceivable to accurately characterize a specific case as ordinary or knee osteoarthritis one, considering components like age, sex, BMI, restorative history, and so forth. The system pursues basic and one of a kind picture preparing procedures to get ligament subtleties. In [12] they completed their exploration work in audit with the measure utilized in patient

with knee osteoarthritis with uncommon significance on practical result measures. They proposed work in teaching orthopedician, physiotherapist, academician and analysts. This gathering of result estimates utilized in the conclusion, guess, and recovery of Prevalence Knee Osteoarthritis (PKOA) is outlined. This work features the requirement for patient-detailed result measures from the creating nations to record the real treatment impact. In [13] information recommend the impact of Total Hip Arthritis (THA) or Total Knee Arthritis (TKA) on real action is littler than the impact on capacity, limit, and saw constraints. The patients won't receive a progressively dynamic way of life in spite of improved capacity, limit, and self-announced physical working a half year after medical procedure. After medical procedure patient's ability during execution tests improved, though their movement level stayed steady. It is conceivable that before medical procedure, there is an error between patient's ability and their genuine physical movement, however the patient's ability is lower than or closes to real physical action, which might be identified with over-burden, for example, torment, weakness, and so on. Bone marrow incitement methods [14], for example, small scale break are essentially used to treat central chondral surrenders. The proof for the utilization of these systems for knee osteoarthritis (OA) stays indistinct. Deferring the necessity for joint substitution by moving the weight burden to the whole territories from the harmed compartments would be the fundamental goal for unicompartmental knee OA. For joint substitution. Young and active patients who will not be appropriate candidates for knee arthroplasty are the ones who will be considered for this procedure. Total knee arthroplasty could be an economic, rewarding and harmless treatment for patients with severe OS.. Unicompartmental knee arthroplasty and patellofemoral substitution can be a fruitful treatment for patients with disconnected average or patellofemoral OA. In [15] to recognize early changes in the structure and mechanical properties of typical maturing and osteoarthritis articular ligament in mice and patients, utilizing Atomic Force Microscopy (AFM) at the nanometer scale, has opened up the energizing prospect of utilizing a basic nano gadget as a potential clinical apparatus, yet additionally to fill in as an amazing creature model for disentangling the sub-atomic component hidden osteoarthritis.

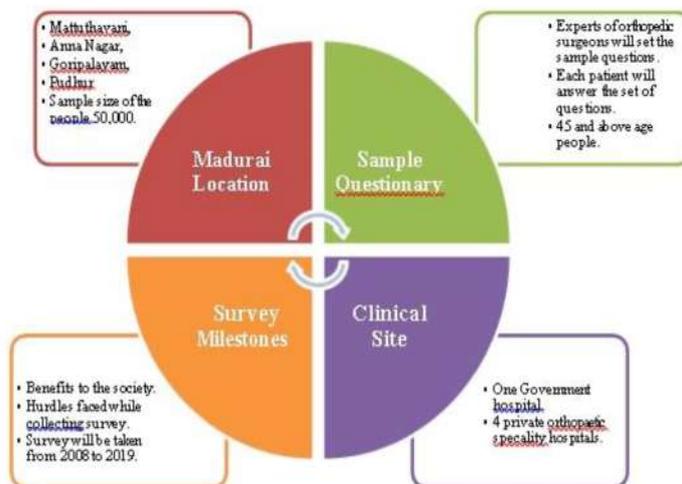
Automated detection of radiographic Osteoarthritis (OA) in knee X-ray images in [16]. The discovery depends on the Kellgren-Lawrence (KL) arrangement grades, which relate to the various phases of OA seriousness Image examination is completed by two different ways: Detecting a lot of picture changes and picture content descriptors that give data on the distinguishing proof of OA in X-beams, and utilizing Fisher scores to allocate loads to the picture highlights. At that point, a straightforward weighted closest neighbor guideline is utilized so as to foresee the KL evaluation to which a given test X-ray test has a place. The informational collection utilized in the trial contained 350 X-beam pictures grouped for the most part by their KL grades. These trial results

demonstrate that moderate OA (KL grade 3) and insignificant OA (KL grade 2) can be separated from typical cases with an exactness of 91.5% and 80.4% individually. Dubious OA (KL grade 1) was distinguished consequently with a much lower precision of 57%. Ligament chondrocytes experience phenotypes and articulation changes that are reminiscent of their end-organ separation in the development plate during skeletal improvement. Hedgehog (Hh) flagging directs ordinary chondrocytes development and separation. In [17] people groups are inspected, human osteoarthritis tests and mice in which osteoarthritis were carefully instigated and find that Hh flagging is actuated in osteoarthritis. Utilizing a few hereditarily changed mice, found that more elevated amounts of Hh motioning in chondrocytes cause a progressively extreme osteoarthritis phenotype. Moreover, it appears in mice and in human ligament explants that pharmacological or hereditary hindrance of Hh flagging diminishes the seriousness of osteoarthritis and that runt-related interpretation factor-2 (RUNX2) possibly intercedes this procedure by controlling a disintegrating and metalloproteinase with thrombospondin type 1 theme 5 (ADAMTSS5) articulation. An OA is related with early loss of bone attributable to expanded bone rebuilding, trailed by moderate turnover prompting densification of the subchondral plate and complete loss of ligament. Subchondral densification is a late occasion in OA that includes just the subchondral plate and calcified ligament; the subchondral cancellous bone underneath the subchondral plate may remain osteopenic. An experimental model in [18] shows no progress in OA, when the subchondral sclerosis defined in the model does not allow prior stage of increased bone remodeling. Increased re-modeling and bone loss in the initial stages and the subchondral densification and slow re-modelling in the later stages are the significant components in the pathogenic process that lead to OA. This paper investigates the role of subchondral bone in the initial and later stages of OA and also provides a survey on the current knowledge on OA. In [19] Rehabilitation Research Center, a mechanized infrared thermo realistic examination strategy for knee Osteo Arthritis screening is created dependent on the gathered information of ordinary subjects and outpatients in facilities. 266 knee warm pictures (166 ordinary, 100 strange) obtained in the China Rehabilitation Research Center, Beijing is utilized in the main preliminary. A successful knee highlights extraction calculation dependent on patella-focusing is introduced. The separated highlights are bolstered to a help vector machine (SVM) classifier to play out the robotized acknowledgment. SVM classifier has a precision rate of 85.49%, an affectability of 85.72%, and a particularity of 85.51% in distinguishing ordinary and anomalous cases. This robotized framework for knee thermal screening would thus be able to give quantitative reference data in helping the clinical conclusion. Basic however novel knee prop structure that endeavors to alleviate the defects of current plans by giving resistive spring-damper powers at the breaking points of the ROM, in [20] while keeping up the advantages of current stopping mechanisms. Shaking impact

accelerates the restoration procedure for the client through drawing in and reinforcing the encompassing muscles of the knee. The steady commitment of the muscles will help settle the knee and decrease the strain on the delicate ACL, encouraging the recovery procedure. While in camp depend upon the patient's condition the above table was suggested by the doctor, at present what are all the treatments are available in Osteoarthritis. From the survey we could infer that only the temporary solution are available not a permanent solution. Human psychology also focused to relief the pain at that time only, not for permanent. So there is no permanent solution for Osteoarthritis. In [21] Symptomatic knee osteoarthritis (SxOA) with more seasoned grown-ups contrast their physical movement and comparably matured grown-ups without knee issues. Review was taken from individual's age 50-85 years with SxOA. Moderate-energetic PA is utilized to ascertain the time go through with contrasts in MVPA and statistic factors between the examples. MVPA and SXOA methods are set aside equivalent effort for a more seasoned grown-ups without knee agony (or) OA. In [22] cross sectional examination was led from eleven nations with the premise of complete knee supplanting with orthopedic specialists' choice to prescribe absolute joint substitution (TJR) in individuals with knee and hip osteoarthritis (OA). From the study 1905 are complete number of patients. From the all-out number of patients over the age of 55 are 1082 patients, out of these lone 561 patients are prescribed for TJR. In [23] Physical capacity and muscle execution cross-sectional examination was led for 40 people with tibiofemoral knee osteoarthritis in physical capacity. In [24] Data gathered by over the age of 18 and tests of 84,647 ladies and 70,590 men were utilized in the strategic relapses to foresee the likelihood of having positive human services uses, while perceptions for 74,603 ladies and 53,890 men were utilized in multivariable relapses anticipating the measure of social insurance uses among the individuals who have positive medicinal services uses. In [25] Atomic Force Microscopy (AFM) at the nanometer scale, has opened up the energizing prospect of utilizing a straightforward nano gadget as a potential clinical instrument, yet in addition to fill in as an amazing creature model for disentangling the sub-atomic system fundamental osteoarthritis. From 2008 to 2018 theses are the methodologies for knee pain. Nowadays orthopedic braces are used for knee cap to product knee from pain.90% of the people are selected Knee replacement surgery for temporary solution. But these are all the temporary solution for human not a permeant one. From this survey India should find the permeant solution for knee pain. This will be applicable for stem cell treatment. Stem cell treatment is used to recreate or culture the damaged cell from the normal knee bone cell. Again this cell will be injected in to the bone with steroid .This is the permeant solution for knee pain from the survey.

### 3. METHODOLOGY

#### 1. Target population and sample size to be covered



In low and middle income urban and rural areas in Madurai (3 million people), such as Mattuthavani, Anna Nagar, Goripalayam and Pudhur(50,000 people), access to appropriate treatment is often limited and depends upon the accessibility of health care services, insurance, availability of different treatment options, and the ability of the patient to pay for health care. People living in these areas have only little awareness about access to treatment of knee pain and the factors associated with presenting to specialist care for consideration of surgical management. Therefore, we are surveying the local cross-sectional study across 5 clinical sites in the Madurai region to assess prior access to treatments among patients presenting with knee pain at specialist orthopedic clinics. We examined the characteristics of patients, severity of knee pain, and treatment recommendations and explored predictors of accessing various treatments and the impact of private and public hospital system on access to care. We hypothesized that patients presenting with knee pain would have had limited access to care, have a higher severity of disease, be recommended non-surgical care, and there would be numerous factors that predict access to treatment, including being treated in a private hospital.

#### 2. Methods of data collection

We conducted a multi-center, cross-sectional study that included patients presenting with knee pain private and government hospitals in Madurai. Patients who met the inclusion criteria and provided concern questions designed to assess patient demo-

graphics, socioeconomic status, knee pain and treatment method, and their knowledge about OA. Their orthopedic surgeons completed questions on the severity of patient's OA and their recommended treatments. Informed consent was received from all participants prior to participation in the study.

**Question Development:** The questions will be developed by the medical experts for the purpose of study by using the current literature. The questionnaire was reviewed by 3 orthopedic surgeons and research methodologists for content validity and identified any questions that they believed would cause a problem for the patient, the attending physician, and/or the research coordinator. This approach helped to ensure that all questions were worded adequately and were culturally relevant and appropriate.

**Clinical Sites:** In Madurai we selected five hospitals to participate in the study based upon patient volume, research infrastructure, and interest in the study. The clinical sites included 1 government and 4 private hospitals.

### **3. Sources of the data**

The medical questionnaire took approximately 10 minutes to interact with doctors and patients to collect data. The research coordinator at the clinical site then checked each question for completeness and stored the data for future references.

### **4. Reference period of the data to be covered**

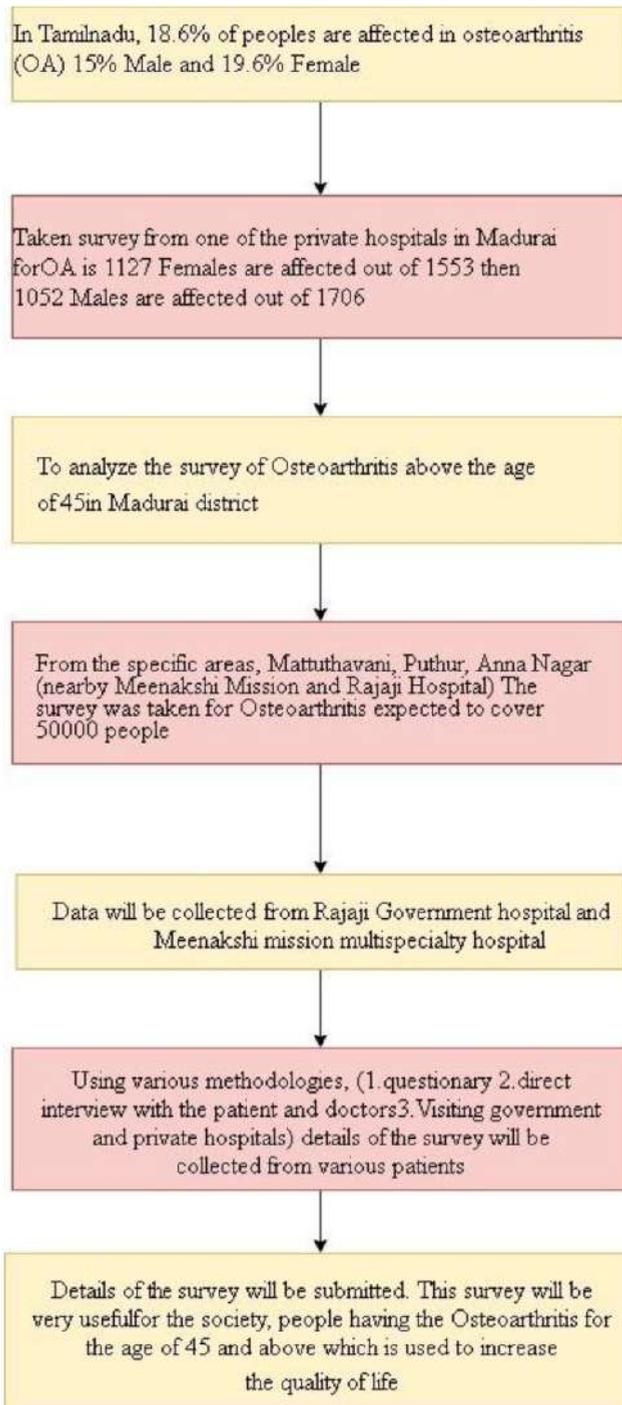
The study of the majority of patients presenting with knee pain and diagnosed with knee OA by a clinician had been experiencing pain and having various deformities from government and private hospitals for past 10 years.

### **5. Method of processing and analysing**

We conducted a multi-center, cross-sectional study that included patients presenting with knee pain private and government hospitals in Madurai. Patients who met the inclusion criteria and provided concern questions designed to assess patient demographics, socioeconomic status, knee pain and treatment method, and their knowledge about OA.

- (1) Above 45 years of age,
- (2) Presence of knee pain,
- (3) Patient's ability to understand and complete the questionnaire and
- (4) Patient's agreement to participate in the study.

## Flow Diagram



### **Expected Benefits:**

- Survey assessment on Osteo Arthritics (above the age of 45) for past 10 years which will be benefit able for society.
- Afer Analyzing the various knee diseasases and treatment methods/schemes for the treatment of OA will be benefitable for people.
- The collected survey will be submitted to the government to create awareness among people about OA and also to provide a best treatment which will be benefit able for the people.
- Treatment of OA will come under the scheme of Chief minister comprehensive health insurance scheme which will be benefit able for people.
- This survey will be benifitable and also it create a good welfare to people with improvements and new revolutions in science and technology.

## **4 CONCLUSION**

The main aim of this survey is to analyze Osteoarthritis for past 10 years from 2008-2018. From the survey in India women's are affected more than men. There is no permanent solution for knee pain in India. In the world wide there is some new techniques are implemented for knee pain with culture. This stem cell therapy is a new technology and does not come out of the blues. In fact, this has been successfully implemented in various areas and applications. If proper technologies along with proper aid are given in the region, this can surely help a lot of people as it has been proven to be highly effective when compared with the existing conventional methods. This can provide a high potential in unlocking newer healthcare domains and solutions for existing problems. In future, our country is going to adopt this stem cell treatment for people who are suffering from Knee osteoarthritis. This survey will be useful for the society.

## **5. ACKNOWLEDGEMENT**

We would like to thank International Research Center of Kalasalingam Academy of Research and Education for providing financial assistance under the scheme of University Research Fellowship(URF) and we also thank the Department of Electronics and Communication Engineering of Kalasalingam Academy of Research and Education, India for permitting to use the computational facilities available in Signal Processing and VLSI Design which was setup with the support of the Department of Science and Technology (DST).

## 6. REFERENCES

- Cohen, Joel W., Steven B. Cohen, and Jessica S. Banthin,** (2009, July).The medical expenditure panel survey:a national information resource to support healthcare cost research and inform policy and practice" *Medical care* ,vol 47, pp.44-50,.
- Favre, Julien, et al,** (2013, Oct). Patterns of femoral cartilage thickness are different in asymptomatic and osteoarthritic knees and can be used to detect disease-related differences between samples," *Journal of biomechanical engineering* ,vol 135,pp 10,.
- Samuel, Asir John, and Durairaj Kanimozhi,** (2019,Jan-Feb) Outcome measures used in patient with knee osteoarthritis: With special importance on functional outcome measures, *International journal of health sciences* ,vol 13.1, pp 52-60
- Argenson, Jean-Noel, et al,**(2008) Patient-reported outcome correlates with knee function after a single-design mobile-bearing TKA," *Clinical orthopaedics and related research*,vol 466.11,pp 69-76, (2008).
- Anbarasi, C., et al,** (2013) A hospital based cross sectional study on the prevalence of musculoskeletal diseases in Varm am out-patient department, Siddha Central Research Institute, Chennai,"
- L. T. M. Frederix,† Patrick D. Bosshart, and Andreas Engel,** ( 2009, Jan) "Atomic Force Microscopy of Biological Membranes Patrick," *Biophysical Journal* ,Vol 96 , pp 329-338,.
- Shamir, Lior, et al,** (2009, Feb) Knee X-ray image analysis method for automated detection of Osteoarthritis," *IEEE Transactions on Biomedical Engineering* ,vol **56.2,pp 407-415,.**
- Lin, Alvin C., et al,** (2009, Dec) Modulating hedgehog signaling can attenuate the severity of osteoarthritis, *Nature medicine* ,vol 15,pp 1421,.
- Chappell, Amy S., et al,** (2009, Dec) Duloxetine, a centrally acting analgesic, in the treatment of patients with osteoarthritis knee pain: a 13-week, randomized, placebo-controlled trial, *Pain* 146.3,pp 253-260,.

- Vanelli, Roberto, et al**, (2010, July) Efficacy of intra-articular polynucleotides in the treatment of knee osteoarthritis: a randomized, double-blind clinical trial," *Knee Surgery, Sports Traumatology, Arthroscopy*,vol 18.7 ,pp 901-907,.
- Gignac, Monique AM, et al**, (2019, Feb) Men and women's occupational activities and the risk of developing osteoarthritis of the knee, hip or hands: A systematic review and recommendations for future research, *Arthritis care & research*,.
- Thoma, Louise M., et al**, (2018, Oct) Are Older Adults with Symptomatic Knee Osteoarthritis Less Active than the General Population? Analysis From the Osteoarthritis Initiative and the National Health and Nutrition Examination Survey, *Arthritis care & research*,vol 70.10, pp 1448-1454,.
- Huynh, C., et al**, (2018, Oct) Factors associated with the orthopaedic surgeon's decision to recommend total joint replacement in hip and knee osteoarthritis: An international cross-sectional study of 1905 patients, *Osteoarthritis and cartilage*,vol 26.10,pp 1311-1318,.
- Tevald, Michael A., et al**, (2018, Oct) The contribution of leg press and knee extension strength and power to physical function in people with knee osteoarthritis: a cross-sectional study, *The Knee* ,vol 23.6 ,pp 942-949, Dec 2018.
- White, Peter B., et al**, (2019, May) Role of Anatomical Patella Replacement on Anterior Knee Pain," *The Journal of arthroplasty* ,vol 34.5 ,pp 887-892,.
- Belfrage, Ola, et al**, (2019, Jan) Locally administered bisphosphonate in hip stem revisions using the bone impaction grafting technique: a randomised, placebo-controlled study with DXA and five-year RSA follow-up," *HIP International*,vol 29.1 ,pp 26-34,.
- Samuel, Asir John, and Durairaj Kanimozhi**, (2019, Jan) Outcome measures used in patient with knee osteoarthritis: With special importance on functional outcome measures, *International journal of health sciences* ,vol 13.1,pp 52,.
- Foster, Nadine E., et al**, (2018, Jun) Prevention and treatment of low back pain: evidence, challenges, and promising directions," *The Lancet* ,vol 391.10137,pp 2368-2383,.
- Ibrahim, Alwathiqbellah, et al.**, (2018, Nov ) A smart knee implant using triboelectric energy harvesters," *Smart Materials and Structures* ,.

- Kshetri, Dan Baidwar, et al,** (2018) Prevalence of knee pain differs across ecological landscapes of the Western Development Region of Nepal," PRM+ 1.3,pp 73-77,.
- Kaur, Parminder, Indrajit Walia, and Sushma Kumari Saini,** (2007,Oct ) Study on intensity of knee joint pain by 'Application of Moist Heat'among geriatric population (> 60years of age), Nursing and Midwifery Research Journal ,vol 3.4,.
- Steenstra, Ivan A., et al,**(2017, Sep) Systematic review of prognostic factors for return to work in workers with sub acute and chronic low back pain," Journal of occupational rehabilitation,vol 27.3 ,pp 369-381,.
- Bartys, Serena, et al,** (2017, Aug) System influences on work disability due to low back pain: an international evidence synthesis," Health Policy,vol 121.8,pp 903-912,.
- Suman, Arnela, et al,** (2017, Dec) "Associations between measures of socio-economic status, beliefs about back pain, and exposure to a mass media campaign to improve back beliefs," BMC public health ,vol 17.1,pp 504,Dec 2017.
- Ferreira, Paulo, et al,** ,(2018) Prevention and treatment of low back pain: evidence, challenges, and promising directions," The lancet,vol391(10137),pp 2368-2383.

# **EFFICIENT VETERINARY PHYSIOLOGICAL MONITOR TO DIAGNOSE THE ABNORMALITIES IN VITAL PARAMETERS OF AN ANIMALS**

**Deny John Samuvel**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [jdenysam@gmail.com](mailto:jdenysam@gmail.com), <https://orcid.org/0000-0001-6515-3575>

**Sakthivel Sankaran**

*Department of Biomedical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [sakthivel@klu.ac.in](mailto:sakthivel@klu.ac.in), <https://orcid.org/0000-0002-0200-1934>

**Muthukumaran Elangovan**

*Department of Electronics and Communication Engineering, Dr.B.R.Ambedkar Institute of TechnologyPahargaon, Port Blair, India*  
Email ID: [reachmemk@gmail.com](mailto:reachmemk@gmail.com), <https://orcid.org/0000-0002-0763-9902>

**Abinaya Srinivasan,**

*Department of Biomedical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [abitabi1998@gmail.com](mailto:abitabi1998@gmail.com), <https://orcid.org/0000-0001-5677-2972>

**Sujitha Lakshmanaperumal**

*Department of Biomedical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [sujithalakshmanaperumal@gmail.com](mailto:sujithalakshmanaperumal@gmail.com), <https://orcid.org/0000-0003-0947-1426>

**Amal Raj**

*Department of Biomedical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*  
Email ID: [amalraj.klubme@gmail.com](mailto:amalraj.klubme@gmail.com), <https://orcid.org/0000-0002-5371-626X>

## **ABSTRACT**

The main objective of this paper is to design and develop a veterinary physiological monitor at low cost. This will yield a lot of benefit to the veterinary doctors. By using this system veterinary doctor can monitor 4 vital parameters by automation. This system can be used to monitor temperature, heart rate, respiration rate, blood pressure with which we can predict any abnormalities in the veterinary animals at initial stage. The report of the animals during the monitoring process will always be displayed on the LCD screen. As this monitor is compact, it can be easily transported. The animals can be monitored at any time and if problems are detected, needed medical concern can be taken quickly with the notification using alarms. The activation of alarms is

only during emergency (abnormal range of parameters). We have successfully programmed for two parameters (temperature and heart rate), using arduino coding with those sensors and animal testing yet to be completed. Simultaneously we are under process to code respiration rate and Blood Pressure measurement sensors. This will be a boon to animal husbandry sectors.

**Keywords:** Voice Decoder, RF, PIC, Text to Voice Conversion.

## 1. INTRODUCTION

In Veterinary monitoring is used to measure the observation of a disease, condition, one or several medical parameters over time in the veterinary animals. Veterinary monitors are used to diagnose changes in the vital parameters by which the severity of a disease in an animal can be detected. In the Middle Ages Farriers first attempts to regulate and organize the practice of treating animals which focused more on horses because of their economic significance. In the year of 1762 at France, Mr. Claude Bourgele established first veterinary school in Lyon. The care and management of Veterinary animals is normally led by a veterinary physician usually called as veterinary surgeon or veterinarian. The research on veterinary includes prevention, control, diagnosis and treatment of diseases in animals. The randomized control trials used in veterinary medicine are the fundamentals for the establishment of effectiveness of the treatment.

Veterinary Medicine is an emerging field compared to Human Medicine. A veterinary physiological monitor is a medical device used for monitoring. It consists of various parameter measuring sensors which includes, heart rate sensor, respiration sensor, Temperature sensor, blood pressure sensor, processing components and display devices. In India, large number of farmers mostly depends on animal husbandry for their livelihood. In rural economy animal husbandry plays an important role. In the year of 1989, US\$5.2 billion was obtained as an output of gross value from animal husbandry sector. From 2012-13 Livestock sector has contributed about 27.25% GDP. Livestock in India industry makes up high for a significant amount of world's livestock resources. The national economy as well as socio-economic growth of country is reversed by the livestock sector. Livestock sector is offering high potential and excellent contribution in agricultural sector over the past years. Additionally, this sector is performing good in the manner of value addition and export of wool, fishery, dairy, poultry, production and other products. The mortality rate of animal too increasing every year compared to their economical support because of lack of health care in animal husbandry sector and final stage of diagnosing a deadly disease. To improve diagnosing methods as much as easy process we have designed veterinary physio-

logical monitor by which four main vital parameters can be measured, if abnormalities in the vitals are measured alarm will be sounded.

## **2. PROPOSED SYSTEM DESIGN**

A sensor is a device which senses the input parameter of physical environment. These parameters might be temperature, light, displacement, motion, moisture, humidity, pressure, or any other parameter of environmental phenomena. The output of the sensor is normally a signal which is being converted into human-readable signal in the display unit of the sensor location or transmitted over a network to remote location for reading or further processing.

Some of the following sensors that we use for our veterinary physiological monitor are,

1. Blood pressure Sensor
2. Heart rate Sensor
3. Respiration Sensor
4. Temperature Sensor

### **2.1. BLOCK DIAGRAM DESCRIPTION**

A temperature sensor is a sensing element which changes its resistance with respect to the temperature variation in the environment where it is placed. Then it converts the physical parameter of temperature into a form of signal that can be understood by a processor. After processing the signal is displayed this can be read by the user. A temperature sensor might be thermistor, Resistance Temperature Detector (RTD) or thermocouple which measures the temperature variation through an electrical signal. RTD is a variable resistor which changes its resistance in proportion to the changes in temperature in precise and linear manner, since it has positive temperature co-efficient. A thermocouple is made up of two dissimilar metals which generate electrical voltage output in response to the variations of temperature in both metals. In our veterinary physiological monitoring system, we are using DS1820 as the temperature sensor.



**Graphic 1.** Photograph of Temperature sensor with Pin Assignment.

## 2.2. HEART RATE SENSOR

A heart rate monitor is a personal monitoring device that is used to measure one's heart rate in real time. It can also be used to record the heart rate for further study. It works on the principle of photo plethysmography. A change in the light intensity through any organ (a vascular region) of the body occurs, when there is a change in volume of blood through that organ. Those changes in the blood volume can be measured by means of heart rate sensor. The timing of the pulses is considered as more important in the case applications where heart rate pulse is to be monitored. The rate of heart pulses determines the flow of blood volume. The signal pulses are equivalent to the heart beat pulses as the light is absorbed by the blood. For designing our veterinary physiological monitor, we are using JX854as heart rate sensor.

There are two types of photo plethysmography.

Transmission: Light emitting device emits the light that is allowed to transmit through any vascular region of the body (like earlobe) and received by the detector.

Reflection: Light emitting device emits the light and that light is reflected by the regions.



**Graphic 2.** Heart Rate Sensor

### 2.3. RESPIRATION SENSOR

Respiration Sensor measures the respiration rate and relative depth of abdominal or thoracic respiration. X4M200 is used as a respiration sensor for our veterinary physiological monitor. This sensor is Novelda's upgraded respiration sensor which is powered by the X4 system on chip. The sensor consists of the integration of standard sleep and respiration monitoring abilities. It provides advanced respiration and movement tracking both during day and night. The main feature for the sensor is an increased programmable detection that ranges up to 5 meters. The sensor chip is integrated for the commercial products. The targeting areas are baby monitoring, elderly care, sleep monitoring and other vital parameters monitoring applications.



**Graphic 3.** Respiration Sensor

### 2.4. BLOOD PRESSURE SENSOR

Blood Pressure Sensor is a device a non-which is designed to measure the human blood pressure in non-invasive manner. Utilizing oscillometric technique, Blood pressure sensor is used to measure systolic, diastolic and mean arterial pressure. MPS20N0040D-S model is used for our veterinary physiological monitor. All the sensors are being interfaced with the Arduino Mega microcontroller.



**Graphic 4.** Blood Pressure Sensor

### 2.5. BLOOD PRESSURE SENSOR

In our project we are using Arduino mega 2560 microcontroller. The Arduino Mega 2560 is an ATmega2560 based microcontroller which consists of 16 analog inputs, 54 digital I/O pins (of which 14 is being used as PWM output pins), 16 MHz crystal oscillator, 4 UARTs (hardware serial ports), a USB port, power jack, an ICSP header, and one reset button. This microcontroller is compatible with Arduino Duemilanove or Diecimila. The operating voltage for the microcontroller can be of 6 to 20 volts. All the sensors are connected to the analog pins of the micro controller and the display unit is connected to the digital pins.



**Graphic 5.** Arduino Mega

### 2.5. OUTPUT DISPLAY

Output display unit is used to provide the visual representation of the physiological parameters. Also this will act as a user interface to change the parameter which has to be modified during the monitoring process. In this project we are using TOUCH DISPLAY NEXTION NX4832T035 - 3.5" HMI TFT LCD. This touch display is connected to the Arduino Mega 2560 microcontroller. Touch display feature provides the easy interface for the user than that of the conventional display model.



**Graphic 6.** NEXTION NX4832T035

### 3. PROPOSED SYSTEM DESIGN

This work is about to design a veterinary physiological monitoring system that is used to monitor four vital parameters for four different animals (cat, goat, dog, cattle) in a single system. To design this monitor first we have studied the normal ranges for all four animals.

Here going to discuss about the physical parameters of veterinary animals. Main animals are Cat, Dog, Cattle and Goat.

#### 3.1. PHYSICAL PARAMETERS OF VETERINARY ANIMALS

CAT:

Normal Feline Physiologic Values for Cats are

Body temperature (average): 101.5°F (38.6°C)

Heart rate:

120 to 140 beats per minute

Respiratory rate (at rest):

16 to 40 breaths per minute

Average Lifespan:

12 to 20 years

DOG:

Normal Feline Physiologic Values for Dogs are

Body temperature (average): 102°F (38.9°C)

Heart rate:

70 to 120 beat per minute

Respiratory rate (at rest):

13 to 34 breaths per minute

Average Lifespan:

8 to 16 years (depends on breed)

CATTLE:

Normal Feline Physiologic Values for Cattle are

Body temperature (average): 101.5°F (38.6°C)

Heart rate:

48 to 84 beat per minute

Respiratory rate (at rest):

26 to 50 breaths per minute

Average Lifespan:

18 to 22 years

GOAT:

Normal Feline Physiologic Values for goat are

Body temperature (average): 102 F to 103 F

Heart rate:

70 to 90 beat per minute

Respiratory rate (at rest):

10 to 30 breaths per minute

Average Lifespan:

15 to 18 years

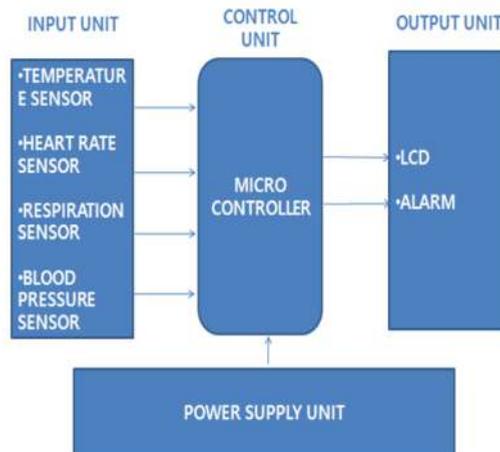
### **3.2. DESIGN**

To design a veterinary physiological monitoring system, we consider four parameter sensors as input to an arduino. This arduino controls the overall system. The values that are acquired from the sensor are processed by the arduino and those values are compared with the predefined threshold values that are already programmed in the arduino. As the arduino is connected with LCD, the values of parameters and the condition of an animal (normal/abnormal) will be displayed in it. As additional feature, alarm is also connected with arduino in output unit. It sounds when the an-

imal is found to be abnormal. As it will indicate the abnormal condition of an animal immediate care and treatment can be given to that animal. This is designed in such a way to know the condition of an animal accurately at early stage. Since the system is automated manual reading can be avoided.

**Table 1.** Sensor Placement in Animals

SENSOR	PLACEMENT
Heart rate Sensor	Earlobe
Temperature Sensor	Below Tongue
Respiration Sensor	Nostril
Blood Pressure Sensor	Respective Limbs



**Graphic 7.** Block Diagram

The system consists of input unit, control unit, output unit and power supply unit. The sensors are connected to the animal body as mentioned in the sensor placement table. The Arduino mega (control unit) receives the value of temperature, heart rate, respiration rate and blood pressure continuously from the input unit. The received data is the input to the program that is inbuilt in the arduino. It compares the input value with the predetermined value and sends the condition (normal or abnormal) and the value of temperature, heart rate, respiration rate and blood pressure to the output unit. The output unit consists of Liquid Crystal Display (LCD), Alarm. The values of parameters measured are displayed in the LCD with the condition as either Normal or Abnormal. If the values are abnormal, the alarm sounds and so immediate care can be taken and medical treatment can be given to the animal.

LCD is mainly used for information display purpose when card is read by reader. Here we are using 2x16 LCD. The ability to display numbers, characters, and graphics. This is in contrast to LED's, which are limited to numbers and characters. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long duration's. LCD pins are connected with the Arduino pins for display of information.



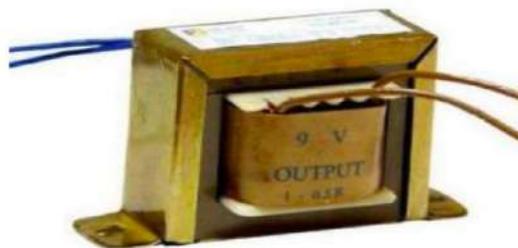
**Graphic 8.** LCD Display

Voltage Regulator regulates the voltage coming from the step-down transformer. It converts 9volts coming from transformer to 5volts. The 5volts is supplied to all devices like RFID Reader and Tags, ULN2003 Driver, LCD Display and micro controller.

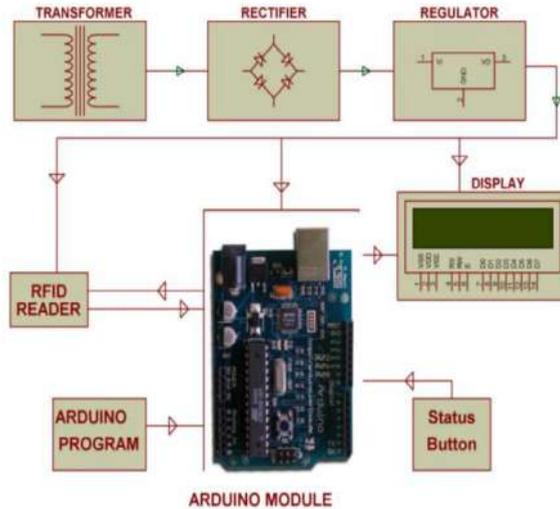


**Graphic 9.** Voltage Regulator

Step down Transformer is used for the working of project. It takes supply voltage of 230volts and makes the voltage to step down from 230volts to 9volts. The voltage is passed to voltage regulator and then it is converted to 5volts using regulator.



**Graphic 9.** Transformer



**Graphic 10.** Circuit Diagram

## 4. CONCLUSION

In this paper, we discussed the veterinary physiological monitoring system using Arduino. This system is an automated sensing system and hence it is more efficient than monitoring the animal manually.

This system consists of heart rate sensor, temperature sensor, respiration sensor and blood pressure sensor. If the animal's parameter range is found to be abnormal, then that animal is detected with the possibilities of diseases. Hence the appropriate medical treatment can be done immediately and much healthcare will be given to the animal.

As we discussed we have designed the prototype for veterinary physiological monitoring system (VPMS) with two parameters (temperature and heart rate). The next stage of this work is to design the whole prototype for VPMS with all the four vital parameter and make it as a product for commercial use which would be more useful for detecting abnormalities in the animals at early stage.

## 5. REFERENCES

- A.Godse,** (2005). Concepts of micro controller 3rd edition Technical Publication.
- Yeates, J., & Main, D.** (2009). Assessment of companion animal quality of life in veterinary practice and research. *Journal of Small Animal Practice*, 50(6), 274-281.

- Patterson, S. M., Krantz, D. S., Montgomery, L. C., Deuster, P. A., Hedges, S. M., & Nebel, L. E.** (1993). Automated physical activity monitoring: Validation and comparison with physiological and self-report measures. *Psychophysiology*, 30(3), 296-305.
- Bamodu, O., Xia, L., & Tang, L.** (2017). An indoor environment monitoring system using low-cost sensor network. *Energy Procedia*, 141, 660-666.
- Kamaraj, A., Radha, K., Priyanka, M., & Punitha, M.** (2016, March). Intelligent transport system using integrated GPS optimized reader. In *2016 Second International Conference on Science Technology Engineering and Management (ICONSTEM)* (pp. 332-336). IEEE.
- Deny, J., & Sivasankari, N.** (2015). Approaches to Iterative Speech Feature Enhancement and Recognition using HMM and Modified HMM.
- Sudharsan, R. R., & Deny, J.** (2020). Field programmable gate array (FPGA)-based fast and low-pass finite impulse response (FIR) filter. In *Intelligent computing and innovation on data science* (pp. 199-206). Springer, Singapore.
- Sudharsan, R. R., Deny, J., Kumaran, E. M., & Geege, A. S.** (2020). An analysis of different biopotential electrodes used for electromyography.
- Deny, J., & Sudharsan, R. R.** (2020). Block rearrangements and TSVs for a standard cell 3D IC placement. In *Intelligent Computing and Innovation on Data Science* (pp. 207-214). Springer, Singapore.
- Deny, J., Sudharsan, R. R., & Kumaran, E. M.** (2021). An orbicularis oris, buccinator, zygomaticus, and risorius muscle contraction classification for lip-reading during speech using sEMG signals on multi-channels. *International Journal of Speech Technology*, 1-8.
- Sudharsan, R. R., Deny, J., Muthukumaran, E., & Selvi, S. C.** (2020). Design, implementation, and estimation of MFCV for 4-different position of human body using FPGA. *Microelectronics Journal*, 105, 104890.
- Sudharsan, R. R., Deny, J., Muthukumaran, E., & Varatharajan, R.** (2021). FPGA based peripheral myopathy monitoring using MFCV at dynamic contractions. *Journal of Ambient Intelligence and Humanized Computing*, 12(7), 7019-7027.

- Krishna, R. R., Kumar, P. S., & Sudharsan, R. R.** (2017, March). Optimization of wire-length and block rearrangements for a modern IC placement using evolutionary techniques. In 2017 IEEE international conference on intelligent techniques in control, optimization and signal processing (INCOS) (pp. 1-4). IEEE.
- Sudharsan, R. R.** (2019, December). Synthesis of FIR Filter using ADC-DAC: A FPGA Implementation. In 2019 IEEE International Conference on Clean Energy and Energy Efficient Electronics Circuit for Sustainable Development (INCCES) (pp. 1-3). IEEE.
- Perumal, B., Deny, J., Sudharsan, R., Muthukumaran, E., & Subramanian, R.** (2021). Analysis of Amplify Forward, Decode and Amplify Forward, and Compression Forward Relay for Single and Multi-node Cognitive Radio Networks.
- Deny, J., Sundarajan, M., Sudharsan, R., Muthukumaran, E., & Perumal, B.** (2021). Reduction of speckling noise of SAR Images using Dual Tree Complex Wavelet (DTCW) and Shearlet Transforms.
- Perumal, B., Aravind, C., Deny, J., & Rajasudharsan, R.** (2021, August). Detection of Food Adulteration using Arduino IDE. In 2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC) (pp. 262-267). IEEE.
- Deny, J., & Sudharsan, R.** (2021). Recognition of Tumours in Human Cerebrum.
- Kumar, D. M., Arthi, R., Aravindhan, C., Roch, A. A., Priyadarsini, K., & Deny, J.** (2021). Traffic Congestion Control Synchronizing and Rerouting Using LoRa. *Microprocessors and Microsystems*, 104048.
- Wan, X., Zhang, K., Ramkumar, S., Deny, J., Emayavaramban, G., Ramkumar, M. S., & Hussein, A. F.** (2019). A review on electroencephalogram-based brain computer interface for elderly disabled. *IEEE Access*, 7, 36380-36387.
- Deny, J., Muthukumaran, E., Ramkumar, S., & Kartheswaran, S.** (2018). Extraction of respiratory signals and motion artifacts from ppg signal using modified multi scale principal component analysis. *International Journal of Pure and Applied Mathematics*, 119(12), 13719-13727.
- Sakthimohan, M., & Deny, J.** (2020). An Enhanced 8x8 Vedic Multiplier Design By Applying Urdhva-Tiryakbhyam Sutra. *International Journal of Advanced Science and Technology*, 29(5), 3348-3358.

**Yan, B., & Lee, D.** (2009, April). Design of sight spot ticket management system based on RFID. In 2009 International Conference on Networks Security, Wireless Communications and Trusted Computing (Vol. 2, pp. 496-499).

# SURVEY ON IOT APPLICATIONS & SECURITY ISSUES

**D. Balakrishnan**

*Assistant Professor Department of Computer Science and Engineering  
Kalasalingam Academy of Research and Education, Virudhunagar, India.*

Email ID: d.balakrishnancse@gmail.com, <https://orcid.org/0000-0001-7312-6227>

**T. Dhiliphan Rajkumar**

*Assistant Professor Department of Computer Science and Engineering  
Kalasalingam Academy of Research and Education, Virudhunagar, India.*

Email ID: dhilipanrajkumar@gmail.com, <https://orcid.org/0000-0001-6309-0275>

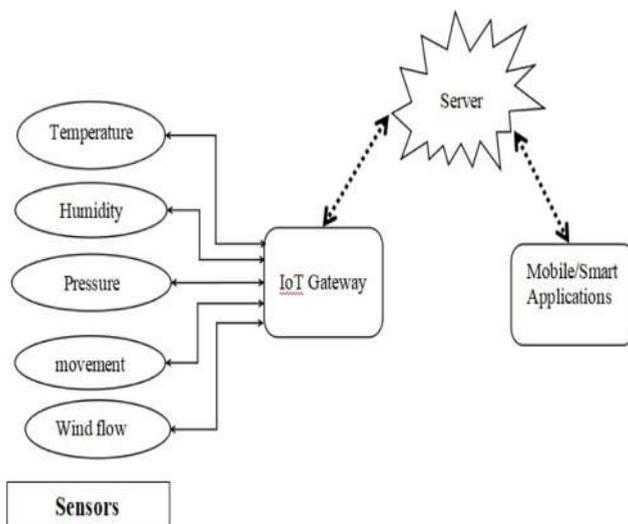
## ABSTRACT

Now a day, IOT is a boon of science. Recently it can occupy everywhere in our world. It is mostly in our world recently it can occupy everywhere in our world. It is used mostly in household, hospitals, surveillance areas, remote applications. IOT of security issues are there in IOT. By means of analyzing its architecture. We can enhancing security features in IOT system. Security of IOT devices mainly focused on encryption technique, communication and protecting data in sensors, server & transmission medium. These focuses mainly about security , privacy and applications in IOT. The main goal of this research work is to analyse and predict the security issues happening all around the world in the Internet of Things Environment. This analysis work discussed about the various relevant research works that focus on ensuring the secured data transmission or handling over the IoT environment. Finally this research work concluded with the merits and demerits analysis observed from the existing research techniques.

**Keywords:** Internet of Things, IoT challenges, Security issues, Privacy.

## 1. INTRODUCTION

Internet of things that refer uniquely used system where every day real time application device, health monitoring, telecommunication, remote area, applications, vehicles, climate changing and whether broadcasting etc. IOT used sensors and actuator for collect the data from various place [6]. For example defense related communication. Enhancing security of our border through controlling/monitoring. If any abnormal change occurs, our sensor will give information to us [6].



**Fig.1.** Basic Block diagram of IoT

Data transfer is an essential part of the IOT system. So all data/information are encrypted. Otherwise mishandling will occur. To avoid mishandling of the data, security of the system should be improved. Various algorithms can be used for enhancing better security. IOT is not a single device, it is a group of connected systems. Batteries are used to supply energy to the devices. Sensors always work. So it can consume more energy. A better energy-saving technique increases the life time of the battery and provides more efficiency.

## 2. IOT SECURITY

Internet of Things security system focuses on protecting your internet-enabled digital devices that connect with each other on wireless networks. IoT security is needed for components safety, network safety and protection from unauthorized persons for mishandling of digital devices and data.

Everyone who uses an IoT system should trust that devices and data they can generate are only accessed with the help of authorized persons or machines. Security solutions are not just about protecting data integrity, data confidentiality and making sure that the renowned IoT infrastructures arrangements should have the ability to withstand from cyber security risks [1]. An IoT device made its users at a risky condition in a number of ways, like as data theft, physical harmness and threats to other people.

Data theft: It is nothing but stored data/information are unique to its individual users, includes online browsing/purchase records, debit/credit card details and personal information. If the system is not protected then the stored details are vulnerable to theft.

Physical Harm :Already discussed about IoT devices usages in the medical industry for our convenients, with examples including heart beat monitoring cuffs, neck brace, pacemakers, heart monitors, defibrillators, pulse oximetry and etc., All these devices can be tuned for enhancing safety of human lifes by doctors. For an example a doctor can make fine movement in pacemaker remotely, these digital devices also vulnerable one from others. An improper secured devices can be change human life. So better security system should be implemented in IoT systems. An IoT system make people more sophisticated so threats can easily enter in to our systems. So we protect our system devices and data from cyber attack.

### 3. ANALYSIS OF SECURITY ISSUES IN IOT

Distributed architecture supports the IoT network applications by providing services at local level and collaborating with all the network devices and users to achieve common goals. Due to the network heterogeneity and device mobility, there can be many security threats and issues encountered with distributed IoT.

Roman *et al.* have identified security challenges in distributed IoT. According to their study, network entity identity, authentication, access control, and secure communication channel establishment are major security concerns in distributed IoT. The proposed mechanisms should be robust to node mobility and network scalability due to the dynamic behavior of nodes. Additionally, the network needs to scale up after installation.

Exploitation of a master key for entity authentication for pervasive computing environments would be also a feasible approach to IoT enabled WSNs [12]. According to [13], the authentication mechanisms for WSN applications can be summarized as password based, remote user authentication using one-way hash functions and ticket based authentication. However, most of the work has the sole purpose of enabling end-user authentication in generic WSN architecture and it does not provide the extensibility for the key establishment. In [14], the authors have proposed broadcast authentication schemes for WSNs. The proposed scheme exploits only one Elliptic Curve Digital Signature Algorithm (ECDSA) signature to authenticate all broadcast messages. Thus, the overhead for the signature is amortized over all broadcast mes-

sages. Besides low overhead, the proposed scheme retains high security that is as strong as conventional PKC based broadcast authentication schemes. Moreover, the proposed scheme can achieve immediate authentication and does not require time synchronization. The reason is that they have less addressed network scalability and device mobility issues.

As the number of collaborators with a large number of disparate access devices increases in ubiquitous collaboration environment, the difficulties for protecting secured resources from unauthorized users as well as unsecured access devices will increase since the resources can be compromised by inadequately secured human and devices. Present an efficient authentication mechanism [15] in ubiquitous collaboration environment. Show that proposed scheme is secure through security analysis and is efficient through the experimental results obtained from the practical evaluation of the scheme in ubiquitous collaboration environment.

In distributed group key negotiation, all group members are treated equally. Hence, group keys should be negotiated among all group members through key exchange methods to ensure fairness. In [16] proposed attack, whereby users can access any other's secret keys and session keys which they should not know according to Dutta's scheme. Moreover, proposed two kinds of improved schemes which are resistant to this kind of attack. The first scheme is unconditional secure communication. The second scheme is in the model of computational secure. In the end, analyse the second scheme and show that it is a self-healing key distribution scheme with revocation and achieves both forward and backward secrecy.

Self-healing approach of key distribution is stateless in the sense that a user who has been off-line for some period is able to recover the lost session keys immediately after coming back on-line. Presents a new self-healing key distribution scheme [17] with revocation capability that requires constant storage of personal keys for each user and we feel, it is more efficient than the previous schemes in terms of communication complexity. The novelty of this scheme is to use a different and more efficient self-healing mechanism compared to the ones in the literature. In the IoT scenario, the above group key negotiation schemes are not suitable for WSNs since the cost of communication and computation is more than that of group key distribution schemes. Moreover, the reasons for the infeasibility of group key distribution schemes are also exist.

In [18] introduce the first fully implemented two-way authentication security scheme for the Internet of Things (IoT) based on existing Internet standards, specifically the

Datagram Transport Layer Security (DTLS) protocol. Recently, a datagram-oriented variant DTLS has been proposed to operate on top of datagram-oriented transport protocols, such as the User Datagram Protocol (UDP). Both IPsec and TLS have the same design and provide equivalent security measures. Proposed security scheme is based on RSA, the most widely used public key cryptography algorithm. It is designed to work over standard communication stacks that offer UDP/IPv6 networking for Low power Wireless Personal Area Networks (6LoWPANs). Each of these key exchange schemes independently implements specific techniques and cryptographic algorithms to derive a secret key and ensure the required mutual authentication between the endpoints of a communication.

Saied *et al* [19] proposed distributed DTLS scheme, a forward error correction scheme will be applied by the source A to handle losses and missing secret parts from assisting nodes. The principle of forward error correction scheme is to add redundant parity packets to the original message, divided into multiple packets, in order for it to be recovered by the receiver even if some packets were altered or lost during the process of transmission. Let  $n$  be the total number of sent blocks,  $k$  ( $k < n$ ) is the minimum number of blocks required to reconstruct the original message. Here 'n' proxies obtain a polynomial share instead of a partition element,  $k$  polynomial shares. The proposed threshold scheme satisfies the two properties such as recovery and Secrecy. On the other hand, the polynomial coefficients are as large as the DH private key of the source so it becomes difficult for larger network. Then it applies the error redundancy scheme to the fragments of the secret key.

All of these security methods relying on key pre-distribution were discarded, as they did not meet energy efficiency and end-to-end security requirement simultaneously. The resource constraints of most IoT components limit the implementation of these complex cryptographic mechanisms required to perform the key establishment, which could rapidly drain their resources and reduce the network performance. The existing work DTLS and TDTLS the communication cost of total energy cost of a specific operation for a sensor is determined by using  $U$ ,  $I$  and  $N$  are respectively the voltage, intensity and frequency of TelosB. Existing methods these values are randomly selected and optimization of these values becomes very difficult so in this research work the existing schemas will be extended to optimization of TDTLS schema. In this subsection ABC assess the communication energy costs of the proposed distributed approaches at the constrained initiator.

## **4. SECURITY CHALLENGES IN IOT**

Securing IoT devices is a challenging task for people. Nowadays IoT devices are cheap so lot of chances are there for getting malfunctioned. The device manufacturer's does not pay more attention to provide security update. All IoT application developers are always beware of threats and attacks [2]. All should always be ready with an alternate plan to secure our information if in case of an attack.

The following are the top challenges in IoT security system such as Authorized devices, manage the whole system devices updates, Securable communication throughout the entire system, Ensure the data privacy and integrity in smart phones and other related applications [2]. And also it should enable to detect vulnerabilities and Manage vulnerabilities[1].

- a) Authorize and authenticate devices: After successful encryption of data, there may be chances of device itself being hacked. Communicated data to and from an IoT devices should be authenticate. For an example, suppose we built a sensor for measuring room temperature. Even though if data is encrypted and transferred to cloud server, it may be a chance to change the data and make malfunctions. Authentication issues may not be direct one but definitely affect a security risk.
- b) Manage device updates: Device updates are important one in IoT systems otherwise hackers may enter in to our systems. Most of IoT products and devices don't get enough updates. IoT manufacturers are eagerly produce and deliver their devices as fast as they can, without giving proper security systems. Unfortunately most of the manufactures are produced security system for short period of time only. After that it need to updates regularly for protecting from malware and threats [6].
- c) Secure communications: After securing devices and sensors, we need to secure communication between devices and server or vice-versa. There may be a chances to hack the network between devices and server, it may leads to hack our data. Encrypting the data is the only way to protect our data and also make separate network to isolate the devices for enhancing the security [1].
- d) Ensure data privacy and integrity: Data privacy is a crucial part of the IoT system. Data should be transmitted through various networks in IoT operations, so data needs to be maintain privacy by implementing security system. Ensure

data integrity, digital signature may added to increase the data integrity in networks [1].

Secure web, mobile, and other applications: Mobile, web and other smart devices are directly connected with IoT systems, so we implement better strategies to implement security system to that devices.

e) Detect vulnerabilities and Manage vulnerabilities: Large gap IoT systems contains large number of sensors, networks, devices and leads to a complex networks. So it is not a easy one to detect fault/vulnerability occur in the systems. Regular monitoring the networks and devices can easily locate vulnerabilities. Suppose any cyber attack is founded then isolate the device from the system and then spotted the vulnerabilities [1]. Before managing vulnerabilities, take back up all our information and data. Lot of software/solution is available for managing vulnerabilities.

## 5. CONCLUSION

Science is as a both side knife, so great care should be taken in IoT technologies. Otherwise we should face privacy and security issues. In this paper, We discussed about various applications and security issues in IoT system. Nowadays cyber attacks are increased enormously , it make a big question mark in security of the digital devices. This research work provided the discussion of various related research work which attempts to perform secured data handling in the IoT environment. From those research works, it is concluded that there is no proper methodology is found for ensuring the secured communication in the IoT. So proper security system should be implemented to enhance the protection of our informations.

## 6. REFERENCES

- 1. M. Abomhara and G. M. Kjøien**, "Security and privacy in the internet of things: Current status and open issues," in *Privacy and Security in Mobile Systems (PRISMS)*, International Conference on. IEEE, 2014, pp. 1–8.
- 2. L. Atzori, A. Iera, and G. Morabito**, "The internet of things: A survey," *Comput. Netw.*, vol. 54, no. 15, pp. 2787–2805, Oct 2010.
- 3. E. Borgia**, "The internet of things vision: Key features, applications and open issues," *Computer Communications*, vol. 54, pp. 1–31, 2014.

- 4. S. Chen, H. Xu, D. Liu, B. Hu, and H. Wang,** “A vision of IoT: Applications, challenges, and opportunities with china perspective,” *IEEE Internet of Things journal*, vol. 1, no. 4, pp. 349–359, 2014.
- 5. G. Gan, Z. Y. Lu, and J. Jiang,** “Internet of Things Security Analysis,” in *Proc. of 2011 Int. Conf. on Internet Technology and Applications (iTAP)*, Aug. 2011.
- 6. M. M. Hossain, M. Fotouhi, and R. Hasan,** “Towards an analysis of security issues, challenges, and open problems in the internet of things,” in *Services (SERVICES)*, 2015 IEEE World Congress on. IEEE, 2015, pp. 21–28.
- 7. J. S. Kumar and D. R. Patel,** “A survey on internet of things: Security and privacy issues,” *International Journal of Computer Applications*, vol. 90, no. 11, 2014.
- 8. H. Ma, L. Liu, A. Zhou and D. Zhao,** On the networking of internet of things: Explorations and challenges, *IEEE Internet Things J.* 3 (2016) 441–452.
- 9. J. Margulies,** Garage door openers: An internet of things case study, *IEEE Secur. Priv.* 13 (2015) 80–83.
- 10. Muhammad Usman , Irfan Ahmed M.Imran Aslam,** “ A Light weight Encryption Algorithm for Secure Intenet of things”,*International Journal of Advanced Computer science and Applications*, Vol.8,No.1,2017.
- 11. K. Zhao and L. Ge,** “A survey on the internet of things security,” in *Computational Intelligence and Security (CIS)*, 2013 9th International Conference on, pp. 663–667, IEEE, 2013.
- 12. F. Zhu, M. W. Mutka, and L. M. Ni,** “Private entity authentication for pervasive computing environments,” *International Journal of Network Security*, vol. 14, no. 2, pp. 86–100, 2012.
- 13. S. Shin, T. Shon, H. Yeh, and K. Kim,** “An effective authentication mechanism for ubiquitous collaboration in heterogeneous computing environment,” *Peer-to-Peer Networking and Applications*, 2013.
- 14. Y. Liu, J. Li, and M. Guizani,** “PKC based broadcast authentication using signature amortization for WSNs,” *IEEE Transactions on Wireless Communications*, vol. 11, no. 6, pp. 2106–2115, 2012.
- 15. Shin, S., Shon, T., Yeh, H., & Kim, K.** (2014). An effective authentication mechanism for ubiquitous collaboration in heterogeneous computing environment. *Peer-to-Peer Networking and Applications*, 7(4), 612-619.

- 16. Xu, Q., & He, M.** (2009). Improved constant storage self-healing key distribution with revocation in wireless sensor network. In *Information Security Applications* (pp. 41-55). Springer Berlin Heidelberg.
- 17. Dutta, R., Wu, Y. D., & Mukhopadhyay, S.** (2007, June). Constant storage self-healing key distribution with revocation in wireless sensor network. In *Communications, 2007. ICC'07. IEEE International Conference on* (pp. 1323-1328) .
- 18. Kothmayr, T., Schmitt, C., Hu, W., Brünig, M., & Carle, G.** (2013). DTLS based security and two-way authentication for the Internet of Things. *Ad Hoc Networks*, 11(8), 2710-2723.
- 19. J. Arkko, E. Carrara, F. Lindholm, M. Naslund, K. Norrman,** MIKEY: Multimedia Internet KEYing, IETF RFC 3830, August 2004.



# A NOVEL REVIEW ON MICROMACHINED MICROPUMPS AND MICRONEEDLES FOR TRANSDERMAL DRUG DELIVERY

**Velmurugan Subbiah Parvathy**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: s.p.velmurugan@klu.ac.in, <https://orcid.org/0000-0002-3314-1454>

**Sivakumar Pothiraj**

*Professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: siva@klu.ac.in, <https://orcid.org/0000-0003-1328-8093>

**Jenyfal Sampson**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: jenyfal.sampson@klu.ac.in, <https://orcid.org/0000-0001-8007-3995>

## ABSTRACT

This study encapsulates the current statistics, depiction outcomes and simple working principle of various types of micromachined microneedles array employed for transdermal drug delivery (TDD) or blood extraction. So as to evade the concerns linked to drug squalor by intestinal path and their removal via the liver, a modest solution will be creation of microneedles array with decomposable guidelines. TDD avoids drug squalor, and having minimum dispersion constant therefore transferring hydrophilic and weighted drugs by inert covers is a difficult process. Even though, there are 20 types of drug that pertinent to previous covers. Microneedle alone can transfer hydrophilic and weighted drugs, owing to its stuff. Early, there are several investigations in TDD, blood withdrawal, skin precaution arenas with a microneedle have been presented. Prevailing microneedle has been modeled through silicon, titanium, metal, and polymer materials. In this study, various creation techniques of microneedles and its features have been investigated.

**Keywords:** Fabrication, Microneedles, Novel review, and Transdermal drug delivery.

## 1. INTRODUCTION

Presently, the transdermal itinerary has turned into an operative and inventive domain for drug delivery investigation, and forty percentage of the drug applicant coming under scientific assessment concomitant with transdermal methods. The

methodology has an established report of Food and Drug Administration (FDA) endorsement as the ultimate transdermal spot has been endorsed during 1981. The seek for transdermal things are noteworthy rising tendency and it is possible to endure for the probable prospect. The cumulating TDD products endure to provide actual healing advantage to humans worldwide [1]. Delivery using the microneedle can able to transfer, yet, hydrophilic and weight, then it creates micro fleabags on the skin. Vitro experiments approves the drug penetrability into the skin is 10,000 times [2] superior to inert dispersal and a petite skin injury than tape [3]. Patient acquiescence, suitability, evasion of the liver's firstpass absorption and squalor in the intestinal region are some advantages of microneedles. It necessities a drug and ecology arena. Chiefly, TDD, blood withdrawal, skin overhaul arenas are more vital [4]. It has been established in numerous techniques such as parenteral delivery, oral delivery, transdermal delivery and implant delivery, etc. The mostly employed technique is oral delivery. It is very simple and practicable. However, this technique has a concern because of the drug squalor by intestinal path and disposal through liver [5]. It injects drug keen on the body, so drug engrossed at the same time then drug absorption in plasma improved quickly and attainment the peak. The enriched drug is regularly abridged by metabolism. Its concentration silhouette displays it is unsafe to patient while drug concentration is more than tolerable range [6]. Lately, numerous microneedle fabrication procedures by MEMS have been established attributable to the requirement of the microneedle. They are categorized into solid, coated, dissolving and hollow microneedles. In hollow type needle drug passage happens within the needle and the solid type looking identical to acupuncture.

## **2. REVIEW OF MICROPUMPS**

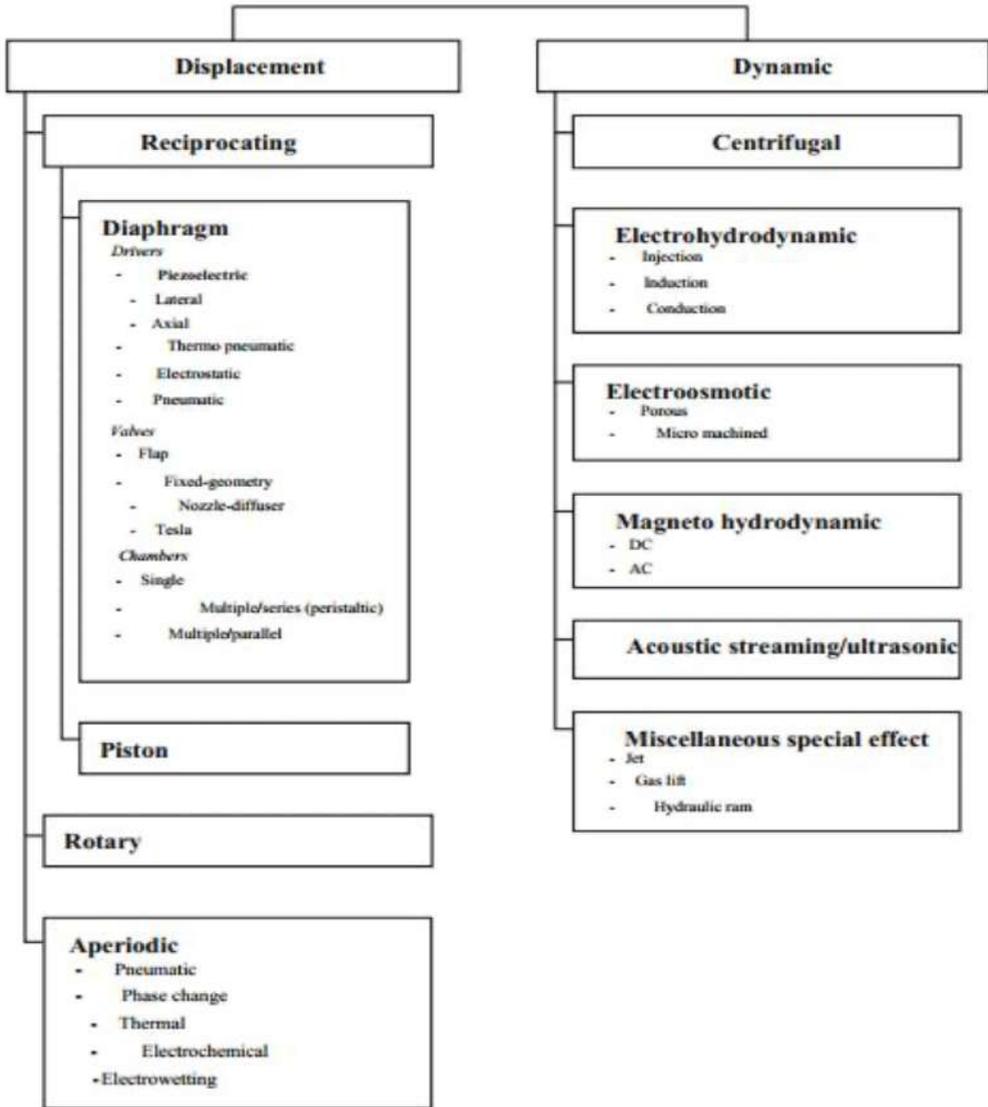
Jan Smits invented the concept of micropumps during 1980 to inject insulin in a controlled manner to the diabetic's patients [7]. They have been employed to distribute concocted macromolecules keen on lumps or the arteries [8, 9]. Weighted stream rates are not to be obligatory in entrenched micropumps, however precise measuring is essential. The pressure to be produced for implantable micropumps are not unimportant, by way of the back pressure stated in vivo as 25 kPa. Consistency, power depletion, price and biocompatibility are complex. Presently, inadequacies have excluded extensive establishment of micropumps. Perhaps, presently accessible embedded insulin injection systems devising stagnant pressure basins measured by solenoid-made regulators and about the size of 50 cm<sup>3</sup> [10]. The grouping of micro pumps has been exposed in Figure 1.

## **Displacement micropumps**

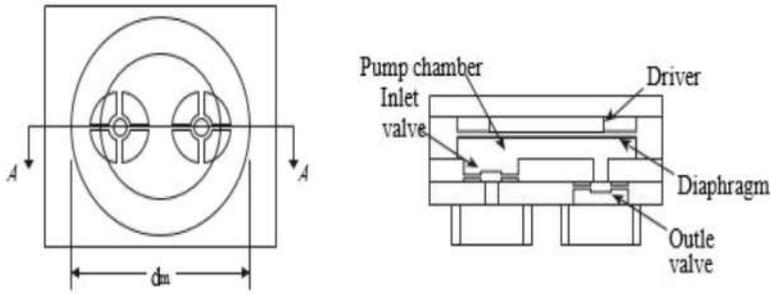
### **(i) Piezoelectric Micropumps**

In this type poignant borders or exteriors apply pressure on the drug in a particular interval. Pistons act as poignant borders in most of the macroscale reciprocating pumps, however outmoded, wrapped piston configurations are not employed in micropumps. The pressure smearing poignant exterior acts as a substitute for deformable salver and the pump diaphragm is availed with enduring edges. Generally they are made-up of silicon, glass, and plastic. The construction and working principle of a generic diaphragm-based reciprocating displacement micropump has been shown in Figure 2. Pump chamber, actuator apparatus and 2 passive valves; placed at suction side and discharge side are the main components.

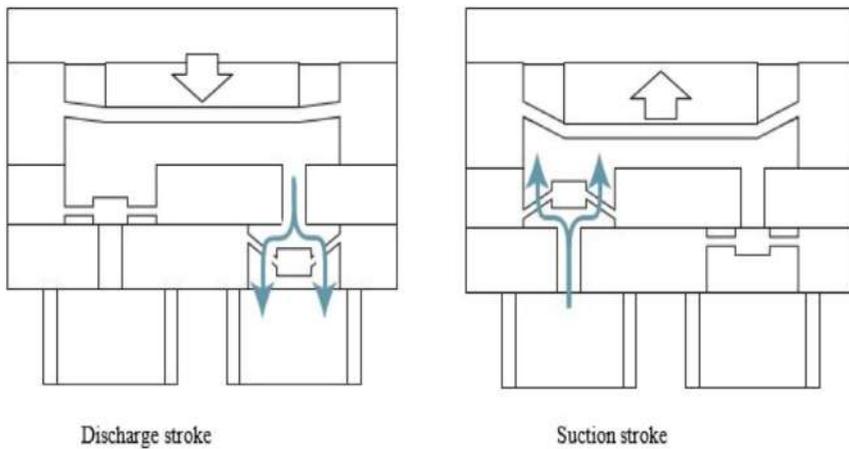
The actuator enactments on the pump diaphragm to consecutively upsurge and reduce the volume of the chamber. During suction stroke the fluid has been extracted into the chamber and pushed out during discharge stroke. The valves placed in inlet and outlet are concentrated on fluid flowing in and out of the chamber, remedying the stream by a two-stroke pump cycle [11].



**Figure 1:** Types of micropumps  
**Source:** (D. J. Laser *et al.*, 2004)



**Figure 2:** Top view and parts of standard reciprocating displacement micropump  
**Source:** (D. J. Laser *et al.*, 2004)



**Figure 3:** Discharge and suction strokes of standard reciprocating displacement micropump  
**Source:**(D. J. Laser *et al.*, 2004)

### 3. FABRICATION OF MICRONEEDLES

The graphical outlook of various techniques of TDD into the skin by microneedles has been illustrated in Figure 4. Microneedles have been made-up by numerous resources, comprising metal, polymer, glass and ceramic, in various structures and dimensions, as desired for dissimilar requests. Utmost microneedle fabrication approaches are according with the conformist microfabrication methods of toting, eliminating, and doubling microstructures by means of photolithographic methods, silicon engraving, laser wounding, metal plating, metal electropolishing and micromolding.

## Creation of solid microneedles

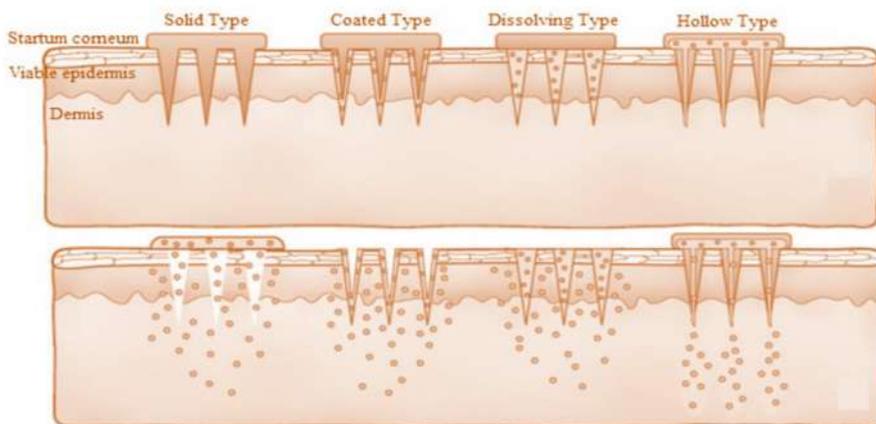
It has been manufactured by offering suitable force by selecting material and geometry and decreasing the strength required to inject microneedles into skin by enhancing sharpness. They have been made-up using numerous materials [12].

### i) Silicon microneedles

Needle material and geometry are the vital factors in this technique. It has been made-up by a silicon dry engraving procedure established on reactive ion engraving with a chromium layer [13], along with isotropic engraving in a united plasma etcher [14]. Moreover, they have been made-up to aid as neural probes by cubing a silicon substrate to produce a grid design of yawning channels and then acid engraving the ensuing pillars to make sharp tips [15].

### ii) Metal microneedles

3D laser ablation, laser trimming, wet engraving, and metal plating approaches were employed to make these needles.



**Figure 4:** Various methods of drug delivery to the skin by microneedles

**Source:** (Yeu-Chun Kim *et al.*, 2012)

### iii) Polymer microneedles

They have been made-up by photolithography by optically treatable polymers, they are formerly characteristically used as main configurations for repetition by casting.

#### iv) Ceramic microneedles

Ceramic micromolding and sintering are used to fabricate them. Also an intensive laser was skimmed inside a photophobic polymerceramic amalgam of mastic by a galvano scanner and a micropositioning arrangement to influence polymerization.

#### v) Microneedle rollers

They are made-up on smooth, planar substrates, likely they are concomitantly surged into the skin. They are made-up on a cylinder-shaped exterior and injected into the skin in the form of a roller. They can able to cure huge regions of skin.

**Table 1:** different fabrication methods of microneedles and its characteristics

Categories of Microneedle	Material employed	Material assets	Geometry	Applied load	Array size	Fabrication method
Hollow/ in plane	Silicon	E = 168.9 GPa	Rectangular with sharp tip	Transverse load = 130 mN		DRIE
Hollow, metallic	Palladium, Palladium-cobalt alloys		Sole needle with many lumens for supply with sharp tip	Drug pressures maximum of 700 kPa	Nine-needle	MEMS
Bulk, hollow	Titanium		Sharply pointed tip		In-plane orientation, two titanium thin foils embedded	Titanium substance micromachining and multilayer coating
Hollow	Photodephynable epoxy resin					Titanium substance micromachining and multilayer coating
In-plane and out of plane, side openings	Silicon dioxide		Sharp tip		10 × 11	MEMS, Bi-mask
Taper hollow	Nickel		Sharp edges with funnel slants in the bound of 4.6° to 5.7°		6 × 6	Su-8 thick photoresist
Circular, Rectangular and Square	Silicon	E= 169 GPa		3.183*106 Pa		MEMS with three piezoelectric sensors
Hollow/ Symmetric/ Out of plane	Silicon dioxide	E = 70 gpa, P.R. = 0.2	Cylindrical	Transverse Load = 0.53 mN		Standard Photolithography and DRIE

Hollow/ Asymmetric/ Out of plane	Silicon dioxide		Conical		20 × 20	DRIE, diamond vane spherical slicing and isotropic engraving
Solid/Out of plane	Poly lactic acid	E = 190 GPa, P.R. = 0.17	Rectangular	Axial load =2.7 MPa/2 N		Injection molding, UV excimer laser.
Hollow	Polymer		Cylindrical		10×10	Photolithography Process Combined with Micromolding Technique
Hollow	Silicon		Sharpened tips		4 × 4	Photoresist,, DRIE
Solid/Out of plane	Polyglycolic acid	E = 10 GPa, ry = 90 MPa	Cylindrical with different tip shapes		120 needle/ array	Injection molding
Solid/ Out of plane	Carboxymethylcellulose, Polylactic acid		Conical, Pyramidal		3 × 3	Micro-molding
Hollow/ Symmetric/ Out of plane	Nickel	5.9e7 Pa	Octagonal	Axial load 3.183 MPa		Novel electroplating
Hollow/ Symmetric/ Out of plane	Polymer SU-8		Conical		10 × 10	Spin coating, Electroplating
Hollow/ Symmetric/ Out of plane	Nickel		Conical	Axial load 0.2 N	4 × 4	Laser piercing, casting, electroplating, wet engraving

### Fabrication of Coated microneedles

Coating can be done by different methods, like dipping or spraying them by a solution frequently framed for improving viscosity to hold more during drying; a surfactant to smooth moistening on surface; serum or any agent are used to guard the drug from destruction while aeration and packing.

### Fabrication of Dissolved microneedles

They have been made-up by micromolds occupied by flush molding packed with a polymer thaw allowable to coagulate in the mildew, and in-situ polymerization of liquid monomer in the mildew. Extraction techniques of creation are employed with polymer/sugar thaws and polymer/sugar solutions. Several resources for example CMC, chondroitin sulfate, dextran, dextrin, PVP, PVA, PLGA, fibroin and sugars have been liquefied in water, occupied into the mildew holes and permitted to arid.

Another construction technique pulls up liquid inventions to produce elongated microneedle configurations that coagulate in position. They were modeled as multi-needle arrangements by a measured, stepwise extraction method endowed by a microfabricated device [16].

### **Fabrication of Hollow microneedles**

They are made-up from a material substrate by MEMS for instance laser micromachining [17], deep sensitive ion engraving of silicon, a cohesive lithographic casting method, yawning X-ray photolithography, and wet chemical engraving and microfabrication.

They are prepared using glass, polymer and metal by conservative fabrication techniques. They are modeled by acclimatizing conventional strained glass micropipette methods [18]. Mostly they are made-up by indirect approaches liable on sacrificial substrates. Hot decoration joint with an UV excimer laser ray method was presented to make them with side opening holes [19].

## **4. COMPARISON OF DIFFERENT MICROMACHINED MICRONEEDLES**

As the results from the literature survey, the different fabrication methods of microneedles and its characteristics such as material used, material properties, geometry, applied load and array size are tabulated in Table I.

## **5. CONCLUSION**

In recent days, the field of microneedles has been steadily developed. The microfabrication instruments have comprised of several microneedle models for TDD into the skin. It is composed of various materials such as silicon, titanium, metals, polymers, and ceramics using different fabrication methods including lithography, wet and dry engraving, laser trimming and micro-molding. Solid substrates are combined as rollers and applied for treating the skin and therefore increase the skin penetrability in the order of scale. A drug preparation or reinforcement could be smeared for handling skin. Otherwise, the drugs can be reduced in the water-doable matrix which can be utilized as a veneer on the top of metal or polymer microneedles or matrix material of the microneedles. When it is injected into the skin, the matrix gets liquefied and discharged the condensed drug. The hollow microneedles are applied to infuse liquid creation of drug into the skin. As a result, distinct fabrication methods

of microneedles and its characteristics are briefly examined. This study found that the utilization of titanium substrates can remove the breakage persuaded damage happen in harder materials when upholding tolerable stringency. Furthermore, the biocompatibility of titanium makes it as an idyllic model for TDD.

## 6. REFERENCES

- R. Langer** (2004). Transdermal drug delivery: past progress, current status, and future prospects. in *Advanced Drug Delivery Reviews*, vol. 56, no. 5, pp. 557-558, 2004/03/27/ 2004.
- H. J. G. E. Gardeniers et al** (2003). Silicon micromachined hollow microneedles for transdermal liquid transport. in *Journal of Microelectromechanical Systems*, vol. 12, no. 6, pp. 855-862, 2003.
- J. Hyu and Kim** (2008). Improvement of the clinical experiment which uses the Micro-needle and Galvanic Current Machine of skin condition. in *Sookmyung Women's University*, 2008.
- M. Wijaya, P. Davis Shawn, R. Holiday Nicholas, W. Jenny, S. Grill Harvinder, and R. Prausnitz Mark** (2004). Transdermal Delivery of Insulin Using Microneedles in Vivo. in *Pharmaceutical Research*, vol. 21, no. 6, pp. 947-952, 2004.
- M. Han, D.-H. Hyun, H.-H. Park, S. S. Lee, C.-H. Kim, and C. Kim** (2007). A novel fabrication process for out-of-plane microneedle sheets of biocompatible polymer. in *Journal of Micromechanics and Microengineering*, vol. 17, no. 6, pp. 1184-1191, 2007/05/15 2007.
- A. L. Teo, C. Shearwood, K. C. Ng, J. Lu, and S. Moochhala** (2006). Transdermal microneedles for drug delivery applications. in *Materials Science and Engineering: B*, vol. 132, no. 1, pp. 151-154, 2006/07/25/ 2006.
- J. G. Smits** (1990). Piezoelectric micropump with three valves working peristaltically. in *Sensors and Actuators A: Physical*, vol. 21, no. 1, pp. 203-206, 1990/02/01/ 1990.
- J.-L. Coll, P. Chollet, E. Brambilla, D. Desplanques, J.-P. Behr, and M. Favrot** (1999). In Vivo Delivery to Tumors of DNA Complexed with Linear Polyethylenimine. in *Human Gene Therapy*, vol. 10, no. 10, pp. 1659-1666, 1999/07/01 1999.

- A. Dash and G. Cudworth** (1998). Therapeutic applications of implantable drug delivery systems. in *Journal of Pharmacological and Toxicological Methods*, vol. 40, no. 1, pp. 1-12, 1998/07/01/ 1998.
- J. Selam** (2001). External and implantable insulin pumps: current place in the treatment of diabetes. in *Exp.Clin.Endocrinol.Diabetes*, vol. 109, pp. 333-340, 2001.
- H. T. G. van Lintel, F. C. M. van De Pol, and S. Bouwstra** (1988). A piezoelectric micropump based on micromachining of silicon in *Sensors and Actuators*, vol. 15, no. 2, pp. 153-167, 1988/10/01/ 1988.
- S. Henry, D. V. McAllister, M. G. Allen, and M. R. Prausnitz** (1998). Microfabricated Microneedles: A Novel Approach to Transdermal Drug Delivery. in *Journal of Pharmaceutical Sciences*, vol. 87, no. 8, pp. 922-925, 1998/08/01/ 1998.
- G. Yan, K. S. Warner, J. Zhang, S. Sharma, and B. K. Gale** (2010). Evaluation needle length and density of microneedle arrays in the pretreatment of skin for transdermal drug delivery. in *International Journal of Pharmaceutics*, vol. 391, no. 1, pp. 7-12, 2010/05/31/ 2010.
- J. Ji, F. E. Tay, J. Miao, and C. Iliescu** (2006). Microfabricated Silicon Microneedle Array for Transdermal Drug Delivery. in *Journal of Physics: Conference Series*, vol. 34, pp. 1127-1131, 2006/04/01 2006.
- R. C. Kelly et al** (2007). Comparison of Recordings from Microelectrode Arrays and Single Electrodes in the Visual Cortex. in *The Journal of Neuroscience*, vol. 27, no. 2, p. 261, 2007.
- K. Lee, C. Y. Lee, and H. Jung** (2011) Dissolving microneedles for transdermal drug administration prepared by stepwise controlled drawing of maltose," in *Biomaterials*, vol. 32, no. 11, pp. 3134-3140, 2011/04/01/ 2011.
- S. P. Davis, W. Martanto, M. G. Allen, and M. R. Prausnitz** (2005). "Hollow metal microneedles for insulin delivery to diabetic rats. in *IEEE Transactions on Biomedical Engineering*, vol. 52, no. 5, pp. 909-915, 2005.
- P. M. Wang, M. Cornwell, J. Hill, and M. R. Prausnitz** (2006). Precise Microinjection into Skin Using Hollow Microneedles. in *Journal of Investigative Dermatology*, vol. 126, no. 5, pp. 1080-1087, 2006/05/01/ 2006.

- D. Bodhale, A. Nisar, and N. Afzulpurkar** (2010). Structural and microfluidic analysis of hollow side-open polymeric microneedles for transdermal drug delivery applications. in *Microfluid Nanofluid*, vol. 8, pp. 373-392, 2010.
- D. J. Laser, Juan G Santiago** (2004). A review of micropumps in *Journal of Micromechanics and Microengineering*. vol. 14, pp. R35-R64, 2004.
- Yeu-Chun Kim, Jung-Hwan Park, Mark R.Prausnitz** (2012). Microneedles for drug and vaccine delivery. in *Advance Drug Delivery Reviews*. vol. 64, pp. 1547-1568, 2012.

## **RFID BASED BUS PASS SYSTEM FOR UNIVERSITY**

**Deny John Samuvel**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [jdenysam@gmail.com](mailto:jdenysam@gmail.com), <https://orcid.org/0000-0001-6515-3575>

**K. Harish Kumar**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [harish955063@gmail.com](mailto:harish955063@gmail.com), <https://orcid.org/0000-0003-4108-387X>

**V. Jaswanth Reddy**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [janardhan.krishnayya@gmail.com](mailto:janardhan.krishnayya@gmail.com), <https://orcid.org/0000-0001-9126-6469>

**G. Janardhan**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of  
Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: [vjreddy.1999@gmail.com](mailto:vjreddy.1999@gmail.com), <https://orcid.org/0000-0002-8138-6528>

### **ABSTRACT**

This paper presents the design of "RFID Based Bus Pass System". In existing system, Bus pass is mainly used in most of the cities but ticketing is done by manually, hand held machine systems etc. It is important to store the information of passenger's and travelling details at some secure location so that it can be reused whenever it is necessary. Our strategy involves design, development and creating a smart card authentication system for bus traveller's that reads the RFID tag and matches the details of tag with the database and authenticates it. If user is authorized person, then only it allows the passenger to travel otherwise it shows an error that card is in valid. This system will help passengers in making better travelling decisions in easy way. Here RFID reader acts like conductor of bus in this system and RFID tag of user act as ticket taker. The RFID cards being reusable, they are much more convenient compared to the paper based and hand held machine ticketing. With this system we can decrease the human labour in buses and user's use their own ticketing system individually. Here the RFID reader and tag acts as wireless devices.

**Keywords:** RFID, Busspass System, Automotive ticketing.

## **1. INTRODUCTION**

In most of the developing countries like India PTS (public transport system) remains the major source of income. Bus is the major form of transport for many students who daily travelling from home to colleges, so it is majorly used by so many students for coming to college. As per statistics the bus transport is 10 times safer than private transport. RFID (radio frequency identification) is a fastest technology for identification for RFID tags. RFID consists of a RFID tag, RFID reader and antenna. RFID reader reads the radio frequency coming from RFID tag. When RFID tag is brought near to RFID reader it activates the radio frequencies with unique id in tag, if the user is authorized person then he can access, otherwise in display it will show as invalid. The encoded message in the tag is decoded by RFID reader. It is a flexible auto identification technology which is easy for students to use. RFID operates in three modes Low frequency (LF), High frequency (HF), Ultra high frequency. Commonly for bus pass system we use mostly 125KHZ of RFID reader frequency. The main purpose of this system is to identify the user and authenticate the user. The system will consist of information like user details, route information, validity of pass etc. RFID technology is faster and it is better than bio-metrics like finger prints, retina scanning etc.

## **2. EXISTING SYSTEM**

Today's world most of the buses are running with conductor system for ticket. Paper ticket or electronic machine system is used for ticket. Manual ticket will be done with no record of the passengers. All process is handled by bus conductor. Motivation: Making easy system for students and passengers to use this system with existing system. Decreasing the work of the labor with this automatic system.

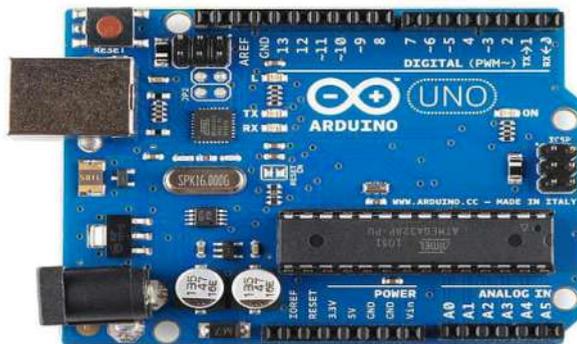
## **3. PROPOSED SYSTEM DESIGN**

In our proposed work travelling will be easy for passengers from one place to another. Here, RFID tags will act as a bus passes for passengers and RFID reader is act like a conductor for the buses. The RFID tags have a unique code with some frequency range associated with reader. When passenger bring tag near to reader the electromagnetic waves passes between the card and reader, If the person is authorized then he can travel the bus otherwise he cannot board the bus. The coding for the passengers is enrolled in the program uploaded in the micro controller using USB jack. The components used for the implementation of the project are, ARDUINO UNO, RFID Tags, RFID reader, voltage regulator, ULN2003 driver, transformer, LCD display. The supply voltage of 230 volts from switch board is given to transformer

which converts 9v supply to 5v. The 5v supply is given to all devices connected with voltage regulator. The micro controller is coded with USB jack and the digital pins of micro controller are connected with the LCD pins. The brightness of the LCD can be controlled with operable switch near the LCD. It is used for the displaying information for the valid or invalid tags. The reader has a frequency of 125KHZ with which it can detect the tag frequency when it will bring near to reader. With this system we can make bus passes for the students in colleges or schools which are easy to handle for the students.

#### **4. HARDWARE DISCIPTION**

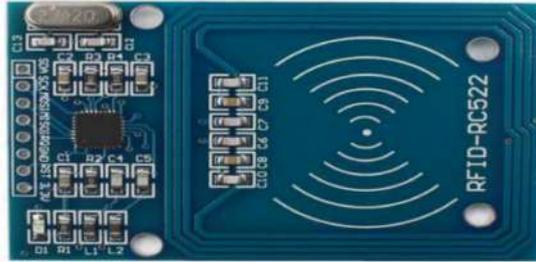
This is a micro controller board made with ATmega32. It has 14 digital inputs and outputs pins with 6 analog inputs. It works on 16 MHz crystal oscillator, a power Jack and a reset button. It contains everything needed to support the micro controller. It has 4/8/16/32K bytes of In- System Programmable Flash with Read-While-Write capabilities. The board is given with 5volts supply coming from voltage regulator. The program is uploaded with USB jack with appropriate code required for design of project.



**Graphic 1.** Arduino UNO Board

This work is about to design a veterinary physiological monitoring system that is used to monitor four vital parameters for four different animals (cat, goat, dog, cattle) in a single system. To design this monitor first we have studied the normal ranges for all four animals.

RFID Reader is a coil included in plastic. A reader captures the data provided by the tag within the detectable area of the Reader. There can be one or more tags within the capture area. A reader is typically capable of reading multiple tags simultaneously.



**Graphic 2.** RFID Reader

It is Radio Frequency Identification cards which makes the readable by the electromagnetic waves with the frequencies of reader. The function served by RFID is similar to bar code identification, but line of sight signals is not required for operation of RFID.



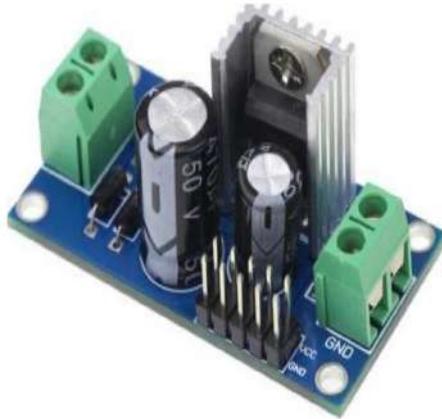
**Graphic 3.** RFID Tag

LCD is mainly used for information display purpose when card is read by reader. Here we are using 2x16 LCD. The ability to display numbers, characters, and graphics. This is in contrast to LED's, which are limited to numbers and characters. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long duration's. LCD pins are connected with the Arduino pins for display of information.



**Graphic 4.** LCD Display

Voltage Regulator regulates the voltage coming from the step-down transformer. It converts 9volts coming from transformer to 5volts. The 5volts is supplied to all devices like RFID Reader and Tags, ULN2003 Driver, LCD Display and micro controller.

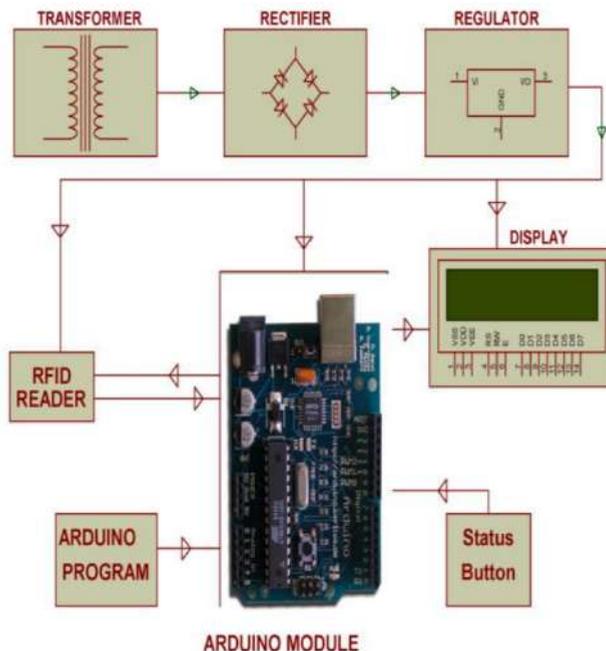


**Graphic 5.** Voltage Regulator

Step down Transformer is used for the working of project. It takes supply voltage of 230volts and makes the voltage to step down from 230volts to 9volts. The voltage is passed to voltage regulator and then it is converted to 5volts using regulator.



**Graphic 6.** Transformer

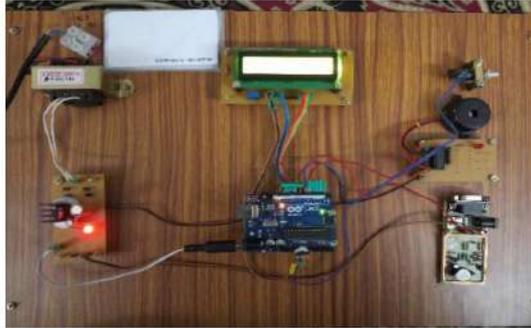


**Graphic 7.** Block Diagram

The following sketch is the brief description about the project where connections are given for all devices shown in above figure. The working of the block diagram is explained in the proposed work. The Arduino micro controller is connected with reader, display, voltage regulator and voltage regulator are connected with transformer and rectifier. The supply is given to all devices with regulated voltage of 5volts. RFID reader and Tag is connected with the micro controller. The bridge rectifier is used for the control of voltage flow coming from transformer. Voltage regulator has three pins input/output and ground pin. The output pin is connected with the Arduino, LCD, RFID reader which gives 5volts supply for these devices.

#### 4. RESULT AND DISCUSSION

The prototype of the project is shown in figure 8, when RFID tag is connected with frequency which exists in RFID reader then it shows whether the person using tag is authorized or not. If the person is not authorized, then the user cannot travel in bus. Here ULN2003a driver is input output driver in which we can connect up to 7 output devices. We used buzzer in the prototype for the person who is unauthorized instead of bus open or door process. We can provide GPS tracking of bus which will help users to track the current location and expected arrival time of bus using android application.



**Graphic 8.** Output

This is the overall prototype of the project that is implemented.

## 5. CONCLUSION

RFID is going to be used to implement a Smart Card system for bus passengers. The main aim of the proposed system will authentication of information of the bus passengers. This system helps users by providing timetable of all bus routes in the city through android application for making better travelling decisions independently. We can provide GPS tracking of bus which will help users to track the current location and expected arrival time of bus using android application.

The future work of the project is to implement the prototype in the college or school buses for product to be use. After the implementation of this product next step is to do some real time applications with the same project for metro train's entry, metro buses and etc. Using this type of system makes the users for easy work done and decreases the labour work. Our next step is developing the android application in which users can see the routes and all timetables of the buses for travelling.

## 6. REFERENCES

- A.Godse,** (2005). Concepts of micro controller 3rd edition Technical Publication.
- Deny,J, G.Sridhar, M.Muneeswaran,** (2016). Implementation of Bidirectional Dc-Dc Converter For Aerospace Applications, International Journal of Pharmacy & Technology, Vol. 8, Issue 3
- Deny, J., & Sivasankari, N,** (2015). Approaches to Iterative Speech Feature Enhancement and Recognition using HMM and Modified HMM.
- H.L.Bertoni,** (1987). Radio Propagation for Modem Wireless Systems, Prentice Hall.

**Jack Smith**, (1989). Programming the PIC Microcontroller by Using Basic Embedded Technology, Hardcover Publication, 5th Edition.

**John Peatman**, (2000). Design of PIC Microcontrollers 2nd edition, Technical Publication.

**Rajkamal**, (1998). The concepts and features of micro controller, Prentice Hall.

**Agarwal, M., Sharma, M., & Singh, B.** (2014, September). Smart ration card using RFID and GSM technique. In 2014 5th International Conference-Confluence The Next Generation Information Technology Summit (Confluence) (pp. 485-489). IEEE.

**Ramani, R., Selvaraju, S., Valarmathy, S., & Niranjan, P.** (2012). Bank locker security system based on RFID and GSM technology. International journal of computer applications, 57(18).

**Sudharsan, R. R., & Deny, J.** (2020). Field programmable gate array (FPGA)-based fast and low-pass finite impulse response (FIR) filter. In Intelligent computing and innovation on data science (pp. 199-206). Springer, Singapore.

**Sudharsan, R. R., Deny, J., Kumaran, E. M., & Geege, A. S.** (2020). An analysis of different biopotential electrodes used for electromyography.

**Deny, J., & Sudharsan, R. R.** (2020). Block rearrangements and TSVs for a standard cell 3D IC placement. In Intelligent Computing and Innovation on Data Science (pp. 207-214). Springer, Singapore.

**Deny, J., Sudharsan, R. R., & Kumaran, E. M.** (2021). An orbicularis oris, buccinator, zygomaticus, and risorius muscle contraction classification for lip-reading during speech using sEMG signals on multi-channels. International Journal of Speech Technology, 1-8.

**Sudharsan, R. R., Deny, J., Muthukumar, E., & Selvi, S. C.** (2020). Design, implementation, and estimation of MFCV for 4-different position of human body using FPGA. Microelectronics Journal, 105, 104890.

**Sudharsan, R. R., Deny, J., Muthukumar, E., & Varatharajan, R.** (2021). FPGA based peripheral myopathy monitoring using MFCV at dynamic contractions. Journal of Ambient Intelligence and Humanized Computing, 12(7), 7019-7027.

- Krishna, R. R., Kumar, P. S., & Sudharsan, R. R.** (2017, March). Optimization of wire-length and block rearrangements for a modern IC placement using evolutionary techniques. In 2017 IEEE international conference on intelligent techniques in control, optimization and signal processing (INCOS) (pp. 1-4). IEEE.
- Sudharsan, R. R.** (2019, December). Synthesis of FIR Filter using ADC-DAC: A FPGA Implementation. In 2019 IEEE International Conference on Clean Energy and Energy Efficient Electronics Circuit for Sustainable Development (INCCES) (pp. 1-3). IEEE.
- Perumal, B., Deny, J., Sudharsan, R., Muthukumaran, E., & Subramanian, R.** (2021). Analysis of Amplify Forward, Decode and Amplify Forward, and Compression Forward Relay for Single and Multi-node Cognitive Radio Networks.
- Deny, J., Sundarajan, M., Sudharsan, R., Muthukumaran, E., & Perumal, B.** (2021). Reduction of speckling noise of SAR Images using Dual Tree Complex Wavelet (DTCW) and Shearlet Transforms.
- Perumal, B., Aravind, C., Deny, J., & Rajasudharsan, R.** (2021, August). Detection of Food Adulteration using Arduino IDE. In 2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC) (pp. 262-267). IEEE.
- Deny, J., & Sudharsan, R. R.** (2021). Recognition of Tumours in Human Cerebrum.
- Kumar, D. M., Arthi, R., Aravindhan, C., Roch, A. A., Priyadarsini, K., & Deny, J.** (2021). Traffic Congestion Control Synchronizing and Rerouting Using LoRa. *Microprocessors and Microsystems*, 104048.
- Wan, X., Zhang, K., Ramkumar, S., Deny, J., Emayavaramban, G., Ramkumar, M. S., & Hussein, A. F.** (2019). A review on electroencephalogram based brain computer interface for elderly disabled. *IEEE Access*, 7, 36380-36387.
- Deny, J., Muthukumaran, E., Ramkumar, S., & Kartheeswaran, S.** (2018). Extraction of respiratory signals and motion artifacts from ppg signal using modified multi scale principal component analysis. *International Journal of Pure and Applied Mathematics*, 119(12), 13719-13727.
- Sakthimohan, M., & Deny, J.** (2020). An Enhanced 8x8 Vedic Multiplier Design By Applying Urdhva-Tiryakbhyam Sutra. *International Journal of Advanced Science and Technology*, 29(5), 3348-3358.

**Yan, B., & Lee, D.** (2009). Design of sight spot ticket management system based on RFID. In 2009 International Conference on Networks Security, Wireless Communications and Trusted Computing (Vol. 2, pp. 496-499). IEEE.

**Wu, D. L., Ng, W. W., Yeung, D. S., & Ding, H. L.** (2009). A brief survey on current RFID applications. In 2009 International Conference on Machine Learning and Cybernetics (Vol. 4, pp. 2330-2335). IEEE.

# A NOVEL APPROACH ON MEDICAL IMAGING DATA SECURITY OPERATION BASED ON HONEY ALGORITHM

**G.Jayahari Prabhu**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: jayahariprabhu@gmail.com, <https://orcid.org/0000-0002-8612-202X>

**B.Perumal**

*Department of Electronics and Communication Engineering, Kalasalingam Academy of Research and Education, Krishnankoil, Virudhunagar (Dt), India*

Email ID: palanimet@gmail.com, XXXXXXXXXXXXX

## ABSTRACT

Medical data Security is the one of the significant thing for transmitting the restorative current information. Medical Imaging Data Security is a Necessary system for secure or maintain the sensitive information and their related patient data and the information are placed and transmitted over the open system. To choose an algorithm for secure information communication, the algorithm ought to give higher Privacy, security and better effectiveness. Here in Medical Imaging data, Honey encryption algorithm is used to mess up the restorative medical data or information. The presentation of the future methodology is assess utilizing different estimation measures such as, Peak Signal to Noise ratio (PSNR), entropy, Mean Square error (MSE) and Correlation Coefficient (CC) and so on. The proposed study uses a variety of ways to hide vital health information, including the Honey Encryption Algorithm. Using this hybrid strategy, the Mean Square Error (MSE) is reduced to 3% and the Peak Signal to Noise Ratio (PSNR) is increased to 51%. This methodology will be efficient for building efficient encryption and intrusion detection systems.

**Keywords:** Medical Imaging data, Honey Algorithm, Blowfish, Cryptography.

## 1. INTRODUCTION

With the Innovation in the field of Medical Imaging technique, Security is a basic requirement for all applications to protect data while stored and transmitted over open area networks[1].With the extensive enhancements of Communication and Technologies, Medical Imaging and Digital Image application can trade over the internet Digital images occupy a large part of our daily communications Encryption of sensitive data is necessary, encryption algorithms designed to protect data and

ensure confidentiality and the only authorized recipient can access the decryption data[2]. This paper deals with previous work in Medical imaging data security, for Medical applications and some applications of each method in medical imaging operations are described.

Encryption is a process to convert data in an unreadable format by unauthorized users using cryptographic algorithms to preserve data. It is used to keep sensitive data so that it can be difficult for unauthorized users to see it. The good algorithms must have been tested to meet the requirements of the security which protect the encryption components. The information can be utilized to give different security. Because of different issues with correspondence security [3], most basic encryption calculations will use as content information or matched information. Here Advanced Encryption standard, Data Encryption standard and RSA, etc. the primary ciphers are not appropriate figures to be utilized. Also, these Primary figures require much computing time and high system power. The significance of encryption for the Medical information must be secured [4]. Medical images will be performed with the compelling of Honey Encryption algorithm can be obtain the Cryptographic task can help in giving the necessary security data by figuring[5] Here the optimization algorithm is used to decrypt the input images [6].The data will be securely transmitting it between the sender and receiver.

In the existing ,Medical image is performed with Blowfish algorithm since it does not give the necessary security to the Medical data. Here Section II tells about related work, Section III is the methodology and features of Medical Image data Security, Section IV contains Result and Discussion.

## **2. RELATED WORK**

In the AL Crypto set of rules algorithm the proposed machine extends its execution for large textual content files and images. The proposed studies applies with the AES set of rules to the statistics security and Privacy. Where the RSA set of rules is carried out to the generated Key. With this proposed technique the records and its key grow to be high position and unbreakable [7].

Intelligible and Unintelligible which convert the facts between forms by Encryption/Decryption functions with the control of key(s). Nowadays cryptographic key control issues that stand up due to the allotted time of IT resources, as well the distributed nature of their management [8].

Explained about the capable of studying classifiers with the medical image and a statistics demonstration simultaneously with other images. It may allocate its best aid requirements without human involvement. It strongly chooses the corrected data with the medical image for the transmission [9].

The technique which includes various levels of transmission various number of encryption techniques based on different levels, a shuffling image segment and a protecting phase of the image. [10].

### **3.METHOLOGY**

In the previous time, security has focused on the difference in algorithms and conventions for encryption, verification and information with some relative identification is needed for medical data these existing security frameworks secret writing or steganography is the main thing for privacy and ideal course of action of image [11]. To mix up medical imaging data some of them will use this data as the main data to use in the cryptosystem.

In verifying that noteworthy Medical information, random numbers assume to be the part of the nature of assumption and it is signify by standard keys. Some of security issues identified with Medical imaging and transmitting, so it is critical to keep the information and the security of the medical image. Mostly the confirming of medicinal images will guarantee protection, safeguard of medical information put away in a sequence framework, for this requirements. Honey Encryption for medical imaging security is shown in Fig. Consider Honey encryption and additionally Blowfish for medical image security process. This Honey is raised to advance both the Private and other key, after the decryption process, the yield image will be the first image by utilizing the PSNR and the other measures [12].Normally Security is one of the protections factor from the attack. Some of the security aspects are given below

#### **1) Security attack**

#### **2) Security mechanism**

#### **3) Security service**

1) **Security attack:-** Some of the Information which raises some security by a company. There are 2 types of attack.

- a) **Passive attack** it's very hard to detect because they do not involve any wavering of the data or information. Typically, the Transmission is in normal style

and neither sender nor receiver is attentive that the hacker has read the message.

- b) Active attack – By creating some false information to prevent active attack.
- c) Security mechanism: A security mechanism is a process in which it is used to design, spot, put off or recover from a security attack.

**Security service:**

- a) Authentication – There will be the guarantee during the communication.
- b) Access control – avoidance of the illegal use of a source
- c) Data confidentiality – safeguard of the data from unauthorized one.
- d) Data Integrity – guarantee that data received is exactly sent by an authoritative entity
- e) Norepudiation – protection against disagreement during communication.

**2) Security properties:-**

- a) Confidentiality: Attacker is not possible to get the information or data
- b) Integrity: There will be no attack and the system will be work properly
- c) Availability: Events by an attacker do not prevent users from having admittance to use of the method.

Medical imaging security is an important role while transmitting some digital images and their patient information record across the Public area network [13]. Here it is proposed that a honey is dedicating PACS security server .where the technique which acts as an image authority to ensure and confirm the image origin and integrity upon request by a user. The honey algorithm is an valuable tool for a secure data communication. The method has been utilized recently in DICOM Security. Medical image security by the honey encryption in a PACS environment has become a vital issue as communications of Medical images increasingly extends over open networks [14].

Medical imaging security has been executed using 2017a with the i5 processor and 6GB RAM. For security analysis Medical images were collected from hospital and some security measures are examined here.

$$\text{PSNR} = 10 \log(255^2 | \text{MSE}) \quad (1)$$

$$\text{MSE} = \sum_{Dim} \left( \frac{1}{Dim} (o_i - D_i)^2 \right) \quad (2)$$

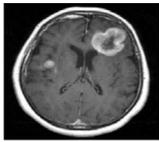
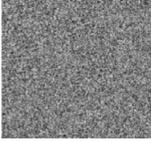
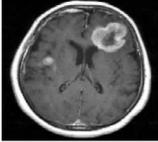
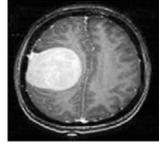
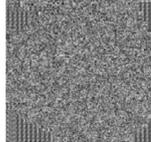
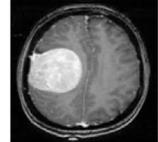
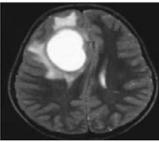
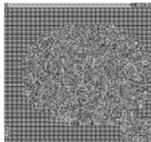
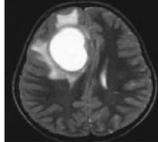
$$\text{CC} = \frac{\sum_{i=1}^N (I_i - d(I)) - (m_i - d(m))}{\sqrt{\sum_{i=1}^N (I_i - d(I))^2 - m_i - d(m)^2}} \quad (3)$$

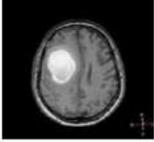
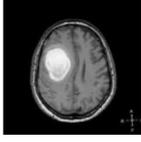
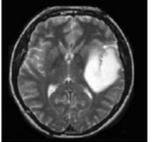
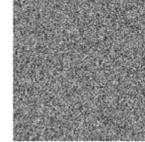
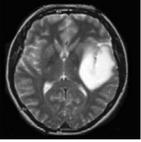
$$\text{Entr} = \sum_{i=0}^{2^N-1} P_i \log\left(\frac{1}{P_i}\right) \quad (4)$$

The proposed Honey encryption is raised with the other Algorithm and evaluation measures showed up in Table 3. At that point, the Medical imaging is encoded with the blowfish and Honey encryption calculation. The honey Encryption algorithms which transmit the medical image protected and secure way. Toward the end decoding is done so as to retrieve the image back. From the table, the medical image has the Peak signal to Noise ratio average estimation of honey Algorithm is high than the other. Table 3 contains the other performance of Noise signal, Error, Correlation Coefficient and Entropy of other techniques, for instance

## 4. RESULTS

**Table 1.** Image Security Performance for blowfish Algorithm

Images	Encrypted Images	Decrypted Images	PSNR	MSE	CC	Entropy
			59.23	0.011	0.99	7.85
			58.90	0.085	0.94	8.02
			54.22	0.02	0.97	7.90

			55.86	0.037	0.96	7.85
			56.78	0.09	1	80.2

PSNR's effective Image Encryption Relative Result, MSE and CC is shown in Table 1. It compares the Blowfish method to various entropy values.

**Table 2.** Image Security Performance for Honey Algorithm

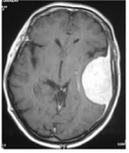
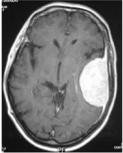
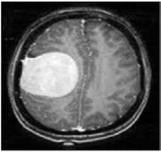
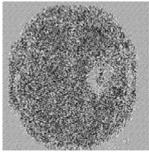
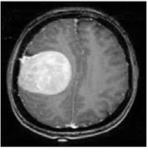
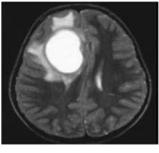
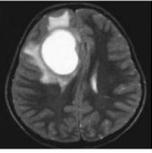
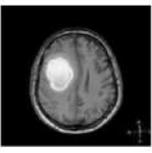
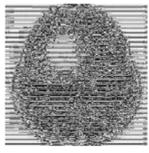
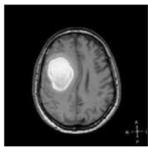
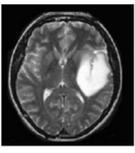
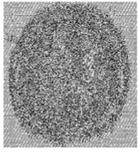
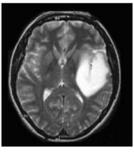
Images	Encrypted Images	Decrypted Images	PSNR	MSE	CC	Entropy
			59.61	0.019	1	7.80
			58.90	0.013	0.99	8.02
			56.22	0.02	0.97	7.91
			57.86	0.031	0.96	7.85
			57.78	0.06	1	8.02

Table 2 shows the effective MSE, PSNR and CC values of the proposed Honey encryption algorithm and compares with the entropy values.

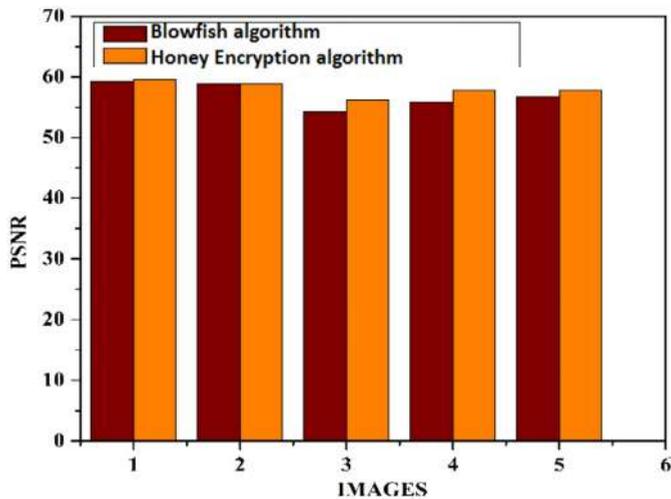
## 5. PERFORMANCE MEASURES

The medical images are then encoded using standard procedures, as well as a comparison of Entropy and Key sensitivity. The HE algorithm transfers medical images in a secure and trustworthy manner. Furthermore, decoding is completed at the conclusion to ensure that the information is understood.

Because it differs from the other equivalent algorithm, the proposed technique has a low mean square error.

### (i) PSNR

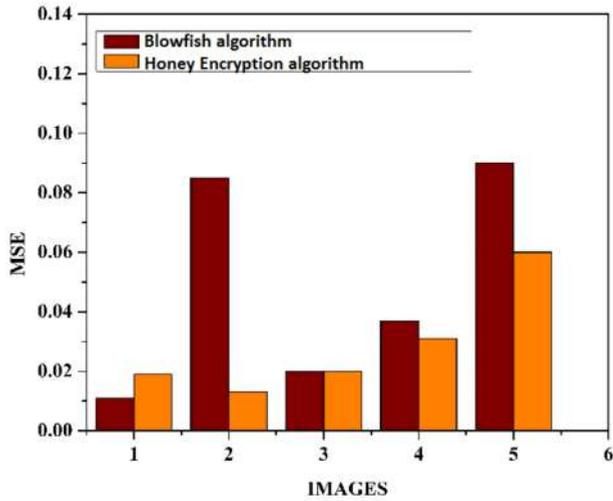
Fig.1 shows a comparison of the PSNR for HE algorithm, the Blowfish with Ant-lion optimization.



**Fig.1.** Comparison of PSNR values of HE algorithm with Blowfish from literature for data security.

### (ii) MSE

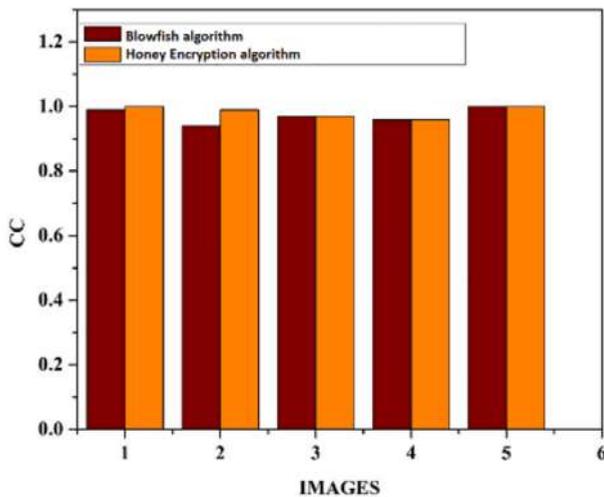
Fig.2 displays a comparison of the MSE for HE algorithm, the Blowfish with Ant-lion optimization



**Figure 2.** shows a comparison of the MSE for HE algorithm, the Blowfish with Ant-lion optimization

(iii) CC

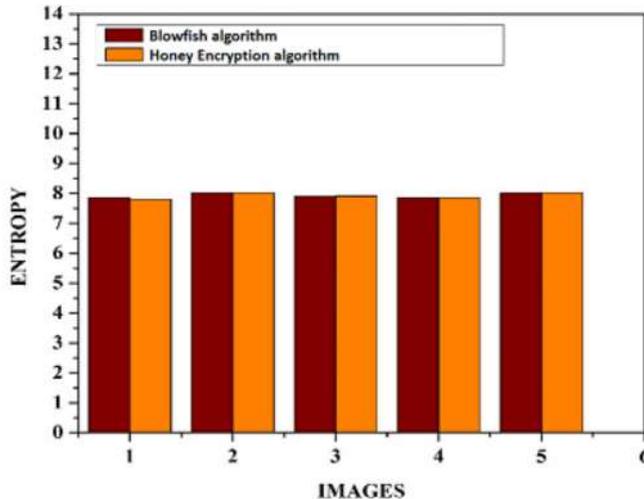
Fig.3 measures the effective CC of the proposed methodology, that is superior to that of the conventional algorithm. It is evaluated using a variety of image security and a low error rate.



**Fig.3** shows a comparison of the CC for HE algorithm, the Blowfish with Ant-lion optimization

## (iv) Entropy

The effective Entropy of the proposed methodology, which is superior to that of the standard algorithm, is measured in Fig.4. It has a low error rate and is tested using a variety of image security.



**Fig.4** shows a comparison of the Entropy for HE algorithm, the Blowfish with Ant-lion optimization

The Honey encryption here exhibits the peak signal to noise ratio of different protection calculations. The Peak signal to noise estimation in the planned strategy. Honey encryption are about the equivalent and don't change fundamentally. This affirms that the honey encryption perform as well for a extensive scope of Medical images. The estimation of relationship Coefficient in near unity. Mean square error is figured by determining the blunder bits over all bits in the medical image. MSE in the above figure, the Mean Square error regard for the proposed system is low when appeared differently in relation to the next Algorithm.

## 6. CONCLUSIONS

Here in this paper the blowfish Algorithm and the honey Algorithm. is used to extend the safety for medical imaging technique.here it is used to optimize the cryptographic keys during encryption process. Performances of the honey encryption technique which are raised and evaluated by using PSNR, MSE, CC and Entropy than the blowfish Algorithm. The entropy maximizes with Honey Encryption model the PSNR value seems to be high than the blowfish Algorithm. The computing effort and the nec-

essary computation time will decrease with this honey encryption method.. Honey encryption processed with the MATLAB 2017 with the i3 processor and 6GBRAM for model. We consider some medical images. And that medical image was collected from hospitals for security analysis. Security measures are examined by adding image encryption scheme. The Honey Encryption Algorithm is one of the methods used in the proposed study to hide crucial health information. The Mean Square Error (MSE) is decreased to 3% and the Peak Signal to Noise Ratio (PSNR) is enhanced to 51% using this hybrid technique. CC increases from the conventional approach by 12% with an improvement in entropy arising at nearly 3%. These outcomes indicate that this system will be effective in the development of encryption and intrusion detection systems.

## 7. REFERENCES

- Dasgupta, D., Shrein, J.M. and Gupta, K.D.,** 2019. A survey of blockchain from security perspective. *Journal of Banking and Financial Technology*, 3(1), pp.1-17. <https://doi.org/10.1007/s42786-018-00002-6>
- Dulla, G.L., Gerardo, B.D. and Medina, R.P.,** 2019, February. A unique message encryption technique based on enhanced blowfish algorithm. In *IOP Conference Series: Materials Science and Engineering* (Vol. 482, No. 1, p. 012001). IOP Publishing. <https://doi.org/10.1088/1757-899X/482/1/012001>
- Karbhari, S.,** 2019, A survey of cyber security operations based on Machine learning & Deep learning. *Information*, 10(122), pp. 1-35. <file:///C:/Users/CHAITH~1/AppData/Local/Temp/information-10-00122.pdf>
- Kuila, S., Dhanda, N., Joardar, S., Neogy, S. and Kuila, J.,** 2019. A Generic Survey on Medical Big Data Analysis Using Internet of Things. In *First International Conference on Artificial Intelligence and Cognitive Computing* (pp. 265-276). Springer, Singapore. [https://doi.org/10.1007/978-981-13-1580-0\\_26](https://doi.org/10.1007/978-981-13-1580-0_26)
- Prabhu, P. and Manjunath, K.N.,** 2019. Secured Image Transmission in Medical Imaging Applications—A Survey. In *Computer Aided Intervention and Diagnostics in Clinical and Medical Images* (pp. 125-133). Springer, Cham. [https://doi.org/10.1007/978-3-030-04061-1\\_12](https://doi.org/10.1007/978-3-030-04061-1_12)
- Prathap, R., Mohanasundaram, R. and Kumar, P.A.,** 2019. Design of EHR in Cloud with Security. In *Smart Intelligent Computing and Applications* (pp. 419-425). Springer, Singapore. [https://doi.org/10.1007/978-981-13-1927-3\\_45](https://doi.org/10.1007/978-981-13-1927-3_45)

- Rohini, S. and Bairagi, V.** 2010. Lossless medical image security. *International Journal of Applied Engineering Research, Dindigul*, 1(3), pp.536-541. [https://moam.info/lossless-medical-image-security-integrated-publishing-association\\_59b062c71723ddb8c561689a.html](https://moam.info/lossless-medical-image-security-integrated-publishing-association_59b062c71723ddb8c561689a.html)
- Saharan, R. and Yadav, S.,** 2019. A Novel Method for Image Encryption. In *Information and Communication Technology for Intelligent Systems* (pp. 427-434). Springer, Singapore. [https://doi.org/10.1007/978-981-13-1742-2\\_42](https://doi.org/10.1007/978-981-13-1742-2_42)
- Shanmugapriya, E. and Kavitha, R.,** 2019. Medical big data analysis: preserving security and privacy with hybrid cloud technology. *Soft Computing*, 23(8), pp.2585-2596. <https://doi.org/10.1007/s00500-019-03857-z>
- Sudheep, K. and Joseph, S.,** 2019, March. Review on Securing Medical Big Data in Healthcare Cloud. In *2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)* (pp. 212-215). IEEE. <https://doi.org/10.1109/ICACCS.2019.8728351>
- Thakur, S., Singh, A.K., Ghrera, S.P. and Elhoseny, M.,** 2019. Multi-layer security of medical data through watermarking and chaotic encryption for tele-health applications. *Multimedia tools and Applications*, 78(3), pp.3457-3470. <https://doi.org/10.1007/s11042-018-6263-3>
- Younes, M.A.B.,** 2019. A SURVEY OF THE MOST CURRENT IMAGE ENCRYPTION AND DECRYPTION TECHNIQUES. *International Journal of Advanced Research in Computer Science*, 10(1), p.9. <http://www.ijarcs.info/index.php/ijarcs/article/view/6350>



# GLOVE FOR A COMMUNICATION DISORDERLY PERSON USING HAND GESTURE RECOGNITION

**Sivakumar Pothiraj**

*Professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: siva@klu.ac.in, <https://orcid.org/0000-0003-1328-8093>

**Jenyfal Sampson**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

Email ID: jenyfal.sampson@klu.ac.in, <https://orcid.org/0000-0001-8007-3995>

**Velmurugan Subbiah Parvathy**

*Assistant professor Department of Electronics and Communication Engineering  
Kalasalingam Academy of Research and Education Krishnan koil, Tamilnadu, India.*

.Email ID: s.p.velmurugan@klu.ac.in, <https://orcid.org/0000-0002-3314-1454>

## ABSTRACT

Gestures help us decipher meaning in communication. A gesture means a non-verbal communication involving visible body actions to communicate particular messages, with respect to the conjunction of speech. It will include the movement of hand or face. People move their hands while they talk, resulting in gestures. It is also found in people who are blind by birth. Thinking of this hand gestures in communication, gives the idea of helping mute people to communicate in the normal way with others. Generally mute people use sign language for communication, but they find it difficult to communicate with others who don't understand sign language. [1]This system is made with a glove connected with flex sensors and an accelerometer sensor. With the help of these sensors, the movements of the fingers are captured, and the captured information's are processed, and the information is fed into the speaker. And to make it as a two-way communication, we are capturing the speech of normal person and displaying it on an LCD screen, so that a normal person and a mute person can communicate at ease. We will be using Bluetooth for the signal transmission, incorporating the same with the help of Arduino. This can be easily handled and will be a gift to the mute people.

**Keywords:** Arduino UNO, Bluetooth module, Glove, Two-way Communication.

## **1. INTRODUCTION**

Hand gesture is an elementary movement of an individual's hands and represents the thoughts of a person. Evolutionary experts in anthropology say that they have been used since the origin of mankind and thus definitely much older than speech. Not only that, but they are also natural, ubiquitous, and meaningful part of a language, and researchers seem to claim that gesture and sound form a highly integrated system during human cognition. The aim of this project is to make the communication process of the hearing and speaking impaired person much easier. They are using sign language for communication. [2] The sign language can be understood only by the people who are exposed to it. The normal people who don't know the sign language find it difficult to communicate with them. This language problem has made them as an isolated group in the society. This project will help to overcome this inequality of our society.

The glove that we are providing will capture the signs which those people are gesturing using flex sensors and an accelerometer sensor and convert this into an audio signal which in turn comes out as a voice message through the speaker. In order to make this communication more efficient like the communication between normal people, the speech of normal person will be displayed in the LCD Screen. By this way, a mute person and a normal person can communicate in the most efficient way. [3]

## **2. INDIAN SIGN LANGUAGE**

Sign Language in India is predefined by a well-structured code gesture. Each and every gesture has its own meaning. It is the only means of communication for the impaired people. With the advances in technology numerous techniques have been proposed not only to minimize the problem of the impaired people but also to implement it in different domains. A person, who is not impaired, will never try to learn the sign language for interacting with them. [4] This becomes a cause of isolation of the mute people. If it is possible to develop a device to make their isolation disappear, there will be no difference between the normal people and the impaired community. A system has been proposed which would be able to recognize the various alphabets of Indian Sign Language for normal and mute interaction giving more accurate results at least possible time. It will not only benefit the mute people of India but also could be used in different applications in the field of technology. The following picture describes the gestures made in Indian Sign Language to represent the English alphabets.[5]



**Figure 1:** Gesture for alphabets

**Source:** Own elaboration

### 3. HETERO MOTIVE GLOVE

#### GESTURE TO SPEECH

The gesture to speech module will always begin with the glove, which is the core component of the project. It consists of five flex sensors, an LDR and a three-dimensional x-y-z axis accelerometer. All these sensors are commercially available and are normally used in our laboratory. The flex sensor is the most adaptable sensors as most of the letters can be distinguished based on the finger's flexibility. This provides two degrees of flexes of the fingers. These are nothing but variable resistors. As the flex sensors bend its resistance changes approximately linearly. They are originally six inches long. An accelerometer is normally required for movement or orientation detection. Specific hand movements are the only way to detect the letters J and Z. The only way to distinguish the letters G and Q is sensing the orientation of the thumb and index finger. The accelerometer comes in handy to the rescue. The purpose of LDR is to differentiate between a set of numbers in which the flex sensors are ambiguous. Numbers such as 1, 2 and 3 have only minor differences which is the not bending the other fingers. LDR will help to clearly establish the difference between the required numbers.



**Figure 2:** Number Representation is sign language  
**Source:** Own elaboration

There is a small, embedded board on top of the glove which receives all the outputs from the flex sensors. For all the flex sensor outputs, there are two set of heads from the Detection unit that are plugged into two sets of pins on the Glove circuit. The heads and pins provide a smooth interface between the glove and Detection unit. To disconnect these units, only the two sets of heads need to be unplugged.

The idea is to make the glove works in real time. All the ten numbers can be found by detecting the position of the fingers. Detection through hierarchy is fast and stable for most of the numbers. Flex sensors are normally highly sensitive, so they are sometimes unexpectedly activated when other parts of the hand are moving. Secondly these sensors cannot be tied to the glove in their fixed or initial position, and thus cannot be activated for certain numbers. By carefully monitoring and increasing the length of de-bounce time, the code will be able to recognize these difficult numbers with at most 1 or 2 misinterpretations. The fastest rate we can achieve is two numbers per unit time. Anybody who is not visually impaired can pick up the glove and learn its usage. After learning, the results will be fairly accurate.

### SPEECH TO TEXT CONVERSION

Voice Recognition which is also called Speaker Recognition has two main types: speaker identification and speaker verification. The first type is used to determine which one of the people is speaking, for example "one out of more election; and speaker verification is used to determine whether a person specified speaks, i.e. "One-on-one recognition". According to the voice that is detected from different materials, voice recognition can be categorized into the text-dependent and text-independent technology. The first type of voice recognition system requires speaker to pronounce with respect to the contents of the text. The sample sound profile needs

to be established accurately. A person also must be identified by the contents of the text during recognition to achieve better effect. The second type of recognition system does not require fixed contents of words, thus which is relatively difficult to model, but is convenient for user and can be applied to a wider range of applications. Voice print recognition is an application based on physiological and behavioral characteristics of the speaker's voice and linguistic patterns. The unique features of voice are analyzed to identify the speaker. With voice samples, the unique features will be extracted and converted to digital symbols, and then these symbols are stored as that person's character template. The template is kept in a computer database, a smart card or bar-coded cards. User authentication is being processed inside the recognition system to identify if there is a match or not.

Speech recognition technology is one of the emerging engineering technologies. Approximately 22% of the world's population is suffering from various disabilities; many of them are not able to see or unable to use their hands effectively. But they can share information with people by using a computer through a voice input. The performance of these systems is usually evaluated in terms of accuracy and speed. Accuracy is usually rated with Word Error Rate (WER), whereas speed is measured with the real time factor. Other measures of accuracy include Command Success Rate (CSR) and Single Word Error Rate (SWER).

#### **4. IMPLEMENTATION**

The above proposed model has been implemented with the help of Flex Sensor connected to a Microcontroller. The Flex sensors on each finger recognizes the Number specified by the person. This is done with the help of identifying how much each substrate or sensor has been bent. Smaller the radius, higher the resistance value. Thus, with the help of the current flowing through the I/O pin, the amount of bend can be determined. The glove with the flex sensor, microcontroller, interfacing and interconnecting components is being depicted in Figure 3, as shown below.



**Figure 3:** Implementation of the Proposed Model  
**Source:** Own elaboration

## **4. SCOPE**

The main target of this project is Hearing and Speaking Impaired People. Learning in the same environment as theirs, we have grown to know about their inconvenience while communicating. This had shattered their confidence. It is also making them feel like disabled people. So, this project helps in their communication with normal people. Usage of wireless transmission with the help of Bluetooth module makes the project more advanced one. Two-way communications that we are introducing in our project will make the project much easier one to use. As it is easy to handle, there will be a huge welcome for this one.

It is a misfortune that with the increasing smart environment still not many applications are available which can be controlled using hand gesture. This idea can provoke many more applications using this hand gesture such as operation of keyboard and mouse in computers, play stations without joysticks and who knows every click and tick can be done with just gestures bringing Human – Computer Interaction to the next level.

## **5. CONCLUSION**

Over the last decade numerous methods for hand gesture taxonomies and representations have been evaluated for the core technologies proposed in the hand gesture recognition systems. However, the evaluations are not dependent on the standard methods in some organized format but have been done based on more usage in the hand gesture recognition systems. The potential related to the application of hand gesture recognition systems in day-to-day life always keeps inspiring the advances required to realize the reliable efficient accurate and robust gesture recognition systems. We have used different sensors for hand gesture recognition in this project in the real time manner. This technique works well in the clear identification of hand gestures of alphabets with some practice. The performance of the proposed method highly depends on the readings obtained from the flex sensors.

## **6. REFERENCES**

**H. Navarro-Hellin, R. Torres-Sanchez, F. Soto-Valles, C. Albaladejo-Perez, J. A. Lopez-Riquelme, and R. Domingo-Miguel** "A wireless sensor architecture for efficient irrigation water management" *Agr. Water Manage.*, 2015.

**Princesa Cloutier, Alex Helderma, Rigen Mehilli** (2016) "Prototyping a Portable, Affordable Sign Language Glove, A Major Qualifying Project," Submitted to the Faculty of Worcester Polytechnic Institute.

**Navid Azodi, Thomas Pryor** (2016) "These Gloves Offer A Modern Twist On Sign Language" on Conrado Tapado/Univ of Washington, CoMotion.

**Archana S.Ghotkar, Dr.Gajanan k. karate** (2014) " Study of vision based hand gesture recognition using Indian Sign Language" on University of Pune.

**Seonwoo Lee, Si Ping Wang, Jonathan Lang** (2011) "Sign Language Translation", on Cornell University.

**Utpal V. Solanki, Nilesh H. Desai** (2011) "Hand gesture based remote control for home appliances: Handmote" on G.H. Patel College of Engineering and Technology, Gujarat Technological University Gujarat, India.



# MULTITASK CNN FOR RECOGNITION OF TIGERS THROUGH THEIR STRIPES

**P. Naveen**

*Assistant Professor, Department of ECE,*

*Kalasalingam Academy of Research and Education, (India).*

Email ID: naveenam88@gmail.com, <https://orcid.org/0000-0002-5202-2557>

**Sivakumar Pothiraj**

*Professor, Department of ECE,*

*Kalasalingam Academy of Research and Education (India).*

Email ID: sivapothi@gmail.com, <https://orcid.org/0000-0003-1328-8093>

**Konduru Vijay Kumar**

*UG Student, Department of ECE,*

*Kalasalingam Academy of Research and Education, (India).*

Email ID: vinithraju7@gmail.com, <https://orcid.org/0000-0002-2956-7364>

**Akula Siva Ganesh**

*UG Student, Department of ECE,*

*Kalasalingam Academy of Research and Education, (India).*

Email ID: akulasivaganesh1996@gmail.com, <https://orcid.org/0000-0003-0987-8576>

**Somesula Sukumar**

*UG Student, Department of ECE,*

*Kalasalingam Academy of Research and Education, (India).*

Email ID: somesulasukumar@gmail.com, <https://orcid.org/0000-0001-9013-9986>

## ABSTRACT

In natural reconnaissance environment specialists utilized standard following models to quantify the tiger's dependent on the investigation of accumulated tracks. In any case, lamentably segregating morphologically like species assessing is amazingly testing one and even extremely gifted specialists think that it's difficult to give solid results. In current years Artificial Neural Networks (ANN) turn into a great case of mechanization innovation to many examination territories incorporating design acknowledgment so as to improve precision, efficiency and unwavering quality. This paper presents some productive route for all the acknowledgment ventures of tigers. Fundamentally, video grouping gives more data than still picture. It is dependably a testing one to recognize an objective article in a live video, we experience difficulties like enlightenment, impediment in pre-preparing stages. Be that as it may, this can be overwhelmed by target object constantly in each edge, the viola-jones calculation is utilized to distinguish the tiger dependent on the haar highlights of the tiger. We are utilizing Convolution Neural Network (CNN) for the acknowledgment

of individual tiger dependent on their stripes (no two tigers have same stripe design like human fingerprints). CNN gives best outcomes and less mistake rates in the acknowledgment procedure.

**Keywords:** Artificial Neural Networks, Pattern Recognition, Viola-Jones algorithm, Convolution Neural Networks

## 1. INTRODUCTION

In the everyday life the survival of the creatures is exceptionally hard considering the human and natural exercises done. For instance, we are discussing tigers.

Tigers are the biggest feline species accessible on the planet, they are ruddy darker in shading with dark stripes on their body and some are in white shading. The tiger is a best predator which assumes a vital job in the decent variety of environment, and it is the highest point of the evolved way of life and keeps the number of inhabitants in prey herbivores and veggie lover on their feed. But since of human exercises like deforestation, zoological parks the survival of tigers is influenced in this way, we are presenting a tiger acknowledgment framework so as to make the most of an of tigers, in view of the include that tigers making due in the untamed life we can make the fundamental results to be taken to spare the tigers.

In this paper we used to recognize tigers through their stripes, distinctive tiger has distinctive stripe configuration. Based on the individuality of tiger we first use camera trap for object striking, we use viola-jones algorithm for clarifying that the striking object is tiger or not. After striking the tiger, we pre-process the detected image in order to extract stripe pattern from the tigers, later we use CNN for feature extraction and recognition.

## 2. DATA

So as to detect and recognize tiger we are supposed to have a huge set of tigers data-set for learning machine. For data-set of tigers, we had taken video arrangement of tiger in all poses, in all directions. Video arrangement has specified frame rate. So, we extract huge data of tigers by extracting all the frames of video arrangement.

No of Frames = Frame rate \* time of video in seconds



**Figure 1:** Dataset of Tiger from a Video

### 3. RELATED WORK

In olden days numerous approaches are available in totalling tiger census worldwide which includes pug mark, installation of camera, scat approach and radio collar approach.

#### **PUG MARK METHOD: -**

This technique was concocted by Indian forester SR Choudhury. In this technique, the pug mark (impression) of tiger is vital. It is viewed as that every pug mark is one kind, by considering unlike impressions of tigers in the areas of tiger, the quantity of tigers is tallied.

#### **Drawbacks: -**

- Difference in pug marks in water and on rough layers are doubtful to acquire from tiger occupied in landscapes.
- The state of each pugmark lifted is should be recorded without mutilation

#### **CAMERA TRAP: -**

This strategy, cameras are equipped at tiger regions having night view also. By evidencing distinctive tigers, quantity of tiger can be predicted. Evidenced image from every camera are exact, to check the tigers.

**Drawbacks: -**

- It is costlier than Pug mark strategy
- This technique winds up unfeasible in regions having salty waters, it harms the camera and
- It is hard to separate two tigers by this technique on the grounds that just by taking the snap of a tiger to perceive isn't sufficient.

**POOP/SCAT METHOD: -**

In this technique load of tigers are known by crap/scat approach. Poop is inspected by DNA testing and after that we can arrive at a progressively exact tally.

**Drawback: -**

- It isn't usually that somebody get poop of the considerable figure of tigers in a region.

**RADIO COLLAR METHOD: -**

In radio collar mechanism tigers are bagged and tailored with a radio collar. Along these lines the tigers can be tallied.

**Drawback: -**

- Radio collar strategy abort, when tiger get in salty water. On the off chance that the radio collar is lost in any condition it can't be determined under their check.

## 4. PROPOSED MODEL

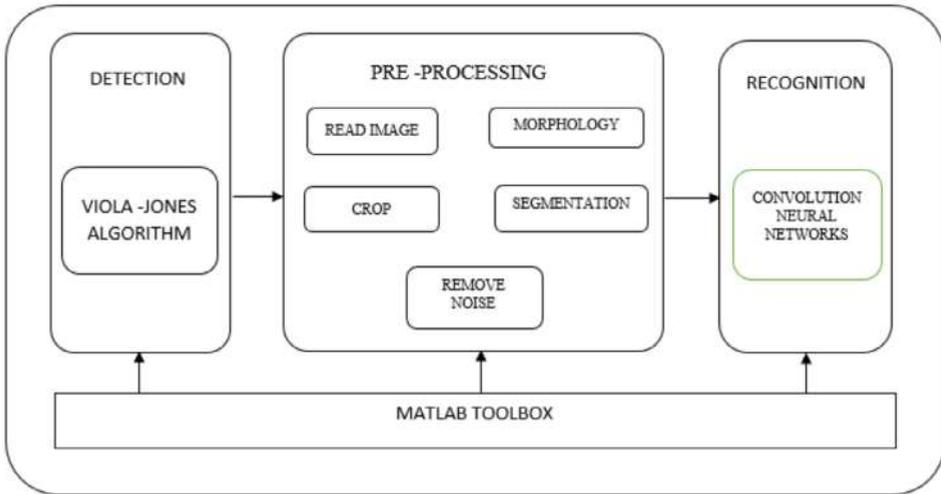


Figure 2: Proposed Model

## 5. METHODOLOGY

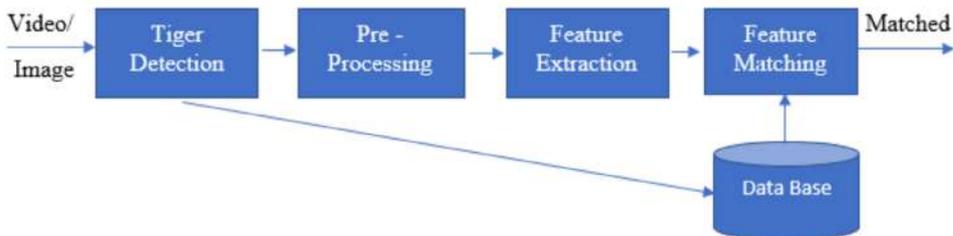


Figure 3: Methodology

We plan a methodology for tiger acknowledgment framework dependent on discovery and acknowledgment demonstrate. To validate our model, we planned a projection-based tiger acknowledgment framework which requires various structure choices. We expressly express the structure choices by presenting a conventional segmental tiger acknowledgment framework. We investigate different executions for discovery, pre-preparing, and acknowledgment modules.

## 6. DESCRIPTION OF THE SYSTEM

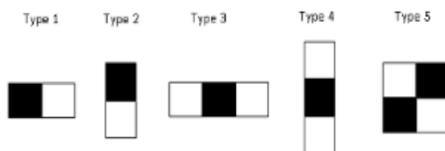
Our framework works in three phases: In first tiger identification, the viola jones calculation is utilized recognize the tiger dependent on the haar highlights to settle the procedure proficiently. In addition, we utilized the Adaboost approach alongside haar highlights for better characterization and frameworks will accomplish su-

perior without human components. The technique can do snappy characterization, requires just quick unpleasant standardization and pre-handling, and always shows preferable order execution over the other methodology on the database.

### 6.1 Stage one: A viola jones detection algorithm:

In 2001, Paul Viola and Michael Jones proposed a system called Viola– Jones object discovery structure. It tends to be prepared to distinguish assortment of objects of various classes. The stripes location handling is the initial step of the tiger acknowledgment framework. The progression will choose the execution of the framework, so it is the most vital advance of the acknowledgment framework. To complete its effectively, numerous scientists have proposed diverse methodologies. In this undertaking we centre around just AI strategies since they take out emotional reasoning elements from human experience. Besides, they just rely upon preparing information to settle on official choices. In this manner, on the off chance that preparation information is efficient and satisfactory, at that point these frameworks will accomplish superior without human components. A standout amongst the most mainstream and proficient learning machine-based methodologies for identifying object is Ada-Boost approach alongside viola jones discovery calculation. The location calculation incorporates the Haar Features, Creating an Integral Image, Adaboost calculation and Cascading.

Haar Features are fundamentally like convolution kernels, which utilized to distinguish nearness of highlights in a picture. A dark area is supplanted by +1 and the white district is supplanted with- 1. When we apply this veil to an information picture, we simply subtract the pixel esteems under white area from pixel esteems under dark locale and yield will be a solitary esteem. Along these lines, what we comprehend from this is, all these Haar highlights have a type of similarity to some facial highlights or qualities of tigers. Thus, Haar highlights speak to certain qualities of face. Viola-Jones calculation utilizes a sub-window from a picture, and it computes these highlights everywhere throughout the picture.



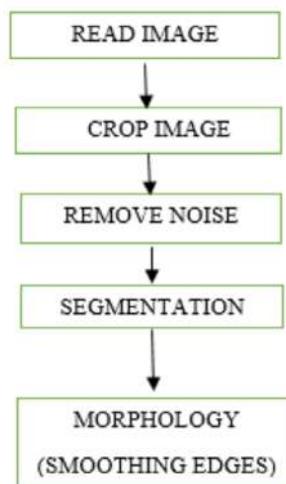
**Figure 4:** Haar Types (Features)

The inspiration in applying AdaBoost calculation incorporates: AdaBoost calculation is a standout among prominent AI calculations. Its hypothetical premise is sound,

and its execution is basic. It has been connected to many example acknowledgment issues, for example, face acknowledgment. Be that as it may, the use of the AdaBoost calculation to interruption discovery has not been investigated up until this point. The AdaBoost calculation amends misclassifications made by frail classifiers, it is less vulnerable over-fitting than most learning algorithms. Example acknowledgment exhibitions of AdaBoost-based classifiers are commonly promising. Informational collections for interruption recognition are a heterogeneous blend of downright and constant sorts of highlights. The diverse element types in such informational collections make it hard to discover relations between these highlights. By consolidating feeble classifiers for ceaseless highlights and powerless classifiers for straight out highlights into a solid classifier, the relations between these two unique sorts of highlights are taken care of normally, with no constrained changes among persistent and all out highlights. On the off chance that basic feeble classifiers are utilized, the AdaBoost calculation is quick.

### 6.2 Pre-processing steps: -

Pre-processing is a technique to play out certain tasks on a picture, to get an improved picture or to remove some helpful data from it. we are going to section the picture, isolating foundation from closer view articles and we will additionally improve our division with more commotion expulsion. The different advances engaged with pre-preparing are referenced underneath.



**Figure 5:** Steps in Pre-processing

Image segmentation is the approach toward isolating figure to numerous segments. This is regularly used to recognize objects or important data in computerized pictures. There are a extensive scope of approaches to perform picture division. In this paper we talked about the verging technique.

### 6.3 Feature selection and extraction using CNN: -

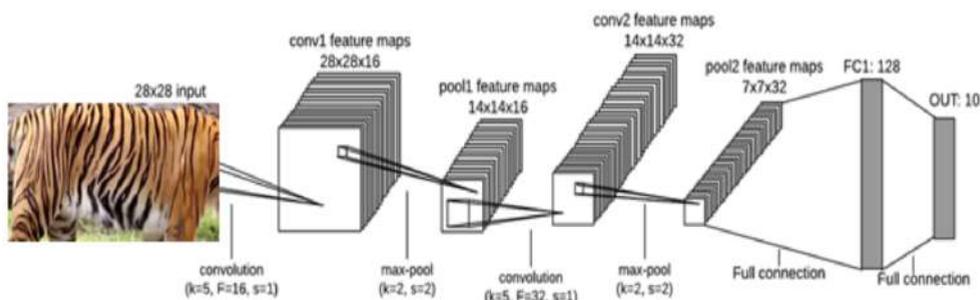
With respect to highlight extraction and coordinating module, we utilizing Convolution Neural Networks (CNN) which has demonstrated very effective in zones, for example, picture acknowledgment and order. Convolution Neural Networks has been fruitful in distinguishing faces, objects and so forth.

Convolution Neural Network is comparative in engineering to first LeNet and arranges an info picture into classifications. As apparent from the figure underneath, on accepting a picture as information, the system accurately doles out the most elevated likelihood for specific picture among pictures. The whole of all probabilities in yield layer ought to be one.

The CNN consists of three steps

- Feature mapping,
- Pooling layer,
- Flattening and
- Fully connected layer.

These three are responsible for the recognition of the tiger based on the unique feature (stripes) of the tiger.



**Figure 6:** Selection and Extraction

### **Feature Mapping: -**

In feature mapping the features (stripes) of the tiger is extracted from the image in the form of weights. For e.g. in the above figure 16 features are extracted from the image in the initial stage and in the second stage the features are multiplied for more efficient way to get the output.

### **Pooling Layer: -**

In the pooling layer the features that extracted in the feature mapping is to reduce the number of features which are unwanted in feature recognition. The max pool takes 2x2 matrix on the feature map. It packs the week features and made them as a strong

### **Flattening: -**

In this step all the features after the max pool are made to be flatten. It involves that the entire features can be formed in a single column which is fed into the Neural Network processing.

### **Fully connected layer: -**

After the flattening step the feature maps are fed into the neural networks. This step has input layer, fully connected layer and output layer. The fully connected layer is where the feature of every neuron is connected to another neuron and the output field is where the prediction takes place. The error in the prediction step is back propagated in order to improve the prediction.

## **7. RESULTS**

This will give the precise results for the census of tigers automatically without any human involvement. We find census with the help of other models which are discussed in the related work but, each one has the drawbacks to find and some need human effort also. But in our project, we proposed the automatic way for the census.

### **Step 1**

In this step from the camera installed in tiger areas to detect the tigers and make a perfect shot of the tiger image for further step.



**Figure 7:** Detection of a Tiger

### Detection Step

From the image captured is saved for the further process of detection. In this step captured image is tested with the training set of data, cropped in the form of training image crop size and saved for the for the recognition step.



**Figure 8:** Tiger image extraction form the captured image

### Recognition Step

In this step the detected image is matched for the template matching in the training data and stripe pattern is extracted from the detected image.



**Figure 9:** Stripe pattern extraction from detected image

Then extracted stripe pattern is matched with the train data. If the test data is matched with trained data the count of tiger is put as it is otherwise the count will be incremented by 1.

## 8. CONCLUSION

Hence, the project is very useful in identifying the individual tigers efficiently with less error rates. The steps that involved in this are very accurate for finding the census of tigers. The results obtained from the created dataset proves a better compared to the existing methodology. This method can be still extended to real time data with huge datasets. With the increment in iteration, we can observe the change of process with respect to loss function and model accuracy.

## 9. REFERENCES

- Steve Lawrence, Member, IEEE, C. Lee Giles, Senior Member, IEEE, Ah Chung Tsoi, Senior Member, IEEE, and Andrew D. Back, Member, IEEE.** (1997). Face Recognition: A Convolutional Neural-Network Approach. *IEEE Transactions On Neural Networks*, 8(1). doi: 10.1109/72.554195.
- Roberto Brunelli and Tomaso Poggio.** (1998). Face Recognition: Features versus Templates. *IEEE Transactions On Pattern Analysis And Machine Intelligence*, 15(10).
- Avraham Levy and Michael LindenbaumJhanavi Jyothish, Mamatha, Srilakshmi Gorur, and M. Dakshayini.** (2000). Sequential Karhunen–Loeve Basis Extraction and its Application to Images. *IEEE Transactions On Image Processing*, 9(8).
- Raffaele Cappelli, Dario Maio, Member, IEEE, and Davide Maltoni.** (2001). Multispace KL for Pattern Representation and Classification. *IEEE Transactions On Pattern Analysis And Machine Intelligence*, 23(9).
- Sankar K. Pal, Senior Member, IEEE, and Sushmita Mitra, Student Member, IEEE.** (1992). Multilayer Perceptron, Fuzzy Sets, and Classification. *IEEE Transactions On Neural Networks*, 3(5).
- Jiexiong Tang, Student Member, IEEE, Chenwei Deng, Senior Member, IEEE, and Guang-Bin Huang, Senior Member, IEEE.** (2016). Extreme Learning Machine for Multilayer Perceptron. *IEEE Transactions On Neural Networks And Learning Systems*, 27(4).

**S. C. Tai, C. C. Lai, and Y. C. Lin,** (1996). Two Fast Nearest Neighbor Searching Algorithms for Image Vector Quantization. *IEEE Transactions On Communications*, 44(12).

**Henry A. Rowley, Student Member, IEEE, Shumeet Baluja, and Takeo Kanade, Fellow, IEEE.** (1998). Neural Network-Based Face Detection. *IEEE Transactions On Pattern Analysis And Machine Intelligence*, 20(1).

**Sameer A. Nene and Shree K. Nayar,** (1997). A Simple Algorithm for Nearest Neighbor Search in High Dimensions. *IEEE Transactions On Pattern Analysis And Machine Intelligence*, 19(9).

**Hans-Ulrich Bauer and Klaus R. Pawelzik.** (1992). Quantifying the Neighbourhood Preservation of Self-Organizing Feature Maps. *IEEE Transactions On Neural Networks*, 3(4).

**Viola P., & Jones M.** (2001). Rapid Object Detection using a Boosted Cascade of Simple Features. *Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*. doi:10.1109/cvpr.2001.990517

# **REINFORCEMENT LEARNING IN AUTONOMOUS VEHICLE TO UNDERSTAND TRAFFIC CONGESTION**

**D Prem Raja**

*Assistant Professor, Department of Information Technology, Kalasalingam Academy of Research and Education. Tamil Nadu (INDIA).*

Email ID: [dpremraja@gmail.com](mailto:dpremraja@gmail.com), <https://orcid.org/0000-0001-5330-0515>

**V Vasudevan**

*Senior Professor, Department of Information Technology, Kalasalingam Academy of Research and Education. Tamil Nadu (INDIA).*

Email ID: [vasudevan\\_klu@yahoo.co.in](mailto:vasudevan_klu@yahoo.co.in), <https://orcid.org/0000-0002-8862-8665>

## **ABSTRACT**

One of the most thrilling areas in Artificial Intelligence is referred to as Reinforcement Learning. Why? Because it's what's closest to human learning. In self-driving cars, a lot of the Machine Learning concerned is based totally on both supervised or unsupervised learning. In Reinforcement Learning, we're taking a absolutely exceptional method and gaining knowledge of to force from experience. With the improvement of the area reinforcement getting to know (RL) has grow to be a effective mastering framework now successful of mastering complicated insurance policies in excessive dimensional environments. Ever growing visitors go with the flow leads to site visitors congestions and jams, giving increase to make bigger in the value of transportation as properly as affecting the events lives of the people. The Reinforcement Learning independent car permits customers to be higher knowledgeable and to make safer, extra coordinated, environment friendly and smarter use of transport network.

**Keywords:** ReinforcementLearning, AutonomousVehicle, trafficcongestions, trafficjams

## **1. INTRODUCTION**

Autonomous vehicle is expected to considerably scale back collisions and enhance quality for the older and also the disabled and scale back the necessity for car parking zone within the cities. Reinforcement Learning is taken into account to be one among the strongest paradigms in autonomous vehicle, which may be applied to show machines the way to behave through atmosphere interaction.

## **2. RELATED WORK**

The objective of this work is to present the current status of work in the autonomous vehicle.

Japan's Tsukuba Mechanical Engineering Laboratory developed the first self-driving car in 1977. Since then many companies have come up with their versions of self-driving cars. In December 2018 Waymo became the first company to commercialize a fully autonomous taxi service in US[13].

Artificial Intelligence helps the autonomous vehicle to drive safely. The Artificial Intelligence software detects whether or not the driver is present in the vehicle. Artificial Intelligence monitors various sensors installed in the vehicle. The Artificial Intelligence software[6] does the following process (Graphics 1).

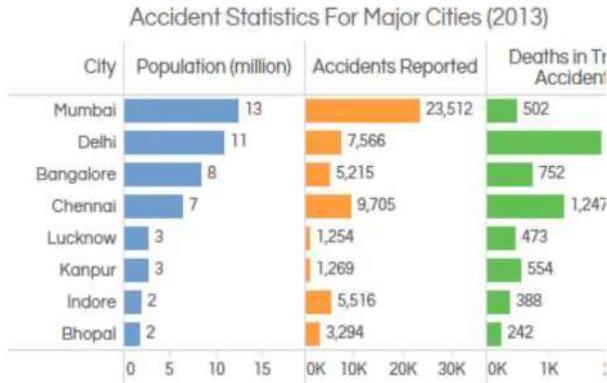
### ***Facial recognition:***

These algorithms find what the condition of the driver is whether or not he's sick or tired and if he desires any medical emergency. The system will mechanically regulate the seat, mirrors and temperature to suit the individual[7].

### ***Eye tracking:***

On perceptive eye gaze, eye openness and head position, eyeSight will find distracted driving and alert the driver to stay the attention on the road. Somnolence is detected by eye openness and head position, permitting the system to come to life the driver[5].

Contextual control: The system tailors the content of the alert shown (HUD) in keeping with wherever the driver's eyes square measure targeted[10].

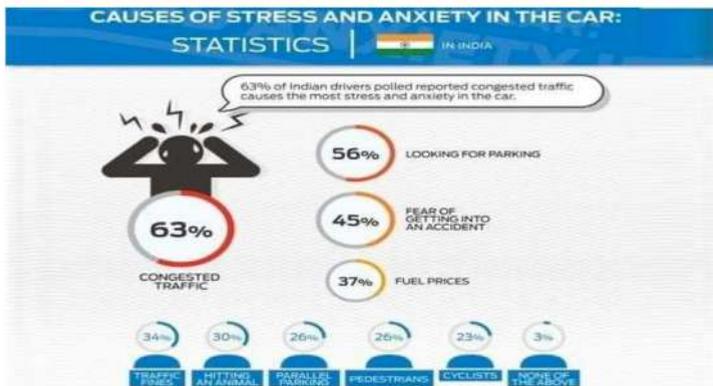


**Graphic 1.** Accident Statistics for Major Cities

A novel Reinforcement Learning approach which perform approximation and have learning for autonomous deciding for intelligent vehicles on the route. Associate degree MOAPI[2] algorithmic program, when ever the options for worth perform approximation learned in a very knowledge driven way.

Artificial Intelligence for vehicles (AIV) intention at making use of both practical and advanced Artificial Intelligence strategies to automobiles so that automobiles can perform human like behaviors[8].

Markov decision processes (MDPs) are used in a wide area of applications such as robotics, manufacturing and automatic control[3].



**Graphic 2.** Statistics for the Cause of Stress and anxiety in car

An event-driven model for AGV system with in the zone management framework. Then road map or route map are strictly designed for the area of the AGVs[1] which supports our zone management model, a track management strategy

is projected, that reroutes the motion conflict resolution among the AGVs from the routing drawback.

Google acknowledged that one amongst its independent cars met with a major collision to have an impact on somebody's life. The incident involved one amongst Google's self-driving vehicles being rear-ended in Mountain View, CA, during checking out[14]

Tesla's autopilot characteristic was once introduced to the Chinese market. This semi-independent fashion presents a tricky driver assist machine (ADAS), nevertheless it wishes a person's administration over the automotive. The accident took place apparently in autopilot mode that collided into the rear of a enchantment car whereas using in clear weather. No attempt at braking was made[11]

An independent automobile killed 49-year-old Arizona resident Elaine two Herzberg in what's believed to be the deadly U.S. crash involving a pedestrian and self-driving vehicle. The Uber driver wasn't observing the street within the moments caused the collision.

To avoid the misconceptions in autonomous vehicle and make them more efficient and bring it is collision avoidance using the ultrasonic sensors and infrared sensors[12]. Self-driving cars are consistently being more equipped with the collision avoidance, obstacle avoidance and alerting systems to envisage the probability for collision with an environment or external sources[4]. Upon noticing a probable collision, such systems characteristically start an action to evade the collision and provide a warning to the vehicle operator (Graphics 2).

### **3. PROPOSED SYSTEM**

We propose the Reinforcement Learning technique because it uses the three techniques State, Action and Reward to understand the surrounding. Based on the current state the next action is taken, based on the action reward is issued. If the action is a correct action then the system gets a positive reward else it gets a negative reward.

Based on the three techniques the system finds the correct and the optimal path or the safest path to make the vehicle move from source to destination without any hindrances.

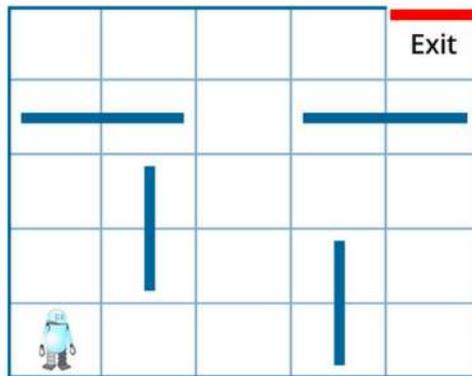
## Machine Learning

Machine Learning,(ML) once applied, will suppose and act virtually like people at large victimization past knowledge.

It will build advised selections supported what it's learned. Big Data, ML and AI generate sensitive autonomous system to support the movement of vehicles.

### How does Reinforcement Learning work?

Imagine a robot is trying to find the exit and it fails. It tries again, fails. After repeating this process 1000 times, it finally succeeds. The robot has now learned how to reach the exit. This is Reinforcement Learning (Graphics 3,4).



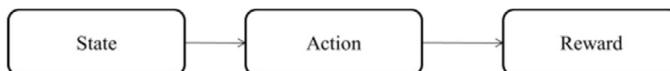
**Graphic 3.** Example of Reinforcement Learning

There are three key terms in Reinforcement Learning

**State** – Describes the current situation.

**Action** – What the agent can do in its situation.

**Reward** – Feedback for whether a particular action in a given state is good or bad.



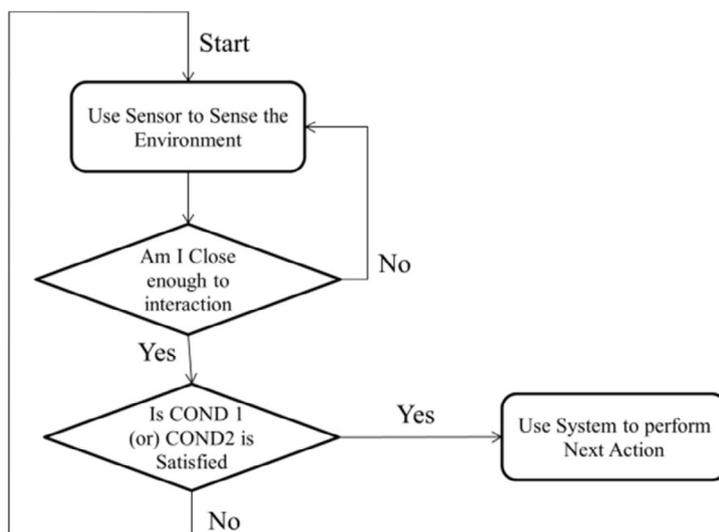
**Graphic 4.** Key terms of Reinforcement Learning

### Path planning technology

Rules, obstacle avoidance, predictive model and object discrimination between different vehicles on the road help the software follow traffic rules and navigate through the obstacles to stay on the road and avoid collision and obey traffic laws. The autonomous car rely on the path planning approach, predictive control and behavior based models. The algorithm process the information gathered by the autonomous car technology to enable the car to react accordingly.

Occupancy grid algorithm, which calculates the risk and flexibility based on the presence of obstacles, lane and road boundaries[9].

Driving corridors algorithm, which recreates continuous collision free spaces, bounded by lane and other obstacles between which the vehicle is expected to drive. It uses data from digital maps built by simultaneous location and mappingmodels.



**Graphic 5.** Flow chart of Proposed work

*Algorithm:*

The algorithm explains the following steps (Graphics 5)

Step1: start the autonomous vehicle

Step2: sensor starts detecting the surroundingenvironment

Step3: if there is any object in the surrounding go to step4 else go back to step2

Step4:

COND1-sense to the left side for any obstacle

COND2-sense to the right side for any obstacle

Step5: if any one condition of the step4 is satisfied, the system will perform then extaction else go to step1.

## 4. CONCLUSION

In this paper we proposed a novel technique for an autonomous vehicle using the reinforcement learning method. The path planning technology helps the vehicle to find the optimized and secure path to move the vehicle from source to destination. Using this method the system will automatically understand the surrounding and act according to it. Reinforcement studying is nevertheless an energetic and rising areain real-world self sustaining riding applications. Although there are a few profitable business applications, there is very little literature or large-scale public datasets available. Thus we were stimulated to formalize and arrange RL functions for autonomous driving. Autonomous riding situations contain interacting marketers and require negotiation and dynamic decision making which fits RL. However, there are many challenges to be resolved in order to have mature options which we discuss in detail. In this work, a particular theoretical reinforcement learning is presented, alongside with a complete literature survey about making use of RL for self reliant using tasks.This helps the autonomous vehicle to prevent it from the obstacles as well as pedestrians.

## 5. REFERENCES

- 1. Andrew L. Kun, SusanneBoll, Albrecht Schmidt** “ShiftingGears: User Interface in theAge of AutonomousDriving” IEEE PervasiveComputing(Vol15, Issue 1 Jan-Mar 2016)
- 2. ChangxiYou, Jianbo Lu,** Dimitar Filev Panagiotis Tsiotras “HighwayTrafficModeling-forAutonomousVehicleUsingReinforcementLearning” IEEE intelligentVehicles 2018
- 3. Jun Li, Hong Cheng,** HongliangGuo, ShaoboQiu“Surveyon Artificial IntelligenceVehicles” AutomobileInnovations2018

- 4. Kalpana.S, JeraldRoiston.J, Krishna Kumar.S, Rajkumar.S, Sinto P Davis** IntelligentCollisionPreventivSystem Using ADRINO Microcontroller, International Journal of Recent Trends in Engineering & Research (IJRTER) Vol.2, Issue 4, April 2016
- 5. KanwaldeepKaur, Giselle Rampersad** “Trust in driverless cars: Investigatingkeyfactorsinfluencingtheadopationof driverless cars” Journal of Engineering and Technology Management Vol 48, April-June 2018 pages87-96
- 6. Keshav Bimbraw** “Autonomous Cars: Past, Present and Future – A review of thedevelopmentsin thelastcenbturay, thepresentscenario and theexpectedfutureifautonomousvehicletechnology” ResearchGateJan2015
- 7. G. Leen, D. Heffernan** “Expandingautomotiveelectronicsystems” IEEE Vol 35, Issue 1, Jan2002
- 8. Marco A.Wiering et.al.** “Reinforcement Learning Algorithm for solving Classification Problems”
- 9. NajbinMomin, Dr. M.S. Patil,** Accident Control SystemUsingUltrasonic Sensor, International Journal of InnovativeResearchin Electrical, E l e c t r o n i c s , Instrumentation and Control Engineering (IJIREEICE) Vol.5, Issue10, October2017
- 10. RaivoSel, Mario Leier, AntonRassolkin,** Juhan-OeeoEmits “Self- driving car ISEAUTO forresearch and education” 2018 19thInternational conferenceonResearch and Educationin Mechatronics (REM)
- 11. B. Ulmer**“VITA-anautonomousroadvehicle (ARV) forcollisionavoidancein traffic” IEEE Xplore 06 August2002
- 12. XinXu, LeiZuo, Xin Li, LilinQian, JunkaiRen and ZhenpingSun** “A ReinforcementLearningApproach to AutonomousDecisionMaking to IntelligentVehiclesonHighways” IEEE TransacionsonSystem – December2018
- 13.** [http://www.robotictrends.com/article/how\\_ai\\_is\\_making\\_self\\_driving\\_c ars\\_smarter](http://www.robotictrends.com/article/how_ai_is_making_self_driving_c ars_smarter)
- 14.** <https://www.intel.com/content/www/us/en/automotive/go-automated-driving.html>

# IOT BASED EXPERT SYSTEM FOR MONITORING AND CONTROLLING CROP DAMAGE FROM WILD ANIMALS

**Karkuzhali S**

*Assistant Professor, Department of Computer Science and Engineering, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India*

Email ID: vijikarkuzhali@gmail.com, XXXXXXXXXXXXX

**Divya D**

*IV Year B.Tech Computer Science and Engineering, Kalasalingam Academy of Research and Education, Tamilnadu, India.*

Email ID: divya.dsh.1998@gmail.com, XXXXXXXXXXXXX

**Haritha G**

*IV Year B.Tech Computer Science and Engineering, Kalasalingam Academy of Research and Education, Tamilnadu, India.*

Email ID: gharitha962@gmail.com , XXXXXXXXXXXXX

## ABSTRACT

Wildlife life prerequisite covers human populace, making cost to inhabitants and developed field. Wild creatures regularly annihilate standing yields, because of which yearly generation of harvests lessens making monetary misfortunes ranchers. In our area, rancher suicide is enormous issue because of low efficiency among homesteads. This low efficiency is a direct result of two primary reasons for example Yield decimated by wild creatures and Crop crushed by nature object. This paper gives survey to finish specialized arrangement utilizing PIR sensor and Internet of Things (IOT) to the ranchers to keep their yields from wild creatures. It incorporates every one of the kinds of sensors, controller, actuator required for PIR sensor and Aurdino UNO as a heart of the System. The proposed work is totally specialized answer for every rancher utilizing wire PIR sensor and Internet of Things (IOT) and spotlights on calculation to distinguish the nearness of creatures close to the yield field. The principle working principle of the system that is utilized here is the Aurdino uno which is a broad stage and the PIR. The Aurdino uno is an arrangement of charge card estimated single-board PCs.

**Keywords:** Crop damage, IoT, PIR Sensor, Aurdino, Wild life.

## 1. INTRODUCTION

The preservation of crop field from the wild creature has been a principle objective of this paper. The creatures from the wild zone are ceaselessly assaulting to edit

from such a large number of years and the insurance of this harvest field from wild creatures is the difficult issue. The wild creatures face a lack of water and sustenance because of which they move towards the agriculture region which makes incredible misfortune to the harvests and yearly pay of ranchers, when wild creatures enter in a homestead there is a requirement for a ready alarm to keep crops from harms from wild creature.

A PIR sensor comprises of countless automated sensors to agreeably monitor physical or environmental conditions. A normal PIR comprises of different bunches associated with the sink node. Each cluster has number of sensor nodes having one Master node fit for gathering the information from outstanding nodes.

Every Sensor node requires four essential units for example sensing unit, processing unit, transceiver unit and a power unit, each node will have every one of the sensors required to distinguish wild life movement so as the vital move will be made by actuator with the goal that the wild creatures will flee. The situation of the creature once recognized is followed by PIR sensor then Arduino uno sends MS to the rancher by utilizing GSM then the bell will deliver the sound.

## **2. EXCITING METHOD**

Meonghun *et al.* (2013) planned to built up the choice emotionally supportive network to estimate farming generation utilizing IoT sensors. This framework was additionally a bound together framework that supports the procedures sowing seeds through offering farming items to customers [1]. Baranwal *et al.* (2016) is arranged to complement the strategies to take care of such issues like recognizable proof of rodents, dangers to crops and conveying ongoing notice dependent on data examination and preparing without human mediation. In this gadget, referenced sensors and electronic gadgets are coordinated utilizing Python contents. In view of endeavored experiments, we had the option to make progress in 84.8% experiments [2].

Rao *et al.* (2012) has outline about Sensing as an administration on cloud utilizing couple of uses like Augmented Reality, Agriculture and Environment checking. They are for detecting as an administration on cloud [3]. Navulur *et al.* (2017) depicts remote administration of farming exercises and their mechanization utilizing new advances is the territory of center for this examination action. A solar powered remote administration and computerization framework for rural exercises through remote sensors and Internet of Things including, an equipment stage dependent on Raspberry Pi Micro controller designed to associate with a client gadget and got to

through the web organize [4]. Malche *et al.* (2017) proposes a model framework plan, usage and portrayal of required apparatuses and advances to create Internet of Things (IoT) based water level observing framework which can be executed in future shrewd towns in India [5].

Gill *et al.* (2017) had proposed a framework accumulates data from different clients through preconfigured gadgets and IoT sensors and procedures it in cloud utilizing enormous information investigation and gives the expected data to clients consequently. [6].

Mekala *et al.* (2017) incorporates remote controlled procedure to perform undertakings like showering, weeding, fowl and creature frightening, keeping cautiousness, dampness detecting, and so forth. Also it incorporates brilliant distribution center administration which incorporates temperature support, mugginess upkeep and burglary identification in the stockroom. Thirdly, shrewd basic leadership dependent on exact constant field information for brilliant water system with savvy control. Controlling of every one of these activities will be through any remote savvy gadget or PC associated with Internet [7].

Rajeswari *et al.* (2017) Cloud based Big information examination is utilized to dissect the information viz. compost necessities, investigation the yields, market and stock prerequisites for the harvest. At that point the expectation is performed dependent on information mining strategy which data achieves the rancher by means of versatile application [8].

Wasson *et al.* (2017) displays the IOT based agriculture generation framework which will screen or break down the yield condition like temperature mugginess and dampness content in soil. This paper utilizes the reconciliation of RFID innovation and sensors. As both have distinctive target sensors are for detecting and RFID innovation is for distinguishing proof This will successfully take care of the issue of rancher, increment the yield and spares his time, influence, cash [9]. Sajid *et al.* (2016) was to feature some significant actualities about modern SCADA frameworks with an accentuation on dangers, vulnerabilities, the board and the present works on being pursued. CPSs, for example, SCADA frameworks are generally utilized. The goal of IoT-based SCADA frameworks is to build their adaptability, cost proficiency, enhancement ability, accessibility and versatility of such frameworks. For this reason, modern SCADA frameworks use the advantages of IoT and distributed computing [10].

"Smart Irrigation Analysis" is an IoT application which gives remote investigation of water system on the field to the enduser which is superior to conventional water system of yield on field. Savvy water system application has a mechanized repeating watering plan; detecting and examination of water utilized for yield and furthermore faculties dampness level giving constant information developed by Kinjal *et al.* (2018) [11]. Venkatesan *et al.* (2017) has built up a framework which will naturally screen the farming field just as performing live video spilling for checking the Agriculture field from the server itself, through raspberry pi camera [12-15]. Elijah *et al.* (2018) utilizes Internet of Things (IoT) and Data Analytics are utilized to upgrade the operational proficiency and profitability in the horticulture part..The change in perspective from utilization of WSN as a noteworthy driver of shrewd horticulture to the utilization of IoT and DA [16].

### **3. PROPOSED METHOD**

Harvests in homesteads are ordinarily assaulted by neighborhood creatures like Bufaloes, Cows, Goats and Birds and so forth. This prompts immense misfortunes for the ranchers. It isn't workable for ranchers to blockade whole fields or remain 24 hours and gatekeeper it. So here we propose programmed crop insurance framework from creatures. This is a Microcontroller based framework utilizing PIC family Microcontroller. This framework utilizes a movement sensor to distinguish wild creatures drawing closer close to the field. In such a case the sensor flag the Microcontroller to make a move.

The Microcontroller currently sounds a caution to charm the creatures from the field just as sends SMS to the rancher with the goal that he may think about the issue and go to the spot in the event that the creatures don't dismiss by the alert. This guarantees total security of yields from creatures along these lines ensuring the rancher's misfortune. Figure 1 shows the block diagram of the proposed method. Figure 2 and 3 shows the implementation result of IoT device for crop damage prevention from wild animal.

#### **LCD DISPLAY:**

A LCD is an electronic presentation module which uses liquid crystal to deliver an obvious image. The LCD show is a fundamental module regularly utilized in DIYs and circuits.

## GSM Module:

GSM module is accustomed to making an impression on ranchers. GSM used to send the message to the proprietor of the homestead.

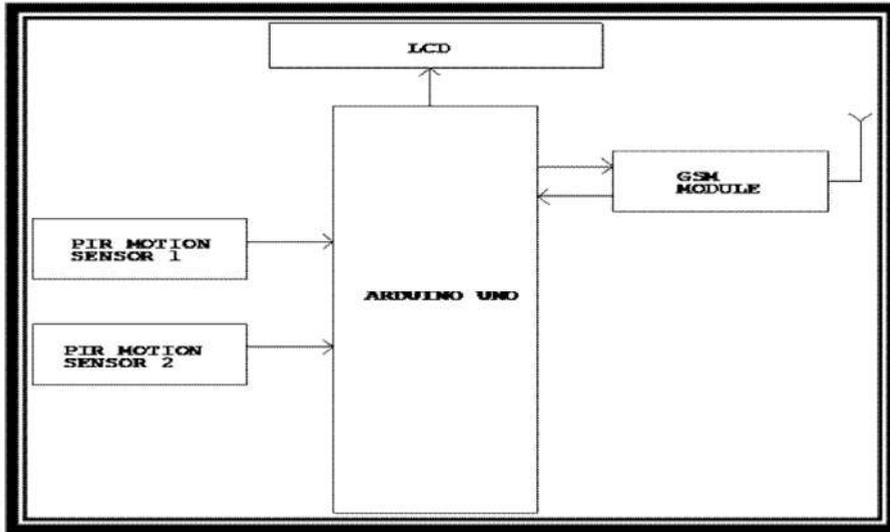
## 4. RESULTS AND CONCLUSION

In this paper, developed integrative methodology in the field of IoT for smart Agriculture dependent on low power devices and open source systems. The objective of this work is to give a repulsing and checking framework for harvest protection against creature assaults and climate conditions. In our future work, we will expand the present functionalities of our framework and examine the opportunity of joining the highlights of our framework to different areas.

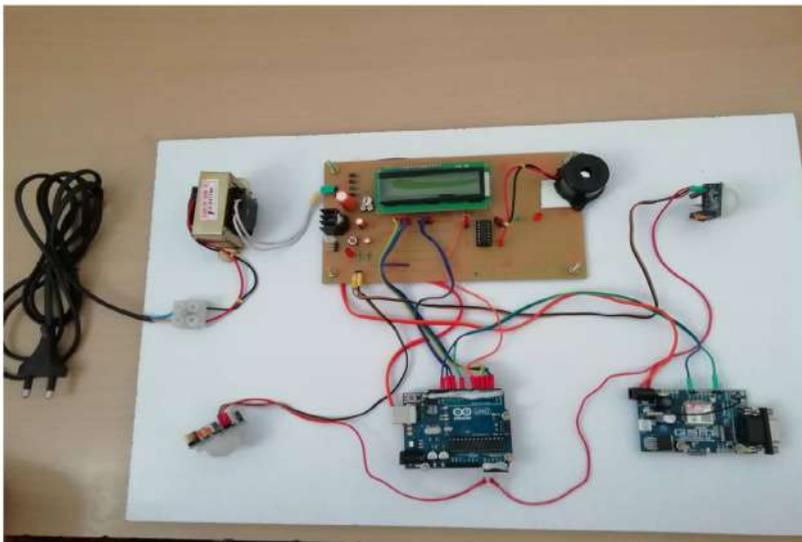
## 5. REFERENCES

- [1] **Lee, M., Hwang, J. and Yoe, H.,** 2013, December. Agricultural production system based on IoT. In *2013 IEEE 16th International Conference on Computational Science and Engineering* (pp. 833-837). IEEE.
- [2] **Baranwal, T. and Pateriya, P.K.,** 2016, January. Development of IoT based smart security and monitoring devices for agriculture. In *2016 6th International Conference-Cloud System and Big Data Engineering (Confluence)* (pp. 597-602). IEEE.
- [3] **Rao, B.P., Saluia, P., Sharma, N., Mittal, A. and Sharma, S.V.,** 2012, December. Cloud computing for Internet of Things & sensing based applications. In *2012 Sixth International Conference on Sensing Technology (ICST)* (pp. 374-380). IEEE.
- [4] **Navulur, S. and Prasad, M.G.,** 2017. Agricultural management through wireless sensors and internet of things. *International Journal of Electrical and Computer Engineering*, 7(6), p.3492.
- [5] **Malche, T. and Maheshwary, P.,** 2017. Internet of things (IoT) based water level monitoring system for smart village. In *Proceedings of International Conference on Communication and Networks* (pp. 305-312). Springer, Singapore.
- [6] **Gill, S.S., Chana, I. and Buyya, R.,** 2017. IoT based agriculture as a cloud and big data service: the beginning of digital India. *Journal of Organizational and End User Computing (JOEUC)*, 29(4), pp.1-23.

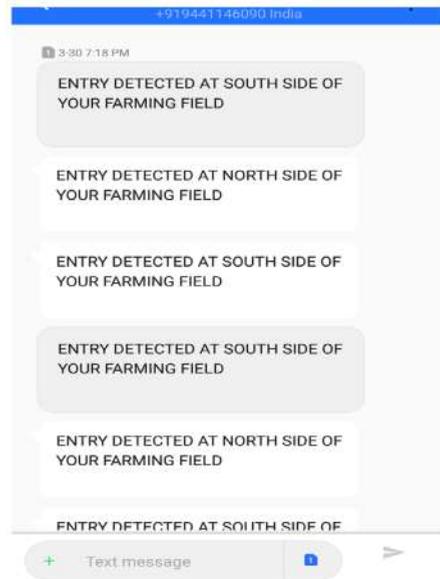
- [7] **Mekala, M.S. and Viswanathan, P.**, 2017, February. A novel technology for smart agriculture based on IoT with cloud computing. In *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)* (pp. 75-82). IEEE.
- [8] **Rajeswari, S., Suthendran, K. and Rajakumar, K.**, 2017, June. A smart agricultural model by integrating IoT, mobile and cloud-based big data analytics. In *2017 International Conference on Intelligent Computing and Control (I2C2)* (pp. 1-5). IEEE.
- [9] **Wasson, T., Choudhury, T., Sharma, S. and Kumar, P.**, 2017, August. Integration of RFID and sensor in agriculture using IOT. In *2017 International Conference On Smart Technologies For Smart Nation (SmartTechCon)* (pp. 217-222). IEEE.
- [10] **Sajid, A., Abbas, H. and Saleem, K.**, 2016. Cloud-assisted IoT-based SCADA systems security: A review of the state of the art and future challenges. *IEEE Access*, 4, pp.1375-1384.
- [11] **Kinjal, A.R., Patel, B.S. and Bhatt, C.C.**, 2018. Smart Irrigation: Towards Next Generation Agriculture. In *Internet of Things and Big Data Analytics Toward Next-Generation Intelligence* (pp. 265-282). Springer, Cham.
- [12] **Venkatesan, R. and Tamilvanan, A.**, 2017, April. A sustainable agricultural system using IoT. In *2017 International Conference on Communication and Signal Processing (ICCSP)* (pp. 0763-0767). IEEE.
- [13] **Rawal, S.**, 2017. IoT based smart irrigation system. *International Journal of Computer Applications*, 159(8), pp.880-886.
- [14] **Baranwal, T. and Pateriya, P.K.**, 2016, January. Development of IoT based smart security and monitoring devices for agriculture. In *2016 6th International Conference-Cloud System and Big Data Engineering (Confluence)* (pp. 597-602). IEEE.
- [15] **Kinjal, A.R., Patel, B.S. and Bhatt, C.C.**, 2018. Smart Irrigation: Towards Next Generation Agriculture. In *Internet of Things and Big Data Analytics Toward Next-Generation Intelligence* (pp. 265-282). Springer, Cham.
- [16] **Elijah, O., Rahman, T.A., Orikumhi, I., Leow, C.Y. and Hindia, M.N.**, 2018. An overview of Internet of things (IoT) and data analytics in agriculture: Benefits and challenges. *IEEE Internet of Things Journal*, 5(5), pp.3758-3773.



**Figure 1:** Block Diagram of Expert System for Crop Damage Detection from Wild Animal using IoT Device



**Figure 2:** Implementation of the Proposed Expert system for Crop Damage Prevention using IoT Device.



**Figure 3:** Implementation Result of Getting SMS about the region of Crop Damage

# IOT BASED SOIL MOISTURE DETECTION SYSTEM FOR AUTOMATIC IRRIGATION

**Karkuzhali S**

*Assistant Professor, Department of Computer Science and Engineering, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India*

Email ID: vijikarkuzhali@gmail.com, XXXXXXXXXXXXX

**Harshitha R**

*IV Year B.Tech Computer Science and Engineering, Kalasalingam Academy of Research and Education, Tamilnadu, India.*

Email ID: ravuvariharshitha@gmail.com, XXXXXXXXXXXXX

**Deepthi Vijayalakshmi N**

*IV Year B.Tech Computer Science and Engineering, Kalasalingam Academy of Research and Education, Tamilnadu, India.*

Email ID: deepunuthi@gmail.com, XXXXXXXXXXXXX

## ABSTRACT

Environmental change and precipitation has been whimsical in the course of recent decades. Because of this in late period, atmosphere savvy techniques called as Smart Agriculture is embraced by numerous Indian ranchers. Savvy horticulture is a mechanized and coordinated data innovation actualized with IOT (Internet of Things). IOT is growing quickly and generally connected in every single remote condition. For this, it is finished utilizing remote detecting, Microprocessor, IOT, is proposed. The real target is to get the continuous information and decrease the water that is lost in the irrigation system process and lessen the time spent on the field. In the agricultural field, sensors are conveyed in the field like soil dampness. The information gathered from these sensors are sent to the Database by means of the android application. In control area, the framework is turned on utilizing the application, this is finished utilizing the on/off catches in the application. Additionally, this framework is turned on consequently when the dampness of the soil is low, the siphon is turned on and relying upon the dampness content.

**Keywords:** IoT, Sensors, GSM, Microcontroller, Soil moisture detection.

## 1. INTRODUCTION

As the world is inclining into present day advances and usage it is a fundamental objective to pattern up in horticulture moreover. Consequently computerization must be actualized in flooding fields to defeat these issues. In this way, to give answer for

every single such issue, it is important to build up an incorporated framework which will deal with watering the yields. In any case, total robotization in water system isn't accomplished because of different issues. In spite of the fact that it is actualized in the exploration level it isn't given to the ranchers as an item to get profited by the assets. Thus this paper bargains about Automatic Irrigation System utilizing IOT.

## **2. EXISTING METHOD**

Karan Kansara *et al.*(2015) has built up the pipe with downpour weapon water system component appended, is associated with the water siphon, the opposite end of the pipe is close to the foundation of the plant. [1].

Rajalakshmi *et al.* (2016) has created crop field observing by gathering the information from sensors are sent to Web server database utilizing remote transmission. In server database the information are encoded in JSON position. The water system is robotized if the dampness and temperature of the field falls underneath the edge. In nurseries light force control can likewise be computerized notwithstanding water system. The notices are sent to ranchers' portable occasionally. The ranchers' can ready to screen the field conditions from anyplace. This framework will be increasingly valuable in territories where water is in rare [2].

Nikesh *et al.* (2016) incorporates keen GPS based remote controlled robot to assistant agriculture in all stages[3].

Suma *et al.*(2017) has incorporates different highlights like GPS based remote controlled observing, dampness and temperature detecting, gatecrashers terrifying, security, leaf wetness and appropriate water facilities. It utilizes remote sensor systems for taking note of the soil properties and ecological factors constantly. Different sensor hubs are conveyed at various areas in the homestead. [4].

Nesa sudha *et al.*(2011) played out an immediate specialized strategy, in which every hub transmitted the information legitimately to the sink first. The following strategy utilized information combination (collection) technique in which hubs were gathered into groups to spare vitality. The reenactment results demonstrated that the accumulation strategy was giving a 10% expansion in the leftover vitality and 13% expansion in the throughput [5]. Roopaei *et al.*(2017) has appeared in helping numerous parts of brilliant water system the board by Thermal imaging. [6].

Kassim *et al.* (2014) provides continuous data about the terrains and yields that will enable ranchers to settle on right choices. Utilizing the essential standards of Internet and Wireless Sensor Networks innovation, exactness horticulture frameworks dependent on the Internet of things (IOT) innovation is clarified in detail particularly on the equipment engineering; arrange design and programming procedure control of the accuracy water system framework [7].

Mat *et al.* (2016) depict about IoT and WMSN in horticulture applications especially in nursery condition. This paper clarified and demonstrated the effectiveness of input control technique in nursery crop water system. A test was led to see the distinctive these two techniques. [8].

Rawal *et al.* (2017) proposes a mechanized water system framework which screens and keeps up the ideal soil dampness content through programmed watering. This worth empowers the framework to utilize proper amount of water which maintains a strategic distance from over/under water system. IOT is utilized to keep the ranchers refreshed about the status of sprinklers. Data from the sensors is normally refreshed on a site page utilizing GSM-GPRS SIM900A modem through which a rancher can check whether the water sprinklers are ON/OFF at some random time [9].

Harun *et al.* (2015) presents WSN as an option and proficient approach to tackle the cultivating assets advancement and basic leadership. Accuracy horticulture frameworks dependent on the Internet of things (IOT) innovation is clarified in detail particularly on the equipment and system engineering and programming procedure control of the exactness water system framework. [10].

Prathibha *et al.* (2017) incorporates checking temperature and dampness in horticultural field through sensors and to ranchers portable utilizing Wi-Fi [11].

### **3. PROPOSED METHOD**

The application has a future component of taking the time from the client and water the field when the opportunity arrives. In manual mode, there is a manual switch in the field to ensure that if the framework fizzles, one can mood killer the water supply physically. Different parameters like the dampness sensor demonstrates the limit esteem and the water level in the soil. Figure 1 shows the block diagram of the soil moisture detection system. Figure 2 and 3 shows the implementation result of the proposed method.

## **SOIL MOISTURE SENSOR**

The current component to gauge the dirt dampness substance is exorbitant and hard to utilize. So we went to structure a dirt dampness sensor which is shoddy and gives fantastic execution. It is comprised of two cathodes and an almost no amount of mortar of Paris.

## **HUMIDITY SENSOR**

A Humidity sensor (or hygrometer) detects, measures and reports both dampness and air temperature. ... Relative mugginess turns into a significant factor, when searching for solace. An example mugginess sensor. Dampness sensors work by recognizing changes that adjust electrical flows or temperature noticeable all around.

## **GAS SENSOR**

The MQ6 is utilized as a sensor to identify the alchogal. For inspecting the zone alcho- we utilized a straight voltage out semi-conductor based LM35 temperature sensor. The yield from the LM35 temperature sensor in sustained to the enhancer through potential divider circuit. The enhancer o/p is nourished to the comparator circuit (operation. speaker IC 741).

## **POWER SUPPLY:**

A power supply circuit is extremely fundamental in any undertaking. This power supply circuit is intended to get controlled yield DC voltage. 7805 IC is utilized to give the consistent 5v supply. Extension rectifiers utilizing diodes is utilized for amending purposes. The power supply segment is for providing voltages to the whole circuit unit.

## **LCD DISPLAY:**

LCD is predominantly utilized for showcase the data. Here we are utilizing 2x16 LCD. Activity of the LCD is the declining costs of LCDs. The capacity to show numbers, characters, and illustrations. This is as opposed to LEDs, which are constrained to numbers and characters. The LCDs are light weight with just a couple of millimeters thickness. Since the LCDs expend less power, they are perfect with low power electronic circuits, and can be controlled for long lengths. The LCDs don't create light thus light is expected to peruse the presentation. By utilizing backdrop illumination, perusing is conceivable in obscurity. The LCDs have long life and a wide working temperature go.

### **DRIVER CIRCUIT:**

The transfer segment contains transfers and ULN2003driver. The microcontroller gives a rationale high yield when required and this rationale high yield needs to drive the transfer.

### **RELAY CIRCUIT:**

Relay are exchanging gadgets. Exchanging gadgets are the core of modern electronic frameworks. At the point when a transfer is stimulated or enacted, contacts are represented the moment of truth. They are utilized to control air conditioning or dc control. They are utilized to control the succession of occasions in the activity of a framework, for example, an electronic warmer, counter, welding circuits, X-beam gear, estimating frameworks, caution frameworks and communication. Electromagnetic transfers are types of electromagnets in which the loop current delivers an attractive impact. It pulls or pushes level delicate iron armatures or strips conveying transfer contacts. A few hand-off contact can be worked to get a few conceivable ON/OFF blends.

### **GSM MODEM:**

Modem (from modulator-demodulator) is a gadget that tweaks a simple bearer sign to encode computerized data, and furthermore demodulates such a transporter sign to interpret the transmitted data. The objective is to create a sign that can be transmitted effectively and decoded to repeat the first computerized information. Modems can be utilized over any methods for transmitting simple sign, from flaw locator circuit.

### **LCD DISPLAY:**

Liquid Crystal Displays (LCDs) have materials which consolidate the properties of the two fluids and gems. Instead of having a dissolving point, they have a temperature extend inside which the atoms are nearly as versatile as they would be in a fluid, yet are gathered in an arranged from like a gem.

### **RELAY:**

The core of the relay is the 'intersection' of the contact focuses. The hand-off contact focuses might be level, round, pointed and mix of all these. Level contacts require more weight for impeccable contact shutting. Half round contacts are better in light

of the fact that the surface defilement will be least. The twin contacts give solid activity.

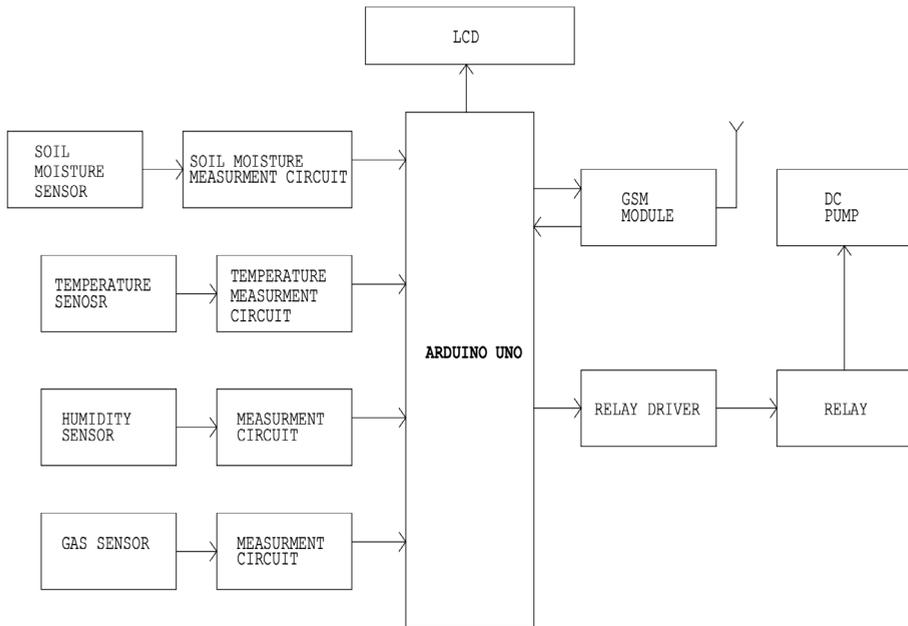
#### **4.RESULTS AND DISCUSSION**

The whole field is first separated into little great oxidation obstruction, and ease of use for untreated areas with the end goal that each segment ought to contain one contact surfaces, for example, film switches and contact dampness sensor. These sensors are covered in the ground at focuses required profundity. When the dirt has achieved wanted dampness a dirt dampness sensor can peruse the measure of level the sensors send a sign to the smaller scale controller to dampness present in the dirt encompassing it. It's a low tech turn on the transfers, which control the engine. Sensor yet perfect for checking a urban nursery, or your .In proposed framework, robotized water system pet plant's water level. This is an unquestionable requirement have apparatus for a component which turns the siphoning engine ON and OFF associated garden. On distinguishing the soddenness substance of the earth. In this sensor utilizes the two tests to go current through space of cultivating, usage of fitting methods for the dirt, and after that it peruses that protection from get the water system is noteworthy. The advantage of utilizing dampness level. More water makes the dirt lead these strategies is to diminish human impedance.All perceptions and exploratory tests to demonstrate that this undertaking is a finished answer for the field based irrigation system problems.

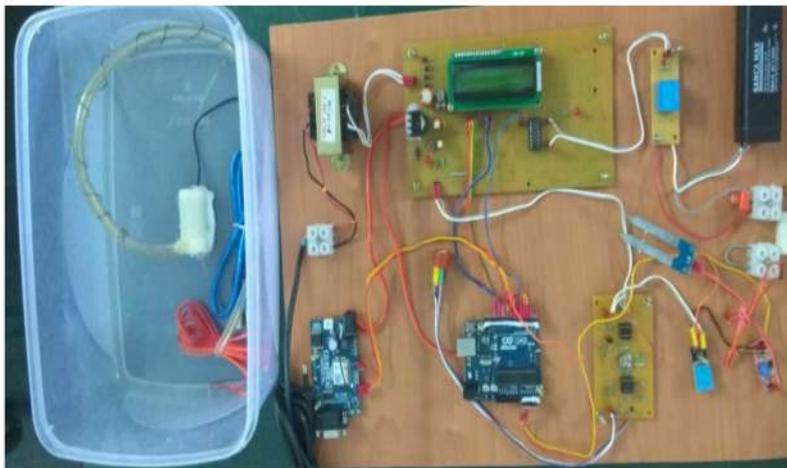
#### **5. REFERENCES**

- [1] **Kansara, K., Zaveri, V., Shah, S., Delwadkar, S. and Jani, K.,** 2015. Sensor based automated irrigation system with IOT: a technical review. *International Journal of Computer Science and Information Technologies*, 6(6), pp.5331-5333.
- [2] **Rajalakshmi, P. and Mahalakshmi, S.D.,** 2016, January. IOT based crop-field monitoring and irrigation automation. In *2016 10th International Conference on Intelligent Systems and Control (ISCO)* (pp. 1-6). IEEE.
- [3] **Gondchawar, N. and Kawitkar, R.S.,** 2016. IoT based smart agriculture. *International Journal of advanced research in Computer and Communication Engineering*, 5(6), pp.2278-1021.

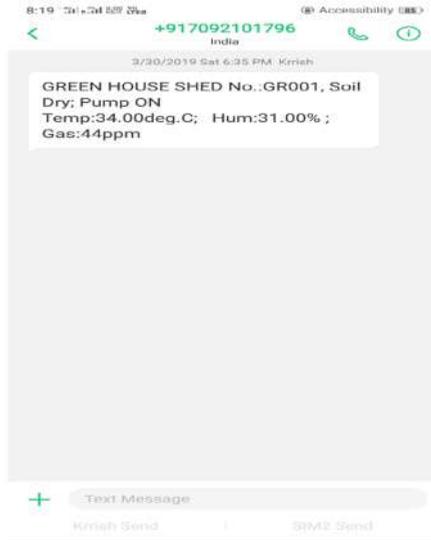
- [4] **Suma, N., Samson, S.R., Saranya, S., Shanmugapriya, G. and Subhashri, R.,** 2017. IOT based smart agriculture monitoring system. *International Journal on Recent and Innovation Trends in computing and communication*, 5(2), pp.177-181.
- [5] **Sudha, M.N., Valarmathi, M.L. and Babu, A.S.,** 2011. Energy efficient data transmission in automatic irrigation system using wireless sensor networks. *Computers and Electronics in Agriculture*, 78(2), pp.215-221.
- [6] **Roopaei, M., Rad, P. and Choo, K.K.R.,** 2017. Cloud of things in smart agriculture: Intelligent irrigation monitoring by thermal imaging. *IEEE Cloud computing*, 4(1), pp.10-15.
- [7] **Kassim, M.R.M., Mat, I. and Harun, A.N.,** 2014, July. Wireless Sensor Network in precision agriculture application. In *2014 International Conference on Computer, Information and Telecommunication Systems (CITS)* (pp. 1-5). IEEE.
- [8] **Mat, I., Kassim, M.R.M., Harun, A.N. and Yusoff, I.M.,** 2016, October. IoT in precision agriculture applications using wireless moisture sensor network. In *2016 IEEE Conference on Open Systems (ICOS)* (pp. 24-29). IEEE.
- [9] **Rawal, S.,** 2017. IOT based smart irrigation system. *International Journal of Computer Applications*, 159(8), pp.880-886.
- [10] **Harun, A.N., Kassim, M.R.M., Mat, I. and Ramli, S.S.,** 2015, May. Precision irrigation using wireless sensor network. In *2015 International Conference on Smart Sensors and Application (ICSSA)* (pp. 71-75). IEEE
- [11] **Prathibha, S.R., Hongal, A. and Jyothi, M.P.,** 2017, March. IOT Based monitoring system in smart agriculture. In *2017 International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT)* (pp. 81-84). IEEE.



**Figure 1:** Block Diagram of the Soil Moisture Detection System



**Figure 2:** Implementation Output of the Proposed Soil Moisture Detection System.



**Figure 3:** SMS alert in the implementation result.



# SECURE ONLINE VOTING SYSTEM USING BLOCKCHAIN

**Gul Shaira Banu Jahangeer**

*Research scholar of Computer Science and Engineering, Kalasalingam Academy  
of Research and Education, Tamil nadu, India.*

Email ID: shairaamjath@gmail.com , XXXXXXXXXXXXX

**Dr. T. Diliphan Rajkumar**

*Faculty of Computer Science and Engineering Kalasalingam Academy of  
Research and Education, Tamilnadu, India*

Email ID: t.dhiliphan@klu.ac.in, XXXXXXXXXXXXX

## ABSTRACT

Voting is a formal expression of preference for a candidate from the list for a proposed resolution of an issue. The main goal of voting, in a Scenario involving the citizens of a given country, is to choose a leader of the people's choice. A voter can use his/her voting right without any difficulties. We propose a secure online voting system that aims to make voting accurate, secure from any manipulation, cost effective, time effective and much easier to vote. The proposed system deals with the weakness of security and difficulty of the conventional voting system by using the block chain technology. This technology will provide a high level of security by using a complex concept of cryptography. This technology will decentralize everything from papers to governments. Block chain will cast votes as transactions. There will be a public ledger to record transactions. The block chain stores these transactions in a block. The blocks added in a direct, sequential order of the mass chain. Every person has a copy of this ledger so no one could ever manipulate or cheat because everyone is monitoring. The proposed work encourages the idea about what way block chain method might be implement to form a secure digital voting system.

**Keywords:** Online voting system, block chain Technology

## 1. INTRODUCTION

Every citizen of country filed their democratic voting through Online voting or e-voting with the help of internet. In state, central and national election online voting system are presented as part of revolutions by using in polls. Many countries, political and institutional organization using online voting secure system since its cost is less, easy and confident.

### A. Block chain

Block chain [1] is commonly a nonstop emergent list of blocks .Each block is linked with each other and provide security using cryptography algorithm. Each block hold address of previous block and its connected using to hash pointer .it also contains a timestamp and operation records. In 2008 some unknown person finds out distributed block chain. It also developed as the basic element for bitcoin. A block chain maintain a record which is distributed and the record is decentralized but open also make transaction recorded among two revelries in a safe manner .The transaction makes sure of validated and protected Entries and preserves historic record that occurs online, which means that once information recorded it couldn't be erased. Block chain hold lot of data and it has held in is distribution and shared collection of record. The data placed in distributed order and not stored in centralized place like public and verifiable. "Online identity and reputation will be decentralized. We will own the data that belongs to us."- William Mougayar.

Block chain has many characteristics like disposal of the central or third parties, resilient to failures, secure by strong encryption by using asymmetric encryption, digital signature and hash encryptions so in case the data of one of the parties in the chain changed it will be rejected by the other parties. Block chain remain integrally strong enough to change of the records. Also, Block chain has many good features like low cost, Point-to-point transmission, highly scalable and autonomous so because of that it is threatening the traditional business model's transactions in banks, contracts and others.[2] .

Currently use new form of technology called Block chain which acts the backbone of Internet and it's mainly designed for digital currency, bitcoin and many trending application. For example, Block chain Identity application provides Safe and Secure Identity Verification. Block chain technology is an ideal application to power digital identities. This digital identity is a certain part of our connected world. Block chain technology with its hardened cryptography and distributed ledgers will provide a high security to this important online information thus the internet will be an easy connected trusted world.

The block chain as a digital ledger has three key properties [3]:

1. It's completely free and open-source software. Anyone can use it freely as distribute and build via block chain source code.

2. it's a distributed digital ledger. The system relies on the block chain as a ledger that works in such a way that many replicas of the record interconnect within the network, and relations are listed and processed by a majority of all copies of the ledger.
3. It's a transparent ledger. The block chain is not a secretive database so everyone is able to monitor transactions. All transactions that have ever taken place in a given network and applications are registered.

These properties create trust for developing records by using block chain so no third party is needed even its trustworthy. Every transaction has to be approved by and recorded on the whole block chain network.

The motivation to use block chain is that the traditional database is maintained and owned by a single organization. When we consider a network where the data being stored is too sensitive and the motive to manipulate it is too enticing even if it could be guaranteed that the responsible organization would never has a fraudulent change to the database there will be a possibility that a hacker could break and manipulate the database [4].

Make sure that handle the database to be private and not to make it as communal. Grant the actors permission and allow them to make a duplicate of the database. Everyone have the style to copy the correct database and make the changes, once the changes completed compared with other database, and make distribution , this go well with static database . Block chain method is same like peer- to peer system and it's exposed to each person. Computational resource is associate are pay to each person and data is transferred to each system. No one have the right to access the property which is allocate and the block chain succeed the account .Organizing specific private assets is elegance. The block chain is absolute, orderly managed, time-stamped, exposed and apparent, available with identification, authentication, and authorization and ultimately stable.

### *B. Electronic Voting System*

Many countries use voting system to express the wish to do some action and its key development. Traditional voting system in early stage is done using paper based method, which cost more and not exact as well as resourceful. In the 21st century, remote voting is ended electronically through gazettes by using internet. Electronic voting system is of two types evoting and i-voting. E-voting is managed by self-governing voting experts. I-Voting use gazettes like phone, Laptops, computers , TV con-

nected to the internet . Electronic Machine is manageable by electorates and it's the most common method.

In UK the Chartist is a governmental and communal change program. The first proposal of voting machine was made by them in the year of 1838. By the year of 1856 Australia is the first place to use uniform official ballots. In the year of 1889, the first automatic control voting machine, was developed by Jacob H. Myers of Rochester. Automatic control voting avoid duplicate voting, result is identified easily by fast counting and reduces the untruthful vote counting. The electronic system uses a public key cryptography encryption method. Here we can file the vote and maintain the voters to be anonymous. This is finding out by David Sham. The blind signature theorem was also used so there is no connectivity between voters and ballots. The set of standards for electronic voting is developed by the Federal Election Commission in the year of 1990.

The voters use the electronic voting system to file the vote using electronic equipment. The device use the less time to save the vote and the process is mobility. Gazettes are used by Voters to file the vote and the cost is very less and the total system cost is very minimal compared to the traditional paper voting system which is conducted and manage by election committee.

Security plays an issue in the electronic voting system, since attackers hack the system and change the file votes, the block system technology is used , since saves data is distributed across the system. Everyone submits their own ID and vote then a verification provider checks the identity of the voter, transaction signing of government agencies then store in the block chain. It combines advantages of bitcoin and electronic voting. The digital ballot box is a smart and cost effective solution to effectively improve existing voting procedures. It will also eliminate issues such as manipulation, errors in registration, as well as encouraging voter participation. After the vote was submitted, it cannot be changed as the results in the block chain is recorded as immutable and verifiable. Also, there will be some restrictions so that not any one is accepted to vote. An electoral system is a set of rules and conditions that are followed to know the result. An electronic voting system that allows for reliable voting can include a punched card or optical scan [5].

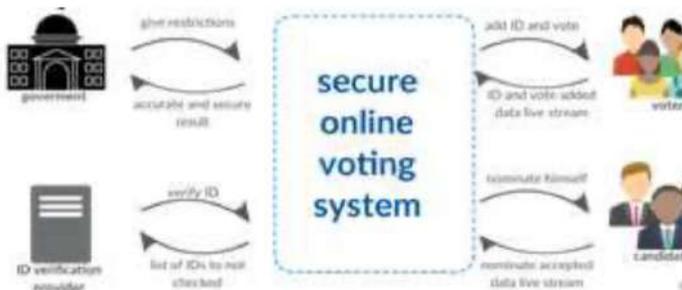
## **2. PROPOSED METHODOLOGY**

This section will explain the proposed methodology. Firstly, it presents the system framework as a simple system model. Secondly, it discusses the system requirements

as functional and non-functional requirements. Finally, it illustrates the system using a use case diagram followed by three sequence diagrams to explain the scenario in more detail.

### I. SYSTEM MODEL FRAMEWORK

The proposed system show overall framework as simple system model. Fig1 shows the system at the middle and all the entities surrounding it with their simple interactions to the system as inputs and outputs.



**Fig 1:** Framework of the system

### II. SYSTEM REQUIREMENT

#### **A. Functional requirement**

The Standard functions of the system to achieve project objectives is Authorize Actor, Manage Election Districts, Manage Election Units,[6] Provide Authentication Means, Provide Security Means, Manage Parties, Manage Candidates, Preview Ballots, Provide Party Info, Cast Vote, Tally Votes, Verify Result Integrity, Verify Result Authority.

#### **B. Non- functional requirement**

The system needs features that require some criteria that can be used to judge the operation of a system:

→ Authentication: Registered people can file the vote with various identities like figure print , address proofs ,to authenticate them as correct .its verified by already saves data in database. Once the authentication is checked they show green signal to cast the vote.

→ Accuracy: Each and every vote should be genuine and no fake votes should be filed, deleted, are reformed.

→ Verifiability: Cross check is made to verify the saved vote is correct.

→ Anonymity: The e-voting system had better not to permit any dealings among voter's individualities and polls. The elector needs to stay unidentified throughout and afterward the voting.

→ Security: the system should be high secure by using block chain technology.

→ Universal: The polling structure need to be open on behalf of

all qualified electorates, devoid of needful superior information, and need to be informal to traverse, containing visuals and resonances device for society , who is disabled persons .

→ Availability: In case of disaster the spare electronic voting system is available and in emergency situation we can make backup.

### C. System Analysis And Design

A use case diagram is a picture of a user's communication through the scheme that displays the association among an involved operator like (voter, candidate, government and ID verification provider) and the different use cases. Fig 2 shows the use case and fig 3 accompanied the sequence of diagrams.

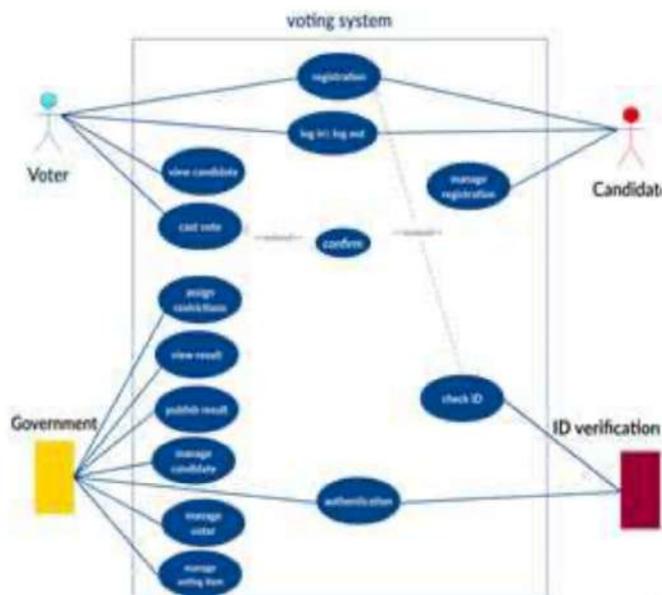


Fig 2: use case diagram Registration Architecture

We subdivide the whole scenario into three phases:

### 1) The beginning of the election

Government will advertise the start of the election: through TV, news and through social media. Government will put some restrictions like rules on the characteristics of the candidate (nationality, gender, age) and the voter (age above 18) and restrictions on the duration of the election when it starts and when it ends. Also, the government can manage the act of the voter/candidate such as modify the voter's profile or delete him. Candidate can manage his profile like if he wants to update their information. [7][15].

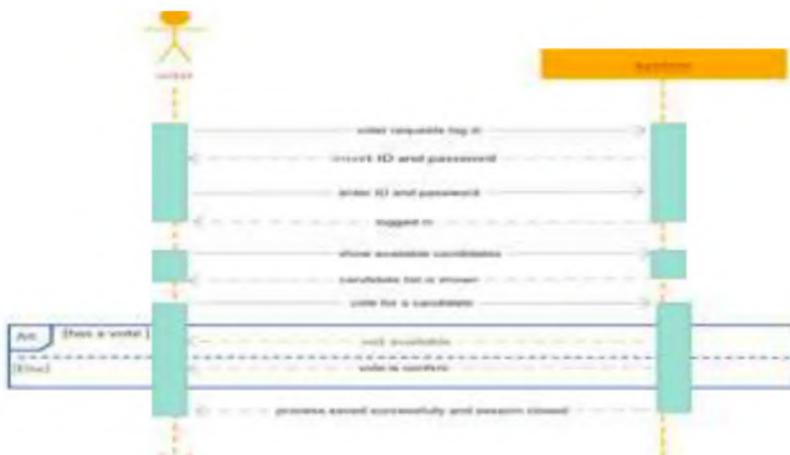
Candidates will candidate himself to the government using his ID, Name, Gender, date of birth, CV etc. Then the government will send a list of authorized candidates to the system. After that the system will allow the citizens to vote for them.

User will choose one of the two options in the system interface either to register as a voter or as a candidate. Voter/candidate will register using his ID to the system. The system will check the ID through the ID verification provider. Also will check if the voter/ candidate are already registered or not. If the voter/ candidate is new the system will ask for a password and other information. After that the voter/candidate will log in to the system easily by ID and password as shown in fig 3.



**Fig 3:** Registration Architecture

## 2) During the election



**Fig 4:** voting architecture

Fig- 4 shows that when the voter wants to vote he/she must log in to the system first and then choose the list of available candidates. The voter will select only one candidate to vote for him. The system will check if this voter has already vote or not by checking the block chain ledger. If the voter has been voted the system will deny the new vote otherwise it will accept the vote and cast it with the ID as transaction. The system sends a confirm message to the voter and the voter confirm his submission. The block chain stores these transactions in a block. Blocks in block chain will be in direct and sequential order every person has a copy of this ledger, so no one could ever manipulate or cheat because everyone is monitoring. [8][14].

## 3) The end of the election



**Fig 5:** Diagram of the publish result of voting

Government will advertise the end of the election through TV, news and through social media and enter to the system as administrator using his ID and password to end the election. The system will stop the voting process and count the votes for each candidate. The result will be sent to the government in a secure manner. Also, the users could monitor data live stream. Finally, the government will advertise the winning candidate through TV, news and social media as shown in figure 5.

### **3. TECHNICAL DETAILS**

#### **A. Block chain mechanisms**

The block chain is a peer-to-peer system that is open to everyone. Everybody is linking and giving computational assets or surrender to new deal (data) to the structure. Nevertheless, it is not wanted aimed at everybody to contact the things allocated to the data and field need to achieved by the block chain. A establishing distinctive of remote stuff is its restrictedness.

Block chain is built from two technologies the first one is Asymmetric cryptography [10][11] which always uses two complementary keys as shown in figure 6. Cypher text produced from block technology key can be decrypted with the other block chain key .The block chain uses asymmetric cryptography to identify accounts where the block chain needs to identify user's accounts to keep up the representing among vender and things. It is the base for classifying customers in the block chain and shielding their things. Also, to authorizing transactions. To be authorized of the transaction the owner would encrypt it with his private key. Then public key is used to decrypt this called digital signature which provides strong control of ownership [16].

The block chain is to preserve its directness though limiting the transmission of proprietorship to the legalized vendor. The digital signatures of communications are cryptographic hash values of deal information encoded with the private key that agrees to the explanation that detached proprietorship. Digital signatures are the method in the block chain can be trace exclusively to process the transaction and key which is private.



Fig 6: Asymmetric encryption

The block chain is to preserve its directness though limiting the transmission of proprietorship to the legalized vendor. The digital signatures of communications are cryptographic hash values of deal information encoded with the private key that agrees to the explanation that detached proprietorship. Digital signatures are the method in the block chain can be trace exclusively to process the transaction and key which is private. The peer- peer technology is the second technology that use block chain uses [9], which is in the form of independent nodes (peers) as shown in fig 7; the communication between nodes is through Gossip style message style that ensures all nodes will receive the information. The block chain can be measured as instrument for succeeding and continuing goodness in distributed systems. Morally scattered peer-to peer structures could use the block chain in direction to attain and to uphold scheme truth.



Fig 7: Distributed network

## B. Structure of the block chain

Each block header contains

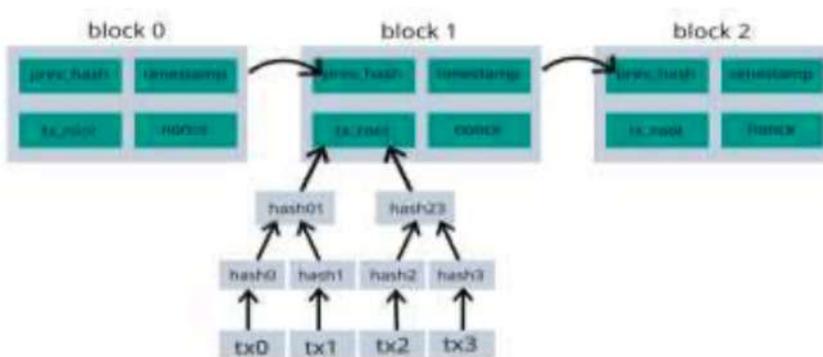


Fig 8: Block chain mechanism

Fig 8 shows the content of a block and how it chained with the others. Timestamp will consider the time once the block was originate. Orientation to parental (prev\_hash) is a confusion of the earlier chunk header which draws respectively chunk to its parent and consequently by initiation to all earlier chunks. Hash location is a location that develops illegal after the data existence referred is altered. Merkle Root (Tx\_Root) is a compact depiction of the usual of relations that is deep-rooted with this chunk. The dealings themselves are providing self-sufficiently making the body of the chunk. Near need to be at least one deal. Each chunk covers thousands and thousands of dealings. It resolves to be dated wasteful to stock all the information inside each block as a chain. Undertaking consequently will make outcome slightly specific deal enormously unwieldy and timewasting. Collection these data chunks into couples of dual, and already available for respectively pair, we procedure a data structure that has two hash pointers, one to each of these chunks. These data organizations create the resulting level up of the tree. If you use a Merkle tree, though, you will seriously censor the time obligatory to bargain out whether a specific deal belongs in that chunk or not. Nonce [12][13] is a randomly chosen quantity to accessibly enhance entropy to a chunk header deprived of transformation the Merkle tree. The chunk's own hash, Completely of the upstairs header substances get chopped into the block hash, which for one is evidence that the extra shares of the header must not been altered, and then is castoff as a reference by the following block.

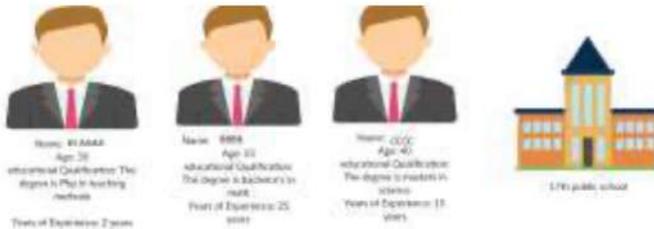
### **C. Hash values**

In distributed peer-to-peer system there is a huge number of transaction data that must be identified by their digital fingerprints. One of the most central immoral technologies of the block chain is hash value. To understand the block chain you must understand the cryptographic hashing.

A cryptographic hash function has important properties in terms of deterministic which mean that if you put the same input many times in the hash function will get the identical outcome. This is important subsequently if you get changed hashes at each single interval it will be unbearable to locating the input. Quick computation, which means the hash value, should be computed quickly from the hash function, which makes the system efficient. Minor deviations in the input alter the hash, any change in input that will make a big difference in hash. Collision resistant every input has a unique hash value.

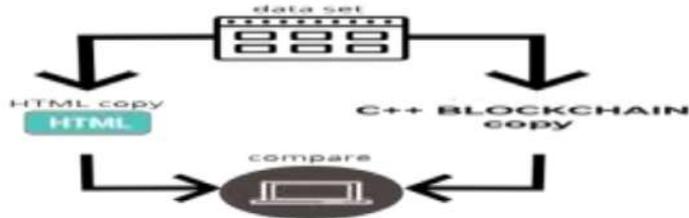
Consider an example of cryptographic hash functions like (MD5), which produce a 128-bit hash. Second of all (SHA), it has several versions in term of (SHA-0, SHA-1,

SHA-2, and SHA-3) each one produces different sizes of hash bits. This Paper is an experiment-based research on a voting system using block chain built using C++ programming. The validation of the system is achieved by allowing a number of voters to vote using our system. These voters are given a number of candidates with certain characteristics to select one of them using an online Website as shown in fig 9.



**Fig 1:** Simple Example questionnaire

The votes have two copies, one will be sent to our block chain voting system and the other will be sent to a database to be saved in a way similar to a conventional voting system. Voting results from both systems will be then compared in order to validate the block chain voting system as shown in fig 10.



**Fig 10:** Validation of the system via dataset

#### 4. RESULT AND ANALYSIS

The database was created by Microsoft SQL Server 2008 due to the simplicity at creating databases, tables, and queries. The login page serves two levels of authorized users; students and administrators. The student logs in by her university ID and the default password (she can change it later). The administrators have their username and password to modify nominee's data. After logging in, the application navigates the user to the main page according to his/her

classified group. For students, the page displays the name and a list of nominee information to vote.



**Fig 11:** Login Form

When the student logs in, the voting page will come out where there are four nominees to choose by pressing the button (vote). When she votes she cannot vote again and the button will disappear.



**Fig 11.** Voting page

By clicking the reference, we show a page of all the voters of each nominee. Finally, the student can change her password and logoff.



The following pages are accessed by administrators. When the administrator logs in an empty main page will come out and three tabs (Students data, nominees' data, and voting page). In nominee data the admin can add nominees and modify their information. The following pages are accessed by administrators. When the administrator logs in an empty main page will come out and three tabs (Students data, nominees' data, and voting page). In nominee data the admin can add nominees and modify their information.



Serial	Name
1	...
2	...
3	...
4	...

Records count : 4

**Fig 13:** nominees list

This page appears when the administrator clicks on a certain name on the list to modify nominee’s information.



Nominee Data

Search

**Name:**

**Name:** Age : 23  
skills : graphic design , c++ , java

**Fig 14:** Nominee information page

Show the sequence of the block chain. When you enter the university ID of a voter it will show the number of the block, university ID, the previous block number, its university ID. Also, shows the hash.

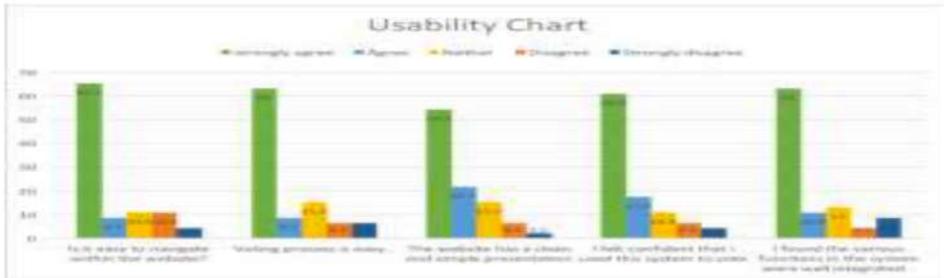


Voting System

Mining :

Mined : 19,43400275,1,36018458,43400272,18 Hash : c6Wbl553mJGbpYWeoJaYmaRzpKOYo2\_cJ2egKSmnJGUrA\*\*

We grouped 47 students of IT and CE department to try the system. After that we give them the usability questionnaire to answer the questions it contains. The result shown in the figure.



**Fig:-15.** usability questionnaire

## 5. CONCLUSION

Voting is an important process for some countries. On the beginning, a traditional voting through a paper-based system was used, but this approach is not efficient, not accurate and costly. Thus, the online voting system is appeared to overcome the drawbacks of the conventional approach. E-voting is in principle a highly desirable technology, but this system has many risks about security and confidentiality, no matter how secure a centralized e-voting system is it remains fundamentally insecure, because any computer system is basically insecure. The only way to overcome this fundamental insecurity of e-voting is of using a more efficient and complex technology like block chain. Block chain is a distributed, transparent and fundamentally secure digital ledger. Rather than through centralization the block chain works through distribution and openness and that is precisely why a block chain-based e-voting system is resistant to tampering.

Online voting system using block chain technology in this project saves information of the voters after registering and ensures that each voter is unique. The block chain data of who has listed to ballot once registered then elector can cast his vote after the verification of his information needs been completed. When election begins the system uses the ID for verification to safeguard these recorded electorates are who they say they are. The system also needs to safeguard that electorates are not compulsory to ballot in a specific way, so we have combined a insure package whereby operators will be encouraged a additional period to settle their proposal beforehand the ballot is directed this will lets us to nearly remove unintentional ballots. Here unpaid to the encryption device of our scheme it would be near to unbearable for slightly being to improvement admission to all the ballots deprived of primary attractive controller of the whole provision system.

## **6. REFERENCES**

- Swan, M.** (2015). Block chain: Blueprint for a new economy. "O'Reilly Media, Inc."
- Kohno, T., Stubblefield, A., Rubin, A. D., & Wallach, D. S.** (2004, May). Analysis of an electronic voting system. In Security and Privacy, 2004. Proceedings. 2004 IEEE Symposium on (pp. 27-40). IEEE.
- Wand, J. N., Shotts, K. W., Sekhon, J. S., Mebane, W. R., Herron, M. C., & Brady, H. E.** (2001). The butterfly did it: The aberrant vote for Buchanan in Palm Beach County, Florida. *American Political Science Review*, 95(4), 793-810.
- Yee, K. P., Wagner, D. A., Hearst, M. A., & Bellovin, S. M.** (2006). Prerendered User Interfaces for Higher-Assurance Electronic Voting. *EVT*, 6, 6-6.
- Segendorf, B.** (2014). What is bitcoin. *Sveriges Riksbank Economic Review*, 2, 71-87.
- Dorri, A., Kanhere, S. S., Jurdak, R., & Gauravaram, P.** (2017, March). Blockchain for IoT security and privacy: The case study of a smart home. In *Pervasive Computing and Communications Workshops (PerCom Workshops)*, 2017 IEEE International Conference on (pp. 618-623). IEEE .
- Mainelli, M., & Smith, M.** (2015). Sharing ledgers for sharing economies: an exploration of mutual distributed ledgers (aka blockchain technology). *The Journal of Financial Perspectives*, 3(3), 38-69.
- Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V.** (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation*, 2, 6-10.
- D. L. Chaum**, "Untraceable Electronic Mail, Return Addresses, and Digital Pseudonyms", *Communication of the ACM*. Vol. 24(2). (1981), pp. 84-90.
- Trueb Baltic**, "Estonian Electronic ID – Card Application Specification Prerequisites to the Smart Card Differentiation to previous Version of EstEID Card Application." [http://www.id.ee/public/TB-SPEC-EstEID-Chip-App-v3\\_5-20140327.pdf](http://www.id.ee/public/TB-SPEC-EstEID-Chip-App-v3_5-20140327.pdf)
- Zhichao Zhao**, T.-H. Hubert Chan: How to Vote Privately Using Bitcoin. *ICICS 2015*: 82-96
- Kibin Lee, Joshua I. James, Tekachew Gobena Ejeta, Hyoung Joong Kim**: Electronic Voting Service Using Block-Chain. *JDFSL* 11(2): 123-136 (2016).

**Yu Takabatake, Daisuke Kotani; Yasuo Okabe:** An anonymous distributed electronic voting system using Zerocoin. IEICE Technical Report: 116(282): 127-131 (2016)

**Bos, J. W., Halderman, J. A., Heninger, N., Moore, J., Naehrig, M., & Wustrow, E.** (2014, March). Elliptic curve cryptography in practice. In International Conference on Financial Cryptography and Data Security (pp. 157-175). Springer, Berlin, Heidelberg.

**Rowstron, A., & Druschel, P.** (2001, November). Pastry: Scalable, decentralized object location, and routing for large-scale peer-to-peer systems. In IFIP/ACM International Conference on Distributed Systems Platforms and Open Distributed Processing (pp. 329-350). Springer, Berlin, Heidelberg.

Ingeniería y Tecnología

