"STATE OF THE ART COMPUTING PARADIGMS FOR SOCIO-ECOLOGICAL RESILIENCE AND ECONOMIC RENEWAL IN THE PANDEMIC ERA"

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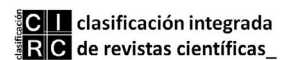
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PROLOGUE

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This set of timely, important and distinguished twelve papers strengthens the transdisciplinary and novel linkages between the fields of human factor engineering, societal resilience, engineering decision analysis, and computational intelligence. These emerging information technologies are essential for sustainability in the era of the COVID-19 pandemic. The twelve papers are associated with the Honoulu, USA-based conference entitled "Recent Trends in Computer Science and Engineering (RTCSE)". We take a unified and holistic approach to the topic: Rather than isolating, stovepiping, and artificially separating the mathematical approaches from their 'real world' use, the dozen contributors to this unique 3C Technologia special issue have taken a unified and integrated perspective.

The need for computational intelligence and societal resilience is growing. The 2021 tensions in Belarus preceded the 2022 uprising in Kazakhstan; the November 2015 terrorist attacks in Paris by the Islamic State and ongoing conflict in eastern Ukraine, Syria and Iraq are recent and important cases. On March 22, 2016, three coordinated nail bombings occurred in Belgium by the same Brussels-based Islamic State terror cell connected to the 2015 Paris terror attacks and other smaller-scale attacks against targets across Europe.

The focus of the Sixth Annual RTCSE International Conference demonstrated the value of the importance of focusing more attention on holistic computational intelligence and the engineering and human factors decision-making issues that their work informs. In this way, the twelve papers in this vital collection help mathematicians, biologists, chemists, engineers and computer science scholars promote a safer and more secure society. This special issue successfully helps reduce disaster risk and promote societal resilience in the face of the global pandemic. It also allows academics, theoreticians and practitioners from both the social and natural sciences to a better model and understands the complex and intricate relationships related to emerging issues in the 21st century. These evolving, intertwined, and complicated issues range from biomedical engineering to climate change and the technological reliability of engineered systems.

The first paper involves the design of an automatic limb therapy rehabilitation device. Here the authors investigate the importance of medical recovery and the latest advances in rehabilitation. The authors review the background of therapeutic rehabilitation and explore possibilities for future research. Key issues involve patient health and advances in limb therapy rehabilitation

The second paper involves prototyping a Model RC Plane for Agricultural Applications. The agricultural sector is growing in importance as we enter an era of climate change and food shortages. Here the authors discuss advances in computational intelligence and mathematical modelling for the agricultural sectors. The proposed plane constitutes a valuable and timely approach for innovating new advances in aviation design.

The third paper involves a broad range of related papers on topics centred around the theory, analysis, and implementation of the design and analysis of sustainable beach cleaners. It can achieve tremendous progress towards sustainability and help with conflict transformation and sustainability in the Anthropocene, a new geological epoch in which humans are a dominant geophysical force-producing previously unimaginable impacts on the earth from global warming to catastrophic deforestation and climate refuges. The need for sustainable beach cleaners is now more urgent and important than ever.

The fourth paper is entitled "Sustainable Electricity Generation and Storage Mechanism through Doors". Here the authors propose a novel approach for sustainable electricity

generation that can help to promote renewable energy, reduce environmental risk and confront society's energy and health crises. In summary, this distinguished, cross-disciplinary, valuable, timely and interdisciplinary paper examines the most challenging sustainable energy and societal-technologic dilemmas facing today. It is critically important in light of recent health and environmental crises and other black swan events facing society. This paper has a special emphasis on crafting original comprehensive, sustainable and intelligent solutions to sustainable energy generation. In this way, the paper can help confront and transform technological challenges effectively.

The fifth paper is, entitled "A Digital transformation model focused on Peruvian industrial fishing", was presented at the conference on "Recent Trends in Computer Science and Engineering (RTCSE)" in Honolulu. The paper uncovered several innovations for fishers and environmental managers. The theories and practice of digital transformation and sustainability in the Anthropocene can provoke new understandings of group decision and negotiation for the fishing industry, new industrial fishing politics, environmental temporality, conflict transformation, spatiality ethics values, and responsibility.

The sixth paper is called "Supercapacitors and their Enactment for renewable energy resources". The authors present innovations for electrical engineering as they relate to sustainability and supercapacitors. A new kind of environmental transformation becomes possible when we consider that the stakes of not addressing renewable energy involve irreparably damaging the world we inhabit and constraining options for future generations. Therefore, this paper is relevant to the dynamics of renewable energy modelling, conflict transformation, and group decision processes in the Anthropocene to promote a more sustainable future.

The seventh paper is entitled "Variable on-tie Control to achieve high efficiency for AC/DC border line current-mode buck converters". The authors discuss advances in control systems and computational intelligence for new insights in systems design and electrical engineering for converter systems. Possibilities, prospects and the potential for revolutionary advances in electrical and electronic engineering are put forth.

The eighth paper deals with "Deforestation in Peru and a Strategic Plan to deal with Deforestation in Amazonian Forests". Key lessons learned involve plans, policies and

administrative actions to improve the health of forests in Peru. Conflict transformation among decision-makers involved in Amazonian deforestation is a core construct of forest-based group decision and negotiation and has accrued several meanings, including the transformation of forest policy issues, rules, structures, actors, relationships, societies and environments. The topic of deforestation is particularly relevant and topical as the COVID-19 post-Cold War international system is experiencing an increase in the scope and intensity of environmental conflicts precipitated by global climate change, political power struggles, the emergence of non-state factions, resource depletion, and internecine ethnic rivalries.

The ninth paper is entitled "Project Management And Its Relation To Land Management In The San Pablo Town Center, Valera District, Bongará – Amazonas". In this paper, the authors focus on advances in environmental management and resilience theory to reduce degradation and improve productivity in the Amazon. Traditional tools and approaches for analyzing and resolving project management disputes have shown to be inadequate to deal with these political, social and environmental conflicts in the Amazon region. During the Anthropocene, project management decisions increasingly occurred within protracted, expensive, and complex interaction networks. Future work suggesting advances in ecological resilience are proposed.

The authors of the tenth paper discuss the urgency and importance of urban hazards: "The Application of Ordinance Number 310-2009-MDJM and noise pollution from the vehicle fleet in the Jesus Maria district". Noise pollution is a growing curse in an urban environment. There is a need to agree on the optimal rules and regulations to promote sustainable urban planning. The authors propose innovative and powerful solutions to promote a more resilient and sustainable future.

The eleventh paper deals with education and optimal temperature levels. The authors present a paper entitled "Evaluating Thermal Comfort in the Educational Institutions of the Puno Region". Here key solutions for improving the performance and sustainability of heating and cooling systems are put forth. The authors particularly discuss a novel solution to the problem of achieving ideal comfort. The system is designed such that cost and reliability are key variables. The system can operate at various scales in multiple educational centres.

The proposed system is a prototype of a large-scale system and demonstrates the overall system design for thermal comfort management. This process is also time effective, robust and can withstand the demands of either a commercial, educational or industrial setting.

The twelfth paper is named "Big Data Analytics Capabilities, Innovation and Organizational Culture: Systematic Literature Review and a Future Research Agenda". Here, the authors discuss creativity in the artificial intelligence era: they note that large benefits can accrue from insights into innovation and research. Currently, large amounts of human capital and industrial resources are wasted every year. They created a detailed literature review to uncover many clever applications for big data analytics with the organization culture integration.

The thirteenth paper is named "Automation of report generation for functional testing - E-Services Operator". The authors describe the conversion of traditional business operations into digitalization. The present role of ICT in all applications are discussed, and the importance of ICT with e-Commerce is provided in their discussion. From a business owner's point of view, his traditional services' automation is considered and presented their work with e-Services automation.

The fourteenth paper is named "Control and Alert Mechanism of RFID Door Access Control System Using IOT". The authors proposed the general door access control system. Their presented work focuses on the Internet of Things and RFID-based technologies integrated, door access control and alert mechanism. Based on the vibration of the door, the system identifies the malfunction with the deployed sensors, and instead of alerting, the door is locked properly in their proposed work as a result of enhanced security.

Accordingly, the fourteen papers in this special issue comprise wide-ranging interpretations and explorations on renewal and sustainability. It should be noted that these papers constitute a sample of the leading papers published in recent Gynacity conferences. In the globalized twenty-first century, big data, societal resilience, conflict transformation and disaster risk reduction strategies often involve international actors and issues as a significant crisis in one country can create disruptions around the world. For example, on March 11, 2011, Tohoku Earthquake in east Japan led to a tsunami, a nuclear facility malfunction, and global economic impacts, which influenced renewable energy decisions in Europe.

Moreover, severe flooding during the 2011 monsoon season in Thailand damaged Honda's automotive plants near Bangkok, negatively impacting the production of vehicles in Europe and Japan and leading to global supply chain disruptions finally, while the 2004 Boxing Day Sumatra-Andaman earthquake and tsunami in Indonesia caused the death of 543 Swedish citizens across the Indian ocean region --- the deadliest disaster in modern Swedish history.

This collection of papers strengthens interdisciplinary linkages and investigates current gaps in big data knowledge and the opening of new research avenues for integrated computational intelligence research. In summary, this cross-disciplinary and transnational collection of papers examines the causes and consequences of human suffering and ecological degradation, with a special emphasis on crafting AI-informed soft computing solutions that are not only cost-effective but also comprehensive and sustainable

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PROJECT MANAGEMENT AND ITS RELATION TO LAND MANAGEMENT IN THE SAN PABLO TOWN CENTER, VALERA DISTRICT, BONGARÁ - AMAZONAS

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ABSTRACT

The objective of this research is to propose project management and its relationship with the control of the territory, in the population nucleus of San Pablo, district of Valera, Bongará-Amazonas, the inadequate management of the projects results in the misuse and management of the territory, as well as in each of its specific aspects for each subzone of the region, the research has a qualitative approach, descriptive-explanatory type. The sources were primary, including the plan mentioned above and supporting documents. The main instrument was a data collection table of our elaboration and based on the Corine Land Cover model. It was also based on data collection, mapping, and measuring geographic areas, both from documents and the field. As a result, a quantity of territory is proposed for each activity, delimiting it in a suitable place through projects for the adequate management of the region. In the case of the "Agricultural and Reforestation Zone", of a total of 1,042 Ha, 937.8 Ha (90% can be recovered, so it is emphasized that projects and their prior management, from the planning stage at the territorial level, can give an approximation of what is expected for its future execution and be more efficient.

KEYWORDS

Management, Projects, Territory, Ordering.

1. INTRODUCTION

Entering the South American context, the characteristics of this territory, the predominance of the Andes Mountains and the Amazon jungle, make favorable situations occur in many aspects. Still, simultaneously, they make other situations with specific problems arise. This is why Peru is no stranger to this; the issues are often accentuated even because of its location (Alomoto, 2018).

In the contexts above, it is understood that various factors lead national or local governments to adapt their policies, regulations, and actions to the multiple conflicts and events generated in their territories, caused by various factors, whether physical or as part of their management. This is how situations arise, such as the management of the region. The inhabitants themselves have been physically transforming it due to the various activities developed throughout history. Many cases, such as those mentioned above, have been carried out responsibly. Others have not, especially where there is evidence of natural diversity of flora and fauna and natural resources necessary for the subsistence of human beings. Other related activities exploit resources for economic purposes, and Peru is no stranger to this (AMBIO, 2018).

The aforementioned corresponds to the management and use of the soil or territory. However, it is already evident that the overexploitation of resources and soil, whether legal or informal, leads to dramatic changes in the region. This makes the authorities look for ways to order and manage it correctly; it should be remembered that the characteristics of the mentioned territories often complicate that action.

It should be remembered that many of these territories are hit by the ravages of nature, even more intensely in some seasons, aggravating the vulnerability of the land and its inhabitants. As mentioned in the magazine "Abriendo Brechas", regarding the relationship between territory and society, "Territory must be considered as a multidimensional accumulation of value capable of producing a set of economic, social, environmental and cultural benefits for an indefinite period" (Abbasi *et al.*, 2019).

Solutions that seek to control this problem, mentioned above, are projects and their management, which intervene in specific areas and each with its problems. Still, it is not

enough to attack in a particular way, if not most of the time; more comprehensive plans are required to mark the path of future projects within a timeline. Land Management Plans (POT), Urban Plans (PU), Land Development Plans (PAT), environmental, among others; which are documents designed to manage the territories through various policies and projects, understanding, above all, that in non-urban areas or population centers, as is the case in many cases in the interior of Peru, they are essential. Situations that must be addressed with solid directions by the Government in the order of complete decentralization and thinking above all that what is at risk are human lives and the very life of the environmental nature of the territory (Al-Hemoud *et al.*, 2019).

In the context of this research, it is worth mentioning that the Peruvian territory is no stranger to this; on the contrary, having the aforementioned territorial characteristics generates a series of problematic situations that are difficult to control or mitigate. Thus, natural phenomena and disasters are already part of the daily coexistence of these areas, and one of the main problems is the lack of intervention by the authorities to prevent damage or solve the problems generated after they have occurred.

The economic activities that are habitually practiced in many of these places and population centers are related to the extraction and exploitation of natural resources without control, such as logging and mining. It is common to observe that the exploitation activities in these places, which are generally populated centers a little far from important cities, some of which are even difficult to access, are carried out informally and without any control. Thus, with the ruggedness of the territories, their climatic phenomena, the coexistence of the inhabitants with their environment is the riskiest, aggravating the land management problem, the central theme of this research (Arana, 2018).

Governments and authorities seek to generate projects and plans to solve part of these problems somehow, whether they are related to natural disasters or caused by the inhabitants themselves. The situation is that every time these are generated, they are not carried out with adequate management or with an in-depth analysis of the real problem (Ascue, 2018).

2. METHOD

2.1. TYPE OF RESEARCH

For the present work, the type of research is "Descriptive and Explanatory," since it describes and explains the causes that originate the problem and the projects that seek to mitigate it, all about the population center, its territory, and nearby environment.

The research method is deductive since it goes from the general to the particular; that is to say, a broad problem is observed, and the parts are analyzed step by step until specific cases are reached (Barrionuevo, 2018). The research approach is qualitative since the indicators depend on specialists who give it a qualitative value for its analysis.

The level presented is non-experimental research, "since the variables are not deliberately manipulated. To observe phenomena as they occur in their natural context, to analyze them" (Castillo, 2018).

2.2. POPULATION AND SAMPLE

The town of San Pablo and its area of influence, which covers part of the district of Valera, province of Bongará in the Amazon region, was selected because it is influenced by the activities that affect it and, in turn, its area, presents the most critical problems. This area comprises 1,069 ha. The sample is non-probabilistic because it was necessary not to exclude any amount of territory from the population since the relationship sought to demonstrate that both variables are evident throughout the region and physically.

2.3. LOCATION OF THE STUDY AREA

Centro Poblado San Pablo in the Valera district.

The study area was located and delimited through observation and review of the plan, according to the problems and the possible projects indicated. This led to defining the study area, which comprises the town center and the influence of its immediate surroundings; then, we proceeded to measure the selected size resulting in the sample obtaining data in hectares of territory. Figure 1 shows the location of the San Pablo population center within the Valera district. In contrast, Figures 2 and 3 show the analysis and diagnosis in plans that

were developed for the rural-urban plan for San Pablo. Figure 1 shows the entire territory selected for this research (Cho & Bruce, 2021).
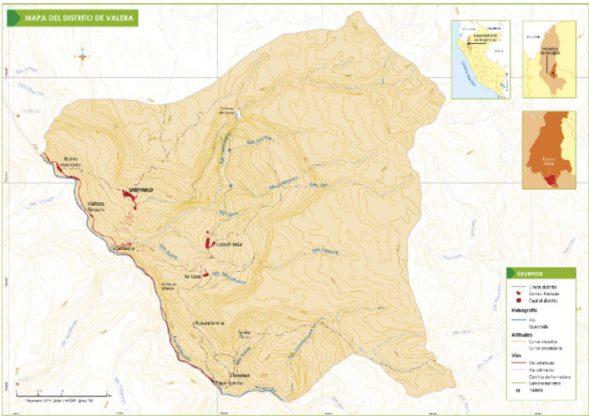
Figure 1. Map of Valera district.
Source: own elaboration.
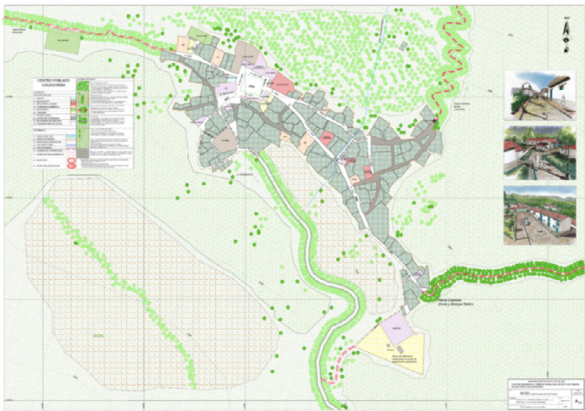
Figure 2. Zoning and land use proposal map, San Pablo town center.
Source: own elaboration.

Map prepared for the San Pablo population center, detailing the information on the projects proposed to mitigate or solve each problem or case described in the map in Figure 2 (Esenarro *et al.*, 2021). The delimitation of the study zones for the specific hypotheses depended on the dimensions that make up the dependent variable, for which three were identified. Each one was also subdivided into different sectors, defined by the physical characteristics of the territory and the activities carried out in it. The first is called the

"Agricultural and Reforestation Zone," the second is the urban expansion zone, and finally, the protection zone (Figure 2).

2.4. DATA ANALYSIS

Once the data collection stage was completed, the information was organized in the data collection table to relate each area of the zones with the corresponding type of project. For data processing, the "Excel Spreadsheet" computer tool was used. For the data analysis, as shown in Table 4, the resulting areas were taken from the overlapping plans in the study zones, which generated a percentage of influence on them when the respective projects were applied. The analysis of the results obtained was developed using counts and qualitative verification according to each case, where the most relevant aspects of each zone, representative information of each variable, and in particular of each situation were evidenced (Etsay, Negass, & Areay, 2019).

Table 1. Distribution of areas.

VARIABLE	OPERATIONAL DEFINITION	INDICATORS (V.D.)	AREA (Ha)
Territory management	Agricultural and reforestation zone	Qty of area for cultivation	521
		Qty area for reforestation	521
	Urban expansion zone	Qty area for buildings	11
		Qty area for roads	3
		Qty area for parks, squares, and gardens	3
	San Pablo protection zone	Qty area at risk for landslides	8
		Qty area affected by flooding due to rains	2

Source: own elaboration.

3. RESULTS

Project management is related to the control of the territory in the town of San Pablo, Valera - Bongará - Amazonas district. When relating the variables and reviewing the analysis

results, the validity of the proposed general hypothesis is demonstrated since a substantial percentage of territory influenced by the projects is observed. Thus, the management of the projects suggested in the research has a significant relationship proposal about their actions in the environment when comparing the region's total recovered area (Femenia-Ribera, Mora-Navarro, & Martinez-Llario, 2021).

Throughout the research development, there was constant advice from professional experts who participated in the development of the plan and external experts, such as architects, engineers, and geographers (Hernández, 2018).
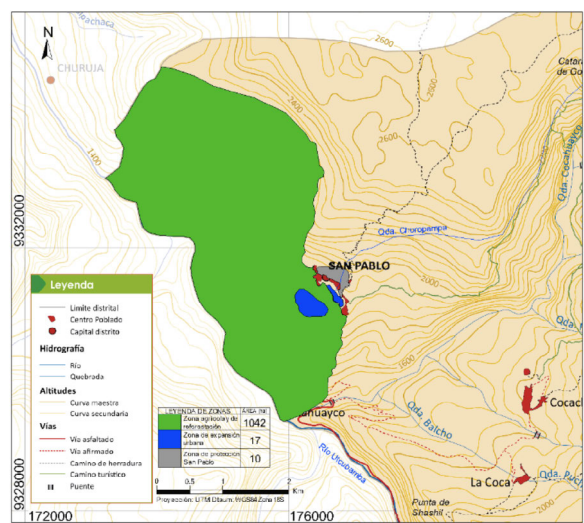
Figure 3. Map of geographic zones.
Source: own elaboration.

Map showing the amount of area delimited for each study zone. The delimitation of the study zones depended on three dimensions. Each one was subdivided into different sectors, defined by the physical characteristics of the territory and the activities carried out in it. The first is called the "Agricultural and Reforestation Zone," the second is the urban expansion zone, and finally, the protection zone (Tafur *et al.*, 2020).
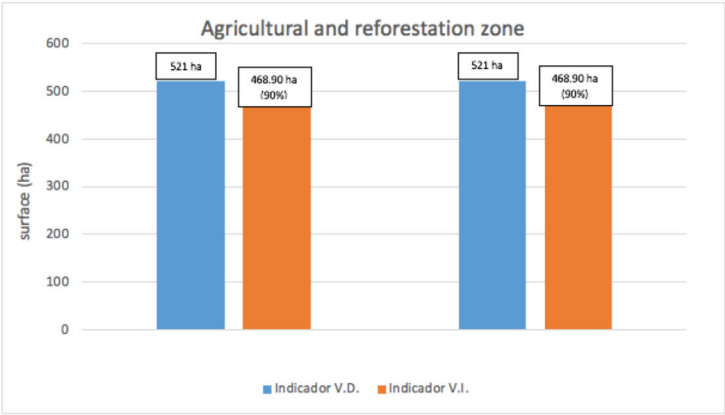
Figure 4. The ratio between % areas to be recovered and total areas per sector.
Source: own elaboration.

Project management is related to the direction of the agricultural zone and reforestation in the San Pablo population center, Valera - Bongará - Amazonas district.

The amount of land for cultivation is 521 ha, of which 90% will be recovered through productive plot projects. The amount of territory for reforestation is 521 Ha, of which 90% was identified, will be retrieved by reforestation projects with native species. The percentages of the area not recovered or not intervening in the territory were placed in the field because they are not accessible and include complimentary or road areas (Hinojosa *et al.*, 2021).
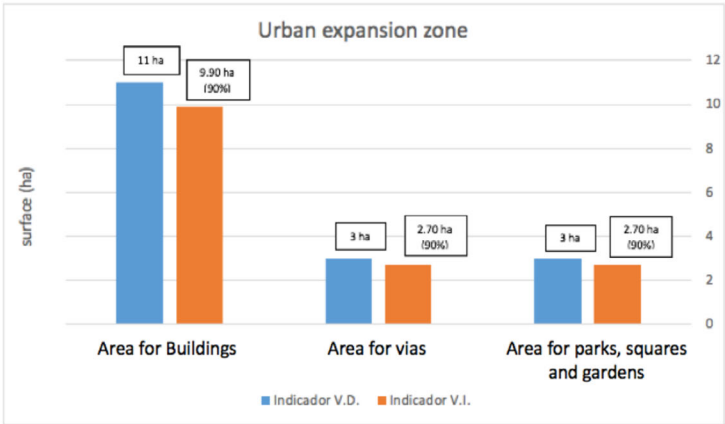
Figure 5. The ratio between % areas projected for expansion and the total regions per sector.
Source: own elaboration.

Project management" is related to the "Management of the urban expansion zone" of the San Pablo population center, Valera - Bongará - Amazonas district.

The amount of land for buildings is 11 hectares, of which 90% will be used as a possible projected area for that purpose. The amount of land for roads was 3 hectares, of which 90% was used as a projected area for sidewalks, trails, and tourist corridors. The amount of territory for parks, squares, and gardens was 3 Ha, of which 90% was used as a projected area for that purpose. In this case, since the urban expansion projection works as a block, it was distributed proportionally for each indicator, being affected in the same way by the resulting remaining area, which is made up of a ravine and other irregularities typical of the area, where it will not be possible to project (López, 2018).
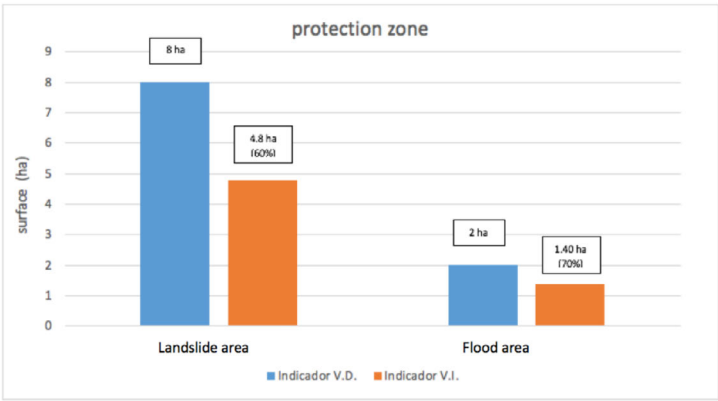
Figure 6. The ratio between % of protected areas and total areas by sector.
Source: own elaboration.

The "Project Management" is related to the "Management of the Protection Zone" in the town of San Pablo, Valera - Bongará - Amazonas district. The area at risk of landslides is 8 hectares, 60% of which is protected by projects for the treatment of slopes, ravines and containment elements, which defines a specific intervened area and one that is protected from the town center. The non-intervention area is the area above the slope and the projects. The area affected by flooding due to heavy rains was 2 hectares, which will be 70% protected when developing projects for possible road channeling, paving, and treatment of the Choropampa stream, depending on the analysis of future projects (Ministerio de Vivienda, Construcción y Saneamiento (MVCS), 2018).

The possible interventions given by the projects proposed in this research are based on projects that recover and improve the territory and its future management, as evidenced by the proposed reforestation of a forested area that deteriorated by indiscriminate logging and inclement weather, as well as the transformation of part of this area into productive plots with traditional crops in the study area. For the urban expansion zones, planned growth projects are proposed in their area, considering all the critical distinguishing factors, such as roads, recreation areas, meeting places, and buildings. For the protection of the town center, it should be understood that the deteriorated state of its facilities and roads was evidenced, generally due to the heavy rains and the little intervention of the streams, surrounding hillsides, and within the same urban area of the town center itself.

Figure 7. Image of the flood zone.
Source: own elaboration.

The image shows the typical balcony, characteristic of the place, which is deteriorated, and the wall, a specific characteristic of the buildings exposed to the area flooded by rains.

Figure 8. Intervention project in the flood zone.
Source: own elaboration.

The image shows the intervention proposal for a road in San Pablo affected by flooding, referred to in Figure 8, using the urban architectural perspective technique.

Figure 9. Image of the Plaza de Armas, south side.
Source: own elaboration.

The image shows the deteriorated Plaza de San Pablo, as well as the surrounding buildings.

Figure 10. Intervention project in the Plaza de Armas, south side, in perspective.
Source: own elaboration.

The image shows the proposed intervention in the San Pablo square and the surrounding buildings, using the urban architectural perspective technique.

At a general level and by way of analysis, in the present study, the observation allowed a verification and review of the study area, being the fieldwork of vital importance, which was made compatible with the information collected in the office, both of the plan taken as a reference and its related documents such as regulations and zoning. Thus, a data collection table was used as an instrument for data collection, which allowed relating the data obtained from the geographic zones, which, in the plan, responded to a specific problem to be solved, which will be done with careful project management applied to each

one of them. This leads to the reflection that, since in many cases plans have been carried out at the national level that are effectively proposed for specific territories, their correct application will depend on how each type of project is managed, starting with the creation of the plans and considering a timeline according to their possible influence during and after their execution (Sobrino, 2018).

The relationship between the independent variable, "Project management" and the dependent variable, territory management, was achieved by superimposing the spots as shown in Figures 1, 2, 3, 4, 5, 6, and 7, which represented various sectors with specific characteristics and percentages of related areas. Some of the selected territories, others, indicating the influence of the projects on these areas, and other spots indicating the rest of the data. These are handled horizontally to relate them in the data collection table, calculating percentages that define the relationship sought through the hypotheses.

4. DISCUSSIONS

According to the results obtained from the research and compared with previous research studies, it can be observed that the use of the territory is gradually affected and influenced by the accelerated urban growth, thus agreeing with the present research when talking about the urban expansion zone, which forces within the plan to change the existing uses of the territory. While it is true that it agrees with the above mentioned, in contrast to the mentioned study, a land-use plan helps or seeks to reorganize the management of the territory in the most coherent way. In the case of the present research and that of Arana, the data collection table tool is used, which generates a conclusion referring to its powerful utility for analysis of the territorial type or referring to geographic areas with determining land uses (Perez, 2018).

We agree with Alomoto's work (2018) in that territorial planning seeks to mitigate the effects caused by various geographic factors. We are even using the TO as an entire governing body. However, in this thesis, we do not propose a POT but methodological guidelines or directives that can be annexed or complemented.

In the case of Hernández, the ZEE is a preponderant factor for the TO, as well as for the methodological process proposed in the case of the present research, even though it does

not generate a POT, it could be a guiding component to generate the predictions expected from the plan (Sroorvogel & Mulder, 2021).

Proposal for a methodology to evaluate the effectiveness of Natural Protected Area (NPA) management to measure the level of establishment and management of NPAs administered by the National Service of Natural Protected Areas (SERNANP).

Castillo (2018) focuses mainly on the management of green areas and its strong relationship with tree planting, agreeing with the present thesis, in the sense of starting with initial project management, seen in its content and the necessary processes, which also start with projects for the subsequent action in a given place, focusing or oriented more to the "Management and Arborization of Green Areas" of a given sector. It differs from the present research because the study area is closer to a large urban area such as Lima. It starts from the analysis of the territory, as the current investigation, but focuses it, a little different and not less important, to the sustainable development of a population with a persistent social problem (Vargas *et al.*, 2021).

Barrionuevo (2018) proposes concepts and theories necessary to strengthen TO in Peru. While it is true that the primary source of this thesis is a Rural-Urban Plan, based on the ideas of POT, the purpose of seeking a result through a methodology of its aims is to contribute a theoretical part to the already existing at the TO level (Xie *et al.*, 2020).

For Ascue, the territories' vulnerability is one of the essential points to attack, which is essentially in agreement with the present thesis. In both, the behavior of society and its effects is highly crucial (Xie *et al.*, 2021).

5. CONCLUSIONS

The 1,069 hectares of the study area show the total territory affected by the problems described, and specific projects are suggested to mitigate them as appropriate. Although the jurisdiction of the geographic zone in which this research was carried out corresponds to the entire Valera district, the specific area of the study is strongly influenced by the presence of the San Pablo population center and its area of influence, which is the capital of the district.

There are areas used for agriculture in the study area that is not clearly delimited or adequately managed. There is also evidence of indiscriminate and informal logging and deforestation in the area. The revised "Urban-Rural Plan" proposes a certain amount of territory for each activity, delimiting it in a good place through projects for the proper management of the region. In the case of the "Agricultural and Reforestation Zone," out of a total of 1,042 ha, 937.8 ha (90%) can be recovered.

There are areas where the population has been settling and building without considering the dangers that this entails, as there are risk areas identified in the evaluated plan. Therefore, the projects to delimit the different proposed areas observed in the Plan are differentiated by the characteristics of each of the components that will make up a future urban expansion, noting that they are located correctly in the proposed area. Therefore, in this urban expansion zone, of 17 hectares, 15.3 hectares (90%) are offered for planned expansion projects.

With its rugged geography and rainy climate, the protection zone creates a series of problems for the town center and its surroundings. Therefore, the plan delimits protection zones and proposes possible projects to mitigate each case. The proposed projects have a strong influence on the affected areas as they seek to protect a large percentage of their territory, safeguarding the lives of their inhabitants. Unlike the previous cases, there are no percentages of protected areas that reach or approach 90%. However, it is justified that 60 and 70% of the 10 Ha have a substantial impact relationship because the possible projects in these cases do not cover the total mapped territory, but limits where the barriers are placed, protection elements or modification of the environment and also the areas that would be affected and with the projects are protected.

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/02/

APPLICATION OF ORDINANCE N° 310-2009-MDJM, AND NOISE POLLUTION FROM THE VEHICLE FLEET IN THE DISTRICT OF JESÚS MARÍA - 2020

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ABSTRACT

The present research work analyzes the noise pollution of the automobile fleet in the District of Jesús María located in Lima - Perú. The general objective was "To determine the incidence of the application of Ordinance N° 310- 2009-MDJM. in the noise pollution of the vehicle fleet in the district of Jesús María, 2020" the type of research is applied; descriptive and explanatory level and non-experimental design. The population object of study was constituted by the inhabitants of the district and the floating population, considering a non-probabilistic sample of 210 people. The instruments used were: measurements of sound pressure in fixed stations, counting of public and private vehicles in the time of measurement of good pressure, and a questionnaire that was validated by expert judges, the same one that constituted 32 items of the scale of Likert. The results found in the sound pressure measurements exceeded the maximum sustainability of the analyzed Ordinance, showing noise pollution. The statistical test used was the Spearman correlation coefficient, determining that there are differences in noise pollution at the stations and not at the timetables; that public and private vehicles increase sound pressure measurements under different conditions; concluding that: "The application of Ordinance N° 310- 2009-MDJM significantly affects noise pollution in the vehicle fleet in the district of Jesús María, 2020".

KEYWORDS

1. INTRODUCTION

When we think of environmental pollution, we think of it as strange elements that alter the conditions of natural development in space. Generally, it is a consequence of the participation of human beings trying to improve their living conditions; however, if the limits that allow maintaining natural balances are exceeded, these actions considered as beneficial become detrimental to the development of living beings, and that is when pollution in all its aspects appears (Alvarado *et al.*, 2020).

One of them is noise pollution, recognized as a polluting agent in the Environmental Congress organized by the United Nations in Stockholm in 1972 and identified for generating unwanted sounds because they lack harmony and are called noise, or is sharper than living beings can withstand without being damaged; Moreover, it is punctual pollution, which does not generate waste and has the particularity of being easy to adapt in individuals, in such a way that it decreases the sensitivity of those who are in contact with it, that is why scholars of this pollution, among others, consider the influence in addition to physical parameters, other subjective parameters to describe it, so it is inconvenient to clearly explain to the citizen that there is a problem called noise, which is affecting their physical, mental health, and their social quality (Alomoto, 2018).

Several human actions generate this contamination; one of them is the vehicle fleet in urban public spaces, especially where vehicles are old and technical revisions are not a priority, there is no adequate organization of vehicular traffic, and urban downtown areas begin to concentrate their activities both public and private in small spaces which generate a high concentration of citizens who inhabit these spaces and live with the floating population that is developing their work activities, education, visits to health centers among others and need means of transportation to mobilize.

The above mentioned happens in the district of Jesus Maria, a very central area within the capital of Peru, Lima; so, we wanted to know if the district authorities were looking for solutions to this problem, considering that they have the Ordinance No. 310-2009- MDJM, a document which establishes the maximum allowable limits for the generation of noise nuisance and regulates the policies of prevention and noise control to educate the neighbors about this pollution (AMBIO, 2018).

Environmental pollution is an alteration of the natural environment generated by foreign elements that cause undesirable changes in the spaces where they occur, which in many cases generate disease in humans; these alterations can be of natural origin or generated by the activities carried out by man. One of these contaminations is called noise pollution, produced by waves that move in space which generate sounds perceived by living beings; in the case of man, he can feel pleasant sounds that can favor his emotions, but there are also unpleasant sounds that can affect his physical, psychological and social health. Noise pollution is generated by different causes; some of the most important are those produced by the vehicle fleet, that is, by the circulation of numerous vehicles that travel through the streets and avenues of a city, which is why it is called urban noise pollution (CSU).

The CSU is increasing exponentially in the big cities of the world; recent studies found that Guangzhou in China has the highest noise pollution; this information corresponds to the measurement made by the global index of hearing, which was created by the founders of the digital hearing application Mimi Hearing Technologies GmbH, they analyzed the results of the hearing tests of 200 000 of its users (Amable *et al.*, 2017).

2. METHOD

2.1. TYPE OF RESEARCH

It is applied; this base is based on the technological findings of basic research, linking theory, and reality (Reyes *et al.*, 2021).

Scientific theories are considered concerning the deterioration of the urban environment due to the excess noise generated by the automobile fleet.

2.2. LOCATION OF THE STUDY AREA

The district of Jesús María is one of the 43 districts that are part of the province of Lima located in the Department of Lima. It is bordered on the north by Breña and Cercado, on the west by Pueblo Libre, on the south by Magdalena and San Isidro, and on the east by Lince and Crecado (Bizkaia, 2018).

Table 1. Number of inhabitants of the district of Jesús María.

TOTAL	DENSITY
71 589 hab.	17 897,3 hab/km2

Source: own elaboration.

3. RESULTS

3.1. SOUND PRESSURE MEASUREMENT

Table 2. Sound pressure measurements at seven stations. Factor: LAeqT.

Station	UTM Coordenatess		L_{AeqT} 10min (dBA)			Average (dB)
	East	South	07:00-09:00	14:00-16:00	19:00-21:00	
E01	277716	8664258	71,3	69,9	71,8	71,0
E02	277687	8663750	75,9	75,7	72,0	74,5
E03	277284	8663443	65,7	70,3	69,8	68,6
E04	276831	8662929	66,6	64,6	65,1	65,4
E05	276496	8662269	72,6	73,0	71,1	73,9
E06	276012	8662589	73,5	71,0	68,3	70,9
E07	275538	8662897	70,9	75,1	68,9	71,6

Source: own elaboration.

Table 2 presents the sound pressure measurements taken at the seven work stations, with the highest figures found at E02 in the morning and afternoon hours with 75.9 and 75.7 dB respectively, and the lowest sound pressure figures at E04, in the afternoon and twilight hours with 64.6 and 65.1 dB respectively, which are reflected in the average measurements. It is noted that all sound pressure measurements are more significant than 60dB.

Table 3. Tests of inter-subject effects.

Dependent variable:	Sound pressure				
Origin	**Type III sum of squares**	**gl**	**Media cuadrática**	**F**	**Sig.**
Modelo corregido	162,820[a]	8	20,353	4,910	,007
Intersección	104742,172	1	104742,172	25270,490	,000
Estaciones	150,505	6	25,084	6,052	,004
Horarios	12,315	2	6,158	1,486	,265
Error	49,738	12	4,145		
Total	104954,730	21			
Total, corregido	212,558	20			

Source: own elaboration.

Table 3 shows the sources of variation, sums of squares, degrees of freedom, root mean squares, F-statistics, and critical levels associated with the three effects present in a two-factor model (Alcántara- Malca & Esenarro, 2018).

The corrected model row refers to all model effects taken together (2-factor, interaction, and intercept or constant effect). The P-value 0.007 < 0.05 tells us that the model explains a significant part of the variation observed in the Dependent Variable sound pressure. A coefficient of determination $R^2 = 0.766$ (162,820/212,558) indicates that the 2 effects included in the model (season and schedule) are explained with the adjusted coefficient of determination 61 % of the variance Dependent Variable sound pressure (Delgadillo & Pérez, 2017).

The intersection is the constant of the model. The two rows are personal effects of the two factors: season and schedule. The significance levels indicate the mean sound pressure of the groups defined by the variable stations differs (0.004 < 0.05) while the groups defined by the irregular schedule have non-significant mean times (0.265 > 0.05) (Figueroa *et al.*, 2018).

The error row is related to the source of error variation or residual. The root means square of the error (4.145 is a divisor of each F-ratio), an unbiased estimator of the variance of the populations studied (assumes all equal). The corrected Sum of Squared Total captures the total variance of each effect plus the error variance.
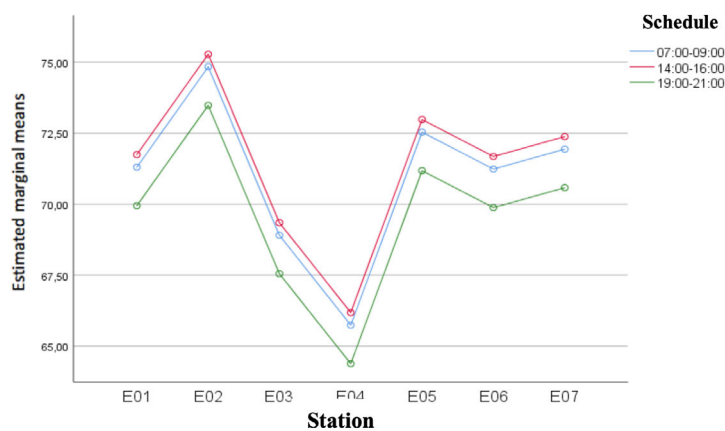
Figure 1. Profile plot results.
Source: own elaboration.

Figure 1 shows the sound pressure averages calculated in each subgroup due to combining each level of the variable stations with each level of the erratic schedule.

3.2. ENVIRONMENTAL NOISE MAPS
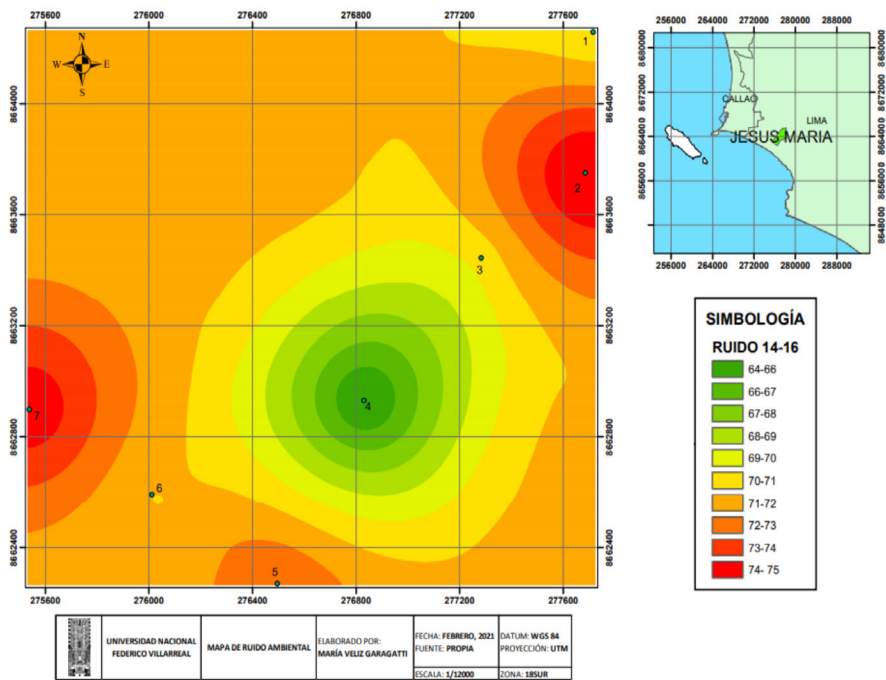
Figure 2. Noise map.
Source: own elaboration.

The afternoon ambient noise map, Figure 1, has been taken because, making use of the statistical results of the profile graph, Figure 3, indicating the estimated marginal sound pressure measurements, which show that in the afternoon hours, the highest sound pressure measurements are presented. In this map, the two most affected stations, E02 and E07, are shown, expressed in the intense red color that represent the figures of 75.9 dB and 75.1dB, respectively; another essential point is E05, where a dark orange color can also be seen that expresses a vital sound pressure figure, 73. 0dB; E06 with 71.1dB, where the orange color is lower, followed by E01, E03, and E04, with 69.9, 70.3, 64.6, which show even lower orange colors up to the green, indicating lower figures. The morning and twilight Ambient Noise maps (Gray, 2017).

3.3. METEOROLOGICAL CONDITIONS ANALYSIS

The monitoring of the meteorological conditions was obtained from the three sampling days, February 12, 18, and 25, 2020, from which the averages of the meteorological conditions have been received by using the measurement hours. In addition, information was obtained from the SENAMHI Mars Field Meteorological Station.

Table 4. Meteorological conditions in the study area.

PARAMETER	12 FEB	18 FEB	25 FEB	AVERAGE
Ambient Temperature (°C)	22,9	25,7	22,3	23,6
Relative Humidity (%)	84	72	83	80
Wind speed (m/s)	2,5	2,9	2,6	2,6

Source: own elaboration.

The figures in Table 4 show temperatures ranging from 22.3 to 25.7 degrees Celsius, with an average of 23.6 °C; relative humidity measurements were also taken in percentages ranging from 72 to 84 percent, with an average of 80%; wind speed was also measured, with an average of 2.5 to 2.9 meters per second, with an average of 2.6 m/s (González, 2019).

3.4. PROFILE GRAPH RESULTS
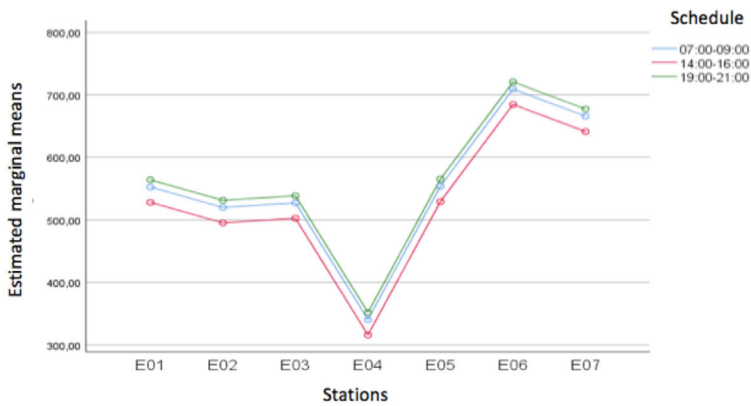
Figure 3. Estimated marginal averages of vehicle flows.
Source: own elaboration.

Figure 3 shows the vehicle flow averages calculated in each subgroup due to combining each level of the variable stations with each level of the erratic schedule.

3.5. PUBLIC AND PRIVATE VEHICLE FLEET CONSIDERING VEHICLES TYPE.

We have considered analyzing the flow of public and private vehicles separately. General cars correspond to the light and dark red colors for each sampling station, and private cars conform to the green variants (Hidalgo, 2019).

Table 5. Public and private vehicles per station.

STATION	% PUBLIC VEHICLES	% PRIVATE VEHICLES
E01	55	45
E02	55	45
E03	40	60
E04	36	64
E05	42	58
E06	38	62
E07	30	70

Source: own elaboration.

Figure 4. Average percentages of public and private vehicles per station.
Source: own elaboration.

Table 5 and Figure 4 present the averages in the percentage of public and private vehicles to determine the ratio of presence of each of them in each station, and we found the following: in stations E01 and E02, there was a more significant presence of public vehicles in 10% more than private vehicles, while in E03, E04, and E06 there is a more substantial presence of personal vehicles in a difference of between 20% to 28% more than public vehicles, in E05 there is a difference of only 16% between private and public vehicles, which indicates that both types of vehicles are essential in that station and in the case of E07 the difference is more significant for personal vehicles with 40% more than public vehicles (Mamani, 2017).
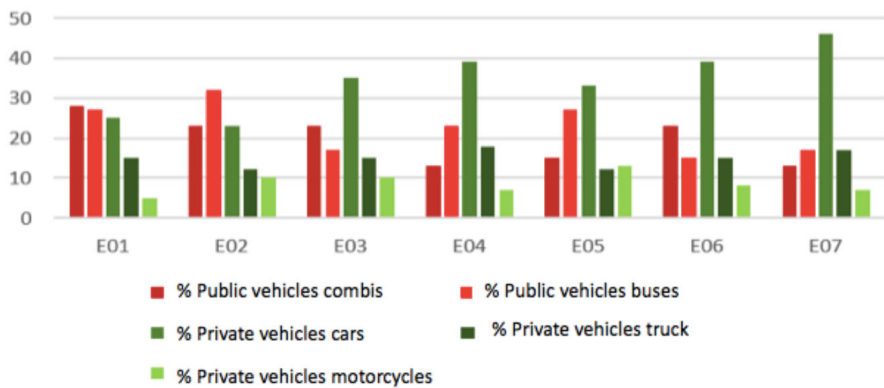
Figure 5. Types of public and private vehicles by station.
Source: own elaboration.

Figure 5 shows that E01 and E02 have more public vehicles, with both vans and buses in fairly close numbers; the differences do not reach 10% and are therefore not relevant. In the case of E03, E04, E06, private vehicles are predominant and have similar results in the arrangement of the different types of means of transport. At the same time, E05 presents figures of private cars with vehicles, vans, and motorcycles with representative statistics and the influence of public vehicles that were also present and with significant figures. In E07, there is a high presence of private cars with a relatively representative number of vehicles (46%) (MDJM, 2019).
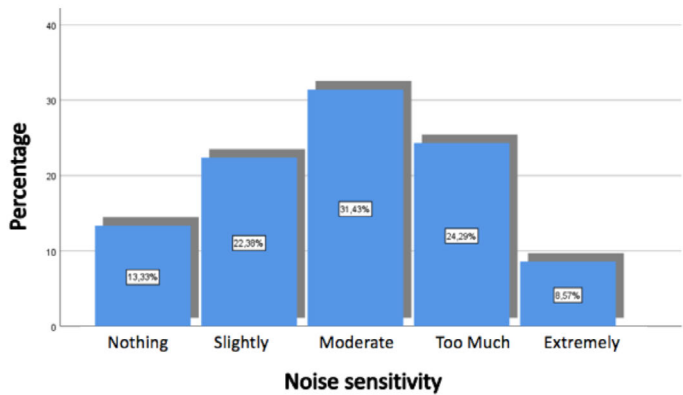
Figure 6. Sensitivity to noise.
Source: own elaboration.

The sensitivity to noise indicated in Figure 6 has been expressed with 31.43% as moderate, 24.29% as too sensitive, 22.38% as slightly sensitive; the last two indicators do not reach 15% each, so they are not considered relevant (Municipalidad de Jesús María, 2021).

4. DISCUSSIONS

The sound pressure meter measurements at the seven stations are significant since P-value $0.007 < 0.05$ indicates that the null hypothesis is rejected, and the alternative view is accepted. It is concluded that the sound pressure is not the same for all stations. To know where the difference is, we proceeded to a Tukey test, where it can be observed that stations E01 and E06 do not differ in any case since P-value is more significant than 0.05, on the other hand, in stations: E02 differ significantly with E03 and E04; E03 differ significantly with E02; E04 differ significantly with E02, E05, and E07; and E05 and E07 differ significantly E04 (Ocas, 2018).

The aforementioned results are expressed in Figure 2, where the results of the Profile graph are shown, in which we can find that E02 is the one that presents the highest sound pressure of all the sampled stations and can be seen in average numbers in Table 4 which indicates the figure of 74. 5 dB; which compared to E04, reviewing the same tables and figure, shows that it is the station with the lowest figures, with 65.4 dB of sound pressure and in the case of E05 and E07, intermediate figures of good pressure are presented with 73.9 dB and 71.6 dB on average, respectively. The proper pressure measurements can be seen with greater representativeness by observing them in the noise map, Figure 3, which offers us an essential geographic appreciation in the space of the analysis of the measurement nuclei and the dispersion that noise produces spatially, generating more deterioration in the area where it is made. We must note that the barriers of the environments that can reduce the strength of the noise have not been considered, although the measurement stations of this work have vast spaces in which the barriers are distant. It is important to note that all the sound pressure figures obtained in this work are above 60 dB, considered the maximum present in any urban public space, as indicated by the Ordinances of different districts of Lima and other districts cities in Peru. Similar results are found in the works developed; who suggests that in the town of Chimbote, in José Gálvez Avenue, the area with the most traffic, Sound Pressure figures were obtained above 60 dB, considered as maximum in the Municipal Ordinance of his district; also in Iquitos in the center of the city was measured up to 84. 24 dB in the town of Cajamarca in its two downtown avenues Av. Hoyos Rubio and Jr. Manuel Seoane exceeded figures of 100dB (Figueroa *et al.*, 2018).

If we analyze works carried out in Lima, in the campus of the Catholic University of Peru was measured above 70dB. Therefore, it is considered that the sound pressure measurements obtained in this research work, as in those carried out in all the results presented as background, the excellent pressure figures exceeded 60 dB for urban public spaces in daytime hours (EFE, 2018).

The measurements of vehicle flow in the seven stations are significant since P-value 0.012 < 0.05 also suggests we reject the null hypothesis and accept the alternative view. And we conclude that the vehicle flow is not the same for all stations. To locate the difference, we proceeded to a Tukey test, where it can be observed that stations E01, E02, E03, and E05 do not differ in any case since P-value is more significant than 0.05, on the other hand in

stations: E04 differs significantly with E06 and E07; in E06 differs significantly E04; in E07 differs significantly with E04 (Ordenanza N°1965, 2016).

Let's look at the profile graph, where the estimated marginal averages of vehicle flow are presented, Figure 4. We find that: the similarities between E01, E02, E03, and E05 is expressed by the vehicle count in 10 minutes which are in the range of 500 - 550 units, while E06 and E07 had a range between 650 - 700 vehicles in 10 minutes count, the highest figures in our work; finally, E04 presented the range between 300-350 units in 10 minutes. In this analysis, we found that not always the highest sound pressure figure is shown in the station where more vehicles are transiting through a station, as is the case of E02, which has the highest sound pressure figure (75 dB average); however, it was found that it is not the most significant number of cars circulating in that space (500-550. Public vehicles in E02 stop in any room to pick up passengers, creating vehicular congestion and not allowing the flow of the vehicle fleet. In addition, E02 is a Special Protection station due to the location of the Rebagliati Hospital; therefore, its maximum allowed level is 50 dB, and an excess of 21.6 dB was found (Table 10).

The study of noise pollution in the city of Tarapoto, where she indicates that the most circulating vehicle is the motorcycle cart, which is a means of public transport and is who has generated a relatively high sound pressure exceeding by 20 dB to 27 dB more than the noise quality standards in the commercial area; also Cerna, 2015 who indicates among other points that, the high noise level is due to the presence of public vehicles in the study conducted on Av. Universitaria in the city of Lima in 2014 (Delgadillo & Pérez, 2017), indicates that the highest sound pressure levels are due to motorcycle cabs, who notably raised the sound pressure figures in the area of San Juan de Lurigancho- Lima; in the case of E02 in this work, it was primarily observed buses and combis significantly deteriorated by the excess of years of service that they present. Therefore, a public vehicle fleet that is inadequate or in poor condition and poor organization in the transit system can generate significant noise pollution (Zeballos, 2019).

If we analyze the E07, also of Special Protection due to the location of the Military Hospital, there were also high sound pressure figures with an average of 71.6 dB, in this case exceeding 21. In this case, 21.6 dB exceeded the maximum allowed, which is 50 dB,

due to the large influx of private vehicles, since in this station, between 650-700 cars were measured in 10 minutes of counting. Also, the poor management of the traffic system generates an inadequate movement of vehicles entering from Brazil Avenue to Faustino Sanchez Carrion Avenue, making a semicircular movement causing a traffic jam, which produces the high sound pressure level in this station (Rosales, 2017).

In the case of E05, where the second-highest average sound pressure level was measured (73.9 dB), we found a similar presence of both public (42% average) and private (58% average) vehicles, which also generates significant traffic congestion in addition to the increased company of motorcycles by 13%, the highest in the entire sampling area, which contributed to develop the high average sound pressure level of 73.9 dB. Therefore, we can indicate that several causes can produce high sound pressure levels generated by the vehicle fleet in our study area, as in E05 of this research work (Zeballos, 2019).

Analyzing the surveys made to the users in the stations worked, the Cronbach's Alpha statistic shows the instrument's reliability presents the tables and figures that support these results. Regarding noise sensitivity, in Figure 6, 53% of people felt light or moderate noise; this indicates that, despite the high sound pressure obtained in the sampled stations, the human body quickly adapts to environmental conditions, which does not mean that the human body quickly adapts to environmental conditions the adverse effects are eliminated. Rodriguez found a similar result in 2015 in the urban center of Zaragoza (Spain), where 40.4% of students showed indifference when asked about the issue of noise from the vehicle fleet.

5. CONCLUSIONS

The application of Ordinance No. 310-2009-MDJM has a significant impact on noise pollution from the vehicle fleet in the district of Jesús María, 2020.

The application of Ordinance No. 310-2009-MDJM has a significant impact on noise pollution expressed in the noise map of the vehicle fleet in the district of Jesús María, 2020.

The application of Ordinance N° 310-2009-MDJM has had a significant impact on noise pollution from private vehicles in the district of Jesús María, 2020.

The application of Ordinance N° 310-2009-MDJM has had a significant impact on noise pollution from public vehicles in the district of Jesús María, 2020.

The Municipality of Jesus Maria maintains the development of the process of surveillance and monitoring of environmental noise that has begun in late 2019, through the mayoral decree No. 008-2019-MDJM of April 29, 2019, so that it achieves the goal of maintaining the maximum permitted levels present in Ordinance No. 310-2009-MDJM, considering that with this research work has demonstrated the high degree of noise pollution by the motor vehicle fleet that exists in its geographical space.

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/03/

SUPERCAPACITORS AND ITS ENACTMENT FOR RENEWABLE ENERGY RESOURCES

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ABSTRACT

Storing energy has been one of the major issues faced around the globe. Storage of energy, through using batteries from renewable energy is not sufficient, as it has lower power density and low life expectancy. However, in the modern as well as in coming future, supercapacitors, are and will be capable of replacing batteries for energy storage purposes and for short term charge/discharge cycles. Super Capacitor (SC) is a double layered capacitor having higher capacitance with higher power density and higher energy density than normal capacitor and battery. Preceding study on the stated purpose relied on batteries and on coupling the batteries since higher density power capacitor was not invented. This study, examines the use of supercapacitors as an energy storage device for renewable energy sources such as "wind energy" and "photovoltaic (solar)." The latest advancement in this field is the invention of activated carbon from biomass for the electrodes for SC applications. This paper provides the insight about the SC technology with reference to carbon and carbon-based materials derived from biodegradable waste. In addition to this, it also provides comparison between the storage mechanisms of the bio-electrodes.

KEYWORDS

Stabilization, Wind energy, Pitch control, Bio-electrodes, Supercapacitor, Energy density, Photovoltaic (PV).

1. INTRODUCTION

With the continuous rapid growth in the economy, there is an increasing demand in energy and the quality of power. The persistent decay of the worldwide climate and the consistent exhaustion of fossil fuel energy, economical energy sources, for example, wind and photovoltaic energy have been given impressive regard due to its contamination free and reusing points of interest. These renewable energy resources become alluring arrangements to satisfy the vitality and the power quality necessity. However, SC's not only just stores the abundant power flexibly into the electrical hardware at night or in clear events, it improves the force nature of the sustainable power age organization, or fills in as a reinforcement power gracefully for the quick force to uphold (Billinton, 2005). Many wind turbines produce a lot of their energy around evening time when winds are higher and solar plants produce power dependent on sunshine varieties. The capacity is one of the whacking problems in the utilization of sustainable power assets such as wind turbine energy and photovoltaic (solar) energy. The potential to store energy when it is delivered is a basic waypoint towards transforming elective energy into normal energy ("Supercapacitors: Making Renewable Energy Viable," 2011).

The sustainable power age requires its energy capacity parts to take a swift reaction trademark, high unwavering quality and adaptable energy on the board. Therefore, many storage modules have been used like flywheels, lead-acid batteries, capacitors and Supercapacitors. Flywheels can be financially feasible at higher force levels, however, having said that, they are truly huge and one must consider various wellbeing and upkeep issues associated with their establishment. Batteries have significant improvement and substitution issues, and observing their condition of charge, is consistently troublesome (Schainker, 2004). Capacitors take too much time in charge and discharge cycle unlike batteries. They cannot store more than batteries whereas batteries store thousands of times more energy than them. In most cases, capacitors are not environmentally friendly as their life span is very less. On the other hand, supercapacitors replacing all of the above storage devices are faster, reliable and however durable. Analysis of lead acid batteries, capacitors and supercapacitors is shown in Figure 1.

The absorption of electrolyte particles onto the exterior of anode materials is employed to hold charge in supercapacitors, also known as double-layered capacitors (Simon *et al.*, 2014). As another element they can give an elite and profitable arrangement a moderate force level, because of its focal points, for example, high charge/release current capacity, high productivity and wide temperature range (Burke, 2000).
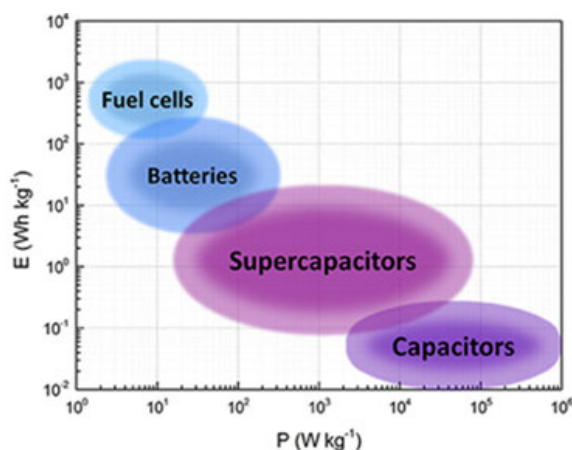
Graphic 1. Ragone plot showing the typical values of energy and power of different energy storage devices. **Source**: (Castro-Gutiérrez *et al.*, 2020).

Supercapacitors end up being better than occupant battery frameworks, performing long ways past the batteries' constraints. Supercapacitors provide lower voltage limits which creates a gap between lithium-ion batteries and electrolytic capacitors. SC's are utilized in various sectors including automotive industry, renewable energy resources, and hybrid transport and so on. In hybrid power systems SC's are being used with batteries for better achievement of mechanism working and it also reclaims energy through restoration of the breaking system in the vehicle. In sustainable energy sources, they play a vital role in wind thermal energy and photovoltaic energy.

Green supercapacitor (SC) technology is the voice of the new techno-world. Materials derived from bio-products and bio-wastes, have attained a high popularity. In this paper, formation of electrodes for SC from various green sources is discussed and compared. This paper provides deep insight about the performance of porous/activated bio-carbon electrodes.

2. MATERIALS AND METHODS

2.1. ULTRACAPACITORS IN RENEWABLE ENERGY RESOURCES

2.1.1. WIND ENERGY

Wind power is one of the quickest developing inexhaustible force age innovations. Nonetheless, wind energy is one of most flighty fuel sources, since it relies upon variable wind speed. An adjustment in wind speed influences the force nature of the lattice since it produces vacillations in the turbines yield power. In recent times, wind turbines highlighted straightforwardly movable rotors to dispense with the dynamic force vacillation. This smooths the force yield; however, it offers restricted abilities to change power. The framework of the receptive force variance is eliminated by utilizing power remuneration gadgets. Having stated that, the dynamic force vacillations can't be settled by utilizing power pay gadgets. The voltage transport of wind homesteads can be settled by utilizing energy stockpiling hardware. It is additionally conceivable to change the dynamic and receptive force by adding a capacity gadget. Research shows that the force nature of the framework is significantly influenced by the fluctuating force at 0.01 to 1 Hz. The forcing nature of the network is enormously influenced by the power fluctuation in this recurrence band. A momentary stockpiling gadget can be utilized to stifle the change of wind power in this recurrence band. However, according to its capacity, a gadget which is fit for understanding its energy in a short timespan has numerous applications in wind power framework. Supercapacitors can be utilized in wind power frameworks to address high current vacillations. It will be highly considerable because of their high current charge and release properties. The long existence of supercapacitors, likewise makes them an ideal usage of wind power. Energy will be released/generated in a way in the supercapacitor when the wind is solid. At a point when the wind speed changes, the supercapacitor will start to release and streamlining the framework's yield power, empowering a more productive matrix framework (Haider, 2020).

2.1.2. PITCH CONTROL OF TURBINE BLADES

Pitch control is the innovation used to work and control the position of the blades in a wind turbine. Wind turbine pitch control is one key approach that is significant from both the purposes of wellbeing and effectiveness, and acts additionally where SC's are picking

up foothold (Pikkarainen, n.d.). An unmanageable blade pitch can swiftly transform into calamitous collapse. Electric pitch control systems, hydraulic pitch control systems, battery pitch control systems, and supercapacitor pitch control systems are the four types of pitch control systems. We will discuss the SC based pitch control system in the paper. SC's are the principal pitch innovation utilized for turbines today, taking the main offer situation of 43% in recently introduced turbines around the world.

The innovation of SC is known for its uncommon capacity to fuel a high flood of intensity in contrast to batteries, supercapacitors can catch and deliver rapid productive energy. An ultra-capacitor stores energy in an electric field, as opposed to in a compound response, so it endures many thousands more in charge and release cycles than a battery. Ultra-capacitors work in much lower and higher temperatures, since they don't contain synthetics that are defenseless to ecological conditions. These characteristics have made them alluring, particularly for hard-to-get to seaward turbines which work in incredibly hot temperatures. SC's are a basic dependability part of the turbine pitch control framework, dealing with the pitch for every sharp edge separately and performing basic capacities by "feathering" the blades to improve the effectiveness of wind energy change, just as closing down the framework by contributing the edges to zero the instance of high winds or a network disappointment for safeguard activity (Dvorak, 2016).

A pitch framework render offers the upside of killing steady battery voltage flaws, and untimely battery framework disappointments. Battery voltage blames regularly show up when a turbine reboots itself after a utility lattice power disappointment, or when there is a battery charger disappointment, or when the battery doesn't charge in cool climate conditions. In the event, the shortcoming can't be settled distantly, so a professional should climb the turbine to survey the issue which results in consistent extra support, and misfortune income and the turbine stays out of activity. Untimely battery framework disappointments are additionally normal, generally when the battery framework works in outrageous cold temperatures.

High temperatures additionally influence battery execution and can add to battery corruption after some time. Changing the encompassing natural conditions makes it harder to foresee the battery framework operational lifetime. Restoring battery frameworks,

which is regulatory essential each four to five years and regularly inside one to two years, is an expensive cycle that requires more support, successive vacation to supplant batteries or beware of battery shortcomings, and an expanded number of turbine climbs, which builds danger to upkeep staff. Therefore, many wind farms have replaced battery systems over ultracapacitor based systems as they work authentically for at least 10 years or more. SC's fundamentally diminish the expense of reinforcement parts and distribution center endeavors, turbine climbs, and removal endeavors (Werkstetter, 2015).

2.1.3. SOLAR POWER ENERGY

Solar power energy is a sustainable free source of energy, which is feasible and absolutely endless, not at all like oil-based products that are restricted. It is moreover, a non-dirtying wellspring of energy and it doesn't transmit any ozone harming substances while delivering power (Younas *et al.*, 2018). The variable contribution of the solar PV cells frequently adversely influences battery life. PV cell creation relies upon the climatic conditions, making them truly unstable and shaky. Battery life is seriously harmed by these yield changes, which interferes with the battery charging and releasing cycle.

In a solar PV framework, the hybrid energy storage system is planned by joining a supercapacitor with a battery to expand the energy thickness of the framework. This framework has a larger number of focal points than the individual utilization of a SC or battery. The weight on batteries can be decreased by utilizing a half breed arrangement of SC's and batteries. The working and upkeep cost of the new framework will be less in light of the fact which diminishes the size and pace of release of the battery and subsequently builds the battery life. This crossbreed stockpiling framework will likewise improve the force quality of a solar PV system (Haider, 2020). A model of solar PV system consisting of SC combined with batteries is shown in the Figure 4 below.
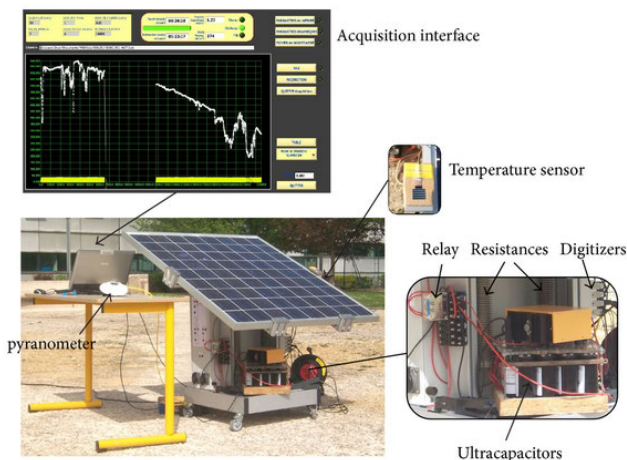
Graphic 2. Instrumented setup of photovoltaic energy storage by supercapacitors
Source: (Logerais *et al*., 2013).

In the above framework blocks, containing shift purposes to restore the force control of an independent force station by considering irregularity in their recreations. The battery has a high energy thickness and the supercapacitor has a powerful thickness, so the blend of both will make an ideal mixture framework. At top force prerequisites, the SC's powerful thickness permits an adequate energy supply inside a brief timeframe. The supercapacitor can rapidly charge after release. Then again, the battery will supply ceaseless capacity to stack for an extensive stretch of time due to its high energy thickness. SC's can likewise lessen battery size in light of the fact that during top hours, the energy will be provided by the supercapacitor, so there is no compelling reason to plan a huge battery to meet pinnacle load prerequisites. Battery life will likewise increment on the grounds that the battery won't go through constant release. Accordingly, the expansion of a supercapacitor will decrease the expense of working and keeping up the framework (Lu *et al*., 2010).

2.2. BIODEGRADABLE MATERIALS FOR ELECTROCHEMICAL DOUBLE LAYER CAPACITORS

Porous carbons have gained popularity in the last decade for the fabrication of SC's. Due to good electrical conductivity, and surface area, carbon based electrodes are widely used. Commonly used carbon based materials are activated carbons AC (Daud & Ali, 2004; Laine & Yunes, 1992; Wang *et al*., 2007), carbon aerogels (Du *et al*., 2019; Fang & Binder, 2007; Liu *et al*., 2007), graphene (Gomibuchi *et al*., 2006; Ke & Wang, 2016; Wang & Yoshio, 2006;

Guanhua, Zhang *et al.*, 2016; Zhang *et al.*, 2010), carbon nanotubes (Honda *et al.*, 2007; Kaempgen *et al.*, 2009; Katakabe *et al.*, 2005; Liu, 1999; Lu, 2010; Ray *et al.*, 2002), carbon nanofibers, and nano-sized carbons (Eikerling *et al.*, 2005; Honda *et al.*, 2004; Sivakkumar *et al.*, 2007) . Due to accessibility, high thermal and chemical stability, sustainability these materials are widely used. However, among all AC's have gained more attention due to its high porosity ratio and surface area (Chen *et al.*, 2017). Table 1 and table 2 summarize the properties of various biodegradable AC's. These properties are responsible for the generation of electrostatic charges.

Table 1. Activated carbon electrodes derived from biowaste performance measurements.

BIOWASTE	PROCESS	ELECTROLYTE	CONFIGURATION OF ELECTRODES	REF.
Coconut kernel Pulp (Milk free)	KOH activation	1 M Na_2SO_4	2 electrodes	(Kishore *et al.*, 2014)
Corn syrup (High fructose)	Self-Physical activated carbon	KOH		(Cao & Yang, 2018)
Sugar cane bagasse	Chemical activation with ZnCl2	1 M Na_2SO_4		(Rufford *et al.*, 2010)
Bamboo	carbonization and KOH activation	3 M KOH	3 electrodes	(Zhang *et al.*, 2018)
Corn stalk core	KOH activation			(Yu *et al.*, 2018)
Fish gill	Carbonization and termal activation	6 M KOH		(Han *et al.*, 2017)
Waste tea-leaves	Carbonisation and KOH activation	2 M KOH		145

Source: own elaboration.

Table 2. Porous carbon electrodes derived from biowaste performance measurements.

BIOWASTE	PROCESS	ELECTROLYTE	CONFIGURATION OF ELECTRODES	REF.
Leaves (Fallen)	activations of (KOH and K_2CO_3)	6 M KOH	2 electrodes	(Li *et al.*, 2015)
Starch (Porous) (microsphere)	carbonisation and KOH activation	6 M KOH		(Du *et al.*, 2013)
Corncob residue	Steam activation without pre-carbonization	6 M KOH	3 electrodes	Qu *et al.*, 2015)
Gelatin (Nanosheets)	hydrothermal	6 M KOH		(Fan & Shen, 2016)

Source: own elaboration.

For sustainable energy generation, the AC production from bio-waste are preponderant phenomena (Benedetti *et al.*, 2018; Guardia *et al.*, 2018; Hill, 2017; Maharjan *et al.*, 2017; Tavasoli *et al.*, 2018; Zhang *et al.*, 2019). AC's are produced from different bio-wastes such as animal, mineral, plant, and vegetables etc. and are used for the fabrication of electrode coating in electrochemical energy generation systems (Gong *et al.*, 2016; Kesavan *et al.*, 2019; Misnon *et al.*, 2015; Na *et al.*, 2018; Nam *et al.*, 2018; Parveen *et al.*, 2019; Sathyamoorthi *et al.*, 2018; Su *et al.*, 2018; Zhang *et al.*, 2019; Zhang *et al.*, 2016) . Carbon-base electrodes are easy to manufacture and have organic electrolytes.

Mi *et al.* (2012) has developed porous carbon from coconut shells for better performance of SC. Porous Carbon was extracted with the help of pyrolysis and steam activation by a single step thermal treatment process. The volumetric ratio between mesopore and total pore was more than 75 percent. (Jain & Tripathi, 2014) has synthesized the same carbon from coconut shells, but by using KOH-chemical activation process. The energy and power densities of 88.8 Wh/kg and 1.63 Kw/kg were obtained by using these electrodes in combination with polymer electrolyte. Yin *et al.* (2016) prepared a multi-tubular but hollow structure of activated carbon from coconut filaments while using KOH-activation. By using this, very high-power density of 8.22Kw/kg with a high-energy density of 53 Wh/kg is obtained. As a result, 3D porous carbon structure exhibits high capacitance among all.

Carbon can be extracted from many agricultural crops and residues for the fabrication of various materials. Wahid *et al.* (2014) has produced 3D carbon nano channels from bagasse of sugarcane. It has a high surface area and conduction ratio. The pre-processing diagram is in Figure 3.
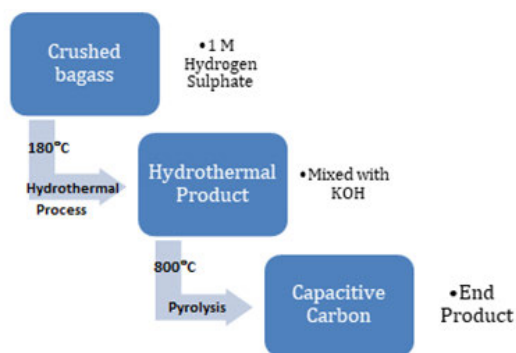
Graphic 3. Carbon extraction from Sugarcane bagass.
Source: own elaboration.

Qu *et al.* (2015) focused on the preparation of corncob residue based porous carbon electrodes for SC's. They have adopted a steam activation method for the preparation, and the results have also exhibited well-developed porosity and good conductivity ratios. In addition to this, the researchers have also tested the corncob-based electrodes with two different electrolytes. The power density in aqueous electrolyte was more than organic electrolyte, showing the value of 8276 W/kg. However, the energy density of 15 Wh/kg is achieved with organic electrolyte respectively.

Various researches have been conducted for the fabrication of porous carbon electrodes for SC's. A crab shell based multi-hierarchical porous carbon is fabricated by Fu *et al.* (2019). This structure exhibits great specific capacitance even at low current densities. It was observed that the crab shell-based electrodes showed 94.5% capacitance preservation over 10,000 cycles. It was concluded that crab shell-based electrodes are a cheap and efficient source of green sustainable energy systems. However, an 84.21% capacitance retention is achieved from biomass waste cotonnier strobili fibers electrodes.

Ismanto *et al.* (2010) showed the preparation of activated carbon based electrodes from cassava peel waste. It has a different range of carbon content ranges from 28.7% to 0.4%, making it a promising candidate for activated carbon precursor. The quantity of carbon present in different bio-waste materials is enlisted in Figure 4. Precursors obtained from porous starch are used for the fabrication of porous carbon microspheres (Du *et al.*, 2013). The samples obtained after stabilization, carbonization and KOH activation exhibited 98 per cent capacitance retention after thousand cycles.
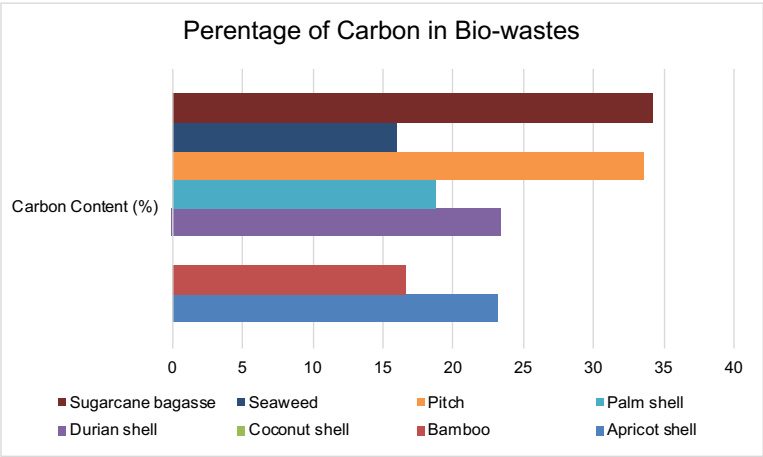
Graphic 4. Corcon Content in different Biowastes.
Source: (Alonso *et al*., 2006; Azevedo *et al*., 2007; Chandra *et al*., 2007; Choy *et al*., 2005; Daud & Ali, 2004; Hu & Srinivasan, 1999; Kumagai *et al*., 2010; Li *et al*., 2010; Ray *et al*., 2002; Raymundo-Piñero *et al*., 2019; Rufford *et al*., 2010; Xu *et al*., 2010).

Soybean based porous carbon is derived from its roots by Guo *et al*. (2016). The roots were carbonized and processed under nitrogen atmosphere and abbreviated as SRPC-nK, whereas n represents the KOH/char weight ratio. It was observed that SRPC-4K possesses 98 per cent capacitance retention over 10,000 cycles. The energy and power densities found to be of 100.5 Wh/kg and 4353 W/kg, respectively.
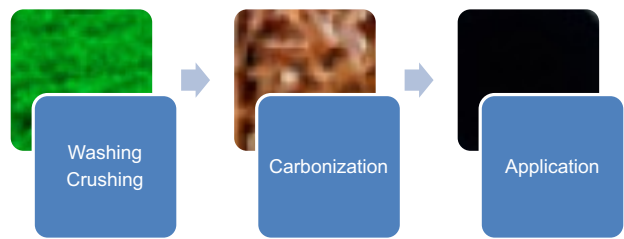
Graphic 5. Carbon activation process.
Source: own elaboration.

Nitrogen-doped activated carbon was fabricated by Ahmed *et al*. (2018) from orange peels. On the other hand, Yin-Tao *et al*. (2015) obtained porous active carbon from fallen leaves. The process diagram is shown in Figure 5. The doped carbon electrode exhibited better specific energy and power densities of 23.3 Wh/kg and 2334.3 W/kg, while others show greater retention rate.

Different electrolytes were also developed from various bio sources. A carbonized coconut kernel pulp (milk-free) is developed by Kishore *et al.* (2014). It was discovered that the surface area is inversely proportional to the temperature. A gel polymer electrolyte from egg white, and SC from its broken shells and rice husks are developed by Na *et al.* (2018). The process diagram is illustrated in Figure 10. The resulting product shows a better specific capacitance, flexibility and stable cyclic performance.
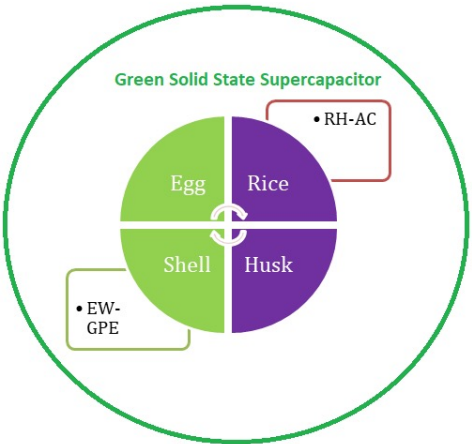
Graphic 6. Fabrication of Green Supercapacitor from egg and rice waste.
Source: own elaboration.

Various bio-waste used for deriving activated carbon that finds application as an electrode material in supercapacitors are listed in Table 3.

Table 3. Physical properties of the activated carbon extracted from biowaste.

BIO-WASTE	POWER DENSITY (W/KG) CYCLES	ENERGY DENSITY (WH/KG)	PERCENTAGE RETENTION (%)	CYCLES	REF.
Bamboo	2250	3.3	91	3000	(Yang *et al.*, 2014)
Celtuce leaves			92.6	2000	(Wang *et al.*, 2012)
Coconut shells		38.5	93	>3000	(Mi *et al.*, 2012)
Coconut shells		69	85	2000	(Jain & Tripathi, 2014)
Coconut shell			97.2	3000	(Sun *et al.*, 2017)
Corncob residue		5.3–15	82	100,000	(Qu *et al.*, 2015)

Cotton (natural)			97	20,000	(Cheng *et al.*, 2016)
Human hair	2243	29	~100	>20,000	(Qian *et al.*, 2014)
Ligno-cellulosic waste fruit stones	3410	13	99	20,000	(Congcong Huang *et al.*, 2014)
Shells of broad beans			90	3000	(Xu *et al.*, 2015)

Source: own elaboration.

3. RESULTS AND DISCUSSION

In this paper, the benefits and drawbacks of Supercapacitors are profoundly evaluated. Two strategies for SC's are utilized for adjusting the voltage of SC's which are proficient and cost effective. SC's are proficient for their quick prominent charging and releasing rate, as well as subsequently can likewise be utilized as a reinforcement power age framework for sustainable power assets. Flywheels are reasonable as they cost less, yet they are gigantic and cannot be utilized wherever more than one elevated level. Lead corrosive Batteries have reliably dangerous issues with respect to charge/release rate and it radically influences the wind turbines, as the drive shaft of rotor edges turn conflicting causing variable voltages for producing power.

Capacitors, then again set aside a lot of effort for charge and delivery rate dissimilar to SC's they don't have longer life consequently they are not naturally cordial. The pitch of wind turbines, can likewise be constrained by utilizing a SC at the more prominent or less point of the edges, which influences the pivot of the sharp edges bringing out lower yield voltage and ending in a failure of the wind turbine. In solar power plants, the conflicting inventory influences the battery life. Batteries are seriously harmed as a result of these yield varieties as they have low force thickness along with a high energy thickness (Younas *et al.*, 2018). Along these lines, utilizing a SC's with a battery, the life of the battery will keep going long and as it won't release constantly and it will diminish the ideal opportunity for upkeep of the framework.
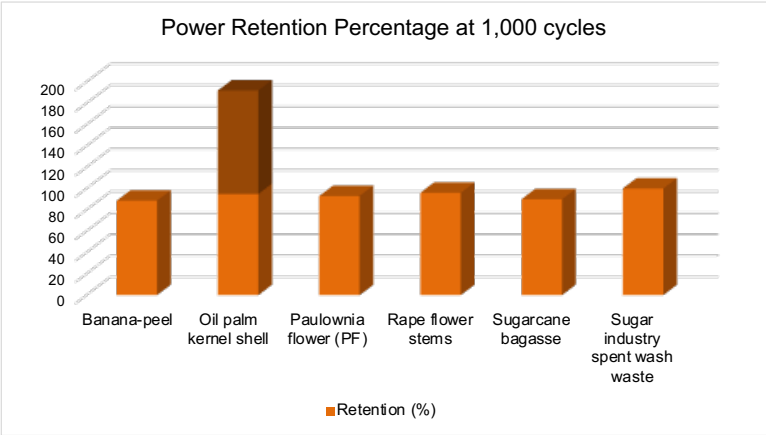
Graphic 7. Power storage capacity of various biodegradable materials at 1,000 cycles (Adopted from Graphic 8 Power density of various biodegradable materials at 1,000 cycles.
Source: (Cao *et al*., 2017; Chang *et al*., 2015; Mahto *et al*., 2017; Misnon *et al*., 2015; Wahid *et al*., 2014; Yunya Zhang *et al*., 2016).

In addition to this, power storage capacity of various biodegradable materials is compared for 1000 cycles in Figure 7. It has been observed that oil plam kernel shows the maximum retention of the charge followed by sugar. However, sugarcane and paulownia occupy the moderate retention. On the other hand, sugar industry spent waste shows the maximum energy density.
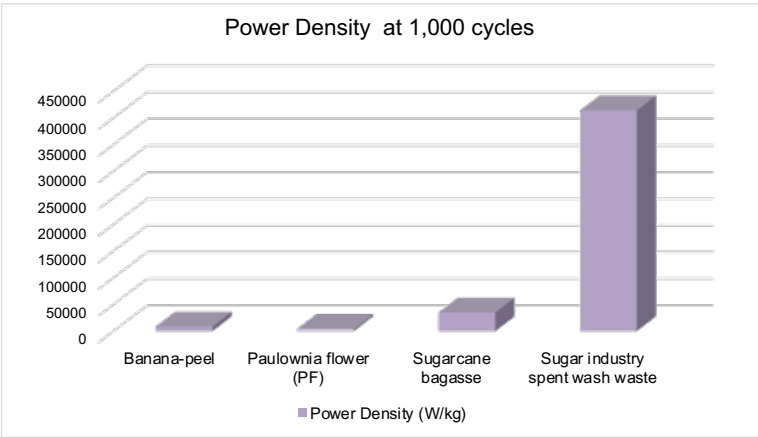
Graphic 9. Power density of various biodegradable materials at 1,000 cycles.
Source: (Cao *et al*., 2017; Chang *et al*., 2015; Mahto *et al*., 2017; Misnon *et al*., 2015; Wahid *et al*., 2014; Yunya Zhang *et al*., 2016).

Figures 9 and 10 shows the power and energy densities and charge retention at 5000 cycles. Figure 9 demonstrate that pea skin has maximum power density, but power retention of

only 75 per cent as shown in Figure 10. In contrast to this, pea skin exhibits 100 percent retention percentage.

Graphic 10. Power storage capacity of various biodegradable materials at 5,000 cycles.
Source: (Ahmed *et al*., n.d.; Fan & Shen, 2016; Ferrero *et al*., n.d.; Rufford *et al*., 2010; Q. Zhang *et al*., 2018).
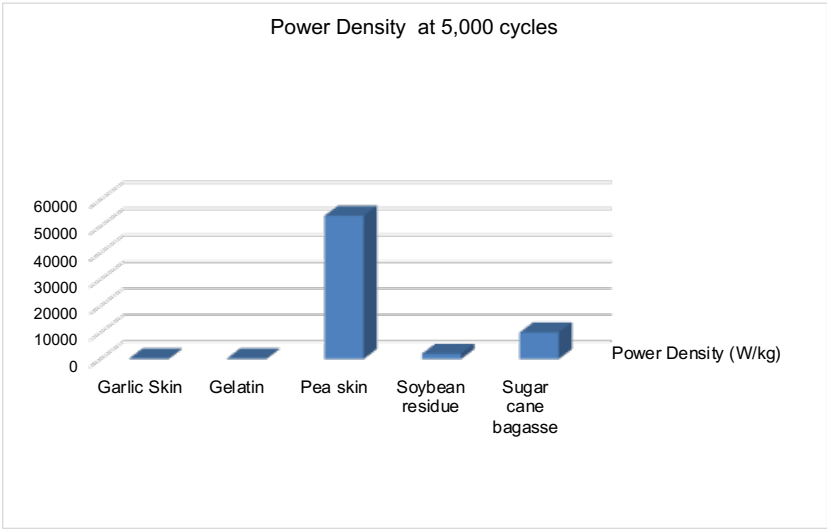
Graphic 11. Power density of various biodegradable materials at ,5000 cycles.
Source: (Ahmed *et al*., n.d.; Fan & Shen, 2016; Ferrero *et al*., n.d.; Rufford *et al*., 2010; Q. Zhang *et al*., 2018).

The different bio-waste materials with superior qualities were discovered from further testing. Key performances for bio-waste activated carbon electrodes are shown in Figure 11 for 10,000 cycles. It has been observed that all the materials exhibit more than 90 percent power retention. Among all rice husk sustain maximum charge retention of 97-99 percent. However, soya bean unveils extraordinary properties with 100.5 Wh/kg and 63,000 W/

kg of energy and power densities, and 98 percent charge retention. The power densities as shown in Graphic 12 are better than the materials discussed in Graphics 8 and 10.
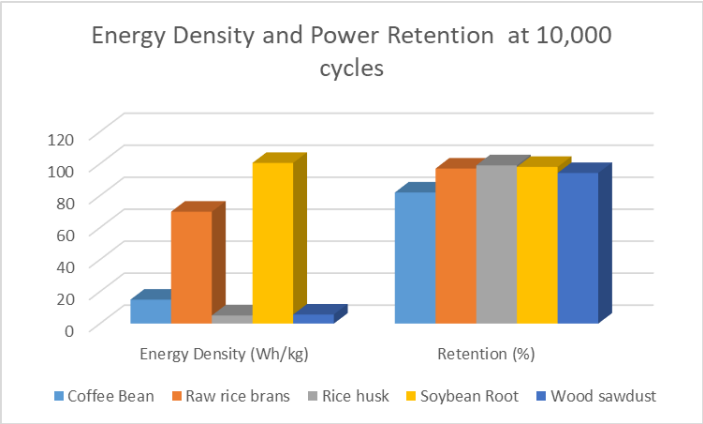
Graphic 12. Power density of various biodegradable materials at 10,000 cycles.
Source: (Guo *et al*., 2016; Hou *et al*., 2014; Huang *et al*., 2013; Huang *et al*., 2016; Sathyamoorthi *et al*., 2018; Teo *et al*., 2016).

4. CONCLUSIONS

The above paper concludes that SC's are best for energy storage and for backup power generation in sustainable power resources, but they do have a voltage balancing problem which can be solved by using an active balancing method or passive balancing method. They have fast charge and discharge ratio due to which they are considered over lead acid batteries, flywheels, & capacitors. Wind turbines, using batteries, store much less energy because of their charge and discharge cycle.
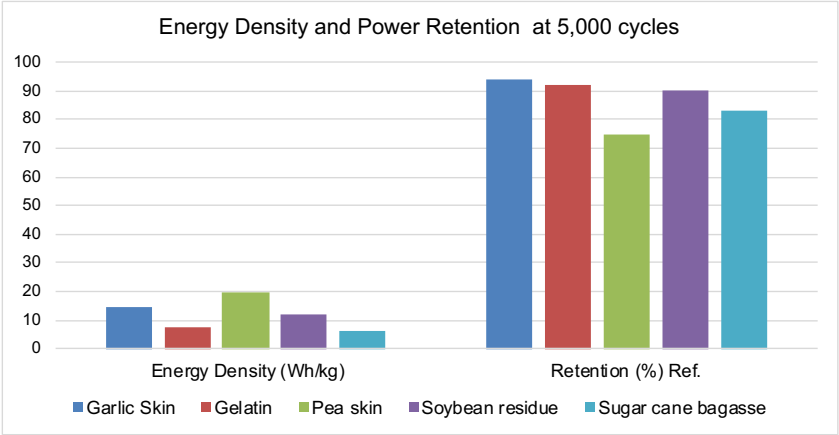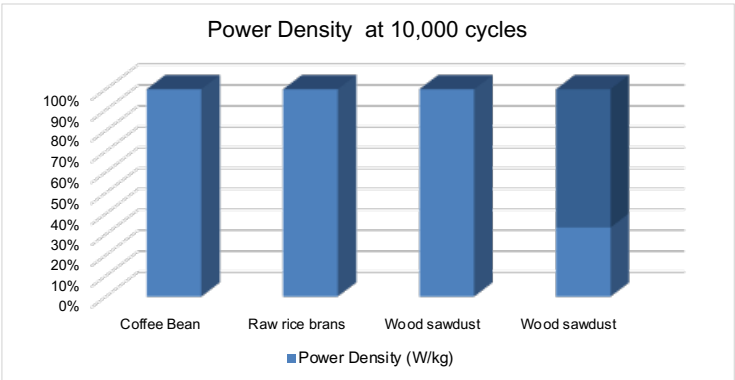

Graphic 13. Power density of various biodegradable materials at 10,000 cycles.
Source: (Guo *et al*., 2016; Hou *et al*., 2014; Huang *et al*., 2013; Huang *et al*., 2016; Sathyamoorthi *et al*., 2018; Teo *et al*., 2016).

However, on the other hand SC's can store more energy as they charge and release faster and can last longer than batteries. In solar power plants SC's are combined with batteries for better performance, as it increases the battery life, as well as costs less with minimum maintenance. Supercapacitor pitch control system is one of the dominant pitch control systems among other types of pitch control systems as SC's work in both cooler and higher temperature conditions. They not only control the pitch control of sharp edges of every blade separately by featuring it to a certain angle, but also controls the inconsistent voltage as lead acid battery has unsteady voltage causing the turbine blades to rotate abnormally fast or too slow leading into a mishap or a failure. Therefore, SC's efficiently reduces the expense of supplementing parts, maintenance which last for about 10 or more years.

Today, one of the most conspicuous trends is the colossal upsurge in the generation of sustainable renewable energy. There is a widespread worry that this will only lead to a myriad of concerns in the society. In my opinion, sustainable renewable energy has more positive impacts than the negatives. In view of the arguments outlined above, one can conclude that despite having some drawbacks, the benefits of supercapacitors in society are indeed too dire to ignore. The SCs' obtained from bio-products can perform efficiently in extreme conditions and provide a cheap and sustainable solution to the green energy.

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DEFORESTATION IN PERU AND STRATEGIC PLAN FOR ITS REDUCE AMAZONIAN FORESTS

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ABSTRACT

The present research aims to evaluate deforestation and strategies to reduce the deterioration of Amazonian forests. Peru has a considerable area of forest cover, by the year 2020 during the pandemic the Peruvian Amazon suffered a significant loss of forest cover due to deforestation, which aggravates floods, droughts and landslides, products of climate change, the expansion of agriculture and livestock, mining, road construction and population growth, among others, are activities that promote deforestation. The technique used is the bibliographic review of different documents produced in public and private institutions related to the subject, also the Joint Declaration of Intent (DCI) is a scheme of economic incentives to combat deforestation and forest degradation, which has the cooperation of Peru, Norway, and Germany, which was raised in three phases: Phase I: Preparation; Phase II: Transformation and Phase III: Payment for results; in October 2018 the implementation plan of Phase II was completed. The agreement that has been extended until 2025.

KEYWORDS

Deforestation, Land use change, Amazon, Joint Declaration of Intent.

1. INTRODUCTION

Peru ranks tenth in the world in terms of area covered by forests, with the jungle region accounting for 90% of this forest area. It is estimated that about 330,000 inhabitants of the country depend directly on forests for their livelihoods through their multiple products and ecosystem services (Smith & Schwartz, 2015; Galarza & La Serna, 2016).

Traditionally, forests have been taken as a source of income from timber production (Unión Internacional para la Conservación de la Naturaleza (UICN), 2018), in addition to the use of non-timber products, biodiversity, ecotourism, and environmental services (Galarza & La Serna 2016), whose economic potential is growing for Peru, to such an extent that the contribution of the forestry sector to the Gross Domestic Product (GDP), which for many years has remained at 1%, could increase to 8% if more attention were paid to the exploitation of non-timber products such as fruits, stems, and medicinal plants, in addition to encouraging ecotourism.

This is without considering the biodiversity present in natural protected areas that, according to MINAM (Ministerio de Ambiente (MINAM), 2021), extend over 20 million hectares of forests and other ecosystems and contribute more than US$1 billion annually due to non-timber forest products scenic beauties, etc. This could point to the forestry sector is one of the most significant potential for economic development (Galarza & La Serna, 2016). However, the Peruvian Ministry of Environment warns that, by 2020 at the height of the pandemic, the Peruvian Amazon lost more than 150 000 ha of forest due to the massive return of migrants to their community (Ministerio de Ambiente (MINAM), 2021).

In tropical countries, including our own, the most important cause of forest cover reduction is the expansion of agriculture and livestock (Ministerio de Ambiente (MINAM), 2016). This deforestation due to land-use change is complemented by the development of extractive industries, road construction, and the growth and creation of towns (Ministerio de Ambiente (MINAM), 2016; Smith & Schwartz 2015; Vargas *et al.*, 2020).

Faced with this scenario, Peru has joined efforts with Germany and Norway through the Joint Declaration of Intent (JIU) to combat deforestation and forest degradation in order to reduce greenhouse gas emissions.

In this article, the link between deforestation and human, economic and environmental components is presented and the actions being carried out to combat deforestation and forest degradation in our country.

2. MATERIALS AND METHODS

The analysis of the loss of vegetation cover in the Peruvian Amazon forests and the fight against forest degradation is fundamental, so we must determine the loss of forest in the coming years if we continue with the same problems that cause the loss of the Amazon forests. For this, we use a simple linear regression equation to project future Amazon forest loss.

$$\hat{Y} = A + \beta\,(X) \tag{1}$$

Where: $\hat{y}$ ependent variable, A ordinate of origin, β slope of the line and X independent variable.

The study area is the humid forests of the Peruvian Amazon, in the departments of Loreto, Ucayali, San Martin, Huanuco, Madre de Dios, Junin, Cuzco, Puno, Amazonas, and Pasco areas of significant deforestation and soil degradation.

The statistical data comes from institutional platforms and reports from secondary sources such as the National Institute of Statistics and Informatics (INEI), the Ministry of Agrarian Development and Irrigation (MIDAGRI) and the Ministry of Environment (MINAM), indexed magazines, books, and information published by private institutions linked to forestry, agriculture and the environment. The bibliographic sources for the capture of data on deforestation in the Amazonian forests during the study period were the institutions mentioned above.

Deforestation rate for the calculation of the annual deforestation rate was obtained from historical data that allowed the analysis in the period 2001-2019, with the following equation:

$$D = \left(\frac{DF - DI}{DI}\right)100 \tag{2}$$

Where: D is the deforestation rate; DF is the area deforested in the final year (2019), and DI is the area deforested in the initial year (2001).

3. RESULTS

3.1. DEFORESTATION IN THE AMAZON FORESTS

The deforested areas of Amazonian forests in Peru, period 2001-2019, amount to 2 433 314 hectares; the annual average is 128 069 hectares (Ministerio de Agricultura y Riego, Ministerio de Ambiente, Servicio Nacional Forestal (SERFOR) & BOSQUES, 2017).

Amazon forests face intense pressures with high trends, as evidenced in Table and Figure 1, the highest levels of deforestation (62.36 %) were carried out in the last ten years. As can be seen in the Table above, the surfaces and percentages in ascending and continuous growth of deforestation. The leading causes of deforestation are agriculture, cattle ranching, the opening of road infrastructure, access to waterways, and small timber extractors, among others (Servicio Nacional Forestal (SERFOR), 2015).
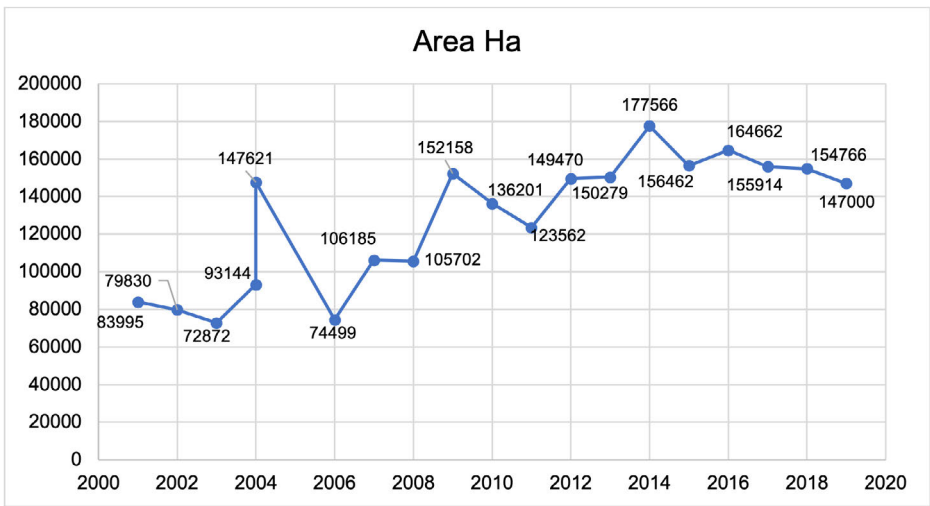
Figure 1. Deforested areas in the period 2001 – 2019.
Source: own elaboration.

The direct and indirect causes of the deforested areas of the Amazon forests are in the expansion of small, medium and large-scale agriculture 51.6%, legal mining 5.8%, expansion of communication infrastructure and extractive industries 0.3%, small and large-scale cattle ranching 39.9% coca cultivation 2.3% (BOSQUES, 2016).

If we continue with the activities described in the previous paragraph, the loss of forests will increase, causing greater socio-environmental problems and biodiversity loss. With the

statistical data for the period 2007-2019, the deforested areas for 2020, 2021, and 2022 can be determined with a simple linear regression equation, this, we have previously considered meeting two of the conditions of being numerical and having a normal distribution of the data set:

$$\widehat{Y} = A + \beta (X)$$

Area (Y) = Constant (A) + Slope of the line (β) Independent variable (X)

Y = 118 062,962 + 3 808,071 X

Y_{20} = 118 062,962 + 3 808,071 (14) = 171 376

Y_{21} = 118 062,962 + 3 808,071 (15) = 175 184

Y_{22} = 118 062,962 + 3 808,071 (16) = 178 992

According to the results obtained in 2020, 2021 and 2022, approximately 171,376, 175,184 and 178,992 hectares would be deforested, respectively, degraded areas that would be used for agriculture and cattle ranching. However, this reality can be reduced simply by complying with the Joint Declaration of Intent (JIU), the cooperation agreement between the governments of Peru, Norway, and Germany that has strategic objectives to contribute to the reduction of greenhouse gas emissions produced by deforestation and forest degradation, sustainable agricultural and forestry development and environmentally sound mining. Agreement that seeks to strengthen the implementation of the United Nations Framework Convention on Climate Change and the national strategy on forests and climate change to reduce forest loss in the Amazon and contribute to sustainable development in Peru (Ministerio de Ambiente (MINAM), 2014).

The deforested areas of Tropical Rainforests, by the department in 2019, amount to 148 426 hectares, equivalent to 200 thousand soccer fields (Sierra, 2018). The departments of Ucayali, Madre de Dios, Huánuco, and Loreto, concentrate approximately 67% of deforested areas. However, the departments of Ayacucho and Cajamarca lost only 1.18 % and 0.82 % of their tropical rainforest of the total deforested regions of the same year.

Table 1. Deforested areas by department 2019.

APARTMENTS	FOREST	2018	%	2019	%	TO 2019	%
Amazonas	2831731	7453	4.82	5805	3.91	94084	3.87
Ayacucho	209922	1744	1.13	2166	1.46	17517	0.72
Cajamarca	346762	1276	0.82	600	0.40	19275	0.79
Cusco	3063940	9643	6.23	7103	4.79	90543	3.72
Huancavelica	17299	18	0.01	92	0.06	1105	0.05
Huánuco	1545972	16560	10.70	14956	10.08	333880	13.72
Junín	1850889	8497	5.49	13960	9.41	165201	6.79
La Libertad	68228	142	0.09	37	0.03	1112	0.05
Loreto	35047942	26203	16.93	23140	15.59	453420	18.63
Madre de Dios	7905744	23492	15.18	21378	14.40	231111	9.50
Pasco	1388278	5610	3.62	6035	4.07	115344	4.74
Piura	41492	60	0.04	26	0.02	3316	0.14
Puno	1423073	6701	4.33	3716	2.50	37010	1.52
San Martín	3344540	21376	13.81	11034	7.43	447546	18.39
Ucayali	9336773	25991	16.79	38377	25.86	422851	17.38
Total	**68422585**	**154766**	**100**	**148426**	**100**	**2433315**	**100**

Source: own elaboration.
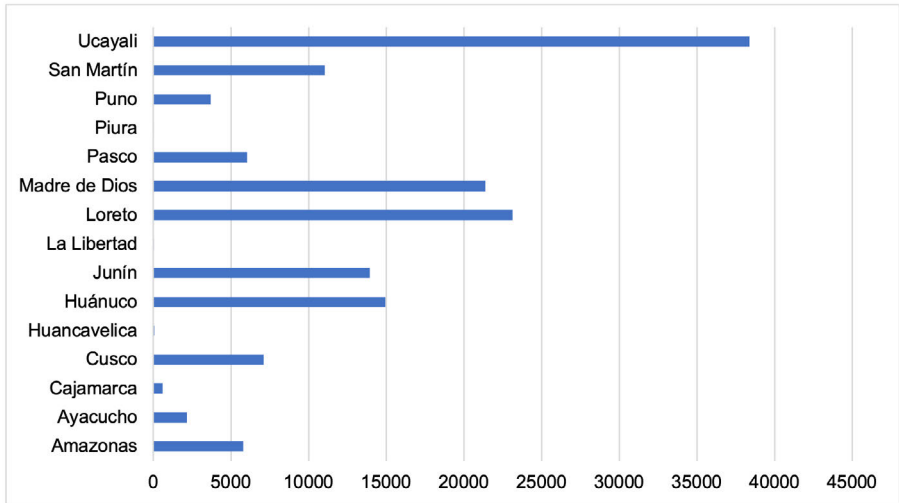
Figure 2. Deforested areas by department 2019.
Source: own elaboration.

One of the causes of deforestation and loss of Amazonian forests is agriculture and cattle ranching for the production of bread crops, rice, corn, cocoa, papaya, coffee and other products in order to serve the domestic and foreign markets. In 2017, a total of 16 220 hectares were deforested for the activities above. In the Interoceánica area, 11 115 hectares have been deforested for gold mining and agricultural activity, likewise, in the Iberia sector, 3 220 hectares were deforested for agricultural activity. In the last months of 2017 in the border of the departments of San Martin and Loreto 750 hectares have been deforested for oil palm production of a large-scale agricultural project and in the Amazonas region, along the Bagua-Saramiriza road 1 135 hectares have been deforested for agriculture and cattle ranching (Sierra, 2018).

3.2. IMPACTS OF DEFORESTATION

Deforestation brings the invasion and illegal appropriation of land by farmers, miners, or loggers, displacement of indigenous populations, conflicts linked to access of forest resources, and loss of knowledge and cultural values. It strengthens climate change affecting surrounding populations and society through increased floods, droughts, and huaycos.

The location of deforestation depends on geographical, political, and economic variables. In Madre de Dios, the construction of the Interoceanic Highway has allowed the migration of poor people to environmentally fragile and isolated areas. Currently, there is evidence of the disproportionate growth of illegal gold mining that devastates forests and contaminates water with mercury and other toxics (Smith & Schwartz, 2015).

Illegal logging, which requires low investments for its implementation, impacts the wellbeing of the populations due to the selective loss of the most valuable species, greater inequity in income distribution, and, mainly, by developing an informal parallel economy that discourages private investment in long-term forest management, generating economic mechanisms of corruption. In coca-growing areas of the country, which occupy 43,900 ha with this crop, drug trafficking also does its thing by dumping chemicals used for coca leaf processing.

Deforestation involves the permanent loss of forest cover and its transformation into another land use. It affects the quantity and quality of water and on its courses that become

more prone to cause flooding due to land degradation. By reducing the potential of the soil, the provision of food, other goods, and services is aggravated, deepening poverty and extreme poverty, marginalization, migration, and inequity, and the loss of biodiversity. This change in land use generates more significant greenhouse gas emissions due to the loss of an important carbon sink through deforestation, thus contributing to the worsening of the impacts of climate change and increasing the vulnerability of populations to extreme meteorological phenomena.

Pendrill *et al.* (2019) infer that deforestation of tropical forests is one of the most important sources of anthropogenic greenhouse gas emissions and carbon dioxide release, driven largely by the expansion of the agricultural, forestry and, the growing demand for agricultural products abroad, and the population explosion in all countries. In the period 2000-2016 GHG emissions from the Land Use, Land Use Change and Forestry (LULUCF) sector averaged 88.8 MTCO2e/year. In 2016 the Sector emissions were 112.88 MtCO2e of GHG emissions. Of this, 89% is due to the change of forest use to another activity, i.e. deforestation in the mentioned period has been the main cause of emissions (Vásquez, 2019).

3.3. STRATEGIC PLAN TO COMBAT DEFORESTATION

MINAM (2018) mentions that the Joint Declaration of Intent (JIU), signed by Germany, Norway, and Peru, is a scheme of financial incentives on the progress and fulfillment of deliverables or goals divided into three Phases: I) preparation (2015-2017), II) transformation (2017-2020) and III) payment for results (2016-2020). We are currently in Phase II of the ICD, whose strategies to reduce deforestation of Amazonian forests are: avoid through the cessation of permits, the change of land use from forest to agricultural services; evaluate the impact of timber harvesting, mining, agriculture, and infrastructure activities due to deforestation and forest degradation; reduce the remaining area of uncategorized forests by 50%; increase the titling of native communities by 5 million hectares; involve at least 2 million hectares in the payment for conservation results of native communities; as well as implement projects of the Forestry Investment Program (MINAM 2018). However, due to the global Covid-19 pandemic, applications have been delayed, redirecting the limited

public budget to address the health crisis, and therefore justifying the extension of the DCI (Bodo, Gimah, & Seomoni, 2021).

On the last day of May, MINAM (2021) reiterated the commitment established in the DCI through an ADDENDUM; this agreement has been extended, renewed, and reinforced with a new partner, the Government of the United Kingdom of Great Britain and the United States as an observer, to reduce and end the loss of forests.

In addition, MINAM's Institutional Policy Framework (2019) confirms the reduction of deforestation and forest degradation using the policy instruments of the National Strategy on Forests and Climate Change (ENBCC), proposing as a vision "for the year 2030 the reduction of GHG emissions associated with the Land Use sector, Land Use Change and Forestry (USCUSS) and the vulnerability of the forest landscape and the population that depends on them, ensuring respect for the rights of citizens, especially indigenous peoples and rural populations linked to forests, with a territorial, intercultural and gender approach, in a context of adequate governance, productivity, competitiveness and valuation of forest ecosystems". The NBSAP establishes strategic actions such as sustainable agriculture and livestock, increasing the value of forests, reducing illegal/informal activities, reducing negative impacts of economic activities, zoning and forest management/granting of rights, monitoring impacts and effects of climate change, the resilience of forest ecosystems and reducing local vulnerability to achieve the objective of reducing Greenhouse Gas (GHG) emissions in the USCUSS sector (Leite-Filho *et al.*, 2021).

4. DISCUSSION

Deforestation is the permanent loss of Amazonian forest cover, replacing forested soil areas for agricultural and livestock use. The effects on soil quality cause land degradation, as it is not suitable for these activities, decreasing soil quality, lowering the productivity of food, other goods, and services, exacerbating poverty, and the loss of biodiversity. This change in land use generates more significant greenhouse gas emissions due to the loss of an important carbon sink through deforestation and soil degradation, thus contributing to the worsening of the impacts of climate change and increasing the vulnerability of populations to extreme meteorological phenomena.

5. CONCLUSIONS

Deforestation causes loss of forest areas, invasions and illegal land appropriation by farmers, cattle ranchers, immigrants, miners, loggers, displacement of indigenous populations, social conflicts and loss of knowledge and cultural values.

GHG emissions from the Land Use, Land Use Change, and Forestry sector averaged 88.8 MTCO2e/year.

The conservation of forests and the reduction of deforestation and degradation of these require coordinated work efforts in a multisectoral manner, in that sense, the activities that are being developed in the public institutions involved in the DCI must be fulfilled with the milestones and goals to be achieved by 2020 in favor of the Amazon to achieve the longed-for sustainable development of our country (Amaya *et al.*, 2020).

The DCI has been extended, renewed and strengthened until 2025 with a new partner, the Government of the United Kingdom of Great Britain, with the purpose of reducing and ending the loss of Amazon forests and promoting sustainable development.

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/05/

DESIGN OF AN AUTOMATIC LIMB THERAPY REHABILITATION DEVICE

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ABSTRACT

The objective of this research work is to design an automatic rehabilitation device in charge of limb therapy in specialized rehabilitation centers. Within the methodology, the quantitative approach was followed, presenting a type of prospective research with a non-experimental design, for this the design of the device was elaborated in its different stages, which were segmented into electronic design, Adaptive structure and Control interface. For this, different matrices were elaborated to obtain the most important characteristics of the adaptive design. In addition, torque and weight calculations were carried out so that the device can work in optimal conditions. It was concluded in the realization of the design of the control and programming system, the adaptive structure of the same device, the power and control circuits for the electronic part, all this making use of the engineering programs Autodesk Inventor, Proteus, Pic C Compiler. Likewise, the simulation was carried out to ensure the correct functioning of the device. Finally, a stress analysis was performed, obtaining a fairly high safety factor.

KEYWORDS

Mechatronics, Device, Systems, Rehabilitation, Physiotherapists.

1. INTRODUCTION

At present there are various types of treatments for physical rehabilitation, each one of them has its benefits and harms, some authors made comparisons between Conventional Physiotherapy and Wiitherapy (Wibelinger *et al.*, 2013), on the other hand, Vibrotherapy is applied (Rodríguez *et al.*, 2006), and "Electro shock, electromagnetic waves, acupuncture, suction cups, among others" (Colegio profesional de Fisioterapeutas de Andalucía, 2012). On the mechatronic side, different equipment has been developed for the treatment such as a mechatronic rehabilitator for ankle sprain (Guzmán & Matías, 2017).

All these devices focus on rehabilitation of tendons, joints, mobility aid, muscle relaxation aid. Therefore, "worldwide it is much easier to treat an injury or have more effective rehabilitation therapies" (Alburqueque & Rondón, 2019; Araujo & Chirinos, 2017; Cortés, Vergaray, & Torrejón, 2017). "In the same way, in Peru several assistive devices in physiotherapy are also being developed, in many cases they are still in the preliminary or development phase" (Camacho, 2018). In the field of Rehabilitation, the most used is Conventional Therapy, aided by magnetic waves, TENS and suction cups.

By not having so much technological development applied in this area, "physiotherapists suffer from ergonomic risk, leading to injury" (Montoya, 2016). "In our country there is no applied technology to carry out therapies, this reduces productivity in treatments, due to the fact that several patients cannot be attended at the same time and it generates saturation in the attention, for this reason the specialized centers of integral rehabilitation are not alien to this problem, many of the physiotherapists suffer injuries in upper extremities, backs produced by the ergonomic risk and work stress generated in their work routine" (Montoya, 2016; Leyva *et al.*, 2011; Morales & Goiriz, 2020). In the following graph the authors Carrera and Morales (2020) shows us the most frequent injuries in physiotherapists.
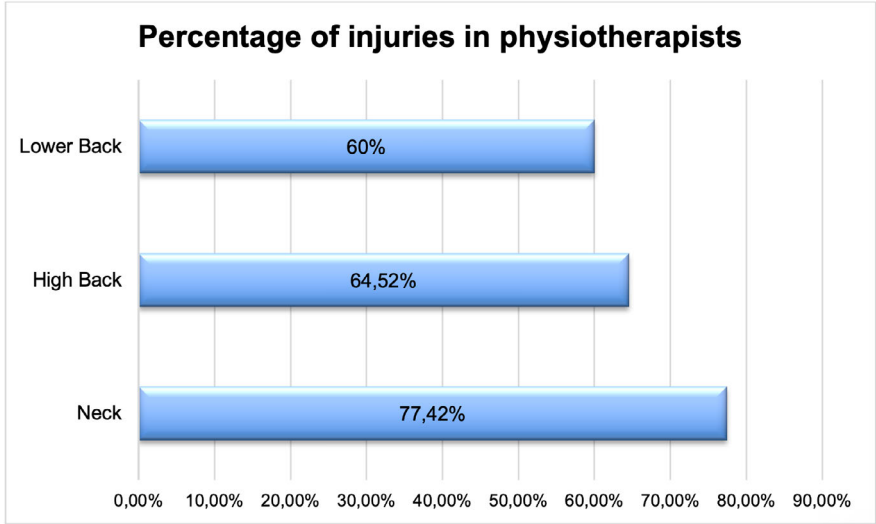
Note: Results obtained from Evaluación del riesgo ergonómico por posturas forzadas en el área de fisioterapia del Hospital de Especialidades Carlos Andrade Marín.

Figure 1. Frequent injuries in physiotherapists in their work routine.
Source: (Carrera & Morales, 2020).

The objective of this project is to design a device that allows limb muscles to be relaxed for patients undergoing physical rehabilitation thanks to the fact that our design allows the device to carry out the therapies in an automated and personalized way for each patient. In addition, it provides the ability to perform therapies in parallel to alleviate the high demand for patients. To achieve compliance with the proposed objectives, a non-invasive or harmful prototype for the patient will be designed to establish corrective observations in favor of health. Its result will allow finding alternative solutions according to the needs of patients and Physiotherapists.

2. MATERIALS AND METHODS

As objectives of our Project, we have the following:

- Design an adaptable structure for various muscles and limb sizes of rehabilitation patients.
- The hardware and software must be interactive and user-friendly with the user and/or physiotherapist.
- Electronic design segmented into different stages, both analog and digital.

To comply with the aforementioned, we propose a flow chart in which we determine the operating process of this device, in this way we can identify the factors that influence when performing a decontraction therapy.
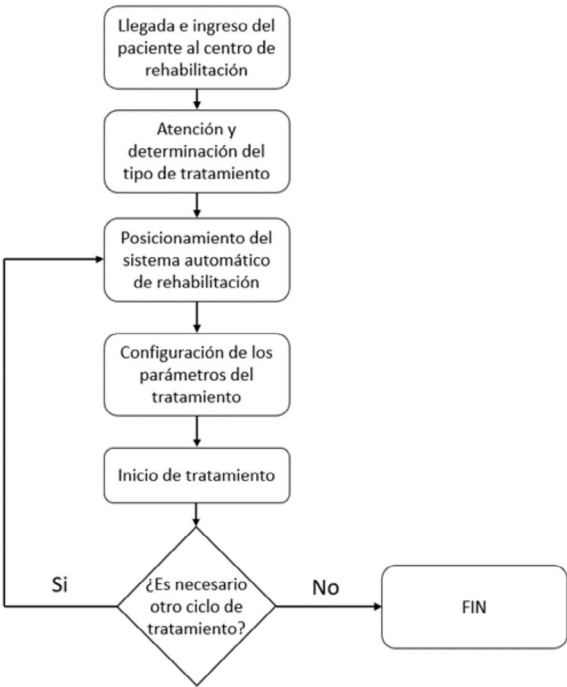
Figure 2. Flowchart proposed of the processes when performing a decontraction therapy.
Source: own elaboration.

For the design of the automatic rehabilitation device, the black box diagram specified in Figure 3, where the inputs of the system are taken into consideration in order to obtain an automated and personalized therapy for each patient.

Figure 3. Black box diagram of the device needs.
Source: own elaboration.

After making the black box diagram, the functions that it will perform for the operation of the device were specified. As a result, the function diagram Figure 4 in which the subsystems that belong to the control stage are determined considering the inputs mentioned above and the output to be obtained.
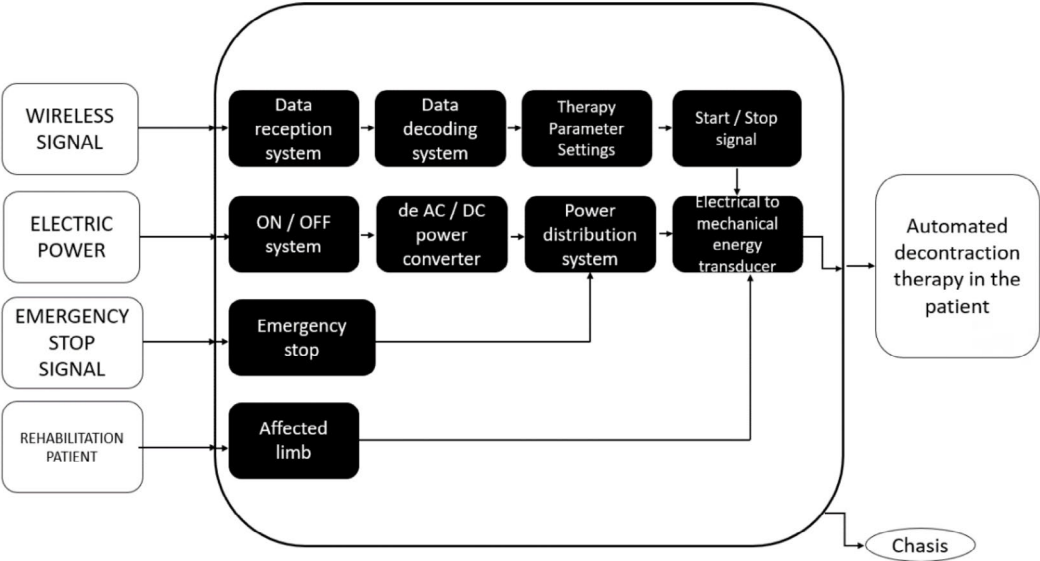
Figure 4. Function diagram of the device design.
Source: own elaboration.

To carry out the design of all the hardware and software we take into account certain criteria determined by the needs of the physiotherapist for their correct use in rehabilitation. This was done using the pair comparison matrix (Figure 5) with the following criteria:

- Impact resistence.
- Adaptability of the device.
- Manufacturing material.
- Ease of manufacture.
- Easy use of the physiotherapist.
- Maintenance.
- Aesthetic.

	RESISTENCE	ADAPTABILITY	MANUFACTURING MATERIAL	EASE OF MANUFACTURING	Easy to use (physiotherapist)	Maintenance	Aesthetic	Sum (1)	Importance
IMPACT RESISTENCE		0	1	1	0	1	1	4	1.905
ADAPTABILITY	1		1	0	1	1	1	5	2.381
MANUFACTURING MATERIAL	0	0		0	1	1	0	2	0.952
EASE OF MANUFACTURING	0	1	1		1	1	0	4	1.905
Easy to use (physiotherapist)	1	0	0	0		1	1	3	1.429
Maintenance	0	0	0	0	0		1	1	0.476
Aesthetic	0	0	1	1	0	0		2	0.952
								21	10

Figure 5. Pair comparison matrix for optimal device design.
Source: own elaboration.

By doing this analysis for the design criteria, we were able to get the most important points to take into account when designing the entire rehabilitator. As a result, we had that the device must present a structure adaptable to the different extremities of each patient to be treated in the specialized center. At the same time, the criteria of resistance to impact and ease of manufacture are equally important. In addition, the easy use of it occupies the third place on this list since it is a very necessary point for the development of this design. Finally, it was determined that aesthetics, maintenance and manufacturing material are the criteria with the lowest value obtained in the table, but they are still important within the needs of the device.

2.1. CONTROL INTERFACE

We elaborated the control interface design in the MIT App Inventor software "due to its possibility of creating applications for IOS and Android in a simple way with bluetooth communication, which is the communication protocol used in our rehabilitation device" (Gutsens, 2020; Ven, 2017).

For the design of the application, we took into account the following parameters to enter, in the same way it is shown in the block diagram of Figure 6.

- The Bluetooth connection with the automatic rehabilitation device.

- The therapy time established by the physiotherapist.

- The intensity of the therapy regulated by the effector.

- The position of the effector on the X axis depending on the type of muscle.

- The therapy start signal.

- An emergency stop controlled from the app.
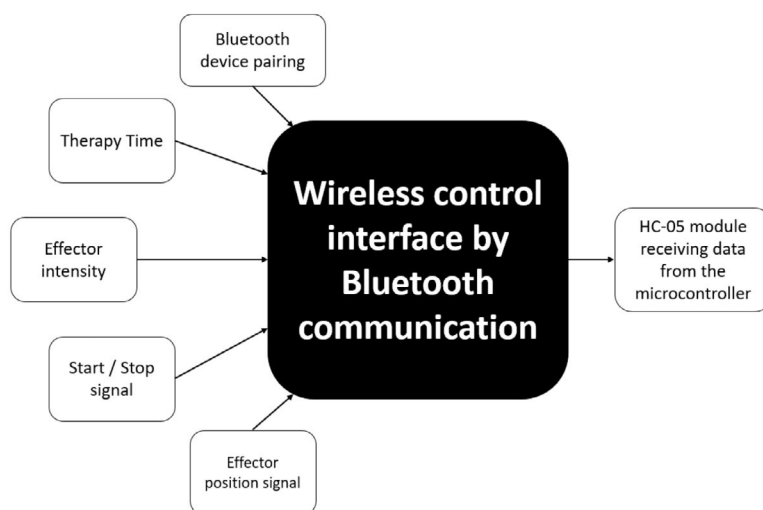
Figure 6. Block diagram of the device's bluetooth user control interface.
Source: own elaboration.

2.2. PROGRAMMING

In the programming design stage, we define two stages, "the first is the data reception stage commissioned by the 16F628A microcontroller and the second stage which controls the actuators and receives the data from the sensors for the correct operation of the device" (Delgado, 2020), "this last stage is designed for the 16F877 microcontroller" (E-Marmolejo, 2017).

The block diagram followed to carry out the programming is shown in Figure 7.
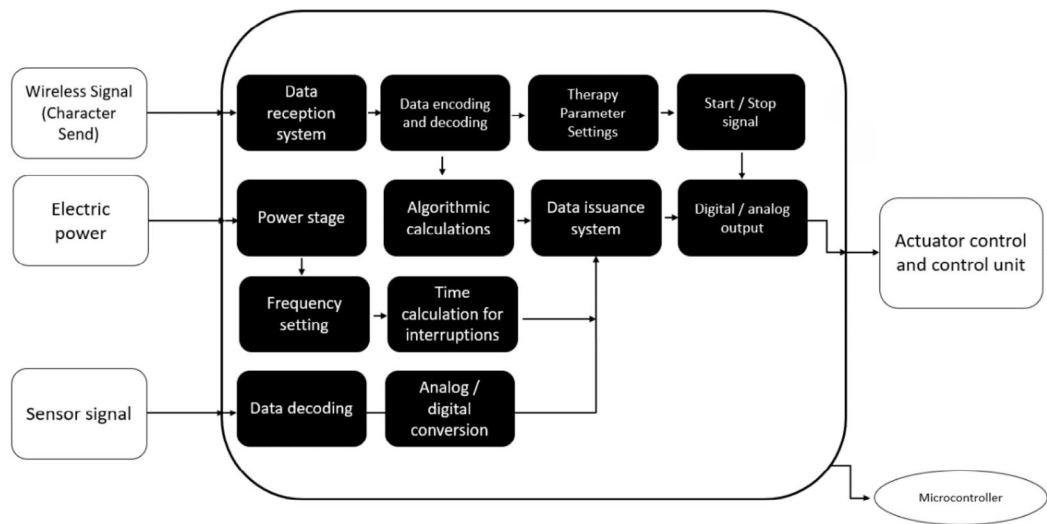
Figure 7. Block diagram of the microcontroller functions for actuator control and therapy customization.
Source: own elaboration.

As mentioned above, the programming of the first microcontroller will be focused on the time management established by the physiotherapists and all the additional configurations for the customization of each therapy, for this, the data is received from the bluetooth interface, for this particular case all they will be characters, then, depending on whether they are data of time, intensity, movement, etc. It will load the necessary value into the microcontroller and then execute the start order to the other microcontroller in charge of actuator control. This is seen in the following figure (Figure 8).
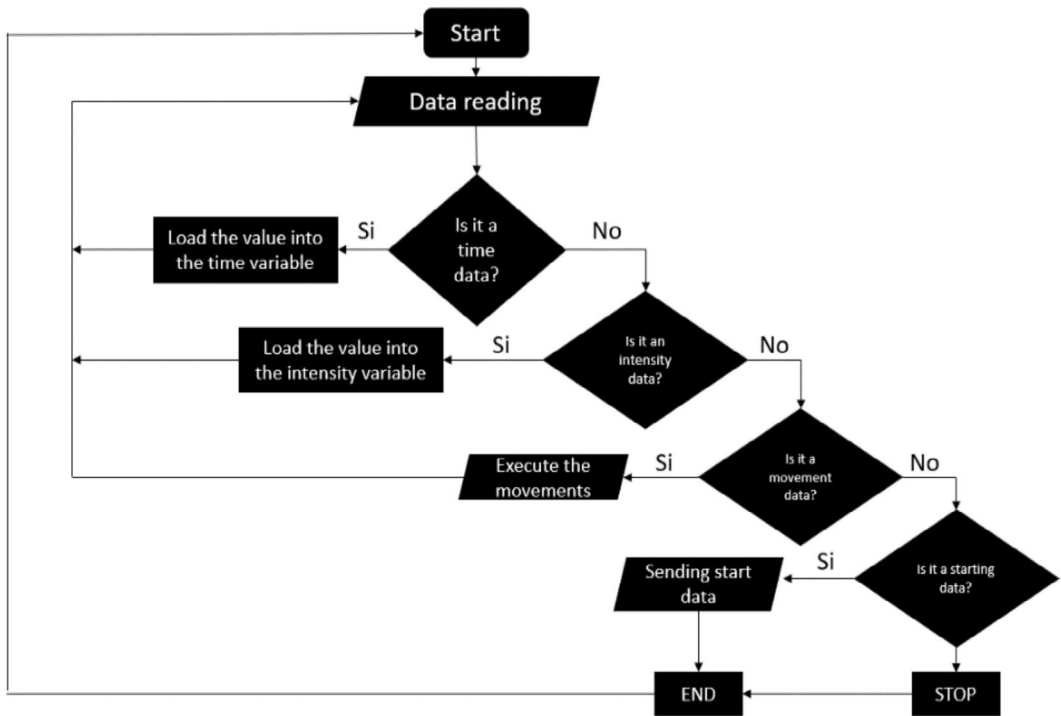
Figure 8. Flow diagram of the logic to follow for the elaboration of the code.
Source: own elaboration.

After elaborating the logic, we proceeded to write the programming code, which carries interruptions of the timer 0 located inside the microcontroller to count the time.

The second microcontroller is focused on receiving data from the sensor, stepper motor control (PAP) through A4988 modules and DC motor control through Pulse Width Modulation (PWM). Because this microcontroller will always be in operation, it will be disabled, until it receives the start data from microcontroller 1 where it can finally perform the analysis of the sensors in IF conditionals and then execute one action or another. The logic for the elaboration of this code is seen in the following flow diagram (Figure 9).
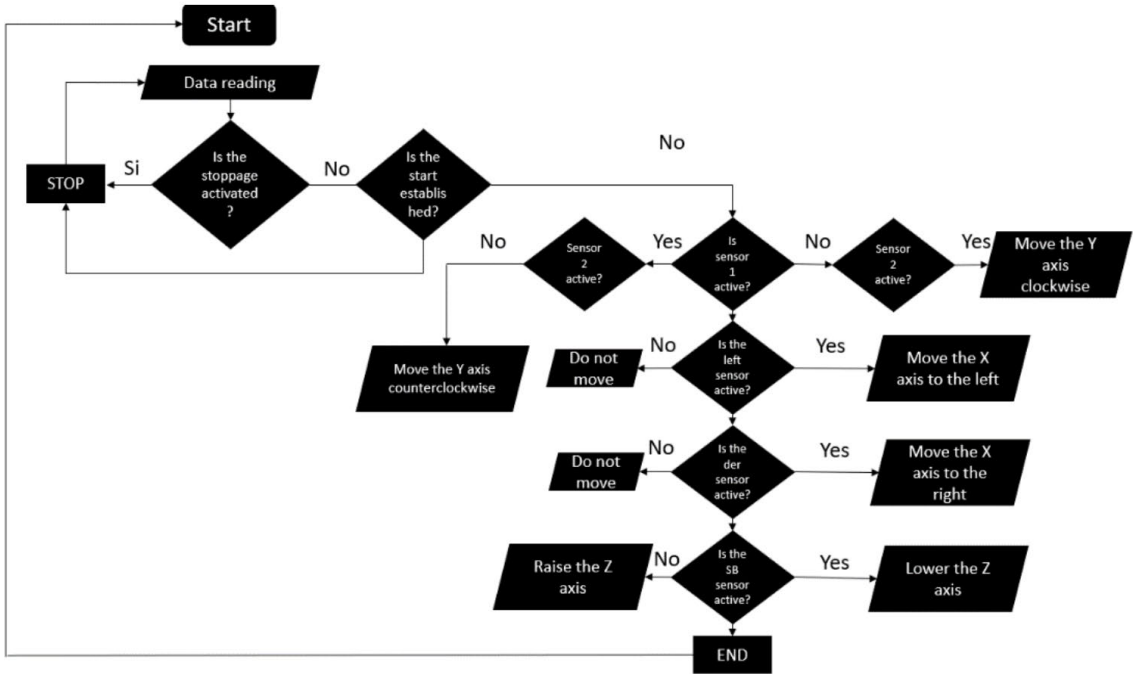
Figure 9. Flow diagram of the microcontroller in charge of the power stage and sensor reading.
Source: own elaboration.

With the defined diagram, we proceeded to read the data from the sensors and with them define whether the motor was moving in one direction or another, in addition, we made use of timer 2 and its interruptions of the microcontroller to control the PWM of the DC motor.

2.3. STRUCTURE

Information was collected by analyzing the work area of the physiotherapists taking into account how the therapies are carried out in the extremities, with this, several design ideas and corresponding measures of the structure were raised to perform the therapies, once this was obtained, the 3D design in Autodesk Inventor software with appropriate measurements. The first design proposed for the device is seen in the following figure.
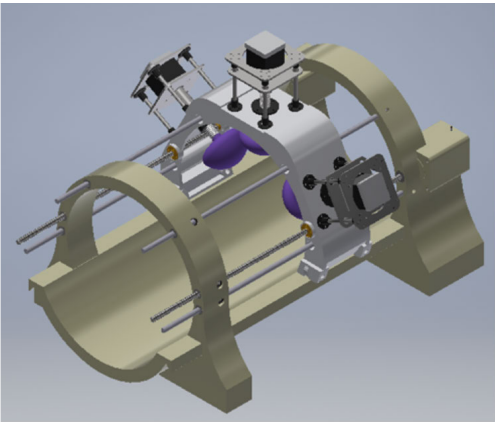
Figure 10. First structural design of the rehabilitation device.
Source: own elaboration.

With the designed structure, we proceeded to calculate the necessary torque of the motors to carry out the movement of the "X", "Y" and "Z" axes. To begin, we collect the mass data that the inventor software offers us, obtaining the following results shown in the following table.

Table 1. Torque calculation as a function of mass and its type of movement.

KIND OF MOVEMENT	MASS	TORQUE
Axis Y	3.4 Kg	2.677 Kgf.cm
Axis X	1.87 Kg	0.887 Kgf.cm
Axis Z	1.1 Kg	0.514 Kgf.cm

Source: own elaboration.

With the calculation of the torque of the motors we make the necessary selection of them, for each of them we determine as a quality criterion the use of PAP motors, since they offer more precision when executing their movement, and for use in rehabilitation is an important criterion for design. We prepare a table shown in Table 2 with the specifications of the stepper motors to be used, and with this we make the selection according to their optimal torque and needs.

Table 2. PAP motors and their various characteristics to meet design criteria and proper selection.

Motor	Voltage (V)	Current (A)	Par kg * cm	Inertia g * cm^2	Length (mm)	N# of conections	Temp min	Temp max	Step Angle	Weight Kg
NEMA 8 SY20STH42-0804A	4.32	0.8	0.33	3.6	42	4	-20	50	1.8	0.08

NEMA 11 SY28STH32-0956A	2.66	0.95	0.43	9	31	6	-20	50	1.8	0.12
NEMA 17 SY42STH33-1334A	2.8	1.68	3.6	54	38	4	-20	50	1.8	0.285
NEMA 23 SY57STH76-2804A	3.2	2.8	18.9	480	76	4	-20	50	1.8	1.03
NEMA 34 SY85STH156-4208A	5.25	4.2	122	4000	156	8	-20	50	1.8	5.35

Source: own elaboration.

With the selection criteria carried out, we obtained that the engines to be used will be the following:

- PAP Nema 14 motor for "X" movement.
- PAP Nema 17 motor for "Y" movement.
- PAP Nema 14 motor for "Z" movement.

Having the structure in the software, we proceeded to carry out the "analysis and simulation tests that allow us to ensure its correct operation" (Torres, Camarillo, & Orozco, 2013).
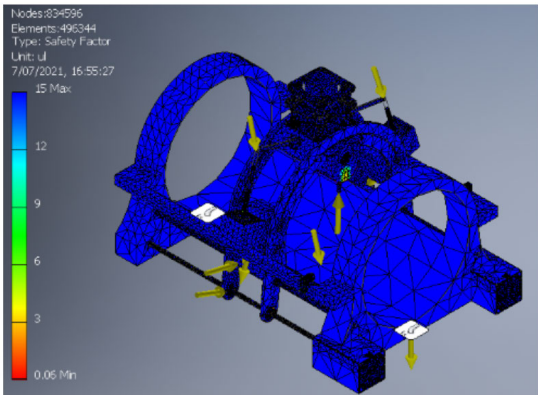
Figure 11. Stress analysis of the structure to obtain the safety factor and determine the safety of the device. **Source:** own elaboration.

As can be seen in the graph, the safety coefficient is quite high, which ensures optimal support so as not to put the patient or the physiotherapist at risk with a structural failure. In addition, the design also has an adaptability depending on the lengths of each muscle.
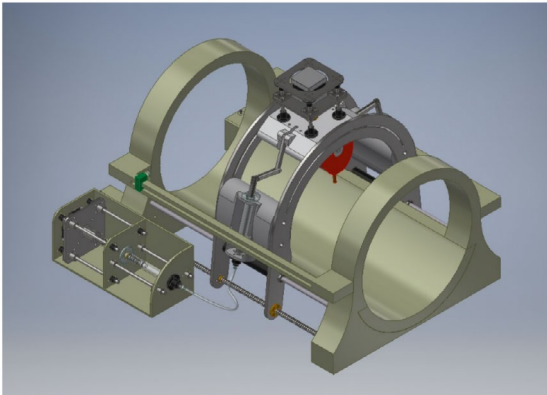
Figure 12. Final structural design of the automatic rehabilitation device.
Source: own elaboration.

This was achieved by implementing a pair of mobile sensors on the sides and millimeter rails so that the personnel in charge of therapy can regulate it depending on the therapy area.

With all the analysis carried out in the structural part, we made the corrections and obtained a final design of the automatic rehabilitation device which is shown in the following figure.

2.4 ELECTRONICS

We contemplate the needs of the equipment previously established as sensor inputs, and microprocessors, this helped us to carry out the data collection in parallel, in this way we could define the inputs, outputs and power stages of the system for the software stage and the electronic development in Proteus software 8.12 (Hubor-Proteus, 2015).

To obtain an electronic design we begin to order and classify it in stages, the power stage (actuators) would be the most important and an order and manufacturer specifications must be obtained to avoid temperature problems and short circuit.
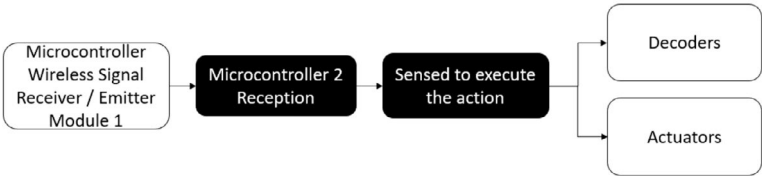
Figure 13. Classification of stages.
Source: own elaboration.

We collect information on the connections of electronic devices that your data sheet offers us from each manufacturer.

We take as a reference these connections from a PIC16F88X family microcontroller with similar characteristics, in this case we will use the internal oscillator configuration and an external source that will power the entire control stage. and the recommended connections of a PIC16F887 microcontroller, in this case we will use the internal oscillator configuration and an external source that will power the entire control stage. For the power supply of the microcontrollers, we use a circuit based on the LM2596 DC-DC module. 7-segment displays are devices used to display information. On this occasion we can display digits from 0 to 9. We use a 7447 decoder; it is an integrated circuit that converts the input binary code in BCD format to logic levels that allow activating a 7-segment common anode display where the position of each bar forms the decoded number. For the design of a PWM module we use an IRFZ44N transistor of MOS-FET technology.

Table 3. Driver selection for stepper motors.

CONTROLLER	VOLTAGE (V)	OUTPUT CURRENT (A)	MICRO STEPS
Driver TB 6600	20 a 42	0.2 a 5	1, 1/2, 1/4, 1/8, 1/16
Driver TB6560	12 a 36	0.5 a 3.5	1, 1/2, 1/4, 1/8, 1/16
Driver Pap A4988	8 a 35	1 a 2	1, 1/2, 1/4, 1/8, 1/16
CNC shield	12 a 36	1 a 2	1, 1/2, 1/4, 1/8, 1/16, 1/32

Source: own elaboration.

This time we use the Driver PAP A4988 module because its technical specifications are adequate for the correct operation of the motors. Specifically, "this stepper motor controller allows you to control a bipolar stepper motor with an output current of up to 2 A per coil" (García, 2020).

3. RESULTS

As a first result, we obtained the final design of the user-friendly interface for the physiotherapist, which is shown in Figures 14 and 15.

Figure 14. Final design of the interface seen from the MIT APP Inventor program.
Source: own elaboration.
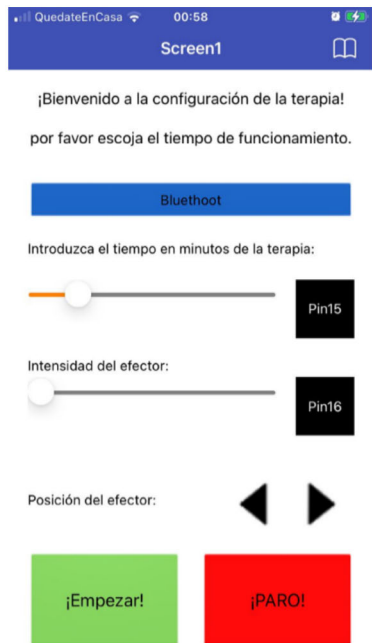
Figure 15. User interface application seen from an IOS device.
Source: own elaboration.

When good results were obtained from the components that match the manufacturer's specifications, the plan for each electronic card was designed separately, specifying the inputs and outputs. 5V is considered for digital circuits.
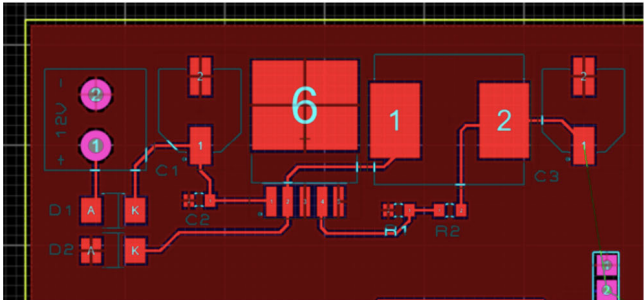
Figure 16. Design of the supply stage based on the LM2596 DC-DC module.
Source: own elaboration.

Additionally, a PWM module was designed for the effector. Next, the PCB board is designed, the measurements of the different stages were taken into account, track size according to the manufacturer, current, voltage.
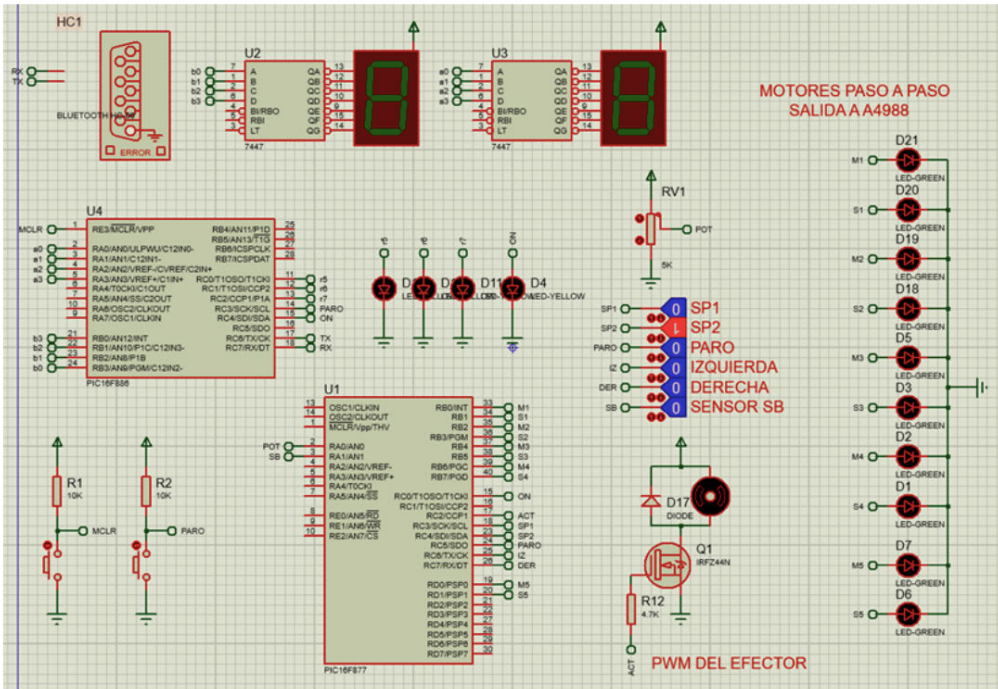
Figure 17. General schematic diagram of the electronic subsystem.
Source: own elaboration.

A 3D design was obtained through the 3D visualizer option offered by the Proteus 8.12 software, which helped us in the implementation of a final design of the entire system.
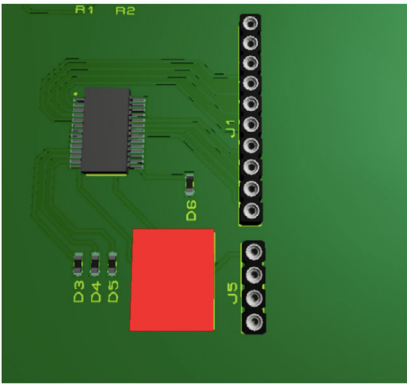
Figure 18. Design of Control 3D PCB in Proteus 8.12.
Source: own elaboration.

The main problems that arose, not having a consideration in the tolerances of the components and not isolating some stages that generated static current. An adjustment had to be made by modifying the size of the tracks and the order of some components for functionality and aesthetics. Additionally, some 3D components had to be designed in the Inventor software, since the Proteus software does not have all the necessary libraries.

Regarding the development of time programming and microcontrollers to personalize the therapy of patients, the corresponding tests were carried out on the oscilloscope of the Proteus 8.12 program and a wave of approximately 1 second was obtained as a result, with which it is performed the programming of the variable time of the therapy.
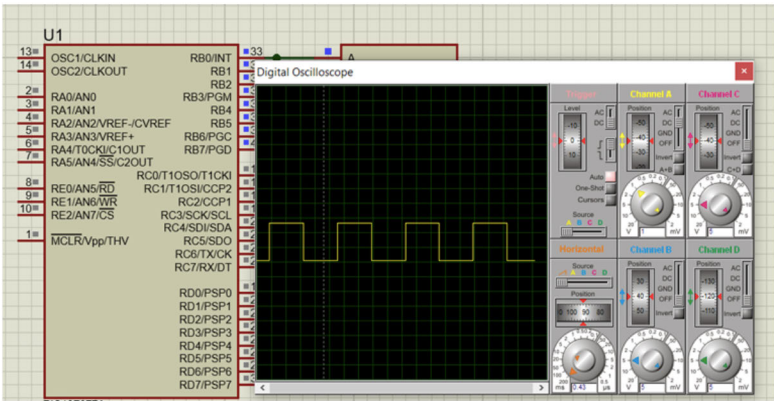
Figure 19. Calculation of the estimated time using the oscilloscope.
Source: own elaboration.

4. CONCLUSIONS

An automatic rehabilitation device in charge of limb therapy was designed, it was possible in all its parts that make it up, obtaining the ability to execute parallel therapies and configuration through the mobile phone.

The design of the control stage was carried out in two parts, first the control interface for mobile phones in the MIT APP INVENTOR software where all the necessary parameters for rehabilitation therapy can be configured, in addition, the programming of the system of control based on two microcontrollers, one for receiving Bluetooth data and the other for controlling the device's power stage, thereby ensuring the optimal functioning of these subsystems.

The design of the PCB boards was carried out in different sections of control, power, feeding and decoding. This was achieved by using the Proteus 8.9 software where the schematic diagram of the circuit was made and then the PCB design with the respective simulation tests where we can check the correct operation of the electronic system.

The structural design was developed complying with all the requirements established by the physiotherapists, which should be adaptable and cover different work areas in the extremities, for this the design was elaborated in the Autodesk Inventor software, in addition, the parameters were studied of the mass and in this way the necessary calculations were carried out for the touches of the motors, which are: 2.677 Kgf.cm, 0.887 Kgf.cm and 0.514 Kgf.cm. The tension analysis was also carried out in the same software to obtain the safety coefficient that ensures the correct functioning of the device.

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/06/

PROTOTYPING OF MODEL RC PLANE FOR AGRICULTURAL APPLICATION

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ABSTRACT

A radio controlled plane (RC Plane) is a small flying machine that is controlled from the ground by transmitter. The plane is piloted with the help of a transmitter that communicates with a receiver and sends signals to it. The plane has servos on board. These are governed by same aerodynamic. The rules governing small aircrafts are the same as those governing large aircrafts. The aircraft under consideration in this study was intended to have optimum lift and drag properties. This was accomplished by determining the best values for fuselage length, wingspan, and other parameters. As this RC place is to be used for the agricultural and disinfectant spraying purpose, The dimensions of the elevator and rudder, as well as the total weight, were determined through different analyses. These analysis were done using solid works software.

We build this RC plane to achieve two different goals. The first one is making farmers job easier, faster and much more effective. Our second goal was to use this RC plane for sanitization and spraying disinfectant as during covid 19 a number lives were lost because the process of spraying disinfectant was too slow which lead to the spread of corona virus through our surroundings.

KEYWORDS

RC plane, Designing, Analysis, Specifications.

1. INTRODUCTION

Our purpose of designing and fabricating this RC plane was to use it agricultural and healthcare purpose. The designing of this plane required different analysis and other electronic parts were used for its building purpose. The first objective was to study aerodynamics of this RC plane and use right parts to make it fly efficiently. The controlling of RC plane is done by a transmitter and receiver. The transmitter we used is (Fly sky i6X) and receiver used is (Fly sky iA6B).

The RC plane works on same principle as of a big aircraft what makes it different is its scaling, Reynolds number, wing loading and its moment of inertia. The wing loading of an R/C model is one to two orders of magnitude less than that of a full-scale airplane (due to the "square-cube law"). Wing loadings on R/C models are typically 1-2 lb/ft2 (16-32 oz/ft2). Whereas full scale planes are larger than 10 (Cessna 172 has a density of 12.6 lb/ft2). The result is lower stall speeds, as well as lower take-off and landing speeds and distances between landing (Azeez *et al.*, 2019). The Reynolds number of RC plane is less than 500,000 (Azeez *et al.*, 2019) as compared to big aircrafts with have Reynolds number greater than 1 million.

After getting a good amount of knowledge from literature review, CFD analysis was done using solidworks on our final design of RC plane so we can get the best possible lift and drag. The designing process of this planes requires use to choose suitable part to achieve better weight optimization according to our desired applications (Visnuprasad *et al.*, 2019).

2. METHODOLOGY

2.1. DESIGNING AND BUILDING RC PLANE

After all the dimensions were decided and cg was successfully calculated, which was 30% of our chord length = 0.30x8 = 2.4 inches from leading edge of wing. We now moved on with our final fabrication process in which we started construction from wing.

We used hot wire machine which we made ourselves to cut foam into 2 identical parts in the shape of airfoil NACA 4415 which was placed on both ends of foam for each wing.

Whole wing was constructed in two identical wings which were half of main wing and were 24 inches length and 8 inches in width as shown in Figure 1:

Figure 1. Separate Wings.
Source: own elaboration.

Now we joint them using german glue and to reinforce them properly we placed 1 SPAR (Figure 2) on top of them and 2 spar on the back, this gives foam extra rigidity which helps the wing to fly stably and smoothly.

Figure 2. Joint Wings.
Source: own elaboration.

Next step to finish wing is to cut the ailerons on them, we used balsa as our ailerons and they were 22x1.1 inches in dimensions.

Using hinges (Figure 3) we made them movable in particular direction and using control horns we connected them to servo motors.

Figure 3. Ailerons.
Source: own elaboration.

Next part we started fabricating was fuselage (Habermann *et al.*, 2021) (Figure 4), exactly like wing, we cut 2 identical shape of fuselage and joined them.

Figure 4. Fuselage body
Source: own elaboration.

Our next step was to join the wing with the fuselage (Figure 5).

Figure 5. Wings and Fuselage.
Source: own elaboration.

Now we cut our elevator (h-stab) (Figure 6) which is the main part of flying mechanism of plane.

Figure 6. Horizontal Stabilizer.
Source: own elaboration.

We reinforced (SPAR) by using balsa wood on both sides. At this point our plane was half ready (Figure 7).

Figure 7. Extra Reinforcement.
Source: own elaboration.

After that we placed servos on the fuselage (Figure 8).

Figure 8. Servo motors.
Source: own elaboration.

Next (V-stab) was fabricated and attached on the elevator (Figure 9).

Figure 9. Vertical Stabilizer Attached with Horizontal Stabilizer.
Source: own elaboration.

Now before we move towards wrapping the body of the plane, it was necessary to do some reinforcement (Figure 10) to better strength.

Figure 10. Fuselage Reinforcement.
Source: own elaboration.

Next step was mounting the motor (Figure 11) after which our plane was 90% ready.

Figure 11. Final Body.
Source: own elaboration.

After motor was mounted, our last was to attach the wings with fuselage. This was done using two strong elastics. After complete assembly our plane was completely ready (Figure 12) for our first test flight.

Figure 12. Completely built RC Plane.
Source: own elaboration.

2.2. CFD ANALYSIS

CFD or computational fluid dynamics analysis is considered as the important and the useful step when designing the RC or a big airplane (Petit *et al.*, 2020). It is done to basically analyze either the wing selected for the plane is suitable for a good lift and drag of the RC model or not (Usherwood *et al.*, 2020). This analysis can be done using different software. For our RC Plane model wing analysis, we used solid works. The data gathered by the analysis is given in following (Figure 13) and CFD domain size (Table 1).
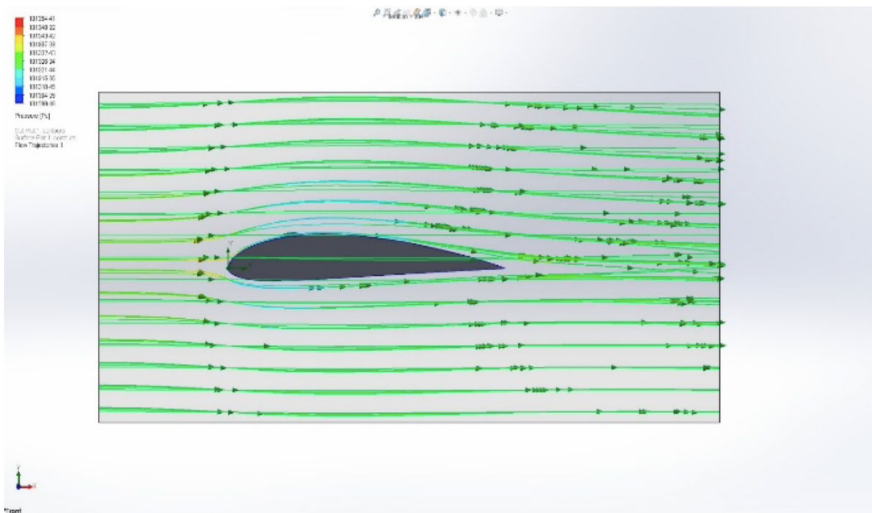
Figure 13. CFD Analysis.
Source: own elaboration.

Table 1. CFD Domain Size

X min	-0.095 m
X max	0.361 m
Y min	-0.103 m
Y max	0.118 m
Z min	-0.095 m
Z max	1.314 m
X size	0.456 m
Y size	0.221 m
Z size	1.409 m

Source: own elaboration.

Table 2. Specifications.

DESIGN PARAMETERS	VALUES
Weight limit	800 grams
Transmitter bandwidth	2.4 GHz
Weight when empty	350 grams
Length	36 inch
Wing span	48 inch
Engine type	BLDC motor 2216-1150KV
Range	2km
Velocity	-------
Material	Thermacole and balsa wood
Angle of attack	2º

Source: own elaboration.

2.3. PARTS AND COMPONENTS OF RC PLANE

After design and analysis of our RC plane was done, the second step was to fabricate it. The building process requires proper selection of components and parts to make it fly with great efficiency and achieve its goal. As the controlling part of the RC plane we used Fly sky i6X transmitter and Fly sky iA6B receiver.

2.3.1. TRANSMITTER

The reason of using this transmitter is its low power consumption along with high receiver sensitivity.

The Omni-directional high gain antenna's high efficiency reduces interference while using less power and maintaining a solid, stable link (Saeed *et al.*, 2020).

2.3.2. RECEIVER

FS-iA6B is a 6 channel receiver which supports (PPM) pulse position modulation output with i-bus and data acquisition interface

2.3.3. NACA 4415 AIRFOIL

The airfoil works on principle of aerodynamics. Lift by an airfoil is generated when a downward force is exerted on the air. Lift is basically the upward force created by an airfoil. The shape of airfoil is such that it creates longer path at upper side of it for air to flow. This makes air molecules to move faster at upper area producing low pressure according to Bernoulli equation. At the lower side of airfoil air molecules travel smaller distance to meet trailing edge producing high pressure. This difference of pressure creates lift. When design of an air foil changes it also changes its lift coefficient with variation in Angle of attack (AOA) (also called as alpha).

The airfoil used for our RC plane is NACA 4415. This airfoil can produce lift even at low speed which make is more suitable or an RC plane. According to Data and analysis of this air is shown in Figure 14 and Graphics 1, 2, and 3.
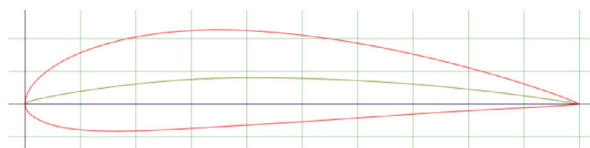
Figure 14. NACA 4415 Graph.
Source: own elaboration.

2.3.3.1. LIFT VS DRAG COEFFICIENT

Lift vs drag coefficient is normally called as the amount of lift that is generated by the airfoil as compared to its drag. This can be obtained by dividing lift coefficient by drag coefficient that are shown in Graphics 2 and 3. lift vs drag coefficient is used to represents the efficiency of an airfoil. The higher the L/D ration the more efficiency the airfoil will produce. Suppose an aircraft is flying steadily, the drag produced by it will be minimum.
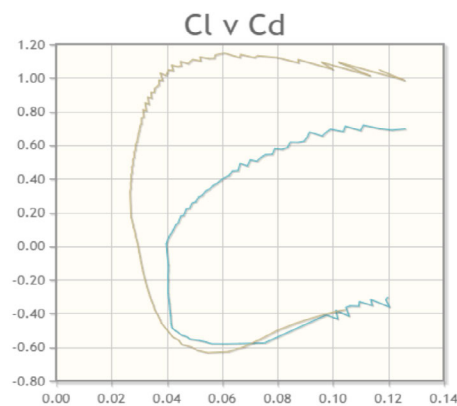
Graphic 1. CL Vs CD
Source: own elaboration.

2.3.3.2. LIFT COEFFICIENT VS ALPHA

The Graphic 2 show how coefficient of lift is effected when you change the AoA of an airfoil. On the x-axis we have AoA from -15 to 20 and on why y-axis we have coefficient of lift. Observe the reading at AOA 0-degree lift is somewhere around 0.38. if we increase AOA the lift will increase and if we reduce AOA the lift will decrease.
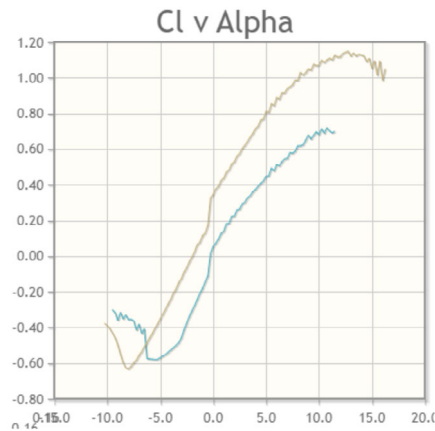
Graphic 2. CL Vs Alpha.
Source: own elaboration.

2.3.3.3. DRAG COEFFICIENT VS ALPHA

Drag is basically known as resistance that an object face in a medium. It is the value that a plane face while trying to generate lift. By looking at the graph below we can clearly see that at 0 AOA drag is lowest which shows less aerodynamic (Marinho *et al.*, 2011). As the

AOA is increased drag and lift is increased but when AOA in reduced drag increased and lift is decreased.
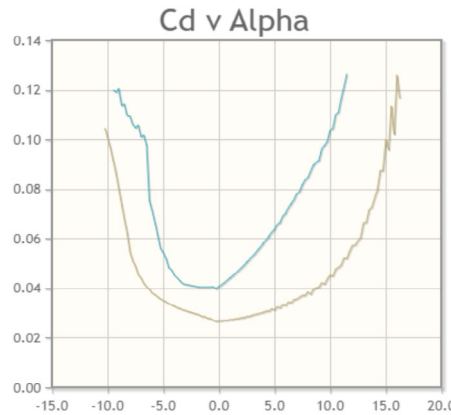
Graphic 3. CD Vs Alpha.
Source: own elaboration.

3. RESULTS

After fully completing the building process of our RC plane we were ready of our first test flight. The results were as we expected, the takeoff and landing of the plane was smooth and the flight was also good in even windy conditions.

4. CONCLUSIONS

After flying and performing different analysis on our plane we found that airplanes have so much potential in performing different tasks in different applications which could improve economy of country as well as provide alternative solutions for better technology used now a days.

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/07/

EVALUATION OF THE CONDITIONING TO DETERMINE THEIR THERMAL COMFORT IN THE EDUCATIONAL INSTITUTIONS OF THE PUNO REGION

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ABSTRACT

This research aims to evaluate the conditioning that determines the thermal comfort in the Educational Institutions of the Puno Region. The schools of the study site lack thermal comfort due to the existing low temperatures, so the study evaluates the conditioning that allows determining the thermal comfort in the Educational Institutions of the Region. The methodology used in this context is experimental since measurements have been made in situ, obtaining results that allow comparing and demonstrating the use of passive materials in the classrooms to improve the interior conditioning, bringing; as a result, an efficiency of 85% as a conclusion we can say that the implementation of passive materials inside the classrooms, helps to improve thermal comfort.

KEYWORDS

Thermal, Thermal conditioning, Comfort, Thermal comfort.

1. INTRODUCTION

Thermal comfort is a neutral sensation of the person concerning a given thermal environment. According to ISO 7730, thermal comfort "is a mental condition in which satisfaction with the thermal environment is expressed. The high Andean areas of Peru have a cold climate during most of the year, with temperatures below freezing. Therefore, the premises for educational use are primarily built with techniques that do not take into account the low levels of environmental temperature, which could lead to the development of a series of infectious diseases among students that would limit their academic performance (Hinojosa *et al.*, 2021).

The development of the research will provide better living conditions for the population and as a result of this the reduction of morbidity and mortality caused by Acute Respiratory Infections (ARI), "Pneumonia being the disease that produces more deaths in Peru, according to the report published in 2013 by the Institute Health Metrics and Evaluation (IHME), which studies the causes of premature deaths in 1990 and 2010. A health problem that mainly affects children under five years old and adults over 65 years old. From 2009 to 2013, the departments with the highest lethality due to pneumonia have been Puno, Huancavelica, Junín, Ayacucho, Cusco and Huánuco" (Umán & Méndez, 2019).

It is for this reason that the present work conducts a study of the educational premises, identifying and analyzing the environmental and constructive characteristics and technical perception of the users inside the classroom and proposing alternatives that overcome the ecological limitations of the school premises, providing them with elements that insulate the classrooms from the cold and thus protect the children who attend them. The contribution of this research, through the study carried out in the educational premises of Puno, is to propose an alternative solution to improve the management of the conditioning process and thermal comfort inside the existing classrooms in the study area through a passive air conditioning system according to the social, cultural and environmental characteristics of these (Esenarro *et al.*, 2021) For which air conditioning strategies will be taken into consideration with the use of natural energies, which are inexhaustible resources and do not generate polluting emissions (Norma EM.110, 2014).

2. METHOD

The methodology used is experimental due to manipulating the variable temperature vs. materials to achieve the required results at the study site (Belón, 2018).

Study area

The study was carried out in Peru, in the city of Puno.

IE N° 72312, C.P. Tiquitiqui is located in Altoandino at 3,889 m.a.s.l., Inchupalla District, Huancané Province, Puno Region (Figure 1).

Figure 1. Location of the study area.
Source: own elaboration.

Current temperature inside the IE 72312, C.P. Tiquitiqui is located in Altoandino at 3, 889 m.a.s.l., Inchupalla District, Huancané Province, Puno Region (Flores & Quispe, 2017).

The temperature inside the classroom
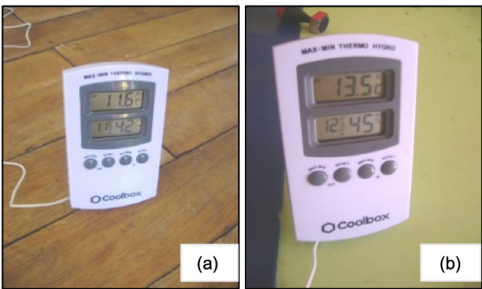
Figura 2. (a) at 8.50 am it is 11.6°C. (b) At 10.50 am it is 13.5°C.
Source: own elaboration.

Type of Research

The quantitative research will analyze the facts before and during the implementation of conditioning materials, explore the thermal comfort inside the classrooms. From the information, the results will be obtained to determine the types of the proposed materials (Quispe, 2015).

Procedure

For the present investigation, a field survey of the School Premises is carried out. Once the field survey has been carried out, the types of materials found and their state of conservation is verified (Quispe, 2013).

3. Results

The results are that temperatures increase from 1°C to 5°C inside each classroom.

Table 1. Table of Existing Materials-Interior Floors.

1.- What is the current state of conservation of the classrooms - INTERIOR FLOORS?		
Field Trip	N°10 of Respondents	Percentage 100%
Well	1	10%
Fair	6	60%
Bad	3	30%
TOTAL	10	100%

Source: own elaboration.

In Table 1, Existing interior floors of the classrooms, it can be seen that 10% are in good condition, 60% of the existing base is in fair condition, and 30% is in a poor state of conservation (Bojórquez, 2010).

Figure 3. Existing interior floors.
Source: own elaboration.

Figure 3 shows the materials used, such as tongue and groove wood 1 "x4", placed on wooden sleepers, with a poor concrete base, set on natural soil.

Figure 4. New interior floors.
Source: own elaboration.

Figure 4 shows the removal of existing 1 "x4" tongue and groove wood + wood sleepers + lean concrete base. New 3/4 "x4" wood screw tongue and groove floor + sealer + wood preservative + dd varnish. Concrete false floor e=4", on compacted granular material + sawdust + plastic sleeve and wood sleepers screw 2 "x3" (MINEDU, 2008).

Table 2. Table of Existing Materials-Windows.

2.- What is the current state of conservation of the classrooms - WINDOWS?		
Field Trip	N°10 of Respondents	Percentage 100%
Well	0	0%
Fair	3	30%
Bad	7	70%
TOTAL	10	100%

Source: own elaboration.

Table 2 shows that 30% of the existing windows are in fair condition, and 70% are in poor condition.

Figure 5. Existing windows.
Source: own elaboration.

Figure 5 shows the casement windows with 1" iron frame "L" profile + 4mm single glazing with deteriorated putty, with enamel paint stains on the front face.
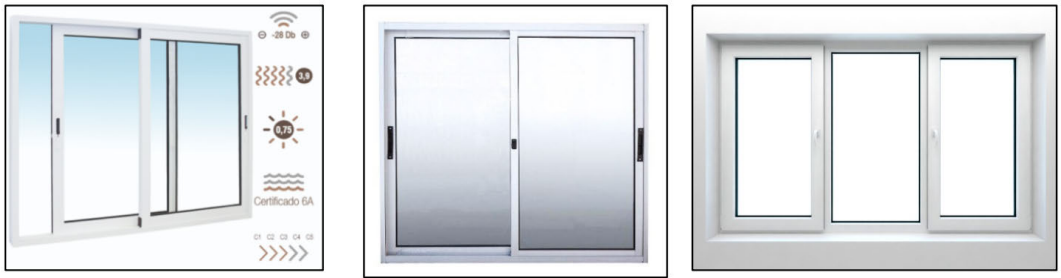
Figure 6. Double glazed windows with intervention.
Source: own elaboration.

Figure 6 shows the windows that were replaced, all single glazing to 4mm double glazing, bonded with silicone + 4-micron security laminate. In addition, new sliding windows will be installed inside the classroom, with aluminum frames and 6mm laminated glass. It will be placed 5cm away from the existing window.

Table 3. Table of Existing Materials-False Ceiling Interior-Exterior.

5.- What is the current state of preservation of the classrooms - FALSE ROOFED ROOFED INTERIOR-EXTERIOR?		
Field Trip	N°10 of Respondents	Percentage
Well	1	10%
Fair	2	30%
Bad	7	70%
TOTAL	10	100%

Source: own elaboration.

In Table 3, the existing interior floors of the classrooms, it can be seen that 10% of the interior-exterior false ceilings are in good condition, 20% are in fair condition and 70% are in a poor state of conservation (Simancas, 2003).

Figure 7. Existing false ceiling: 4mm plywood sheets, fixed to the lower part of the wooden scissors in 1.22m x 1.22m panels, joined with wooden flashing, with varnish paint finish.
Source: own elaboration.

Materials Intervention- False ceiling, interior-exterior

Figure 8. False interior ceiling with Intervention: New false ceiling made of aluminum profiles will be placed 10 cm away from the wooden purlins, where the new acoustic tile sheets will be installed with the aluminized side facing the ceiling + thermal insulation of Roca mineral wool, 2" blanket type + 6-micron plastic sleeve.
Source: own elaboration.

Table 7. Table of Existing Materials - Interior Walls.

7.- What is the current state of conservation of the classrooms - INTERIOR WALLS?		
Field trip	N°10 of Respondents	Percentage 100%
Well	0	0%
Fair	1	10%
Bad	9	90%
TOTAL	10	100%

Source: own elaboration.

Table 7, the existing interior walls of the classrooms, shows that 10% are in fair condition and 90% are in a poor state of conservation.

Figure 9. Existing walls: They are of confined masonry + latex paint, in a regular state of conservation.
Source: own elaboration.

Intervention Table - Interior Wall
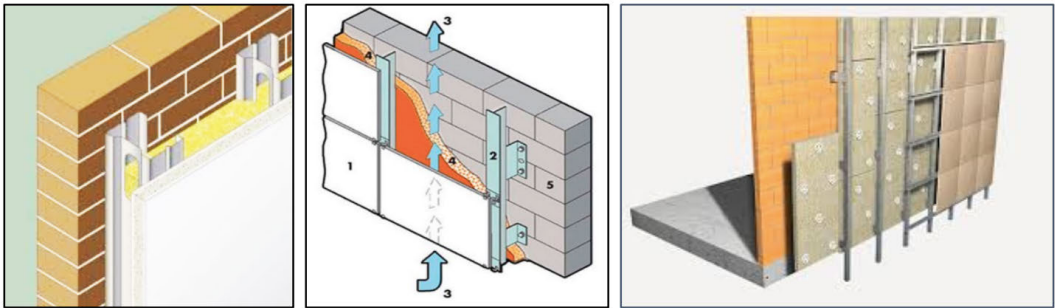
Figure 10. Double walls with Intervention: New 6mm fiber cement wall, fixed to a 64 and 65 mm. drywall metal structure, with interior thermal insulation of 2" mineral wool blanket + matte oil paint after applying base color and sealing of joints.
Source: own elaboration.

Once the state of conservation of the materials found and determining their state of preservation, we proceed to propose the New Materials that will replace or improve the existing materials of the Classroom, to achieve the Conditioning and Thermal Comfort inside the Classroom, to mitigate the cold of the area (Belón, 2018; Bojórquez, 2010).

GREENHOUSE:

In the north-east part, a greenhouse will be implemented, which will function as a heat collector. It is proposed to build a wooden greenhouse, with a translucent polycarbonate cover attached to the classrooms with a north-east orientation.

VESTIBULE:

2 Vestibules are planted, attached to the Classrooms. Both vestibules seek to control the sudden change of temperature between the outside environment and inside the classrooms. It is an intermediate space between the outside temperature and the inside temperature of each classroom.

Figure 11. New Environments to be Proposed.
Source: own elaboration.

Figure 12. Double walls with intervention.
Source: own elaboration.

Likewise, we propose two new environments that will be attached to the classrooms and will serve to control the comfort inside the classrooms; in the back is the greenhouse lobby.

Figure 13. Existing Façades - Façades with Classroom Intervention.
Source: own elaboration.

Figure 13 shows the school before the modification on the left-hand side and the right-hand side with the greenhouse.
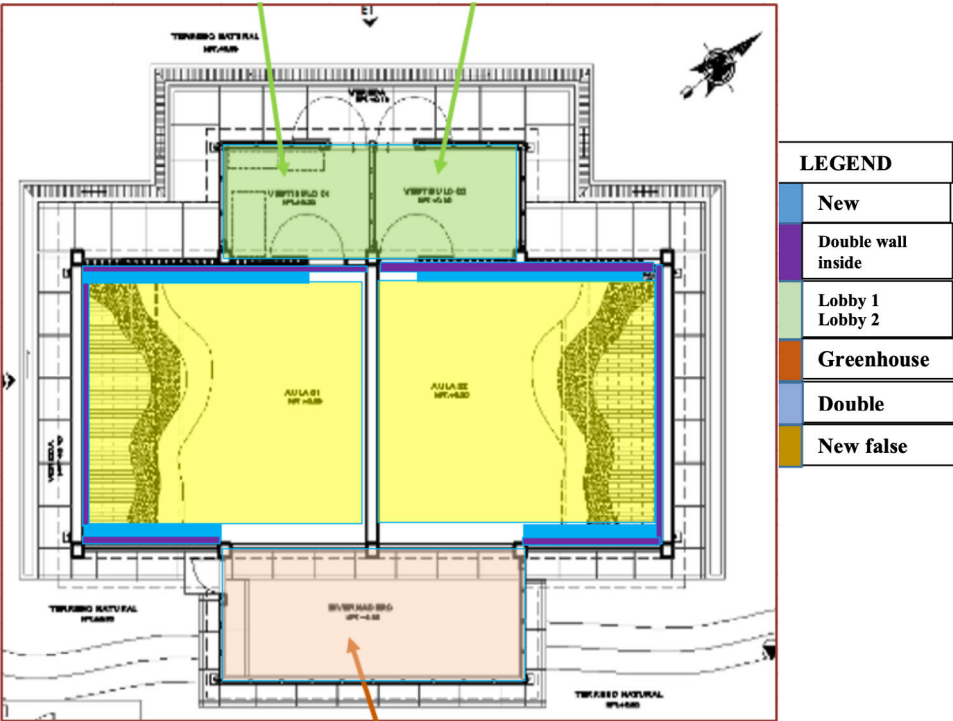
Figure 14. School with new materials.
Source: own elaboration.

Once the placement of the new materials has been completed, the temperatures inside the classrooms are taken every 2 hours and compared with the temperatures taken before the intervention of the classrooms.

4. CONCLUSIONS

The new double glazing and Greenhouse and Lobby windows must be controlled (Bakos & Schiano-Phan, 2021).

When the sun heats up, which is from 7 a.m. to 2 p.m., the Greenhouse will heat up and transmit the heat to the interior of the classrooms.

To keep indoor classrooms comfortable in winter, the lobby doors should be kept closed. Likewise, the design of the façade is essential, which allows the capture of solar radiation and to be able to capture the energy from nature (Esenarro *et al.*, 2020).

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/08/

DESIGN AND ANALYSIS OF SUSTAINABLE BEACH CLEANER

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ABSTRACT

This is the research paper for our project, an efficient and innovative Beach Cleaner. This consists of an introduction to the goals we wish to accomplish with this beach cleaner project that we have designed and analyzed. Our strategy also consists of a literature review of similar beach cleaner projects we found that have been developed in the past by various organizations, companies and students of universities worldwide, we discuss the problems that each of them aimed to eradicate, the problems they faced, how they strategized the whole project and discuss the results. The paper also comprises of a discussion on the steps we used to design and analyze the beach cleaner, and its functionality. Furthermore, we also studied the motion and stress graphs of the design, and concluded our research. We believe that this is the perfect solution to the pollution at the beach. We have successfully designed a beach cleaner that can be implemented easily into a working device.

KEYWORDS

Beach Cleaner, Sustainable, Robot, Ecofriendly, Pollution, Garbage cleaner.

1. INTRODUCTION

Sustainability is the consideration that the resources we have on earth are limited and we must use them wisely to protect the planet. In the events that we do not adopt sustainable behavior, generations to come will suffer greatly. It is our role as inhabitants of earth to take care of it. Being an engineer, that role multiplies itself as we now have a choice to use technology to serve the earth or damage it. We, as engineering students, aimed to target the following three goals of the seventeen sustainable development goals laid out by the United Nations:

Goal #11: Sustainable Cities and Communities

Our project aims toward cleaning the beaches in the city. It will help with the sanitation issues in the city. The pollution control is weak, leading to unhealthy and inefficient cities, our project will help control pollution.

Goal #14: Life below Water

Waste on beaches is normally washed off into the sea and is extremely harmful for the marine life. Cleaning the beach improves the coastal and ocean ecosystem by making sure that none of the trash kills marine life or is toxic enough to disrupt the marine life cycle.

Goal #15: Life on Land

Life on land is also greatly affected by the waste found on beaches. Trash makes the living conditions for human beings unsanitary. It has adverse effects on human health. Be that as it may, trash is also unpleasant to look at and may physically hurt visitors on the beach. The main goal of this project is to develop and implement a machine which will help in the beach environment. There is a lot of pollution that is affecting the beach and the marine life, hence, here we introduce an innovative and efficient beach cleaner.

In public places, cleanliness is vital as hundreds and thousands of people visit them every day. Beaches, for example, are visited for leisure by many people, including children and the elderly. If they aren't kept clean their health can be affected which is a very serious issue. Moreover, places with trash are extremely unpleasant to look at and enjoy in, which proposes a risk to the tourism system as well.

The struggling economy and the crippling solid waste management system in Pakistan specially is in dire need of a cheap, efficient and easy to use solution to work on our beaches not to just solve waste management issues but also to help speed up the process to make the beaches more attractive for tourism purposes and to boost the economy as well.

Garbage Cleaners are a perfect solution for this crucial task of picking up trash from places like the beach. Our solution is a 4-wheel drive vehicle chassis equipped with a cleaning mechanism and a trash bag for garbage collection. The structure will be driven through a motor and the rotational motion of the wheels will further drive the lifter mechanism. The lifting mechanism is a rake attached to a chain which is connected with a chain sprocket. When the wheels are turned Which will collect the garbage from the beach and deposit it in the trash bag.

1.1. LITERATURE REVIEW

A. Promoteo:
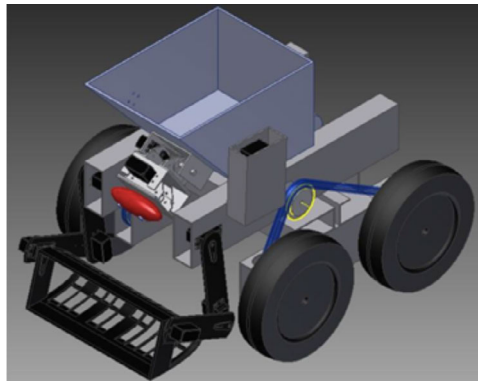
Figure 1. Promoteo.
Source: own elaboration.

Prometeo is a mobile robotics research group. They have designed a robot to oppose the environmental pollution. Their robot is able to traverse on the beach, collect trash found in the vicinity and transport it to a dumpster.

They use cameras on the robot to detect the presence of garbage and also for avoiding obstacles. It has two powered motors for locomotion and nine servomotors for the excavator arm, the pan tilt camera system and the reservoir.

The robot is an efficient modern-day vehicle but the use of computers and a complex operating mechanism makes this robot a little hard to use but as far beach cleaning and remote operation are concerned this project resulted in success.

B. RF Controlled Beach Cleaner Robotic Vehicle:

Figure 2. RF Controlled Beach Cleaner Robotic Vehicle.
Source: own elaboration.

Nevon Projects created this remote-controlled beach cleaner to rid the shoreline of garbage and rubbish spread by visitors.

This project is based on a four-wheel drive vehicle and the chassis consists of a chain sprocket setup for picking up the trash and a plastic bag is attached for deposition of said garbage. A microcontroller is used to navigate the system and the remote-controlled motor is used to drive the vehicle.

This was a basic beach cleaning mechanism and results showed that it picked up small plastic bottles and cans but it had inconsistency in picking up other smaller trash such as plastic bags etc. and bottle caps.

C. HS-GreenFist: Beach Cleaner Robot:
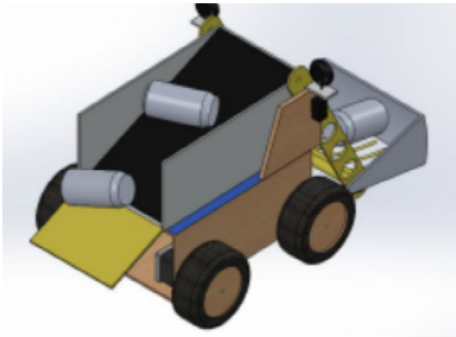
Figure 3. HS-GreenFist: Beach Cleaner Robot.
Source: own elaboration.

The HS-GreenFist is a design developed by a group of students studying Systems Engineering at the National University of St. Agustin in Arequipa, Peru. The fundamental purpose of this project is to help the pollution problems which is affecting the environment. This robot can navigate in sand and it is designed so that it picks up trash and deposits it somewhere else.

The robot has a separate robotic arm to pick up the cans. In addition, the robot uses four wide tires to move under the same principle on which the caterpillar moves. The excavator arm has a claw on the end that allows the robot to collect the cans through the sand, it will also have a small scanning system as an actuator fixed to the claw. The movement of the excavator arm is defined by two movements one to raise the claw and the other to collect cans both Movements are commanded by servomotors.
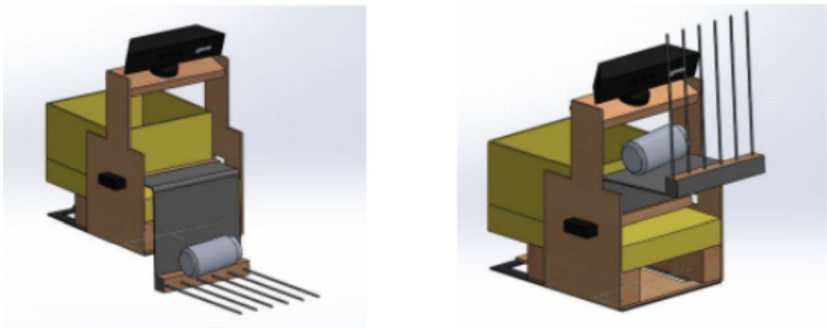
Figure 4. HS-GreenFist: Beach Cleaner Robot.
Source: own elaboration.

The project successfully picks up cans from there different positions. The controlling of the arm using servo motors and actuators had efficient results.

D. Dr. Recare:

The Dr. Recare us designed by Mingyu Jeong. It is a mobile doctor that solves the environmental problem and issue of the polluted seashores.
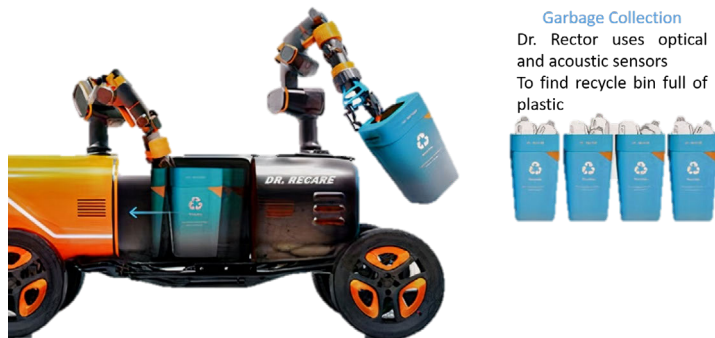
Figure 5. Dr. Recare.
Source: own elaboration.

The robot itself has optical and acoustic sensors which allow it to sift through sand and gather plastic. The plastic is then melted and through an integrated 3d printer is converted into recycled trash cans which can be used as bins to dump garbage rather than pollute the sea bed.

Figure 6. Dr. Recare.
Source: own elaboration.

The robot was a success and used to encourage people to actually use trash cans. This was an innovative way to recycle and use 3d printing.

E. Garbage Collection Robot on the Beach using Wireless Communications:
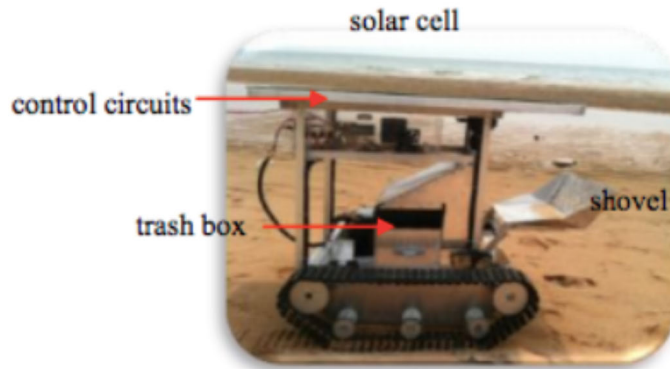
Figure 7. Garbage Collection Robot on the Beach using Wireless Communications.
Source: own elaboration.

The project was developed by students of Electrical Engineering at the University of Si Racha Kasetsart in Chonburi, Thailand. They wanted to engineer something which could controlled wirelessly and was environment friendly. The main aim of this project is to handle tasks more conveniently which is collecting the garbage and controlling capability while considering environmental effects.

To control the robot, they used Visual Basics Applications. The robot moves based on the commands sent via Bluetooth to the micro-processor. The garbage collection robot collects both glass bottles and plastics. The robot can move in a speed of 0.5 meters per second on the sand via the wireless communication.

To summarize their end result, we can observe the hardware implementation of the system. The complete system of garbage this collection robot is divided into 5 major parts: power consumption, structure and configuration of the robot, microcontroller, wireless communication module and IP wireless camera.

F. Autonomous Garbage Collector Robot:

The main aim of the mechanism in this project is to collect garbage which is of similar dimensions to that of juice cartons, plastic bottles, crushed papers, and all light items whose height is between 5 to 20cms.

This trash collection system consists of a set of blades rotating about a shaft connected to the motors. The mechanism will not operate for entirety of the vehicle operation it will operate only when needed. This collection mechanism is mounted on the front side considering some ground clearance. Two motors are mounted on the two sides of the shaft and is connected to Arduino to perform rotating mechanism.

Figure 8. Autonomous Garbage Collector Robot.
Source: own elaboration.

As a result of how the collection mechanism is built it suits public places like gardens, bus stands, footpaths. When the sensor detects stationary obstacles, the mechanism rotates and the garbage is directed into a collection bin which is placed right behind the mechanism.

2. METHODOLOGY

After thorough study of projects with a similar goal, we were ready for our own design. We used measurements that were ideal for both manual use, and use when a motor is attached.

The essential concept is when the assembly is pushed forward, the wheels turn and cause the sprocket to rotate. The sprocket turns the chain assembly with it. Attached to the chain assembly are rakes. These rakes lift any trash that gets in the way.

Basically, we wanted the device to pick up trash as it moved. So, we placed the rakes onto the chain using an adapter. Then we placed the belt roller chain onto the sprockets which were kept synchronized with the wheel using a pin. The pins were inserted through the sprocket and the rod. The rod holds everything together. So now as the wheel moves, the rod rotates and as the rod rotates the sprocket also rotates because of the pin and hence the

sprocket causes the chain to rotate which has the rake attached to it. This lifts up the trash and by the rack and pinion connection it is leaded to the trash bag which is connected by hooks at the back of the assembly.

3. RESULTS

3.1. MOTION STUDY – BASIC MOTION
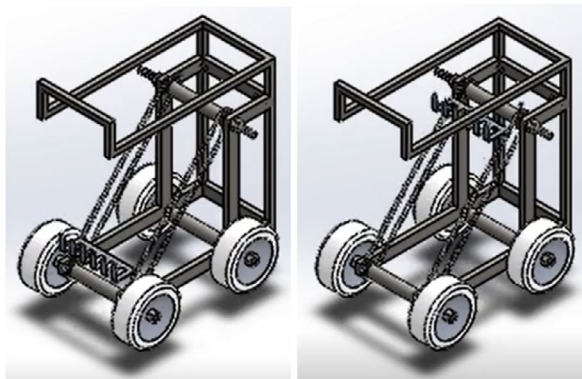
Figure 9. Movement of rake.
Source: own elaboration.

3.2. TORQUE CALCULATION

The mass of the assembly, as evaluated by Solid works mass properties is 216.89lbs. Torque to move the assembly can be calculated by:

$$\text{Torque} = \text{Force} * \text{radius}$$

Here the radius is the radius of the tyre and Force is the weight.

$$\text{Torque} = 216.98 \text{ lbs} * 5 \text{ in}$$

$$\text{Torque} = 1098.55 \text{ lb.in}$$

$$\text{Power} = \frac{\text{Torque} * \text{Speed}}{63025}$$

$$\text{Power} = \frac{1098.55 \text{ lb.in} * 20 \text{ rpm}}{63025}$$

$$\text{Power} = 0.349 \text{ HP}$$

Since, we will use two motors, torque of each motor can be given by:

$$Torque = \frac{1098.55 \text{ lb.in}}{2}$$

$$Torque = 549.275 \text{ lb.in}$$

Therefore, we require two motors of minimum 550 lb.in torque for a speed of 20 rpm. The power of the system would be 0.349 hp.

* In these calculations, we have not considered the weight of the trash, it will be added to the assembly and hence we must use a motor with a slightly higher torque than calculated.

4. CONCLUSIONS

To conclude, there are numerous other projects similar to the Beach Cleaner project. The studied articles that were presented were from different companies, organizations, and universities worldwide. It was observed from the reviewed articles how each group of designers strategized their development. Many remarkable features were observed that can be added to our project to further develop it. The literature review was successfully helpful in improving the knowledge of how to develop and design this project.

Our design uses a mix of different features from different projects around the world we used the chain sprocket arrangement from a certain project and the structure of another, the trash picking technique from one and trash deposition method from another hence our design is a successful innovative combination of a number of beach cleaner devices that have been invented and designed in the past.

Our designed machine consists of 11 parts including a chain sprocket arrangement. It can be used with or without a motor. We believe that this is the perfect solution to the pollution at the beach. We have successfully designed a beach cleaner that can be implemented easily into a working device.

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/09/

VARIABLE ON-TIME CONTROL SCHEME TO ACHIEVE HIGH EFFICIENCY FOR AC/DC BORDER LINE CURRENT MODE   BUCK CONVERTER

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ABSTRACT

The Buck power factor improvement converter (BPFIC) is much better topology because of having advantages like less inrush current, less voltage gain ratio, gives less voltage output ripple and steps down the voltage even with high input voltage, protection from short circuit and its single active switch operation makes it attractive. However borderline current mode (BCM) operated with fixed on-time control technique (FOCT) results in its low efficiency. The main reason of low efficiency is due to high conduction and switching losses which occur due to high peak and rms inductor current. In this paper, varying on-time control technique (VOCT) has been implemented that reduces the peak value of current which results in improved efficiency. In the proposed research, work is related to BPFIC operating in BCM because BCM has many advantages like no reverse recovery of diode, and zero current turning off the switch. To verify the effectiveness of proposed control technique, comparative analysis is obtained between both the two control techniques using SABER SIMULATOR. It is found that VOCT improves the converter's efficiency compared to FOCT.

KEYWORDS

Buck Power Factor Improvement Converter (BPFIC), Borderline Current Mode (BCM), Fixed On-Time Control Technique (FOCT), Varying On-Time Control Technique (VOCT), Saber Simulation.

1. INTRODUCTION

The increasing need of electronic devices (requires AC to DC conversion) have resulted in harmonic content produced by non-linear elements (diodes and thyristors) of electronic devices connected to AC supply system should be in such limit that it meets regulatory standard. This requirement is fulfilled by using active power factor improvement (PFI) circuits that shape the input phase current to be sinusoidal in nature and in phase with input phase voltages. The combined effect of non-linear loads results in problem of serious harmonic distortion in electrical distribution system and its result is poor Power Factor (PF) and power quality, voltage distortion and low efficiency (Azazi *et al.*, 2010). PFI can be categorized into active and passive types. Compared with a Passive Power Factor Improvement Converters (PFIC), an active PFIC can achieve a high PF (Nagaraju & Krishnaveni, 2017). The PFIC are being widely used in ac–dc power conversions to get power factor near to unity and to reduce harmonic distortion so as to meet the standards like IEC61000-3-2 and IEEE 519 (Yao *et al.*, 2011).

Amongst PFIC, buck Power Factor Improvement Converter (BPFIC) is much better topology because of having advantages like less inrush current, less voltage gain ratio, gives less voltage output ripple and steps down the voltage even with high input voltage, protection from short circuit and its single active switch operation makes it attractive. However, because of dead zone in the input current of (BPFIC) has resulted in poor PF and other power quality issues

For enhancing the performance of BPFIC, different authors have proposed several control techniques (Endo, Yamashita, & Sugiura, 1992; Memon *et al.*, 2021).

In this paper, Variable On-Time Technique (VOCT) is implemented to reduce the conduction and switching losses occurred in borderline current mode BPFIC caused by peak and rms value of inductor current.

This paper is divided into six sections. First section gives detailed analysis of traditional BPFIC. In, second section VOCT is implemented to improve converter's efficiency. Third section represents loss analysis caused by conduction and switching losses. Fourth section

shows simulation verification to confirm the effectiveness of proposed control technique. In last section conclusion is discussed.

2. METHODOLOGY

The research methodology is based on:

1. Mathematical analysis of the operating principle of the control schemes for Borderline Current Mode (BCM) Buck Power Factor Improvement Converter (BPFIC) for FOCT with the help of MATHCAD converter.

2. Introducing the Varying On-Time Control Technique (VOCT) to obtain high efficiency.

3. Comparative analysis of the converter for FOCT and VOCT strategy.

4. Developing the simulation model of BCM Buck converter with the help of SABER software.

5. Confirming the results.

2.1. WORKING ANALYSIS OF TRADITIONALLY USED BCM BPFIC

Figure 1 shows the circuit of Buck Power Factor Improvement Converter (BPFIC) that can be operated in borderline current mode (BCM). The working of the BPFIC will be analyzed in detail with the help of equations in order to find out the expression of fixed on-time technique (FOCT).
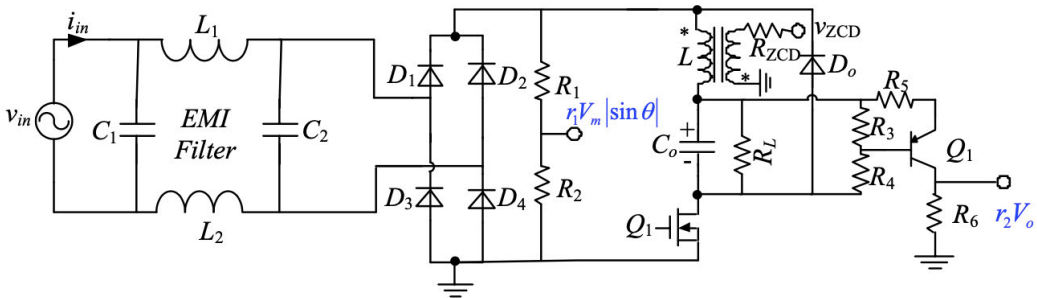
Figure 1. Circuit Diagram of BPFIC.
Source: (Memon *et al*., 2021).

The instantaneous value of source voltage at the input and output of bridge is expressed as

$$v_{in\_bpfic} = v_g = V_m \sin \theta \tag{1}$$

BPFIC operated with BCM has two switching cycles.

The inductor is charged from supply voltage when the buck switch is ON, as indicated in Figure 2 (First switching cycle).
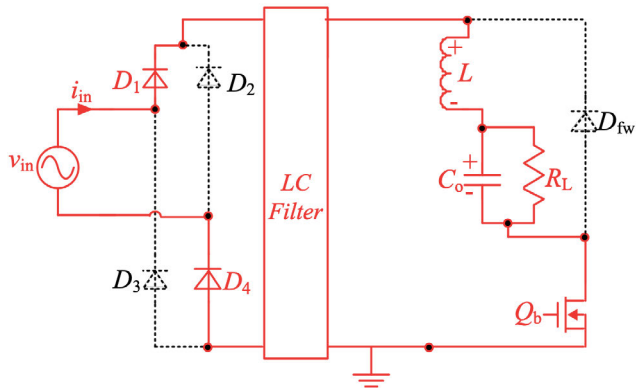
Figure 2. BPFIC when switch is on.
Source: (Memon *et al.*, 2018).

The maximum current flowing through inductor for BPFIC with FOCT is

$$i_{m\_foct} = t_{on\_foct} \frac{V_m |\sin \theta| - V_{o\_bpfic}}{L} \tag{2}$$

The inductor is discharged through load when the buck switch is OFF, as showed in Figure 3 and the expression is given in (3) (Second switching cycle).
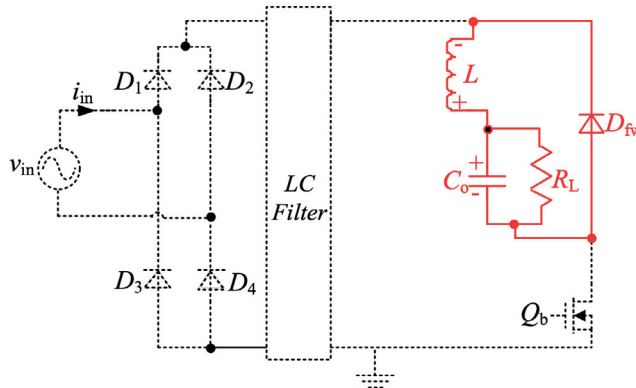
Figure 3. BPFIC when switch is off.
Source: own elaboration.

$$i_{m\_foct} = -\frac{V_o}{L} T_{off} \tag{3}$$

The maximum current for charging and discharging is same as per energy conservation. So, following relation is got

$$t_{off} = t_{on\_foct} \frac{V_m |\sin\theta| - V_{o\_bpfic}}{V_{o\_bpfic}} \tag{4}$$

Similarly

$$t_{s\_bpfic} = t_{on\_foct} + t_{off} \tag{5}$$

By substituting (3) into (5) yields

$$t_{s\_bpfic} = \left(\frac{V_m |\sin\theta|}{V_{o\_bpfic}} \right) t_{on\_foct} \tag{6}$$

The average input current for BPFIC with FOCT is calculated as

$$i_{avg\_bpfic} = i_{avg\_bpfic(foct)} = \frac{i_{m\_foct} t_{on\_foct}}{2 t_{s\_bpfic}} = \frac{t_{on\_foct} V_{o\_bpfic}}{2L} \left(\frac{V_m |\sin\theta| - V_{o\_bpfic}}{V_m |\sin\theta|} \right) \tag{7}$$

From (1) and (7), the input power of the BPFIC with FOCT is given

$$P_{in\_foct} = \frac{t_{on\_foct} V_{o\_bpfic}}{2\pi L} \int_{\theta_0}^{\pi-\theta_0} \left(V_m |\sin\theta| - V_{o\_bpfic} \right) d\theta \tag{8}$$

The value of t_{on_foct} is expressed after supposing 100% efficiency as

$$t_{on\_foct} = \frac{2\pi P_o L}{\int_{\theta_0}^{\pi-\theta_0} V_{o\_bpfic} \left(V_m |\sin\theta| - V_{o\_bpfic} \right) d\theta} \tag{9}$$

2.2. PROPOSED VOCT FOR BPFIC FOR ENHANCING EFFICIENCY

For improving the efficiency for the BPFIC, the on-time of buck CMOS in (9) has to change as

$$t_{on\_voct} = M_{on} \frac{\left(V_m |\sin\theta| \right)^2}{V_{o\_bpfic} \left(V_m |\sin\theta| - V_{o\_bpfic} \right)} \tag{10}$$

where M_{on} is a constant

Replacing (10) into (7), the input current of the BPFIC is

$$i_{in\_voct\_bfpic} = \frac{V_m |\sin\theta|}{2L} M_{on} \quad (\theta_0 \le \theta \le \pi - \theta_0) \tag{11}$$

The input power for BPFIC with VOCT is got as

$$P_{in\_bpfic\_voct} = \frac{1}{\pi} \int_{\theta_0}^{\pi-\theta_0} \frac{M_{on}(V_m \sin\theta)^2}{2L} d\theta = P_o \tag{12}$$

Rearranging (12), we get

$$M_{on} = \frac{2\pi L P_o}{\int_{\theta_0}^{\pi-\theta_0} (V_m \sin\theta)^2 d\theta} \tag{13}$$

2.3. EFFICIENCY COMPARISON

2.3.1. POWER LOSS DUE TO BRIDGE RECTIFIER

The power loss due to bridge rectifier in BPFIC with FOCT and VOCT is estimated as

$$P_{con\_bpfic\_bridge(fotc)} = 2V_{FD}\, i_{avg\_bpfic(foct)} \tag{14(a)}$$

$$P_{con\_bpfic\_bridge(voct)} = 2V_{FD}\, i_{avg\_bpfic(voct)} \tag{14(b)}$$

The value of VFD for GBU 406 is 0.89.

2.3.2. CONDUCTED LOSSES BY CMOS (SWITCH)

The rms current flowing through switch, when it is on is given as

$$I_{rms\_bpfic\_Q\_on} = \sqrt{\frac{\int_{\theta_0}^{\pi-\theta_0} i_{m\_bpfic}^2 D_{on}\, d\theta}{3\pi}} \tag{15}$$

The rms current of the off time period can be determined as

$$I_{rms\_bpfic\_Q\_off} = \sqrt{\frac{\int_{\theta_0}^{\pi-\theta_0} i_{m\_bpfic}^2 D_{off}\, d\theta}{3\pi}} \tag{16}$$

The rms current due to switch on and off is calculated as

$$I_{rms\_bpfic\_foct} = \sqrt{I^2_{rms\_bpfic\_Q\_on} + I^2_{rms(Qb\_off\_cdccs)}} \qquad (17(a))$$

$$I_{rms\_bpfic\_voct} = \sqrt{I^2_{rms\_bpfic\_Q\_on} + I^2_{rms(Qb\_off\_voct)}} \qquad (17(b))$$

The losses due to conduction of switches can be got as

$$P_{con\_cmos\_bpfic\_foct} = I^2_{rms\_bpfic\_foct} R_{DS(on)\_S} \qquad (18(a))$$

$$P_{con\_cmos\_bpfic\_voct} = I^2_{rms\_bpfic\_voct} R_{DS(on)\_S} \qquad (18(b))$$

The resistance from drain to source is 0.188, which is from data sheet of 8N60.

2.3.3. SWITCH OFF LOSSES BY CMOS (SWITCH)

When the switch is off, the loss of BPFC with FOCT and VOCT is expressed as

$$P_{off\_cmos\_foct} = \frac{t_{s\_bpfic} \, t_f}{2\pi} \int_0^\pi i_{m\_foct} \left(V_m \sin\theta \right) d\theta \qquad (19(a))$$

$$P_{off\_cmos\_voct} = \frac{t_{s\_bpfic} t_f}{2\pi} \int_0^\pi i_{m\_voct} \left(V_m \sin\theta \right) d\theta \qquad (19(b))$$

T_f for 8N60 is 12ns.

2.3.4. COPPER LOSS OF THE BPFIC'S INDUCTOR

The inductor's copper loss of BPFIC with FOCT and VOCT is given as

$$P_{cu\_foct} = I^2_{rms\_bpfic\_foct} R_{cu} \qquad (20(a))$$

$$P_{cu\_voct} = I^2_{rms\_bpfic\_foct} R_{cu} \qquad (20(b))$$

2.3.5. CORE LOSS OF BPFIC'S THE INDUCTOR

The inductor's core loss of BPFIC with FOCT and VOCT is given as

$$P_{bpfic\_core\_foct} = \left[\int_0^\pi C_m f_{s\_bpfic\_foct}^{\ x} B_{ac\_bpfic\_foct}^{\ y} \left(ct_0 - ct_1 T_a - ct_2 T_a^2 \right) d\theta \right] \frac{10^3 V_e}{\pi} \qquad (21(a))$$

$$B_{ac\_bpfic\_foct} = \frac{i_{m\_foct}L}{2NA_e} \qquad (21(b))$$

$$P_{bpfic\_core\_voct} = \left[\int_0^\pi C_m f_{s\_bpfic\_foct}{}^x B_{ac\_bpfic\_voct}{}^y \left(ct_0 - ct_1 T_a - ct_2 T_a^2 \right) d\theta \right] \frac{10^3 V_e}{\pi} \qquad (21(c))$$

$$B_{ac\_bpfic\_voct} = \frac{i_{m\_foct}L}{2NA_e} \qquad (21(d))$$

The value of core parameters can be found from Memon *et al.* (2018).

2.3.6. CONDUCTED LOSS BY FREEWHEELING DIODE

The conducted losses by freewheeling diode of BPFIC with FOCT and VOCT is got as

$$P_{bpfic\_con\_freewhdiode\_foct} = \frac{V_{FD_{fw}}}{\pi} \int_0^\pi \frac{i_{m\_foct}}{2} D_{off} \, d\theta \qquad (22(a))$$

$$P_{bpfic\_con\_freewhdiode\_voct} = \frac{V_{FD_{fw}}}{\pi} \int_0^\pi \frac{i_{m\_voct}}{2} D_{off} \, d\theta \qquad (22(b))$$

The forward voltage drop is 0.669 for MUR 860.

2.3.7. THE EFFICIENCY COMPARISON

The efficiency of BCM BPFIC with FOCT and VOCT can be estimated as

$$\eta_{bpfic\_foct} = \frac{P_o}{\left[\begin{array}{l} P_o + P_{con\_bpfic\_bridge(fotc)} + P_{con\_cmos\_bpfic\_foct} + P_{off\_cmos\_foct} \\ + P_{cu\_foct} + P_{bpfic\_core\_foct} + P_{bpfic\_con\_freewhdiode\_foct} \end{array} \right]} \qquad (23(a))$$

$$\eta_{bpfic\_voct} = \frac{P_o}{\left[\begin{array}{l} P_o + P_{con\_bpfic\_bridge(votc)} + P_{con\_cmos\_bpfic\_foct} + P_{off\_cmos\_voct} \\ + P_{cu\_voct} + P_{bpfic\_core\_voct} + P_{bpfic\_con\_freewhdiode\_voct} \end{array} \right]} \qquad (23(b))$$

The calculated efficiency of BCM BPFIC with FOCT and VOCT from (14-23) and specification is depicted in Figure 4. It can be observed the efficiency of BPFIC with VOCT is more than FOCT.
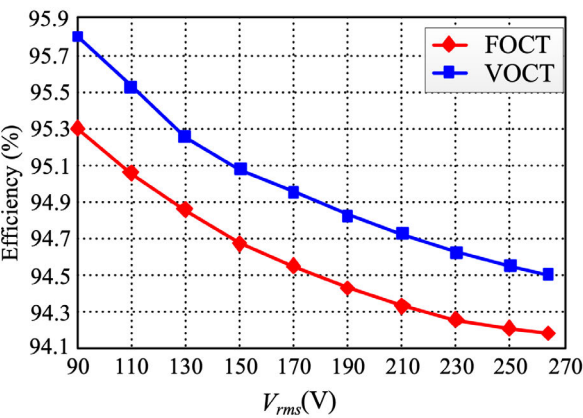
Figure 4. Efficiency at universal input voltage (Mathcad Graph from Eq. (14-23)).
Source: own elaboration.

3. SIMULATION RESULTS

In order to verify the effectiveness of VDCT, simulation verification is obtained using MATLAB. The input voltage range is 90-264VAC, and the output is 80V. For ensuring the current to be in CRM, L6561 IC is used. All the components in the circuit are selected as idea.

In Figure 5, the peak of input current obtained in case of FOCT is more. The current having more peak results in losses that degrades converter's efficiency whereas in Figure 6, the peak of input current obtained in case of VOCT is less which reduces conduction and switching losses hence converter's performance is improved.
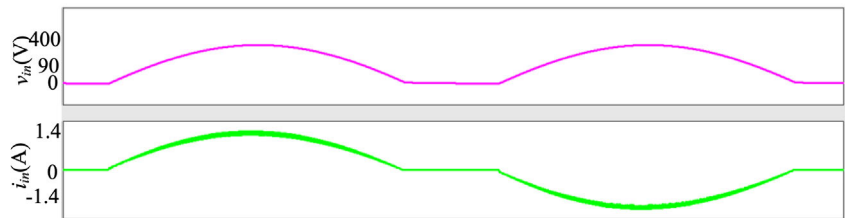
Figure 5. v_{in}, and i_{in} with FOCT (Simulation waveform).
Source: own elaboration.
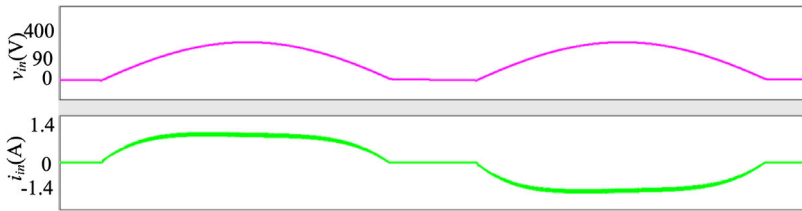
Figure 6. v_{in}, and i_{in} with VOCT (Simulation waveform).
Source: own elaboration.

4. CONCLUSIONS

The Buck Power Factor Improvement Converter (BPFIC) is much better topology because of having many advantages. However Borderline Current Mode (BCM) operated with Fixed On-Time Technique (FOCT) results in its low efficiency. The main reason of low efficiency is due to high conduction and switching losses which occur due to high peak and rms inductor current. In this paper, Varying On-Time Technique (VOCT) has been implemented that reduces the peak value of current which results in improved efficiency.

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/10/

SUSTAINABLE ELECTRICITY GENERATION AND STORAGE MECHANISM THROUGH DOORS

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ABSTRACT

The comfort associated with safety and convenience is here what man fought for. Our idea was to bring both. The culmination of our efforts has led to the us to create a way to utilize wasted physical energy convert it into usable energy and then save it efficiently. As today's world requires a lot of energy the various stages of their life. So, this idea is explanatory about the conversion of muscle strength into mechanical energy can also be converted into useful electricity power. This conversion can be done using a simple track and gear for the opening and closing op doors and generator (dynamo) to covert the motion of the gear on the track to usable electricity. The novelty of this scientific work is the implementation of four different types of batteries for on the same model to evaluate the system's autonomy and the efficiency of these battery types on a driving cycle, in real time.

KEYWORDS

Energy generation, Sustainable development, Gears, Track, Usable energy.

1. INTRODUCTION

More and more engineers needed to play a leadership role in sustainable development, to challenge the global challenges, such as declining resources, pollution, rapid population growth and environmental damage. Looking at the problems facing our world today and the problems that are expected to arise in the first half of the twenty-first century, for engineers to revisit their thinking and adopt a new technology statement - to contribute to building a sustainable, stable and equitable land has become more critical. Since the industrial revolution the world is revolving around machinery and technology that has played a major role in energy consumption and carbon emissions and as our field, mechatronics, also relates to these works it is up to us to think and create a way for our world to be more sustainable. For out project the need for such design and production of a system, which will use free muscle power, to converts it into electricity. Electrical power is a basic and important requirement therefore must be a system present that can convert free energy into electricity power.

This thought essentially assists with capturing of the energy which is wasted while opening and shutting of the door. In this the angular motion of the entryway is changed over into rotary movement. The rotary motion is achieved by the gear that will be rotating on the track that is made and the motor coverts the rotary motion into electricity. dynamo is an electrical generator that makes direct flow utilizing a commutator. The electric dynamo utilizes turning coil of wire and magnetic fields to change over mechanical pivot into a beating direct electric flow through Faraday's law of induction.

Household electricity consumption sector represents one of the main determinant factors of climatic changes, 23 % of the greenhouse gas from the atmosphere coming from this sector. The goal is to reduce the emission of green-house gases and is achievable if the energy generated from sustainable sources are stored with maximum efficiency.

This study presents the autonomy of an Electric system that utilizes four different types of batteries: Lithium Ion (Li-Ion), Molten Salt (Na-NiCl2), Nickel Metal Hydride (Ni-MH) and Lithium Sulphur (Li-S), all of them having the same electric energy storage capacity.

1.1. BACKGROUND STUDY

We combed through a number of research papers and selected a couple that were pertinent to our endeavor. Starting off with the first paper they are looking of necessity for creating and producing a system that will allow the Door to operate more freely, as well as converting the energy received by the generating system into electricity. We conclude that energy that is squandered in one way or another may be used to create electricity using a simple method. Because today's world is totally reliant on many forms of energies, all of which will vanish or exhaust at some point in the future, we must rely on free energy to power our fundamental gadgets that require electricity to function. The components they were using to create these were Gear Set, bearing, belt, LEDs, & Dynamo.

In the second research, we have gone through the necessity for creating and producing a system that will allow the Door to operate more freely, as well as converting the energy received by the generating system into electricity. We discovered how genuine power may be created through the operation of the dynamo employed in the research. We were able to grasp the fundamental ideas of the components after going through the typical design methods they used in the project. We had a good understanding of and expertise with the model's manufacture and construction. We also learned an automated door function, which closed and opened the entrance. The components they used were fly wheel, rack, Spur Gear, Bevel Gear, Shaft, pulley & V-belt.

In the third paper, this concept essentially conserves the muscular energy that is expended during opening and closing. The door's angular movement is translated into rotational motion in this way. The belt and pulley system is used to provide this rotational motion. Two pulleys are employed, one of which is larger and linked to the shaft that passes through the door hinges. The v-belt transmits power and motion from a larger pulley to a smaller pulley. The objective of a V-belt is to maintain a consistent spacing between the bigger and smaller pulleys. As a result, the door's angular movement is transformed to rotational motion, which is then passed on to the generator through the smaller pulley. We conclude that energy that is squandered in one way or another may be used to create electricity using a simple method. Because today's world is totally reliant on many forms of energies, all

of which will vanish or exhaust at some point in the future, we must rely on free energy to power our fundamental gadgets that require electricity to function.

One advantage that our project has is that it can be attached to normal door without the need for extensive removal of door parts and further addition of new parts. The track will be attached to the wall above the door and the motor can be attached to the door itself with some object to align the gear to the track.

2. METHODOLOGY

For our parts we have used acrylic as a material as it has temperature tolerance of up to 170 to 190 degrees. The tensile strength of the material is 64.8-83.4 MPa, shear Modulus of 1.70 GPA and modulus of elasticity of 2.76-3.3 GPA. We also used this as it easier to cut and readily available and cheaper than other alternatives.
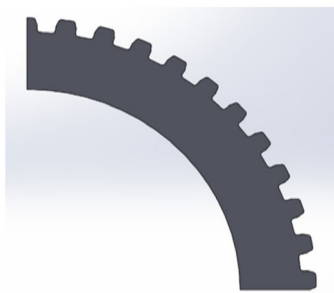
Figure 1. Rack Design.
Source: own elaboration.

Figure 2. Gear Design.
Source: own elaboration.

To make our project we had to create two parts firstly the track and the gear. We made our track which is a normal gear of diameter 19 inches, pitch diameter of 18.5 inches with 45

teeth and diametral pitch of 2.43 inches. The circular gear was extrude cut to make a track of 90 degrees for the smaller gear to move on it.

The smaller gear which has pitch diameter of 2.5 inches, with 6 number of teeth and diametral of 2.4. the small gear is full spur gear which will be used to move on the track and rotate the pin of the motor. The small gear will be attached to the motor and the motor will be attached to the door as the door moves the gear will rotate about the track and the motor will generate electricity to light the led.

For the analysis we used alloy steel as it preferable to use steel as the material. We used acrylic as it would be cheaper and readily available for us. The acrylic pieces are strong as well and can withstand the force produced from pushing the door easily.
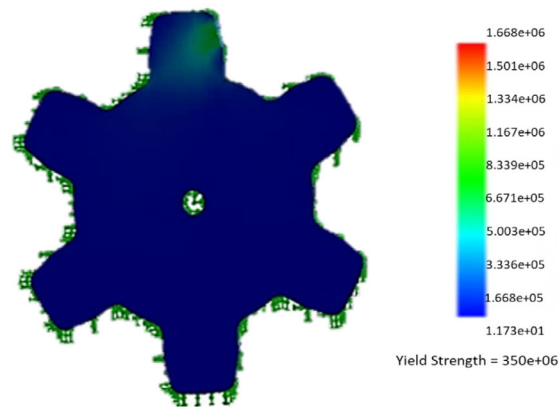
Figure 3. Gear Stress Analysis.
Source: own elaboration.

The electrical characteristics of all four battery types studied in this paper are presented in:

Table 1. Comparison of batteries.

Name	Value for Battery Type				Unit
	Li-Ion	Na-NiCl$_2$	Ni-MH	Li-S	
Maximum Charge	75	84	85	80	Ah
Nominal Voltage	323	289	288	305	V
Stored Energy	24.2	24.2	24.2	24.2	kWh
Maximum Voltage / Minimum voltage	339 / 308	275 / 304	274 / 302	290 / 320	V
Initial Charge	100	100	100	100	%

Number of Cells per Cell-Row	12	12	20	26	-
Number of Cell-Row	17	30	20	1	-
Internal Resistance charge / discharge	1 / 1	1 / 1	1 / 1	1 / 1	Ω
Operating Temperature	33	270	36	30	°C
Specific Heat Transition	0.4	6	0.4	0.08	W/K
Specific Heat Capacity	795	950	677	1650	J/kg*K
Mass of Battery	318	457	534	173	Kg
Battery Price	300	500	400	250	€

Source: own elaboration.

3. RESULTS

From our project design we found that the gear is rotating almost 1.5 rotations. The voltage that we are generating is within a range of 1 volt to 0.1 volt depending on the amount of force you use to push the door. We took multiple calculations and found an average of 0.2 volts being produce while applying regular force to the door. We found that, even after applying as hard a force you can apply to the door, acrylic can handle these forces easily. If the voltage of 0.2 volts can be generated from one motion of opening the door, then for example if one person opens door let's say 20 times in a day then then one person can generate about 4 volts then one these mechanisms can be used in a university were 500's of people use one class room over a day then you can generate about 2000 volts in a day. If this mechanism is used in multiple doors of a university, building or a house then we can generate multiple volts in day.

The results of the four battery types obtained from hardware are presented in Figure 4. Total Output Energy (kJ) and Total Input Energy (kJ) results obtained, with all the four battery types, are presented in Figure 4. The results' analysis reveals that the recovered energy represents between 2 and 4 % of the total consumed energy.
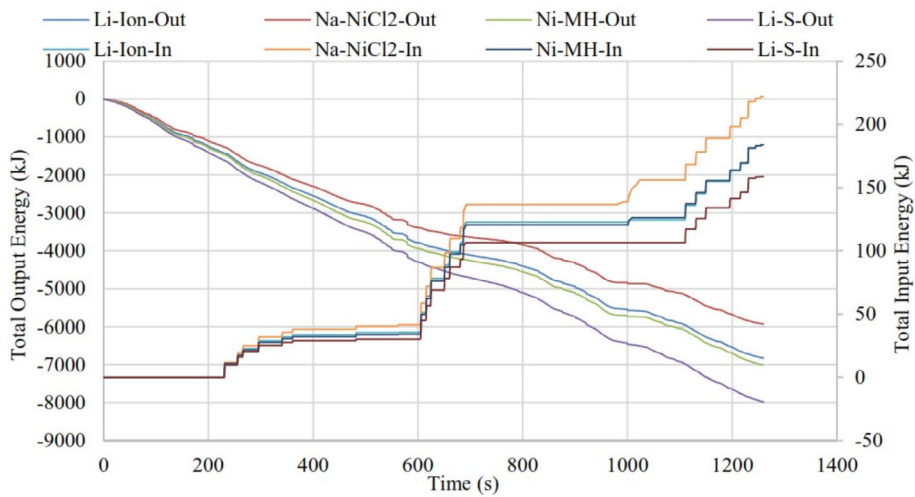
Figure 4. Comparison of Output and Input Energy.
Source: own elaboration.

The Electrical Power (kW) results, calculated, are presented in Figure 5. The power developed by the electric system (identical in all four cases) is similar for all four battery types, compared to the power values developed by the electric system powered by a Li-Ion battery, the Li-S batteries generate 0.5 % less power, Na-NiCl2 generate 0.5 % more power, and Ni-MH batteries generate 1.3 % more power.
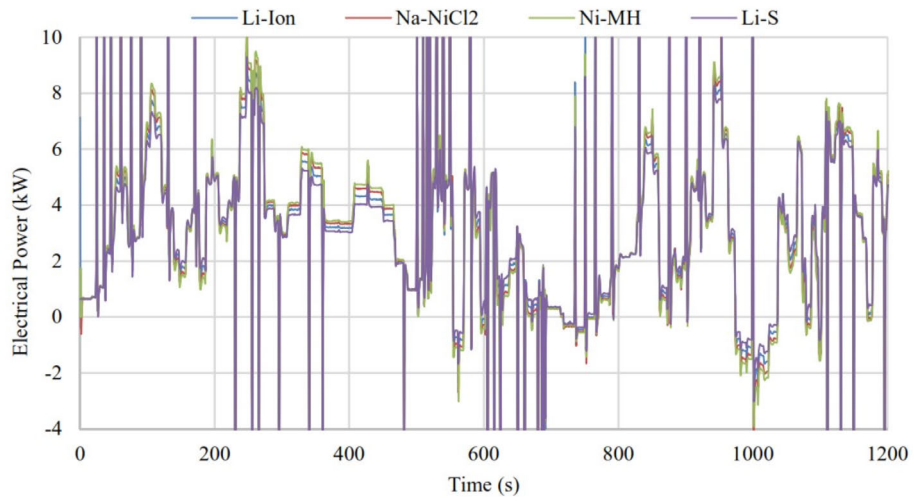
Figure 5. Power Comparison of Batteries.
Source: own elaboration.

4. CONCLUSIONS

In our generation were the whole world and society have become dependent on power and with radical depletion of resources to produce power a way to introduce energy generation from everyday things like opening doors, that would normally have been wasted, can have a huge impact on our resources and carbon footprint as this energy that would be produced will have no repercussions, such as destroying the environment or adding to the already excessive greenhouse gases, can greatly benefit our world from the dangers of the ever depleting resources and can help with the sustainability of energy production, clean energy production. Our project can be further improved by introducing a way for the closing of the door to also generate power so energy can be made two ways rather than one. The number of teeth and gear ratio can further be improved so that the small gear makes more revolutions thus creating more electrical power.

Also, Na-NiCl2 batteries have proven to be the best choice from an energy consumption point of view. Besides that, other important advantages are their low price, increased lifecycle or great functioning under normal parameters in harsh environments. One disadvantage of these batteries is increased operating temperature, which is causing the battery electrolyte to solidify if the vehicle is not used. That is why, it is necessary to have one external system which maintains the battery's operating temperature under functional parameters.

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BIG DATA ANALYTICS CAPABILITIES, INNOVATION AND ORGANIZATIONAL CULTURE: SYSTEMATIC LITERATURE REVIEW AND FUTURE RESEARCH AGENDA

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ABSTRACT

Big data analytics (BDA) have the power to modernize traditional ways of doing business. Nevertheless, the impact of BDA capabilities on a firm's innovation performance is still not fully understood. The 'Age of Data' is thriving because new data is being produced at an unprecedented rate and with an increasing volume, due to global usage of different electronic devices and gadgets which are connected to each other through internet and other networks. Such Big data has the potential to become a key source of competitive advantage. However, proper analyses of both structured and unstructured data need to be conducted to get deeper insights into customer behaviour. Innovation is a key part of the obtaining business value. Since there is very little research on how organizations need to change in order to leverage such innovations, and how business value can be obtained from them, a growing number of studies has been investigating and theorizing about the strategies and structures that might help firms acquire the capacity to continuously innovate by introducing new products with the help of Process Oriented Dynamic Capabilities (PODC). Most researchers explored the phenomenon of Big Data Analytics, from either a theoretical point of view or neglected intermediate and moderate factors, such as PODC, Organizational Culture. In this connection, the "dynamic" resource-based view of the firm identifies dynamic capabilities as the main source of sustainable competitive advantage in a changing competitive landscape. However, to be able to innovate, there is a need to have an organization wide culture that encourages such innovation in the first place. As a result, the current study aims to show the impact which Big Data Analytics (BDA) Capabilities have on the organizational innovation performance with organizational culture as a moderator. The current study will use data from surveys of CFOs, CEOs or CIOs of the pharmaceutical companies of Pakistan and will test a proposed model, using bootstrapped moderated mediation analysis. This research considers the resource-based view of the firm as well as the socio-materiality theory. Practical implications for top executives are also discussed. To this end, this research focuses on identifying the gaps in the existing literature as well as proposing the course of action which can be undertaken for empirical study.

KEYWORDS

BDA Capabilities (BDA Cap), Big Data, Process Oriented Dynamic Capabilities (PODC), Innovation, Organizational Culture (OC).

1. INTRODUCTION

The contemporary time period is considered as the age of big data as newer data is being produced at an unprecedented rate, from all organizations, industrial sectors as well as public organizations and bodies (Mikalef, Boura, Lekakos, & Krogstie, 2019). The exponential growth in the volume of data has resulted in big data being considered as the key source of competitive advantage, business performance and innovation (Chaudhary, Pandey, & Pandey, 2015; Grover, Chiang, Liang, & Zhang, 2018; Jelinek & Bergey, 2013; Mikalef *et al.*, 2019; Shahzad, Xiu, & Shahbaz, 2017). At present, over 3.2 billion people, of the world's population are connected onto the internet with 46% of them being connected through the usage of smart phones (Clement, 2020). Furthermore, this massive shift of IP traffic (web traffic, flow of data across the internet) from fixed networks to wireless based networks is likely to lead to a number of challenges for organizations. It is forecasted that global mobile data traffic from 2017-2022 (in exabytes per month) is from 11.51-77.49 (Clement, 2020). By 2050 these figure are likely to be 95% of world population (Khan, Khan, Alam, & Ali, 2018). According to one estimate, the amount of global digital healthcare data will grow to 25,000 petabytes in 2020, from 500 petabytes in 2012 (Gardner, 2013).

Organizations are required to analyse, in a meaningful manner, structured as well as unstructured data in order to obtain deeper insights into customer related behaviour, their service usage as well as interests on a real-time basis (Mikalef *et al.*, 2019; Riaz, Alam, & Ali, 2017) to enhance business performance, competitive advantage and innovation. Due to the rapid increase of data volume, variety, velocity and veracity, considerable developments have taken place and have also been documented, relating to such technologies and techniques which involve the analysis, visualization as well as storage, of data (Mikalef *et al.*, 2019). Many organizations of different sizes are searching for ways with the aim of improving their performance, innovation and business value, by extensive usage of big data analytics (BDA) tools (Mikalef *et al.*, 2019; Shinwari & Sharma, 2018; Yin & Kaynak, 2015). The pharmaceutical industry is essentially defined by innovation (Petrova, 2014).

The prevalence of big data and the usage of the same can result in enhancement in innovative performances, which then leads to further improvement in economic development (Douglas, 2012; Shahzad *et al.*, 2017). In other words, innovation, which can be termed

as the implementation of creative ideas within the organization, in a very efficient and effective manner, can and does lead to businesses achieving and sustaining competitive advantages (Shahzad *et al.*, 2017; Soares de Almeida, Del Corso, Rocha, da Silva, & da Veiga, 2019; Tidd & Bessant, 2018).

Based upon the upcoming research on BDA Capabilities (Gupta, 2016; Mikalef, Pappas, Krogstie, & Giannakos, 2018; Wamba *et al.*, 2017), studies have shown that although big data is an important resource, yet in itself is insufficient to create any gains related to business value. There are other complementary resources which are necessary and create a synergy to drive an organization's overall BDA Capabilities, in this regard big data is supporting and giving guideline for decision making at strategic level for business value, competitive advantage and innovation performance. BDA Capabilities, can be explained as firm's ability to capture and analyse data so as to be able to generate data insights by effective orchestration and usage of the organizational data, its technology as well as skills (Gupta, 2016; Mikalef *et al.*, 2018).

Organizations which are users of big data proved to be the fundamental pillar in economic development of any region in the world because they have the knowledge, skills and ability to transform ideas to new products through innovation (Duval-Couetil, Shartrand, & Reed, 2016).There is need for continuous improvement of their existing processes and products, as well as the requirement to develop new products as per the requirements of the market. As a result, an increasing number of studies have investigated and theorized about the strategies and the structures which firms may need in order to build the capacity for innovation on a continuous basis, by introducing new products with the help of Process Oriented Dynamic Capabilities (PODC) (Kim, Shin, Kim, & Lee, 2011; Kohlbacher & Reijers Hajo, 2013; Wamba *et al.*, 2017). In this regard, the organisation's dynamic resource-based view indicates the dynamic capabilities as the main source of competitive advantage which is sustainable for the firm, within a changing and competitive landscape (Mikalef *et al.*, 2019; Teece, Pisano, & Shuen, 1997; Wamba *et al.*, 2017).

To be able to innovate, there is a need to have an organization wide culture that encourages such innovation in the first place (Shahzad *et al.*, 2017). It relates to the collection of the norms and values shared by individuals and groups within in the organization (Hill, Jones,

& Schilling, 2014). These norms and values are likely to have an impact on the behavior of the members of the organization when they interact with each other as well as with stakeholders. According to (Shahzad *et al.*, 2017) a significant relationship exists between organizational innovation performance and organizational culture. The flexibility/support to alter as well as the organizational climate is relatively significant factors for the creativity and the innovation performance (Shahzad *et al.*, 2017).

Due to the emergence of big data within the pharmaceutical industry, it has played a very important role in streamlining different complicated business procedures as well as improving efficiency across the board (Joshi, 2019). Data-driven approach taken by pharmaceutical companies gives leverage, related to the usage of big data to identify several business procedures (Ibid). Based upon real-time information, it is possible to take relevant actions without waiting for the extraction of data or manual data mining. Consequently, investments worth $4.7 billion have been made in big data within the healthcare and pharmaceutical industries(Joshi, 2019). The aim of such investments and further similar investments within the pharmaceutical businesses is the development of several innovative applications (Joshi, 2019). The theoretical framework in the current study provides the guidance related to the systematic literature review and identifies some findings, related to the value of BDAC. At the same time, it provides a path for several promising research areas for the future.

2. METHODOLOGY

According to review Kitchenham *et al.* (2009) different stages followed for the establishment of systematic literature review for the current study. Review protocol developed at first stage. On second stage current study had identified the main criteria for the inclusion and exclusion of the latest and relevant publications. Thirdly, study carried out in the detailed assessment for the current study, with the step followed by critical appraisal, extracting data and synthesizing previous literature. All previously mentioned stages are described in the next sub-sections. Fourthly, a detailed search for studies was conducted, followed by critical appraisal, data extraction and a synthesis of past findings. The next sub-sections describe in detail the previously mentioned stages.
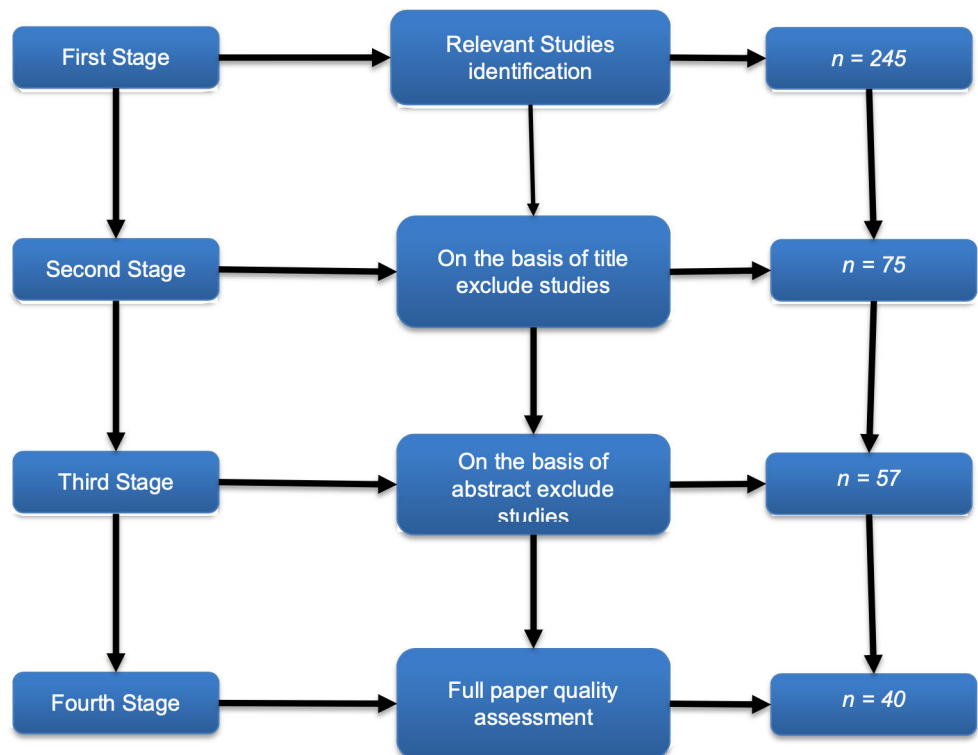
Figure 1. Review Protocol.
Source: own elaboration.

2.1. DEVELOPMENT OF PROTOCOL

For the development of systematic literature review as per Cochrance Handbook for Systematic Reviews of Intervention (Barclay, Higgins, & Thompson, 1995; O'Connor, Green, & Higgins, 2008). According to the mentioned guidelines, the procedures and the policies of the protocol helped in establishing the main research question which played an important role in the selection of papers, the strategy used to conduct the search, the criteria used for inclusion and the quality of material, as well as the method of synthesis. The following research question guided the review process: What are the main aspects of definitions, distinctive characteristics, problems, transformational changes in organizations, innovation performance and business value associated with BDA and BDAC? Critically focusing on above mentioned research questions, the relevant subject areas and relevant publications and materials were searched.

2.2. INCLUSION AND EXCLUSION CRITERIA

Due to the importance of the selection phase in determining the overall validity of the literature review, a number of inclusion and exclusion criteria were applied. Under the selection phase, studies were identified for including in the research, if they emphasised on how big data could provide business value through the use of innovation. Publications from 2016 onwards, were selected as that is when the term gained momentum in the business environment as well as the academic field. The systematic review included the research papers which had been published in the academic outlets, for example the conference proceedings and journal articles, as well as reports focusing on business executives and a larger audience, like scientific magazines. In progress research and thesis were not included in this review. In this research our main aim was to identify quantitative, qualitative, survey reports and business report in which business transformation that big data plays a role in.

2.3. SOURCES AND STRATEGY OF DATA AND QUALITY ASSESSMENT

Big data, Big data analytics capability, innovation performance, firm performance, organizational performance, dynamic capabilities, process oriented dynamic capabilities, socio-materiality, resource-based view, data scientist, competitive advantage and organizational culture were the key words used. Keywords were searched within the title, abstract, and keyword sections of the manuscripts. The search strategy included electronic databases such as Sage, Scopus, Wiley, Emerald, Taylor & Francis, Springer, Web of Knowledge, ABI/inform Complete and the Association of Information Systems (AIS) library. To further complement our search, we applied the search terms in the search engine Google Scholar. The search was started on the 25th of September, 2019 and was concluded on the 30th of June, 2020. At that stage, 245 identified papers were entered into the EndNote. In the second stage, all authors went through the titles of the different studies compiled in the first stage to determine the relevance of these studies to the systematic review. At this stage, studies which were not related to the topic of business value of big data were excluded from the research, regardless of whether they were empirical. Additionally, articles which focused on big data for public administration were also not included in the next stage of the research. The number of articles which were retained after the process abovementioned were 170. In the third stage, all of the remaining articles were assessed in

terms of their abstracts as well as their focus, related to the research question which had been identified. However, there were few abstracts which were of varying quality. Some lacked information about the contents of the article, whereas there were others which apparently were not connected with their title and therefore did not fit in our review. At this stage, just like the previous stage, each papers' abstracts were reviewed independently by author. From the remaining 170 abstracts assessed, a further 57 were excluded. At the final stage of this process only 40 quality papers were identified for review of this study.

2.4. EXTRACTION OF DATA AND SYNTHESIZE OUTCOMES

The first step was taken to synthesize the research findings and to categorize the studies based upon the scope of our research. This step involved the researcher identifying the main concepts from each of the studies, by using the authors' original terms. Then the key concepts were organized in a spreadsheet so as to enable comparing them across different studies and translating the findings into higher-order interpretations.

An analysis was the carried out based upon the following areas of focus: big data, firms' performance results of big data, human skills and knowledge, innovation, tangible and intangible resources, culture as well as organizational culture, the adoption as well as diffusion of big data initiatives within the context of the business environment. For empirical studies, the researcher also recorded the kind of the study that was conducted (e.g. quantitative, qualitative, case study etc), the size of the sample, the different instruments used (e.g. surveys, observations, interviews), as well as factors surrounding the study in a contextual manner (e.g. industry, country, firm size). Constant consensus meetings of all the researchers established the data extraction stage and the categorization of publications. The remaining 40 papers were thoroughly reviewed as per the coding scheme, and relevant data were the extracted, analysed, and synthesized.

3. LITERATURE REVIEW

3.1. BIG DATA ANALYTICS (BDA)

There are some definitions of big data which focus exclusively on the data and the defining characteristics of data (Abbasi, Sarker, & Chiang, 2016; Akter, Wamba, Gunasekaran,

Dubey, & Childe, 2016; Davis, 2014) while other definitions cover the tools and techniques as well as analytical procedures being used (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Russom, 2011). There are others who have explained the effect of analyzing and presenting of big data on the business's value (Beyer & Laney, 2012; De Mauro, Greco, & Grimaldi, 2016; Schroeck, Shockley, Smart, Romero-Morales, & Tufano, 2012; White, 2011). Whereas the BDA's definition includes a broad range of different elements which are critically important for the success of big data, the organizational resources needed to convert big data into actionable insight are not included in these definitions. It is indeed a complex and multifaceted task to become a data-driven organization and requires attention from managers at different levels. To focus on the change towards a data-driven time period and hence provide guidelines to the practitioners on deploying their big data initiatives, the term 'BDA Capabilities' is being used. This is with reference to an organization's skill in utilizing big data so as to obtain insight of both strategic and operational nature. BDA Definitions showed in (Table 1).

Table 1. Definitions BDA.

YEARS & AUTHORS	DEFINITIONS
Loebbecke and Picot (2015)	BDA: an approach for the analysis and interpretation of any type of information which is digital in nature. Advances in BDA which are of technical and analytical nature and which mainly identify the functional scope of current services and products which are digital in nature, are essential for developing improved artificial intelligence, business intelligence, and computing capabilities which are cognitive in nature
Ghasemaghaei, Hassanein, and Turel (2015)	BDA, defined as different processes and tools usually applied to large and varied datasets with the aim of attaining insights which are meaningful, has received considerable attention in Information Systems research due to its ability to enhance an organization's performance
Müller, Junglas, Brocke, and Debortoli (2016)	BDA: the statistics-based modelling of large size, and varied datasets of content as well as digital traces which has been user-generated.

Source: own elaboration.

3.2. BDA CAPABILITIES

It is broadly defined as an organizational capability to provide insights into the use of data management, infrastructure, and human capabilities to convert business into a competitive

force (Akter *et al.*, 2016; Kiron, Prentice, & Ferguson, 2014). The research conducted so far in this domain has focused on strategic BDA Capabilities as well as the approaches by which competitive advantages and the associated gains are obtained (LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011). As per different scholars, BDA Capabilities which are focusing on the processes that need to be put in place so that the advantages of using big data can be obtained (Cao & Duan, 2014; Olszak, 2014). The crux of the matter is that the concept of BDA Capabilities focuses on inclusion of all related organizational resources which are essential in utilizing big data to their full strategic potential. Important definitions explained in (Table 2).

Table 2. BDA Capabilities Definitions.

YEARS & AUTHORS	DEFINITIONS
Davenport Thomas and Harris (2007)	BDA Capabilities is defined as an organisation's specific capability in establishing a price which is optimal, in the detection of important issues, deciding the minimum inventory level which can be possibly held, or trying to identify profitable and loyal customers, all within the environment of big data.
Kung, Kung, Jones-Farmer, and Wang (2015)	Competencies of Big data: an organizational capability of acquiring, storing, processing, and analysing large quantities of data in different forms, and delivering required information to the related users thereby allowing organizations in extracting value from big data in a timely manner. The resources of big data are considered to be a combination different resources of Information Technology, complementary in nature, which are relevant in utilizing big data to improve the performance of the concerned organizations.
Shuradze and Wagner (2016)	A data analytics capability is treated as the organizational capability in mobilizing and deploying resources which are related to data analytics, together with resources and capabilities for marketing, which comprise an innovation focused IT capability leading to enhancement in organizational performance

Source: own elaboration.

Till today, there is very little empirical research related to the concept of BDA Capabilities. A lot of the studies constitute of evidence which can best be considered as unreliable and anecdotal and, specifically related to the effect of an organizational BDA Capabilities on organizational performance (Agarwal & Dhar, 2014; Akter *et al.*, 2016). At the same time,

there are different views about what comprises BDA Capabilities. This is because different theoretical perspectives are often considered.

3.3. BDA CAPABILITIES RESOURCES

There is limited published research on BDA Capabilities. However, there are some studies which relate to the resources required for developing such capability. These resources are the fundamental building blocks upon which the organization's overall BDA Capabilities is developed. Most of studies till now have focused on both the resources and the processes which are required for the strategic usage of the big data. However not much insight is offered into the ways with which organizations tend to form a strong BDA Capabilities (Gupta, 2016).

3.3.1. BDA TANGIBLE CAPABILITY

In an economy which is considerably data-oriented, the resources of data which possess the characteristics specified previously are considered to be important for an organization in order to achieve the competitive advantage (Kiron *et al.*, 2014). Wamba, Akter, Edwards, Chopin, and Gnanzou (2015) has mentioned that having data available and integrated from various sources is very important. Traditionally this could be the result of extant architectures related to Information Technology. The concerns relating to the availability of data is also specified by Mikalef and Pateli (2017), who have found that commonly companies purchase data to complement their analytical results and obtain better results related to their operations and customers.

In addition to data itself, an infrastructure which is capable of storing, sharing, and analyzing data is also important for the organizations. One of the main characteristics of Big data is that it is unstructured and requires investments in sophisticated infrastructure in order to derive meaningful and valuable information (Ren, Fosso Wamba, Akter, Dubey, & Childe, 2017). Some scholars consider organizational big data infrastructure in relation to the amounts of investments made in specific kinds of technologies (Kamioka & Tapanainen, 2014), while other scholars emphasize on the technological aspects themselves (Akter *et al.*, 2016; Garmaki, Boughzala, & Wamba, 2016; Gupta, 2016; Wamba *et al.*, 2015).

3.3.2. BDA INTANGIBLE CAPABILITY

Keeping knowledge, skills, effective coordination of activities, resources, and tasks up to date depends a lot on the capability to form and maintain networks, within the organization as well as outside the organization (Ravichandran, Lertwongsatien, & Lertwongsatien, 2005). Hence the role of intangible resources is essential as it reflects structures, ties and roles which are developed for managing the different types of the available resources. One of the most commonly used terms for including all the activities and decision-appropriation mechanisms related to IT based resources is governance. Sambamurthy and Zmud (1999); Tallon, Ramirez, and Short (2013) put forward a proposed framework particularly for understanding the practices and structures which are meant for governing information artifacts.

3.3.3. BDA HUMAN SKILLS AND KNOWLEDGE CAPABILITY

Human resources-based skills and knowledge level is one of the most important factors related to the organizational capability to use big data tools and technologies (like the ones specified above) and then be able to make strategic level decisions based on such outcomes. Such knowledge and skills can be further divided into technical knowledge, business knowledge, relational knowledge and business analytics knowledge. Technical knowledge includes aspects related to management of databases, retrieval of data, programming knowledge, and management of cloud services. Business knowledge relates to organizational decision making, utilization of strategic foresight for deployments of big data, and using the insights obtained. Related know how involves the communicating and collaborating of employees' skills from backgrounds of different types. Business analytics knowledge involves mathematical and statistical modeling, simulation and developing different scenarios as well as visualization of interactive data. Although an important things about data science is having the capability to analytically think about the data, this skill set is critical for the data scientist as well as for organization wide employees (Prescott, 2014).

3.4. ORGANIZATION INNOVATION PERFORMANCE

Henderson and Clark (1990)conducted a research on architectural innovation in order to identify what exists in between the above-mentioned extremes. The researchers discovered

that very small changes can also, sometimes, have a significant effect on the competitive position. As a result, they included the levels of component and architectural innovation. From the economic point of view the focus on innovation is related to the implication which innovation has on the relevant markets(Abernathy & Clark, 1985). It is important to understand that innovations which are incremental, lead to small improvements in the existing products, and in this manner, they are not new to the market. On the other hand, innovations which are of a radical nature, result in a product which is totally new for the market.

3.4.1. ORGANIZATIONAL CULTURE AND INNOVATION PERFORMANCE

Innovation is defined by Amabile, Conti, Coon, Lazenby, and Herron (1996) as being when creative thoughts are executed efficiently within an organization. A very important point for innovation is to be able to implement creativity practically. This encourages creative ideas to continue and hence be able to play their role in the innovation and its implementation.

Market based innovation relates to either using a new marketing related program for existing products or trying to develop new markets for existing or new products. A number of studies show that there exists a significant relationship between culture and innovation (De Clercq, Thongpapanl, & Dimov, 2010; Hislop, Bosua, & Helms, 2018; Laforet & Tann, 2006; Mavondo & Farrell, 2003; Miron, Erez, & Naveh, 2004). Wang and Ahmed (2004) considered innovations as the introduction of methods which are modern and current and are related to management and production, adopting technologies which are innovative in nature, and improving management related systems which relate to products. Organizations further develop such cultures which encourage their employees to focus on innovation in terms of ideas and also participate in management-based decisions and innovation related strategies. The study by Hislop *et al.* (2018) showed that organizational values and beliefs, knowledge sharing, work environment and all the cultural happenings within an organization have a substantial impact on organizational innovation and learning.

In accordance with the KBV theory of organization related culture, ideas generated by individuals are treated as intangible asset, thereby playing an important role within the development of the organization. An organization's culture is considered as the employees' beliefs and values, which are shared within the organization at all levels and showing

the organization related characteristics (Schein, 1984). Although creativity is related to individuals and/or a team, changes happen within the organization. An organization's culture is essential to enhance the sharing of knowledge amongst the creative minds within the organisation, which are considered essential for the success of an organization (De Long & Fahey, 2000).

3.5. ORGANIZATIONAL DYNAMIC CAPABILITIES RESOURCES

Organizational dynamic capabilities manage to alter its resources including physical, human, and organizational assets. As a result, organizations should constantly adapt to such changes by consistently renewing, reconfiguring and recreating their own resources and capabilities within the competitive environment. The organization must be able to respond to external changes via developing their core capabilities, although the process by which dynamic capabilities are embedded within each organization is likely to be specific to the organization and the industry(Wang & Ahmed, 2007). Helfat *et al.* (2007) had described dynamic capabilities as an organization's purposefully developed capacity to create, extend, and improve its resources. These resources include organization's tangible, intangible, and human resources as well as those capabilities which are owned and controlled by the organization so that the organization can achieve higher economic value than its competitors. Mathiassen and Vainio (2007)had claimed that dynamic capabilities are intended to capture the organizational capability to adapt to unpredictable and rapidly changing environments by allowing the organization to alter its resources and respond to market changes effectively.

3.5.1. COMPETING VALUES MODEL (CVM)

Organizational culture relates to a system of beliefs, values and assumptions shared throughout the organizations and which helps both individuals and groups to function effectively within the organizations(Lee & Kim, 2017). By way of managerial values and rituals, an organization's culture can mould the behaviour of the employees and influence the organizational investment as well as resource allocation decisions (Chan, Shaffer, & Snape, 2004).

Several alternative ways have been proposed by different scholars for categorizing organizational culture (like relationship- and transaction-oriented culture(McAfee, Glassman, & Honeycutt Jr, 2002) and focus- and control-oriented culture (Khazanchi, Lewis, & Boyer, 2007)), so that the role of organizational culture in improving innovation performance can be explored. In one particular research the framework for CVM (Competing Values Model) which had been put forward by both Cameron and Quinn (Cameron & Quinn, 2011) had been used for investigating an organization's culture. The main reasons for choosing the Competing Values Model for studying an organization's culture are mentioned below.

Firstly the organizational culture's measures, which assess the CVM, both directly and indirectly had been managed in over 10,000 organizations worldwide, within such academics related disciplines as accounting, marketing, management, supply-chain management, social services, health care as well as hospitality (Hartnell, Ou, & Kinicki, 2011). Secondly, the CVM focuses on those problems associated with organizational change which are of great relevance to understanding innovation (Naranjo-Valencia, Jiménez-Jiménez, & Sanz-Valle, 2011). Thirdly, the CVM revealed the complexity involved in value orientations and allowed comparing organizations' value orientations. It is therefore considered a suitable model in "Fig 2." for such studies which are related to organization based culture and which are conducted with reference to developing economies which have considerable potential for evolutionary dynamics (Liu, Ke, Wei, Gu, & Chen, 2010) (p. 375).

FLEXIBILITY/DISCRETION

Cultural type: **Clan**
Dominant attributes:
Cohesiveness,
participation, teamwork,
sense of family
Leadership: mentor,
facilitator
Bonding: loyalty,
tradition, cohesion

Cultural type: **Adhocracy**
Dominant attributes:
Entrepreneurship, creativity
Leadership: entrepreneur,
innovator, risk-taker
Bonding: entrepreneurship,
flexibility, risk
Strategy: innovation fosters
new sources, growth

INTERNAL MAINTENANCE AND INTEGRATION

EXTERNAL POSITIONING AND DIFFERENTIATION

Cultural type: **Hierarchy**
Dominant attributes:
order, regulations,
uniformity
Leadership: coordinator,
Administrator
Bonding: rules, procedures
Strategy: stability,
predictability, smooth
operation, control fosters
efficiency

Cultural type: **Market**
Dominant attributes:
competitiveness, goal
achievement
Leadership: decisive,
achievement-oriented
Bonding: goal orientation,
competition
Strategy: competitive
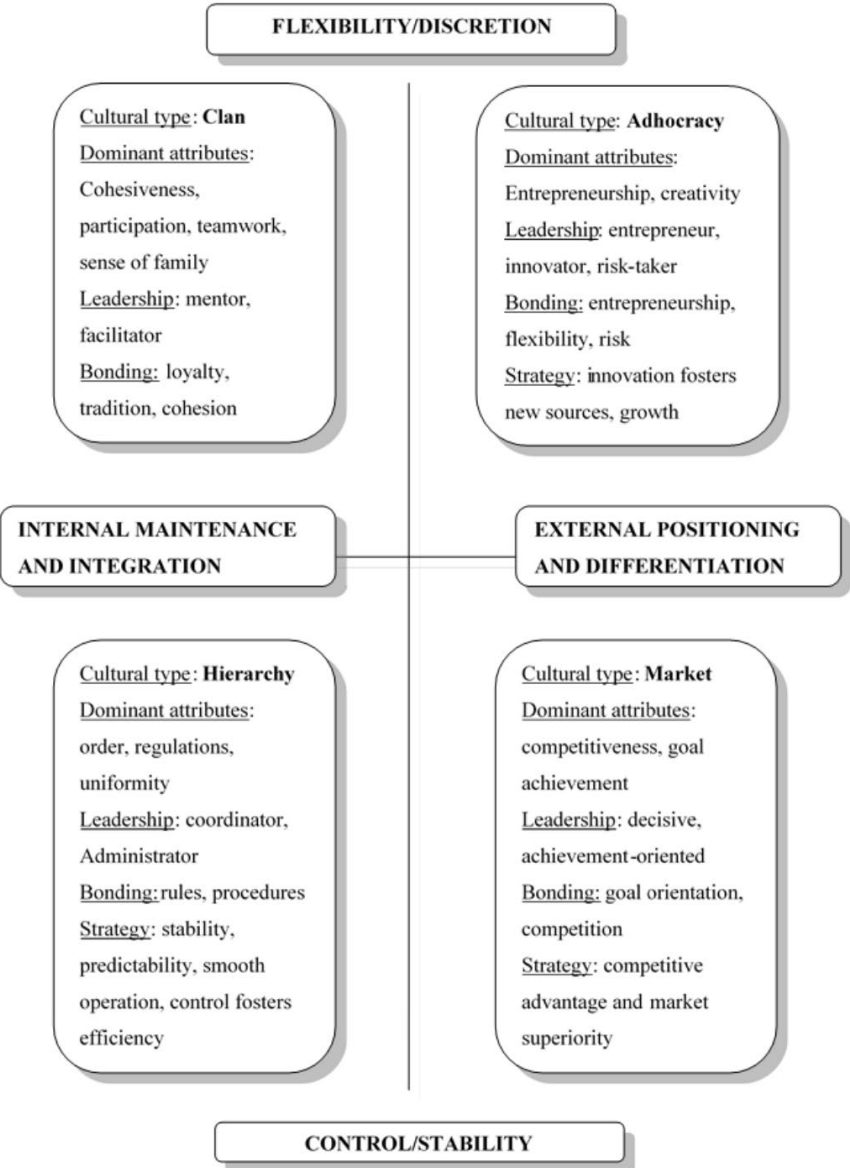advantage and market
superiority

CONTROL/STABILITY

Figure 2. The competing values model of organizational
Source: (Ralston *et al*., 2006, p. 830).

4. THEORETICAL AND PRACTICAL CONTRIBUTION BY THE STUDY

This study contributes to the knowledge within the domain of BDA Capabilities and innovative performance theoretically, practically as well as methodologically. This study will investigate the impact which BDA Capabilities have on the organizational innovative performance. It will also include the impact of the organizational culture. The study will focus on top management among pharmaceutical companies in Pakistan. On the behalf of organization, the CEOs, CIOs or CFOs who represents top management, will be contacted through a questionnaire-based survey to collect data. Provided a conceptual framework and empirical support by determining the relationships among BDA Capabilities and the impact upon OIP in Pakistan. Current study will be answered the call for more research of BDA Capabilities in contextualization of industry under developing countries

5. CONCLUSIONS

From the above-mentioned systematic literature review, some of the important aspects in the field of BDA Capabilities and its impact on the Organizational innovation performance via the process oriented dynamic capabilities and the role of organizational culture have been discussed. The important thing is to consider how the BDA Capabilities can be utilized into developing the organization's innovation performance. This is because it is innovation; through the development of process oriented dynamic capabilities which can help the organization develop its business value in changing environment and hence changing business situations. All this is possible in an organizational culture which encourages such innovations and risk taking to take place. If such a culture is not present in the organization, the potential benefit which BDA Capabilities can deliver will likely not be obtained and the optimum business value which could be generated will be left untapped. The current study anticipates examining the effect of BDA Capabilities on the Organizational Innovative Performance (OIP) through its impact on the process oriented dynamic capabilities (PODC). It also examines this relationship considering the organizational culture (OC) as moderator. More specifically, the study aims to examine the following research questions: To what extent BDA Capabilities affect OIP? How PODC mediates the relationship between

BDA Capabilities and OIP? How organizational culture (OC) moderates the relationship between BDA Capabilities and OIP?

Based on the above-mentioned research questions, the following are the research objectives of this research. To determine the impact of BDA Capabilities on OIP. To determine the extent to which PODC mediates the relationship between BDA capabilities and OIP. To determine the extent to which Organizational Culture moderates the influence of BDA capabilities on OIP.

Literature has been extensively reviewed on the relationships in this study so as to develop a sound foundation of the framework. The framework of this research study and relationship among the selected variables lays its foundation on the integration of two famed and largely recognized theories that is resource-based theory and socio-materiality theory. Thereafter the model of this study will be tested empirically.

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/12/

DIGITAL TRANSFORMATION MODEL FOCUSED ON PERUVIAN INDUSTRIAL FISHING

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ABSTRACT

The objectives of this research work were to determine the degree of improvement in the efficiency of the digital transformation, the efficiency in the extraction of fishing and the performance and the reference in the implementation of the digital transformation in the processes of extraction of fishing. A proposal for a model of digital transformation of processes was shown that helps in the improvement of the fishing production management process based on time, resources, profits and the collection of information on the entry and exit of the fisheries. Now they must be responsible for taking conditions at the time of carrying out the strategic method that will improve the production processes and be able to control the objectives based on bar charts. The development of technological change will allow monitoring alerts and obtaining control through devices within the reach of any responsible user. In summary, the results were the product of the comparative analysis of the last 4 years of fishing, due to the changes between fishing seasons

KEYWORDS

M-Learning, Digital Transformation Model, Operational Efficiency, Efficiency and yield of crops and references.

1. INTRODUCTION

1.1. DESCRIPTION OF PROBLEM

The FAO in its latest report stresses that "society is faced with the enormous task of providing food and livelihoods for a population that will exceed 9 billion people by the middle of the 21st century, while at the same time solving the problem of the disproportionate effects of climate change and deterioration in the state of the environment as a resource base" (FAO, 2018).

Fish is the largest segment of the food market. "fish consumption accounts for 16% of the total amount of animal protein consumed in the world.", (FAO, 2018). This assessment of the global fish market is provided by Jürgen Vogele, director of the World Bank's Agriculture and Ecological Services Department.

Industrial fishing despite COVID 19, contributed 1.5% of GDP in 2020, Fishing industries manage their processes using SAP as the main ERP, however, the extraction process is controlled through customized developments (web and mobile applications), having a delay in data integration, and therefore in decision making.

These industries also do not have an end-to-end management of the extraction process, they only focus on complying with the quotas granted by PRODUCE (Peruvian fishing regulator), sometimes causing overfishing and threatening fish stocks, especially anchoveta.

1.2. ADAPTING TO TECHNOLOGICAL CHANGE

Emerging technologies, leveraging the ubiquity of cell phones and tablets, cloud computing, blockchain, have the potential to contribute to data collection. Automating and empowering data processing and analysis, employing business intelligence and analytics tools facilitate the communication of results to relevant stakeholders (Mnatsakanyan & Kharin, 2021).

Technology can also be used to expand the distribution and accessibility of data to decision makers, enabling them to optimize fishing based on the best available information and transforming unidirectional flows of information (fleet to manager) into a collaborative and mutually beneficial cycle of data collection, synthesis and sharing.

Adapting organizations from siloed organizational approaches to process-oriented, indicator-based management, agile and value-oriented approaches are objectives that have not yet been fully implemented in fishing companies.

The digital transformation allows a gradual change in fishing companies, allowing an effective use of new technologies and their progressive adaptation in the organization.

1.3. OBJECTIVES

- Determine the degree of improvement in operational efficiency (vessel use, fuel use, cycle time) by implementing digital transformation in harvesting processes.

- Determine the degree of improvement in harvesting efficiency (quota advancement, fish quality, quota compliance per fishing trip and per season) by implementing digital transformation in harvesting processes

- Determine the degree of improvement in performance and benchmark (top 6 industrial fishing companies) by implementing digital transformation in harvesting processes.

2. MATERIALS AND METHODS

In the research "Opportunities to improve fisheries management through innovative technology and advanced data systems" provides an overview of the current status and challenges of technologically advanced data systems in the fisheries extraction process, and proposes a solution to guide greater use of technology, with the aim of improving fisheries performance (Bradley *et al.*, 2019).
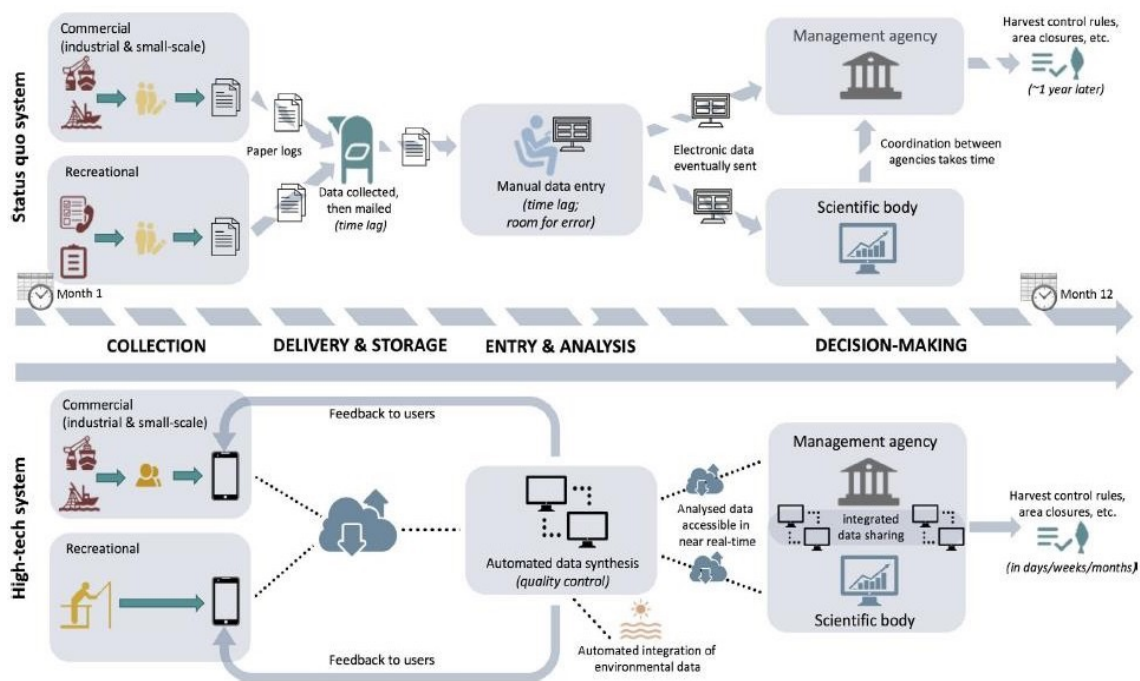
Figure 1. Conceptual diagram of fishery-dependent data collection systems using traditional systems (top) and the use of high technology (bottom).
Source: own elaboration.

2.1. PROPOSAL DEVELOPMENT

Next, we will show the conceptual diagram of the proposed digital transformation model based on the improvement of the management process by indicators.

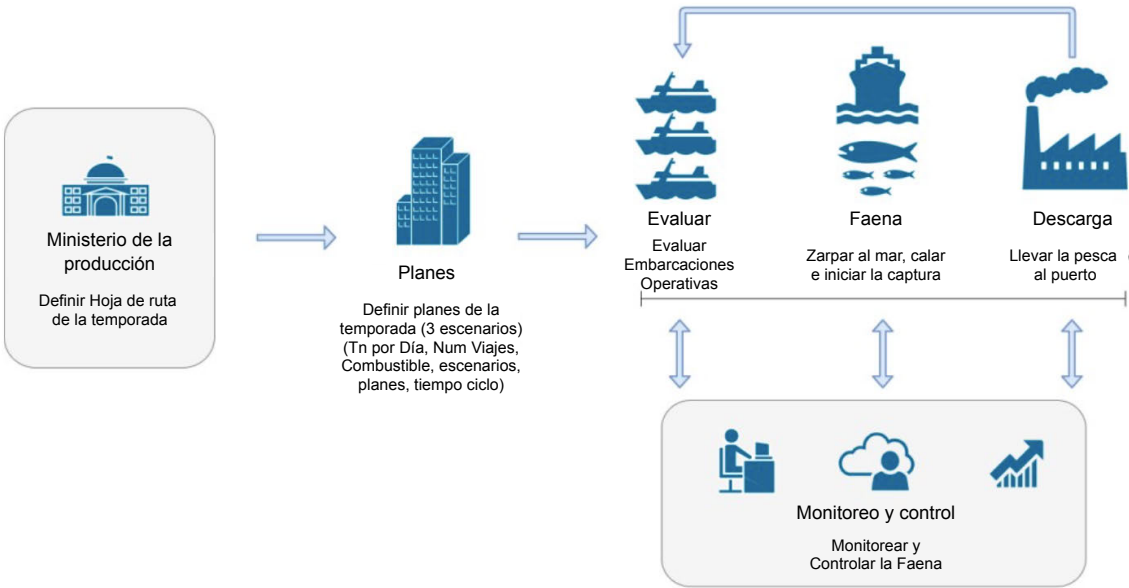**a. Digital transformation model proposal**

Figure 2. Proposal of the digital transformation model.
Source: own elaboration.

b. Description of the digital transformation model

The following table shows the respective summary of the digital transformation model:

Table 1. Responsibilities defined in the digital transformation model.

RE	EXTERNAL RESPONSIBLE. It is the maximum responsible for defining the terms of the fishing season. Includes authority and veto right.
RI	INTERNAL RESPONSIBLE. Responsible for defining the daily strategy that the organization will employ in the extraction of anchovy. (R)
MAC	MONITORING ALERT AND CONTROL. Is the maximum responsible in the control of the fulfillment of the goals and alerts the casuistry found every day in the different mobile devices, tablets, web applications and blockchain. (A)

Source: own elaboration.

Asks of the persons in charge

- **RE** is responsible for:

    - Evaluating whether the sea state is conducive for fishing.

- Defining the date on which the two fishing seasons begin.

- Defining the number of days of operation.

- Defining fishing quotas.

- Define the size of the fishery.

- **RI** is responsible for:

  - Directing the evolutionary strategy of the daily fishing.

  - Carrying out fishing plans.

  - Carrying out fuel plans.

  - Making the fishing chronogram.

  - Define the sea route.

- **MAC** is responsible for:

  - Monitoring fuel consumption.

  - Monitoring the capacity of the vessel.

  - Monitoring the quality of the catch.

  - Alerting long unloading times.

  - Alerting long waiting times to set sail. o Alerting long waiting times to set sail o Alertinglong waiting times to set sail.

Detail of the tasks

Assessing the state of the sea

The Peruvian Ministry of Production carries out an evaluation of the state of the Peruvian sea and defines the areas reserved for artisanal and industrial fishing.

Define season start date

The Ministry of Production defines the start date of the season after the exploration of the Peruvian sea where it is verified that it is in conditions of exploitation. This procedure is carried out twice a year, in the Peruvian sea there are two extraction seasons.

Define Quota and magnitude of fishing

The Ministry of Production defines the fishing magnitude after the evaluation of the Peruvian sea. This magnitude allows the rational exploitation of these hydrobiological resources.

Define days of operation

The ministry of production defines the days of the season allowing the rational exploitation of these hydrobiological resources.

Define evolutionary strategy

The organization defines a flexible evolutionary strategy for each fishing day because fishing is volatile. It takes into consideration the three fishing plans, fuel plans, vessel conditions, trip schedules, waiting times for unloading the catch, the time it takes to unload the catch, and the time it takes to wait before setting sail.

Define Fishing Plans

The organization defines three fishing plans, which allows you to visualize each day the status as the vessels report (favorable plan, intermediate plan, unfavorable plan).

Define Fuel Plans

The organization defines the fuel plans allowing you to make the plans flexible among the vessels according to their daily consumption and how much they have fished during the season.

Make the trip schedule

The organization defines the trips that the boats will make according to the weather, sea temperature and the fishing season they are in. To make the schedule more flexible due to navigation setbacks, GPS data is taken from the boats.

Defining the maritime route

The organization defines the fishing route in the areas where the Ministry of Production allows it, taking into account historical data and experience of the fleet when defining the route where the anchoveta shoals are found.

Monitoring fuel consumption

The organization monitors the daily consumption of each vessel and the capacity of the vessel's hold. It analyzes fuel consumption per ton fished and distributes the information on the maritime route taken by the vessel so that the evolutionary fishing strategy can be redefined.

Monitor the vessel's hold capacity.

The organization monitors the free space of the vessel's hold, if the quantity fished is appropriate the RSW (refrigeration) is used due to the higher fuel consumption, but also ensures the quality of the anchoveta. Likewise, the sensors in the hold calculate the tons caught.

Monitoring the quality of the catch

The organization monitors the quality in which the anchoveta arrives at the port, dividing it into standard, prime and super prime. When a vessel arrives and fills more than 60% of its hold, it is decided to use the cold system (RSW) to maintain the highest quality.

Monitoring of fishing zones

The vessels have sensors, GPS and satellite communication, allowing to know the areas with schools of anchoveta, this allows to alert better fishing areas than those drawn at the beginning of the season in the schedule of trips, to comply with the fishing plan.

Alerting of waiting time for unloading

The organization monitors the waiting times for unloading in the ports and can divert the unloading in another port if it is not favorable.

Alerting of unloading times

The organization monitors vessel unloading times, sensors in the port unloading area send an alert to the vessel when unloading is completed and the actual tons unloaded at the port is declared.

Alerting waiting times for departure

The organization monitors the time it takes for vessels to depart after anchovies have been unloaded.

Relationships of tasks and responsibilities

Table 2. Process tasks and their relationship to responsibilities.

PROCESS TASKS	RI	MAC
Define fishing plans in three tonnage scenarios	R/A	I
Define fuel consumption plans	R/A	I
Define the maritime fishing route	R/A	I
Make the fishing trip schedule	R/A	I
Monitor fuel consumption	I	R/A
Monitor vessel's hold capacity	I	R/A
Monitor the quality of the catch	I	R/A
Monitor fishing zones	I	R/A
Alerting long unloading times	I	R/A
Alerting long waiting times to set sail	I	R/A
Alerting long waiting times for unloading	I	R/A

Source: own elaboration.

3. RESULTS

a) **Fishing extraction results for the last 4 years**

The analysis is a comparison of the result of the last 4 years of fishing, due to the changes in the weather between the first and second fishing season, the analysis is divided in two: Season-I and Season-II of the last 4 years.
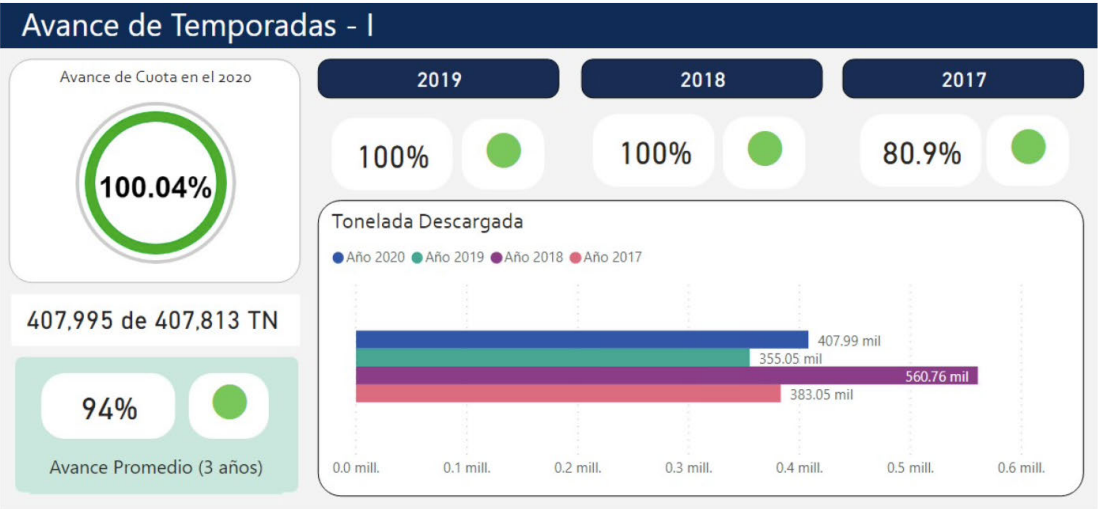
Progress of tons fished

Figure 3. Tons fished advances.
Source: own elaboration.

According to Figure 3, the following was observed:

- In the last 4 years, the goal was reached with the exception of 2017, which only reached 80.9%, narrowly missing the minimum established of 80%. The traffic light for the years 2019, 2018 and 2017 is the comparison with the year 2020 and the average of the 3 years, which is in compliance with what was established.

- In the year 2020 it is observed how the target of 407,813TN (tons) was met and exceeded.

- The bar graph shows the amount of tons fished. Each year is different due to the quota assigned by the Peruvian Ministry of Production.
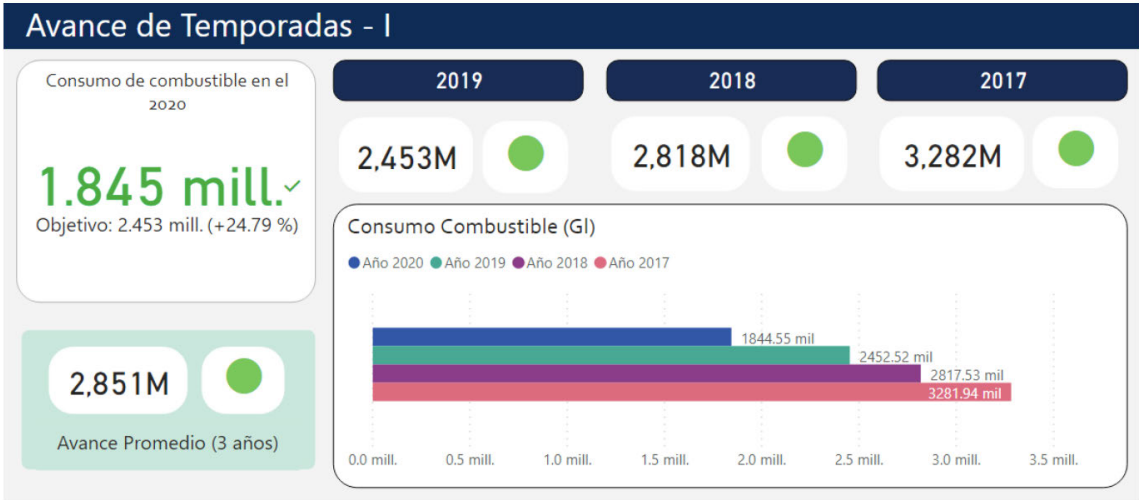
Fuel consumption

Figure 4. Fuel consumption.
Source: own elaboration.

Fuel consumption GL/TN

Figure 5. Fuel consumption GL/TN.
Source: own elaboration.

According to Figure 4 and Figure 5, the following was observed:

- Fuel consumption in 2020 is 1.845 million gallons, which is below the consumption of previous years; however, fuel consumption is linked to the quota that the company must fish, which can be seen in the advance graph of tons fished.
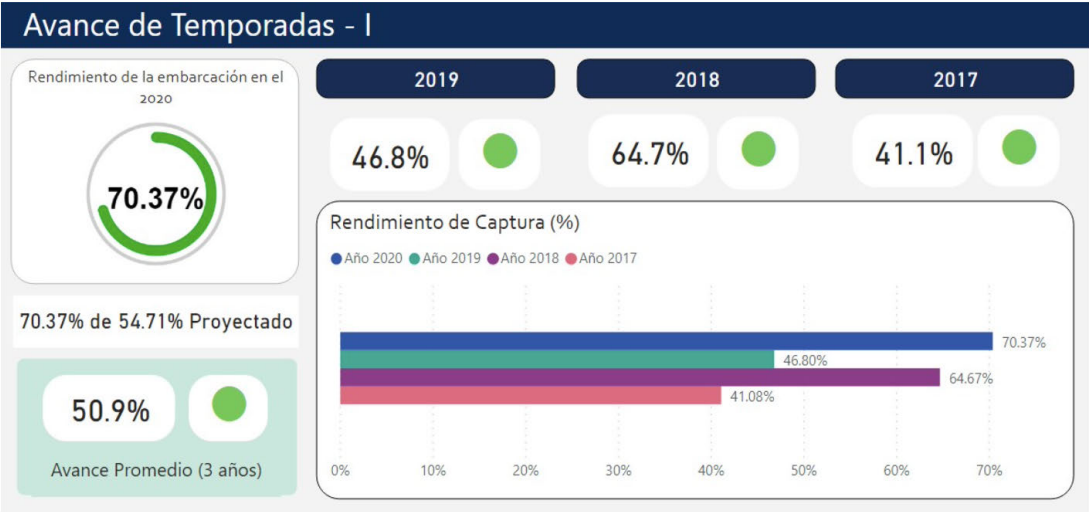
Advancement of vessel performance

Figure 6. Advancement of vessel performance.
Source: own elaboration.

According to Figure 6, the following was observed:

- Increasing performance in 2020 compared to previous years.

Analysis by vessel size

The last 5 years of the fishing season-I are observed.

TEMPORADA_REGION	Tiempo de ciclo	Numero de Viajes	Capacidad de Bodega	Cantidad consumida de combustible	Toneladas pescadas	%Avance de la temporada	%Rendimiento	Consumo de combustible (GL/H)	Consumo de combustible (GL/TN)
Temporada 2020-I-Norte	32.50	1541	579,795.00	1,844,554.00	407,994.50	100.04 %	70.37 %	51.27	4.52
Flota Grande	39.13	217	122,210.00	462,601.00	93,805.22	109.54 %	76.76 %	76.97	4.93
Flota Mediana	31.09	1046	380,880.00	1,107,376.00	257,138.36	104.31 %	67.51 %	47.57	4.31
Flota Pequeña	32.58	278	76,705.00	274,577.00	57,050.92	75.40 %	74.38 %	41.05	4.81
Temporada 2019-I-Norte	35.38	2164	758,615.00	2,452,524.00	355,048.55	100.04 %	46.80 %	47.96	6.91
Flota Grande	46.05	200	109,070.00	514,884.00	57,522.45	77.18 %	52.74 %	75.76	8.95
Flota Mediana	33.97	1399	502,950.00	1,444,556.00	228,729.11	106.62 %	45.48 %	46.13	6.32
Flota Pequeña	34.90	565	146,595.00	493,084.00	68,797.00	104.47 %	46.93 %	37.84	7.17
Temporada 2018-I-Norte	33.00	2377	867,070.00	2,817,530.00	560,756.56	100.04 %	64.67 %	50.16	5.02
Flota Grande	37.27	296	162,710.00	644,211.00	116,084.51	98.62 %	71.34 %	79.73	5.55
Flota Mediana	32.19	1539	561,640.00	1,700,942.00	355,702.15	104.98 %	63.33 %	47.88	4.78
Flota Pequeña	32.94	542	142,720.00	472,377.00	88,969.91	85.54 %	62.34 %	37.60	5.31
Temporada 2017-I-Norte	36.28	2618	932,375.00	3,281,942.00	383,047.82	80.95 %	41.08 %	46.17	8.57
Flota Grande	44.44	294	158,440.00	740,015.00	77,078.04	77.57 %	48.65 %	74.36	9.60
Flota Mediana	35.54	1695	609,580.00	1,963,371.00	237,197.80	82.92 %	38.91 %	43.63	8.28
Flota Pequeña	34.38	629	164,355.00	578,556.00	68,771.98	78.33 %	41.84 %	35.88	8.41
Temporada 2016-I-Norte	98,512.99	996	352,985.00	1,467,076.00	142,993.34	48.08 %	40.51 %	41.92	10.26
Flota Grande	103,151.25	109	57,150.00	337,194.00	30,632.37	47.95 %	53.60 %	69.15	11.01
Flota Mediana	104,499.28	665	238,080.00	883,653.00	89,262.71	50.09 %	37.49 %	38.85	9.90
Flota Pequeña	78,303.65	222	57,755.00	246,229.00	23,098.27	41.76 %	39.99 %	33.36	10.66

Figure 7. Report of the last 5 years of the fishing season-I.
Source: own elaboration.

According to Figure 7, the results of the digital transformation are seen in 2020, we visualize a slight reduction in cycle time.
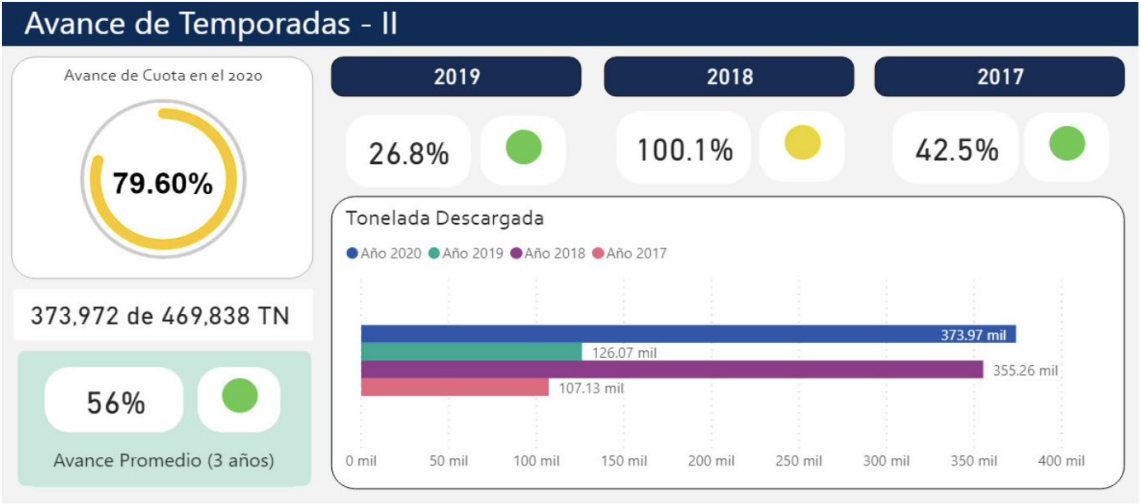
Tons fished for the season – II

Figure 8. Season progress - II in tons of fish caught, own elaboration.
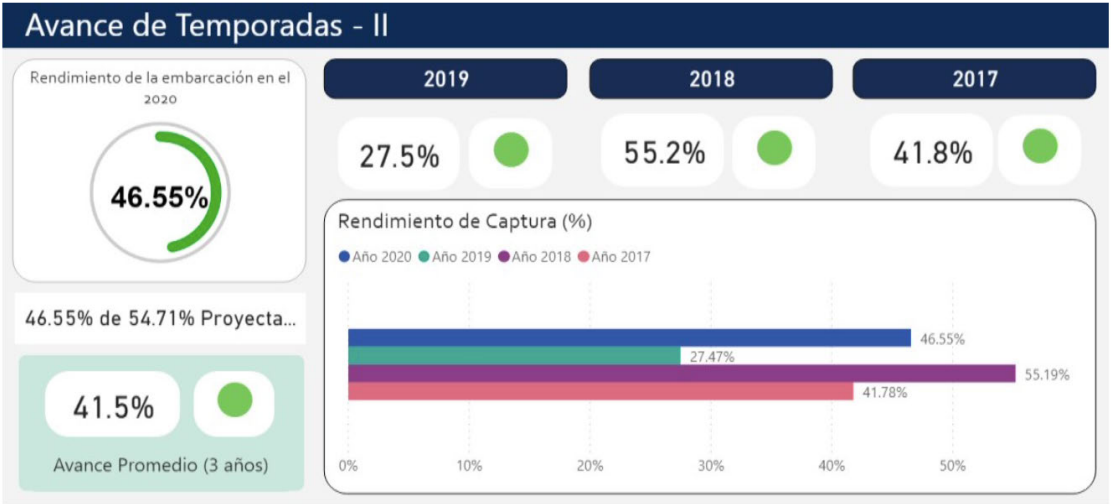
Advancement of vessel performance

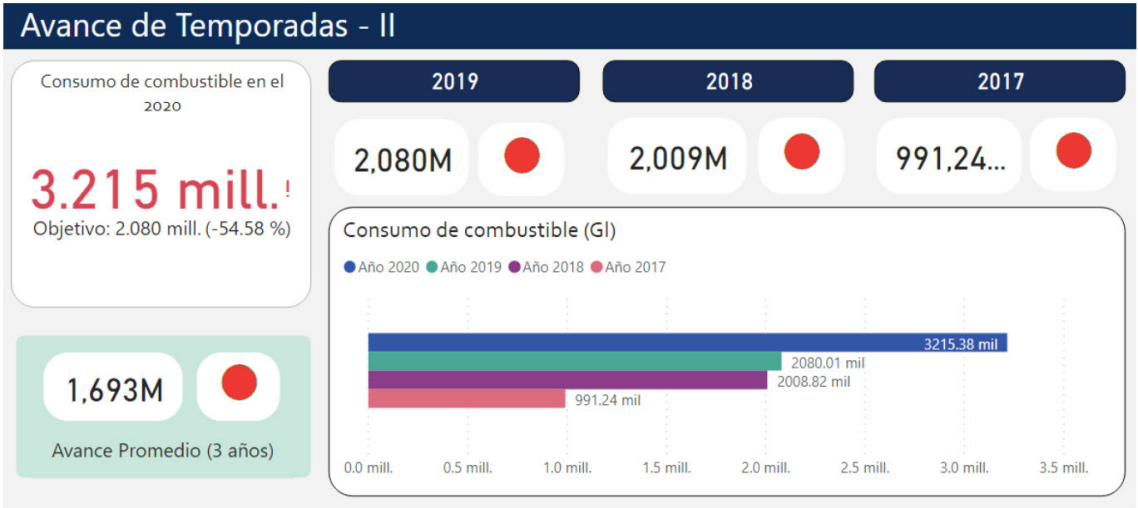**Figure 9**. Vessel performance reportown elaboration.

Fuel consumption

Figure 10. Fuel consumption report.
Source: own elaboration.

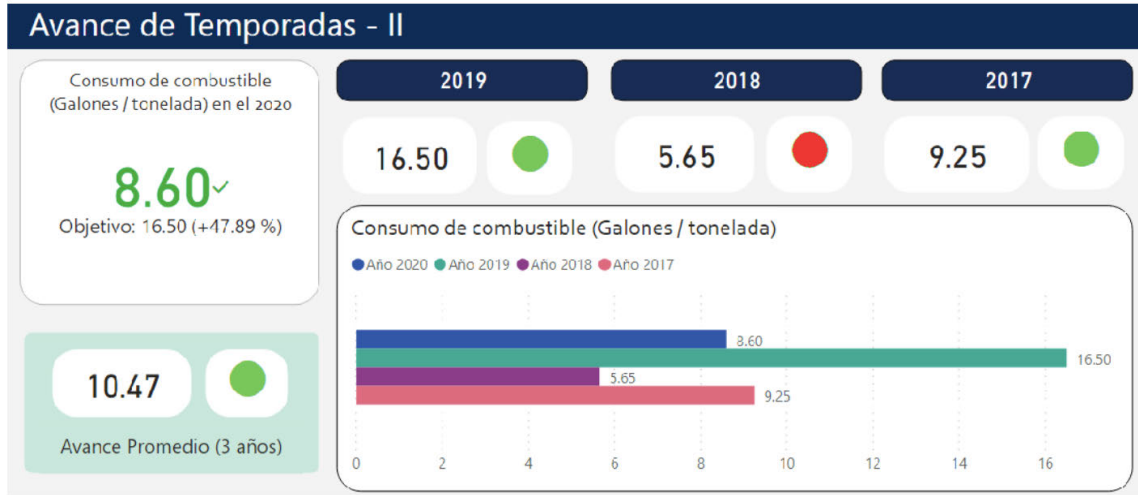## Fuel consumption GL/TN

Figure 11. GL/TN Fuel Consumption Report.
Source: own elaboration.

Analysis by vessel size

The last 5 years of the fishing season-II are observed.

TEMPORADA_REGION	Tiempo de ciclo	Numero de Viajes	Capacidad de Bodega	Cantidad consumida de combustible	Toneladas pescadas	%Avance de la temporada	%Rendimiento	Consumo de combustible (GL/H)	Consumo de combustible (GL/TN)
Temporada 2020-II-Norte	35.19	2238	803,425.00	3,215,377.00	373,972.27	79.60 %	46.55 %	49.07	8.60
Flota Grande	43.83	246	133,220.00	706,462.00	70,495.03	71.45 %	52.92 %	76.70	10.02
Flota Mediana	33.81	1469	531,820.00	1,938,664.00	230,045.37	81.00 %	43.26 %	47.31	8.43
Flota Pequeña	34.95	523	138,385.00	570,251.00	73,431.89	84.24 %	53.06 %	37.18	7.77
Temporada 2019-II-Norte	39.81	1285	458,885.00	2,080,014.00	126,067.44	26.77 %	27.47 %	47.58	16.50
Flota Grande	49.19	139	74,520.00	417,532.00	24,916.26	25.20 %	33.44 %	75.80	16.76
Flota Mediana	37.60	861	310,080.00	1,285,104.00	80,946.45	28.44 %	26.11 %	46.66	15.88
Flota Pequeña	41.86	285	74,285.00	377,378.00	20,204.73	23.13 %	27.20 %	35.38	18.68
Temporada 2018-II-Norte	34.23	1812	643,690.00	2,008,818.00	355,260.56	99.95 %	55.19 %	44.05	5.65
Flota Grande	48.49	214	116,980.00	490,468.00	71,200.45	95.54 %	60.87 %	58.60	6.89
Flota Mediana	32.82	1148	409,730.00	1,160,889.00	216,660.78	100.99 %	52.88 %	42.16	5.36
Flota Pequeña	30.97	450	116,980.00	357,461.00	67,399.33	101.54 %	57.62 %	36.88	5.30
Temporada 2017-II-Norte	34.82	711	256,405.00	991,243.00	107,129.34	42.54 %	41.78 %	47.63	9.25
Flota Grande	45.59	73	40,980.00	211,752.00	18,968.53	35.87 %	46.29 %	72.67	11.16
Flota Mediana	32.34	487	176,110.00	599,392.00	72,087.09	47.36 %	40.93 %	45.91	8.31
Flota Pequeña	37.51	151	39,315.00	180,099.00	16,073.73	34.40 %	40.88 %	37.21	11.20
Temporada 2016-II-Norte	21,688.96	2272	811,260.00	3,071,178.00	326,083.77	98.68 %	40.19 %	47.09	9.42
Flota Grande	4,210.22	246	132,210.00	668,592.00	63,059.16	88.85 %	47.70 %	76.10	10.60
Flota Mediana	21,388.94	1488	538,660.00	1,849,431.00	203,633.85	102.84 %	37.80 %	44.82	9.08
Flota Pequeña	30,510.80	538	140,390.00	553,155.00	59,390.76	96.65 %	42.30 %	36.47	9.31

Figure 12. Analysis report by vessel size.
Source: own elaboration.

Next, we are going to show the dictionary of key words regarding the fishing process:

- Cycle time: It is the average time it takes for a vessel, waiting in port, unloading the catch and the time it takes to set sail again.

- Number of trips: The number of trips made by the vessels as a whole.

- Hold capacity: The storage capacity of the vessels as a whole, expressed by the number of trips.

- Fuel consumption Gl/h: It is the fuel consumption per hour of the vessels.

- Fuel consumption Gl/TN: Fuel consumption per tons fished.

4. CONCLUSIONS

An improvement in operational efficiency was increased through the digital transformation in the collection processes, since it reached an increase in the last 4 years with a normal margin of 80.9%. In the year 2020 the objective was achieved and the margin of 407,813TN was exceeded. In addition, there is a bar system that shows the amount of catches obtained during the year, observing the development and progress of Peruvian productions.

Harvesting efficiency was improved through the application of digital transformation in harvesting processes as there was moderate consumption with the bar platform evaluating the harvesting margin of fish for 4 to 5 years, achieving the objective as a point of improvement. within marine production.

A lower consumption of 1,845 million gallons could be obtained in reference to previous years due to the effectiveness of the platform that was able to evaluate the points in favor for production from the production analysis to the unloading times and waiting for delivery of the products. Sea products.

There was a total improvement in performance and reference based on the implementation of digital transformation in the collection processes with a margin of 70.37% in 2020- I, 46.55% in 2020- II, a higher rate than expected allowing invest in different resources that can help the production processes of the harvest based on different flexible techniques to be able to have fishing processes based: fuel, ship conditions, unloading time and sailing time, a lot of criteria must be considered in order to be able to have the highest effectiveness in the production method.

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AUTOMATION OF REPORT GENERATION FOR FUNCTIONAL TESTING - E-SERVICES OPERATOR

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ABSTRACT

Technology advances every day because the business world should not be left behind in it, so there is the adoption of new ways of doing business. This is how ICT (Information and Communication Technologies) plays a key role in these new companies converting traditional processes such as bringing your customers through a web converting to e-Commerce, to a digital process.

Due to the rise of ICT has been the implementation of electronic billing systems, this type of systems come to stay; improvements are given based on an already predetermined structure, mapping in a better way the taxes and operations of taxpayers. Then, this type of business implies having well-trained IT and accounting staff that allows the online sending of the CPE (electronic receipts).

Therefore, this project seeks to improve an internal process in the development phase of the OSE BIZ LINKS that grants validity to electronic receipts, for we will use tools that can be reusable over time, such as Data-Driven Testing, which is a testing technique that has as its pillar two types of data: real data (functional test results) and expected data (results that should have each functional test case), making a comparison of both proceedings to report according to each data compared in this process.

KEYWORDS

ICT, Electronic bill, Electronic receipts, Data-Driven Testing, TDD, Reporting.

1. INTRODUCTION

In Peru the electronic invoicing process dates to 2012, where everything starts with a pilot project; by the end of 2013 SUNAT (National Superintendence of Customs and Tax Administration) by RS No. 374-2013 designated 239 companies that, from October 1 of that year, begin the implementation of electronic invoicing, where you should first be approved to issue electronic vouchers (invoice, ticket, electronic notes) (RN° 374-2013 sunat).

In this context, BIZLINKS is born, a company approved to the PSE and OSE service; having as main functions to validate and declare the electronic receipts. These validation processes.

With this purpose, BIZLINKS SAC proposes to make use of the reengineering to carry out a restructuring of the OSE BIZLINKS, with the objective of having a better adaptation and response to the changes. For the realization of this project, the company took its own human resources and will make the necessary arrangements for the delivery of an optimal service. Functional testing, regression and stress testing will be used as quality activities. Within this framework, to reduce the evaluation time of the functional tests, the data-driven Testing technique will be added.

1.1. CONCEPTUAL FRAMEWORK

1.1.1. JAVA LANGUAGE

Java is an object-oriented programming language, the facility offered by this language is to be executed on any device through JVM, it can be applied even in mobile devices providing portability (Mitsunori, 2018, p.2).

It should be noted that since its inception was open sources and has remained so until today, being one of the programming languages that remain with greater labor demand.

Figure 1. Java logo.
Source: own elaboration.

1.1.2. BUSINESS PROCESS MANAGEMENT (BPM)

Process management is considered a discipline, which combines technology and methodology; it aims to improve internal processes by providing better resource management in an organization.

The technique of process modeling, execution, and measurement is a strategy that can be performed using this BPM technology.

According to Laurentiis (2003), he defines it is "a set of activities or specific work in a specific place that is performed by people or systems, having a clear beginning and end; with several specific inputs and outputs".

Figure 2. Bizagi logo.
Source: own elaboration.

1.1.3. TESTNG FRAMEWORK

According to Nordeen (2020), TestNG is an automation testing framework in which NG stands for "Next Generation". TestNG is inspired by JUnit which uses the annotations(@).

Figure 3. TestNG logo.
Source: own elaboration.

1.1.4. MICROSOFT SQL SERVER MANAGEMENT

Microsoft allows us the free and easy-to-understand use of its SQL Server database engine. In this we will be able to create the database structure considering the appropriate fields to compare (code, file name, description).

Figure 4. Microsoft SQL Server Management.
Source: own elaboration.

1.1.5. DATA-DRIVEN TESTING

It is a technique of testing software abbreviation TDD provides a great opportunity to accurately determine using predefined scenarios by the data input and output.
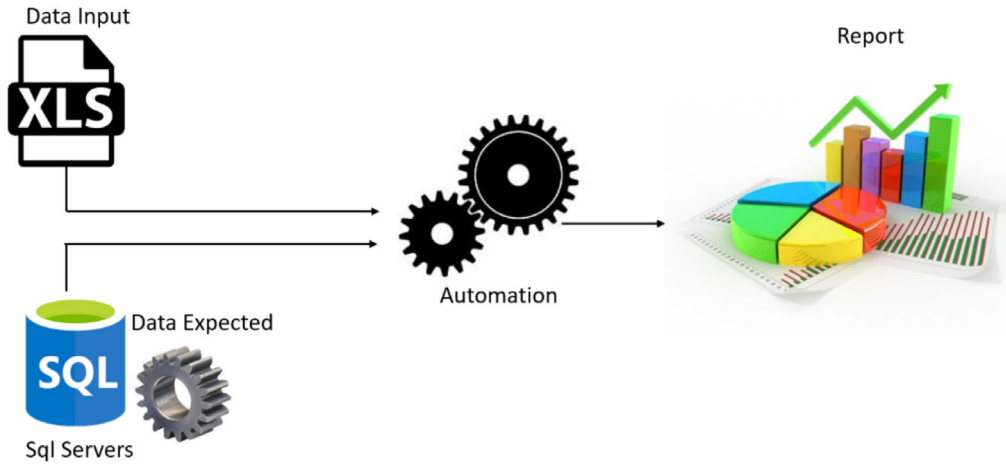
Figure 5. Data Driven Testing.
Source: own elaboration.

2. METHODOLOGY

2.1. TYPE OF RESEARCH

This research project allows us to apply knowledge, tools to improve the processes of the system therefore it is Applied Research.

2.2. KANBAN METHODOLOGY

Kanban is an agile framework, meaning the Japanese "Kan" visual and "Ban" cards; its origins are given with the Japanese company Toyota, which observed how in the U.S. supermarkets as these replenished only the missing did not have either an excess. From this scenario, Toyota coupled as pillars of its production system the just in time and automation under a human perspective (Laurentiis, 2003).

Kanban cards or sticky sheets, the quantity will be necessary according to what is to be produced; the description is minimal, direct, and concrete, often codes are placed for the recognition of the activity. However, no matter how visual these cards are, they do not replace the need for verbal communication.

Kanban boards have divisions for 3 states, do, doing, and done basically. Making a mix of methodologies like Kanban and Scrum is possible because both are considered agile methodology.
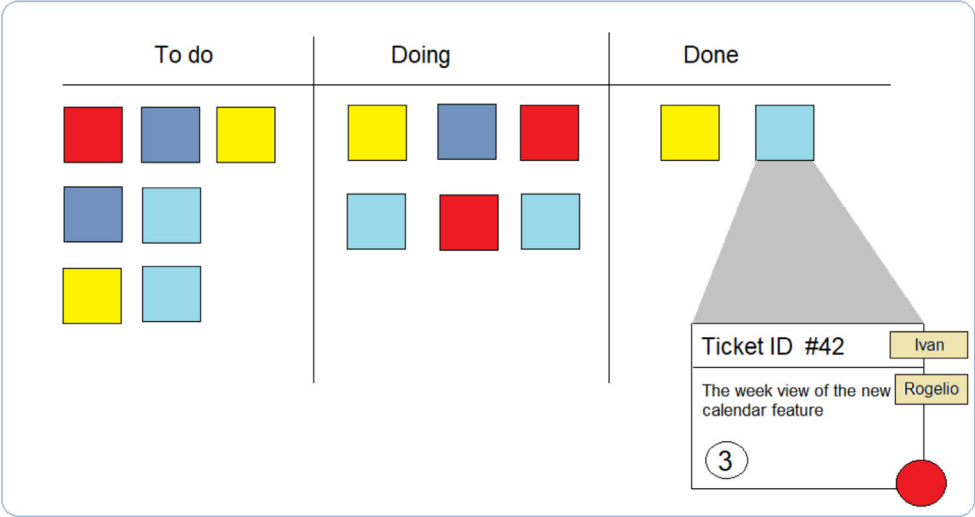

Figure 6. Kanban Board.
Source: own elaboration.

2.3. METHODOLOGICAL PROPOSAL

The activities to use in the development stage will be established in the process flow, in order to recognize the inputs, internal processes and outputs, these are intended to ensure that the result of functional testing has been correct.

For this purpose, the following strategy is established:

1. Organize requirements.

2. Design current and improvement process flow.

3. Collection of answers obtained in functional tests.

4. Database creation and data entry.

5. Solution programming.

6. Testing of the system to be implemented.

7. Use of live solution.

1. Organize requirements

Requirements often describe what the program or system is expected to do, in our case, we will have two types of requirements found; functional requirements and non-functional requirements.

According to the study for this project as a functional requirement must be considered, which will show the failed and correct cases, the filters to be considered, how long it will take graphical display.

2. Design the current process flow and improve

In this section it is currently contemplated which are the steps to follow to obtain the report of the functional tests, comparing them of the processes that will be considered with the improvement (Crispin & Gregory, 2009; Kaner, 2008).

In this way, it will be possible to verify if the improvement is covering all the necessary processes
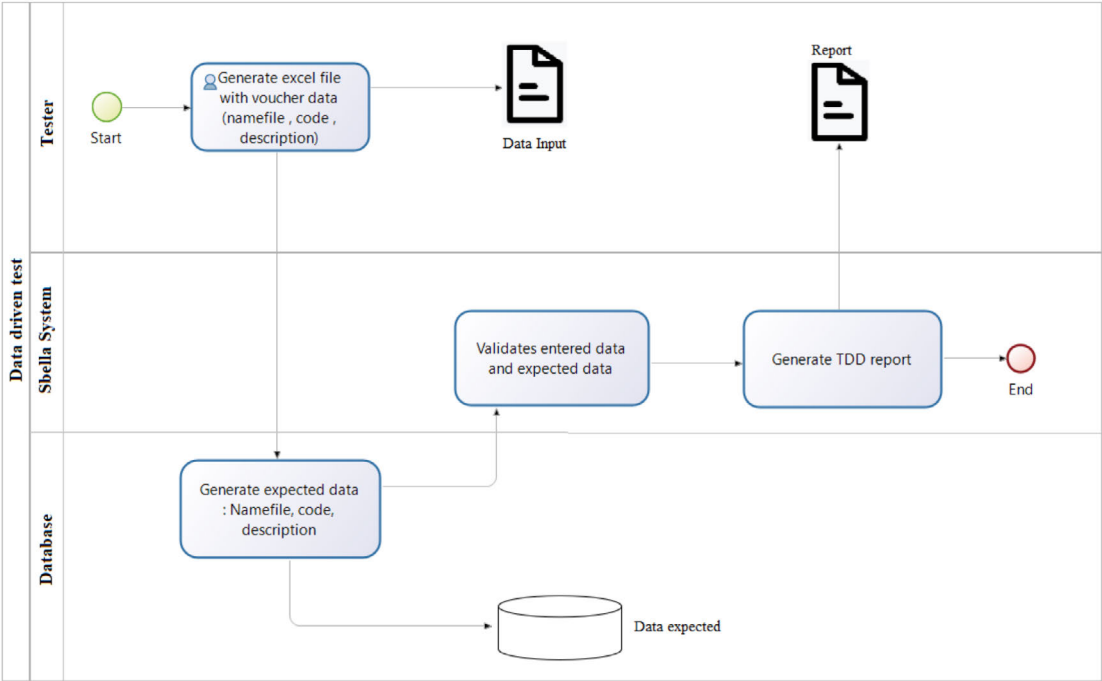
Figure 7. Current process flow.
Source: own elaboration.

3. Collection of answers obtained in functional tests.

At this point, it is necessary to clarify that TDD is a support technique for the evaluation of functional tests but it is not part of them.

Therefore, first of all, the functional tests must be executed and the answers must be recorded in a file and then this file must be considered as the base for the TDD technique since this file will be checked with the database.

On the validity of the functional test case, it will be accepted or failed according to the data in the database.

4. Database creation and data entry

For this step, we consider setting up a simple database that allows us to store the desired data. Queries will be performed under the file name (name file field) because each file contains only one registered response code.

5. Solution Programming

According to ISO (2005), In this case, it is necessary to define the participants of the improvement process and declare them in classes together with their methods, to have clear after investigating the way of working of the framework to use, and how to manage in a better way than knowledge, the information crossing must be done.

The elements are also identified as the Excel description field, which will be read and considered, the division of the text will be taken to evaluate a section as the other does not belong to the expected response.

6. System testing implement

According to Beck (2002), Once the solution has been programmed, the system execution should be carried out and the errors should be reviewed in order to present them and make documentation in which the possible solutions are described. Finally, the revised aspects must be solved for the next execution of the system.

7. Use of live solution.

As the last step, the system will have fulfilled its objective, which is to validate the results of more

3. RESULTS

The results obtained were favorable for the proposed objective, which was to reduce the testing time and to have an intuitive result that allows us to give feedback in time, communicating errors early and thus favoring the development of the OSE BIZLINKS.
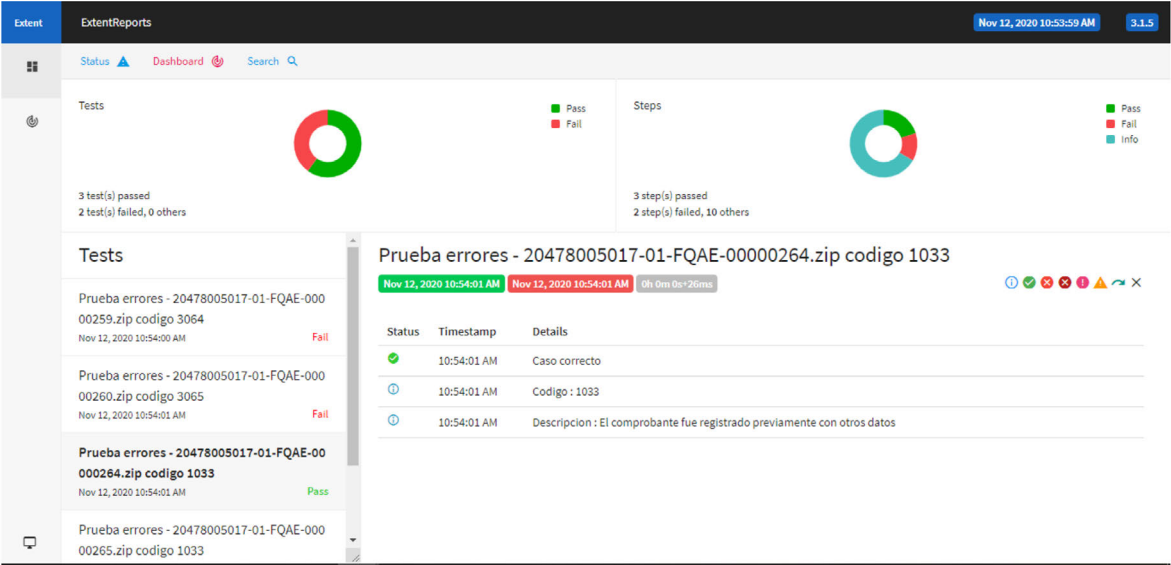

Figure 9. Report generated.
Source: own elaboration.

4. CONCLUSIONS

This project shows a data-driven testing technique, in this case the flow is defined by abstract test cases that when executed become part of specific test case. This type of application allows us to communicate easily, early, and often, which allows us to be part of the Agile project, this way we would be giving frequent feedback (Fester, 2018).

5. EVALUATION

The trust given by the supervising staff who were always kind enough to resolve any doubts that one may have in the process of generating a program is valued. The experience of teamwork and effective communication of each team member. The knowledge gained in this project will be permanent and becomes an asset of the company which generates satisfaction to one as a collaborator. Also, this project helped to have a broader view of the world of software quality (Fewter & Graham, 1999; Crispin & Gregory, 2008; Kaner *et al.*, 2006; Cardoso *et al.*, 2018).

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CONTROL AND ALERT MECHANISM OF RFID DOOR ACCESS CONTROL SYSTEM USING IOT

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ABSTRACT

The RFID Door Access Control System has been providing security and reliability to many secure medical and scientific facilities, official grounds, and locker rooms with confidential files with access key provided for a limited number of people. This system is an advanced hybridized one incorporating multiple access methods with enhanced security, making it easier for members to access the door and impossible for those without the access keys. The system uses three access methods to open the door. 1. A basic RFID Key tag and RFID EM reader, for permanent members. 2. A temporary password that can be input using a keypad, for temporary workers. 3. Remote Door access by administrator using IOT technology, for guests and visitors for a onetime visit. The system uses NIST to track time and data log all the details on the web server, data gets registered whenever the door is used. The date and time at which the door is accessed and the name of the person accessing the door gets registered every single time the door is used. If the system identifies a false access method or an intrusion, the base gets alerted through WI-FI and the door will be permanently locked unless the secure system is reset using a special administrator password. The door lock is activated by means of high torque servo motors with vibration sensors. In case if someone tries to damage the locking system, it will be identified by the system using the vibration sensor and the system alerts the base and gets locked.

KEYWORDS

Automation, Security, RFID, Face detection, Smart door lock

1. INTRODUCTION

The RFID Door access Control System is more secure, reliable, adaptive, and flexible, the proposed method is flexible such that it can be used at homes, offices, schools, for medical and scientific organizations containing specimens or scientific equipment that needs protection, and for people who hold confidential files or any object that needs to be protected from public view or usage (Priyanka *et al.*, 2019). The system uses a primary microcontroller to control all the operations of the system such that the control loop is strongly designed to remove any possible errors that can occur. The preferred servo motor for the locking mechanism is MG995 Servo motor because this servo motor at its peak voltage can exert a torque of 11kg/cm making the lock immovable by human hands. The door material is decided based on the usage location, if it's an office environment the door can be made of tempered glass material, in case of a scientific military facility it can be made of titanium. Regardless of the door material, the control system can be easily installed making it superbly flexible (Sweta, 2021). The Face Detection technique is employed in extremely confidential cases. The IOT technology implements usage of WIFI modules/ routers or Ethernet cables which can be remotely accessed by the administrator through the internet. The internet access for the system is made possible through a unique webpage or a personalized mobile application (Nehete *et al.*, 2016; Pavelic *et al.*, 2018).

2. METHODOLOGY

The System works on three types of access methods and two types of alert method. The whole process happens with microseconds to ensure security at its best. The first access method is members of the organization who have been authorized and are provided a key card, which is mostly an ID card with a chip inserted within the ID card. On placing the ID card on parallel with the RFID EM reader, the chip is identified by the RFID reader. The name of the person accessing is collected from the database and the access date and time is obtained from NIST, and the access is granted, and the data gets logged in the Webpage server. The second method focuses on a temporary password for temporary workers or contract freelancers. The workers can type this password unto the keypad; the system crosschecks the password and will grant access if the password is a match. The date and time are obtained from NIST and the data is logged onto the web server. The third

method is for guests and visitors who visit the secure facility under supervision, the door is activated through WI-FI from the reception or by any authorized person.

- NIST

The NIST stands for National Institute of Standards and Technology is a web server that can be accessed by the microcontroller through the WI-FI module to obtain the official US standard time. With this time, selected hours and minutes are added or subtracted to data log date and time depending on the user's time zone. There are many such web servers that provide date and time, but the NIST server is the simplest to use.

2.1. RFID DOOR CONTROL

2.1.1. HARDWARE REQUIREMENTS

The hardware requirements consist of a microcontroller, sensor modules to input password and key card, servo motor to physically maneuver the door lock mechanism and WIFI module to remotely control the door and the alert mechanism (Nwogu *et al.*, 2020).

- Sensors

RFID EM Reader Module

The RFID EM reader module is a RFID EM-18 Reader module with serial TTL communication. The Module consists of an electromagnetic reader, when the key tag or the ID card containing the RF chip is placed parallel to the electromagnetic reader (Al-Sudani *et al.*, 2018); the reader reads the data in the chip and sends it to the module. The module after processing the data identifies the secure number embedded in the chip and provides it to the micro controller, where the microcontroller crosschecks the data from its database with the received data to know if it's an authorized member or an intruder (Khabarlak & Koriashkina, 2020).
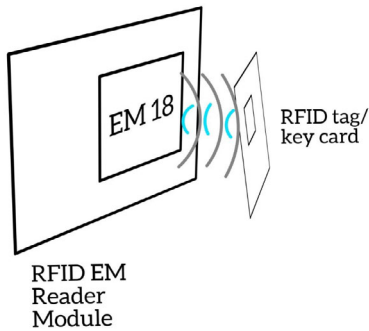
Figure 1. RFID EM Reader Module Working.
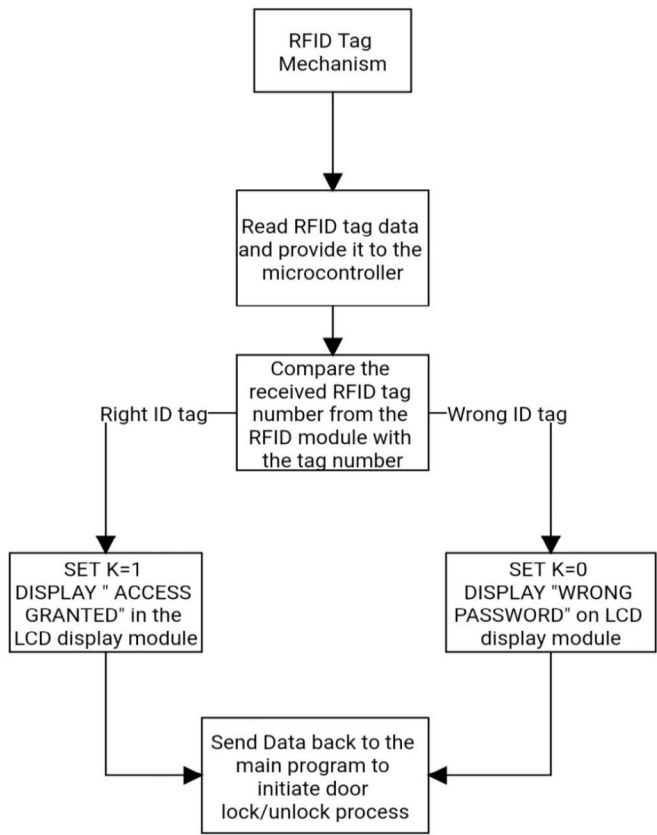**Source:** own elaboration.

Figure 2. RFID Tag Mechanism Flowchart.
Source: own elaboration.

<u>Keypad Module</u>

The Keypad Module is a button sensor device, so when a button is pressed the micro controller can recognize it. The keypad used here is a 3X4 Keypad Module, meaning that it has 3 columns and 4 rows. Once the password is entered; the micro controller will crosscheck the password with the administrator provided temporary password which is regularly obtained through the web server by the administrator. If the password is wrong, the LCD display module will display the message" Wrong Password", if the password is right the lock mechanism is opened. In case of multiple wrong entries, the door is locked until the door access control system is reset by the administrator's special password.
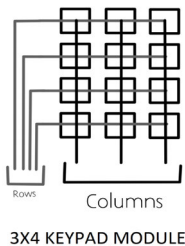

Figure 3. Keypad Module 3X4.
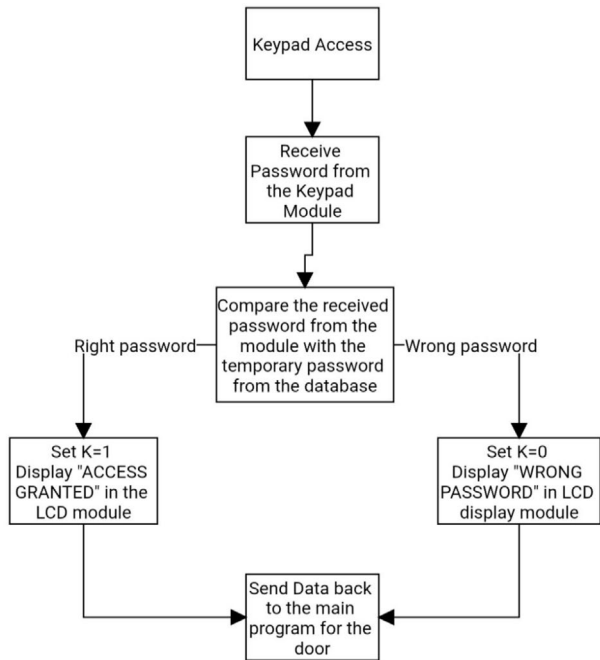**Source**: own elaboration.

Figure 4. Keypad Mechanism Flowchart.
Source: own elaboration.

Vibration Sensors

The vibration sensor is a very sensitive device that is used to measure over a range of vibration and provide the analog values to the microcontroller; an analog value is set as a threshold above which if any vibration is sensed by the vibration sensor, the microcontroller perceives it as an intrusion and activates the alert mechanism (Sweta 2021). The vibration sensor is necessary device for homes, such that when a burglar tries to break the lock the alert mechanism is activated.
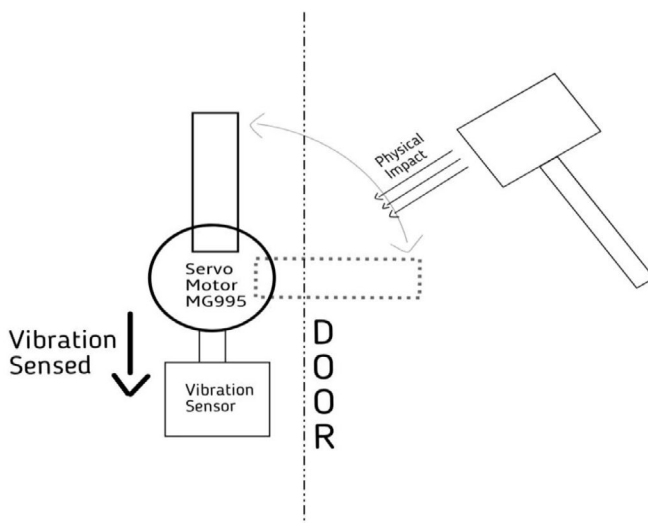

Figure 5. Working of Vibration Sensor.
Source: own elaboration.

LCD Display Module

The LCD Display Module is a 16X2 liquid crystal display panel that is used to provide feedback to the person who is trying to access the door. The LCD display module display the current time as obtained and calculated from NIST server, and a corresponding message as per actions performed as explained below.

1. "Wrong Password", is the password or RFID tag sensed doesn't match with the password provided by the administrator.

2. "Door Open", "Door Closed", is displayed whenever the door is opened or closed, after crosschecking the password.

3. "Intrusion Detected" is displayed when wrong password is identified at multiple instances.

4. "DOOR LOCKED" is displayed when the administrator has locked the door from being accessed by anyone, including the members with the RFID tag.

Arduino Mega

The microcontroller forms the brain of the control system. Arduino Mega is the standard version with multiple features and specifications in the Arduino family. The Uno board consists of Atmega2560 R3, the most powerful microcontroller in the Arduino series. The microcontroller comes with 54 digital I/O pins and 14 of these pins can be used to provide digital PWM outputs. There are 16 analog pins, which can read analog data and can also be used to provide DC power as output. Arduino Uno is the preferred microcontroller because of its serial communication method. The microcontroller can communicate serially with multiple modules at the same time. Due to its simplicity, Arduino mega can be easily re-coded and experimented on the go, adding to its flexibility. The LCD display module and the keypad modules will require a lot of digital pins and control pins which the Arduino Mega will satisfy. Considering all the modules that are to be run in the same instance, the processing speed of the Atmega2560 mc will run the system without hitting a lag, snag or a breakdown and will provide a smooth operation of the control system (Nehete *et al.*, 2016).

Figure 6. Arduino Mega 2560 R3.
Source: own elaboration.

WIFI module

The WIFI module is a very powerful and flexible device that can be used to connect the microcontroller with a specific web server, web page, web app or mobile app through means of internet. The IOT technology has made the remote control and alert mechanism of the door lock system far easier than before and makes it reliable and trustworthy for the consumers. In this security system (Barazanchi *et al.*, 2019; Bdulshaheed, Yaseen, & Al Barazanchi, 2019), the microcontroller is constantly in contact with the NIST server to obtain date and time, by using the NIST server we are removing the need of an RTC Clock Module. When the door is operated the status of the door lock and the name of the person accessing it, gets data logged on the web server. The administrator can open or close the door from a remote location using internet, and this information is also data logged on the web server for future reference. The preferred WiFi module type is ESP8266, but advanced and more secure WiFi module versions can also be used.

Servo Motor

The Servo motor is the most compatible for the door locking system because of its high torque output. The preferred servo motor here is an MG995 servo motor, because of its low operating voltage (4.8v to 6v) and high torque output (stall torque: 11kg/cm). The servo motor can exert a very high torque of 11 kilograms per cm, making it impossible for the human hands the handle or unlock the door. The only way to open the door is by using the servo motor, after all the security methods are satisfied.
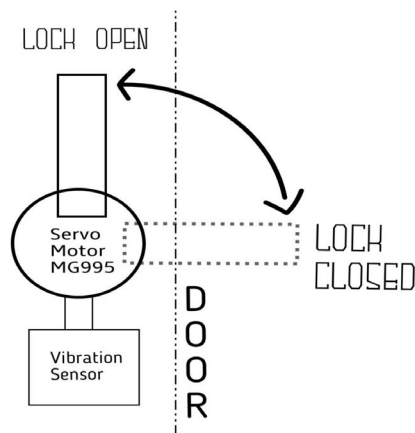

Figure 7. Working of Servo Motor.
Source: own elaboration.

Camera Module

The system uses two different cameras for the security operations. The first is a common CCTV camera, which are already installed external to this system. The second camera is a Arducam MT9D111 camera module, which is compatible with Arduino mega microcontroller. When a user has successfully unlocked the door with the right accessing methods, the Arducam MT9D111 live streams the video featuring the person accessing the door. The web server with the face identification neural network (Abdulshaheed *et al.*, 2018) technology captures the image of the user and checks it with database to identify the person. If the identity check has failed, the door stays locked, and an alert is sent to the administrator. The administrator is mostly the manager, or the operator at the reception. When the user has failed to access the door, the Arducam will live stream to identify the person. If the identification has failed, the image of the user gets captured and a control signal is sent to the server, through which the CCTV camera captures a high quality image of the user when the Access has failed (Al Barazanchi *et al.*, 2021; Al Barazanchi, & Jaaz, 2020).
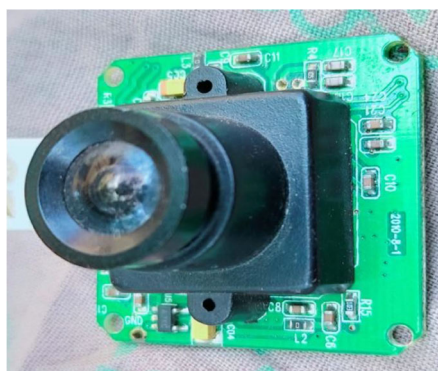

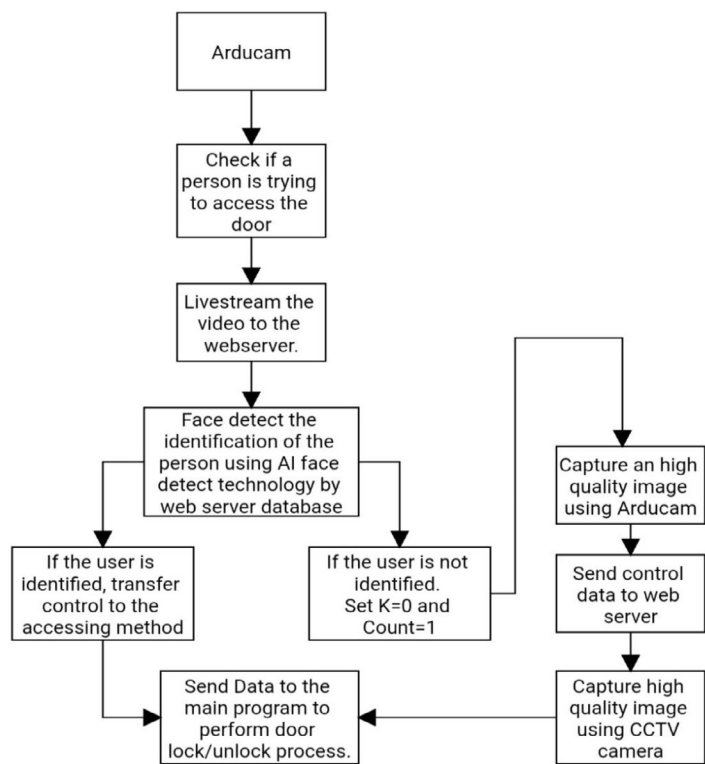**Figure 8**. Arducam Camera Module.
Source: own elaboration.

Figure 9. Working Flowchart of Arducam.
Source: own elaboration.

2.1.2. SOFTWARE REQUIREMENTS

The software system and the user display interface play a vital role in the door accessing methods. The focus of the software structure is divided into two parts, the first part focuses on the individual modules and their operations, and the second part focuses on the control system as a whole.
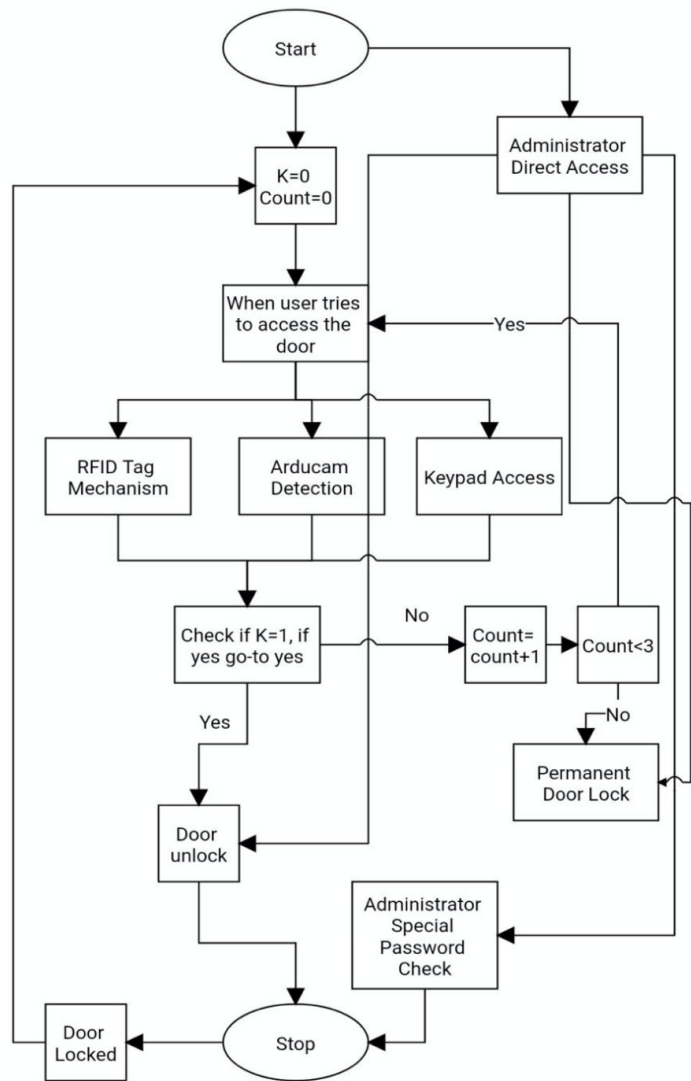
Figure 10. Flowchart of RFID Door Access Control System using IOT.
Source: own elaboration.

Web Server

The web server is essentially the fastest means by which the administrator can remotely control the door lock. The administrator is the person responsible and is authorized by the user organization, and can access the web server (Widadi *et al.*, 2021; Yaseen *et al.*, 2020). The web server also is protected by software security and passwords, by using the password the administrator can login to the web server and can use the option displayed to lock and

unlock the door from a remote location and can view the registered data log to identify the list of people who have accessed the door.

Blynk App

This is a mobile application that allows separate repacking of its functionalities to remote access any IOT based system. Like the web server, the mobile application is also protected by the administrator himself and provides options to lock and unlock the door and also view the data log history of the members who have accessed the door from time to time. This app is either directly used, or an android app is built as per user's preference. Due to the flexibility of the system, the app too should be made flexible and must be able to support different devices and environments it is place in.

3. RESULTS

3.1. WORKING OF THE SYSTEM

The RFID Door Access Control System performs two operations, the first operation is the door accessing method, and the second operation is the data logging and alert mechanism. Regardless of these operations, the microcontroller gets data of date and time from the WIFI module. For this reason, the WIFI module is always connected to the NIST web server. But provided that the WIFI module can only be connected to a single web server, to handle this disadvantage the WIFI module is made to connect with the administrator web server only at certain intervals; intervals when the door is accessed, when data logging and when alerting the administrator (Abbas *et al.*, 2021). The administrator web server is not always connected to the system. So, the web server is designed to wait the connection, once the connection is set the control data is passed to the microcontroller, which will lock or unlock the door appropriately. Hence, the WIFI module is made to connect with the administrator web server to fetch control data for every 1 minute time limit in a 10 minute time interval. When a person tries to access the door using RFID tag or Keypad methodology, the microcontroller will receive the provided password from the modules and will crosscheck it with the password provided by the system or the organization's database. Upon success, the access to the door is granted. Upon failure, the LCD display module will display the message "WRONG PASSWORD", this entry will get registered in the data log

on the web server and the user will have to provide the right password to gain access to the door. In case of multiple wrong entries, the system will finalize it as a fraudulent access and will permanently lock the door from anyone's access and also alerts the administrator. The permanent lock can only remove by resetting the system using a special administrator password by the admin. In case of a thief trying to break the door, the vibration sensor will sense this act and alerts the administrator and again permanently locks the door.
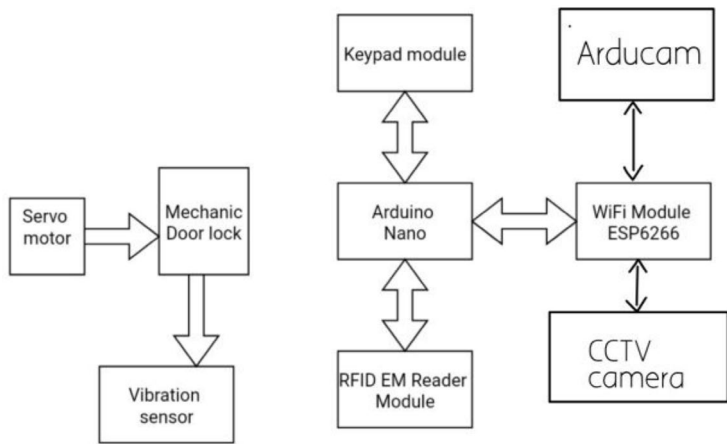

Figure 11. Block Diagram of Working System.
Source: own elaboration.

3.2. PERSONALIZED SYSTEM

Personalizing the security system is an easy task, because of the flexibility the system provides. Personalizing the system might include replacing the access methods by using Fingerprint sensor (Sweta, 2021), AI face detection, AI Eye detection or by advanced gesture control techniques using a camera interface. Depending on the devices to be included, other supportive devices should also be changed in terms of compatibility (Abdullah, Abed, & Al Barazanchi, 2019). The idea of personalizing the security system might help members of an organization who follow a specific culture, and the access methods will not be a trivial action in terms of their working ways.

4. CONCLUSIONS

The usage of Automation has been growing over the years and with the incorporation of IOT technology, existing security and automation systems have upgraded themselves to

a new leash. People can now control their automation systems at office, in the comfort of home and vice versa. With the upgrades of science and engineering, the current system will be upgraded to a pure camera based sensor system, where the user doesn't need a password, key card or other ID. The AI system would be heightened that the users' face is automatically scanned and identified, without needing him to stand in front of the door; he or she can simply walk past the door without having to open with the upgraded systems. Such is the future of these systems and Automation.

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