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Journal of Technology and Innovation

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Presentation of Content

In the first article we present, *Model for identification of correct positioning of parts in a pick and place system*, by CAMPAS-BUITIMEA, Julio, GONZÁLEZ-LÓPEZ, Samuel, MEDINA-MUÑOZ, Luis and RODRÍGUEZ-ESPINOZA, Indelfonso, with ascription in the Instituto Tecnológico de Nogales, as next article we present, *The sustainable technological model (DESUSTEC) as a tool in the development of software for the reduction of electronic waste*, by CENDEJAS-VALDEZ, José Luis, FERREIRA-MEDINA, Heberto, VANEGAS-CONTRERAS, Gustavo A. and ACUÑA-LÓPEZ, Miguel Á., with ascription in the Universidad de Morelia, Universidad Nacional Autónoma de México and Universidad Tecnológica de Morelia, as next article we present, *Augmented Reality (AR) in fingerprint systems for the inclusion in society of people with limited abilities (auditory and language)*, by VANEGAS-CONTRERAS, Gustavo Abraham, ACUÑA-LÓPEZ, Miguel Ángel, CENDEJASVALDEZ, José Luis and BENÍTEZ-RAMÍREZ, María Elena, with ascription in the Universidad de Morelia and Universidad Tecnológica de Morelia, as next article we present, *Design and simulation of a vertical wind generator*, by CHÁVEZ-CANO, Omar, MUÑOZ-HERNÁNDEZ, Germán Ardul, TURIJÁN-ALTAMIRANO, Salomón Noé and RODRÍGUEZ-GONZÁLEZ, Julio, with ascription in the Tecnológico Nacional de Mexico / Instituto Tecnológico de Puebla.

Content

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Model for identification of correct positioning of parts in a pick and place system

Modelo para la identificación del posicionamiento correcto de las piezas en un sistema de selección y colocación

CAMPAS-BUITIMEA, Julio†*, GONZÁLEZ-LÓPEZ, Samuel, MEDINA-MUÑOZ, Luis and RODRÍGUEZ-ESPINOZA, Indelfonso

Instituto Tecnológico de Nogales / TECNM -Departamento de Posgrdo e Investigación

ID 1st Author: *Juan Julio Cesar, Campas-Buitimea* / **ORC ID:** 0000-0003-1190-3929, **arXiv Author ID:** juliokmpas, **CVU CONACYT ID:** 990217

ID 1st Coauthor: *Samuel, González-López* / **ORC ID**: 0000-0002-1511-1227, **Researcher ID Thomson:** N-6460-2018, **CVU CONACYT ID:** 345102

ID 2nd Coauthor: *Luis Arturo, Medina-Muñoz* / **ORC ID:** 0000-0001-9598-1451, **Researcher ID Thomson:** H-4735-2018, **CVU CONACYT ID:** 454558

ID 3rd Coauthor: *Indelfonso, Rodriguez-Espinoza* / **ORC ID:** 0000-0001-6405-9886, **Researcher ID Thomson:** H-5383-2018, **CVU CONACYT ID:** 346230

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Abstract

This article investigates the use of automatic learning classification techniques applied to the task of recognizing the correct shape and color of pieces in a connector using neural networks. The system presented here shows that you can use a set of features extracted from the side view of the piece to recognize the shape of the piece and the color. The proposed model is based on two stages, one performs detection and the other is for recognition. In the first stage, color segmentation algorithms have been tested. In the second stage, a method of extracting personalized features in a color recognition approach is used. Finally, the use of a multilayer artificial neural network (ANN) is proposed to recognize and interpret the different possible shapes and colors with which the pieces can come.

Artificial neural network, Algorithms, Color segmentation, Feature extraction

Resumen

Este artículo investiga el uso de técnicas de clasificación de aprendizaje automático aplicadas a la tarea de reconocer la correcta forma y color de piezas en un conector utilizando redes neuronales. El sistema presentado aquí demuestra que se puede utilizar un conjunto de características extraídas de la vista lateral de la pieza para reconocer la forma de la pieza y el color. El modelo propuesto se basa en dos etapas, una realiza la detección y la otra es para reconocimiento. En la primera etapa, se han probado algoritmos de segmentación de color. En la segunda etapa, se utiliza un método de extracción de características personalizadas en un enfoque de reconocimiento de color. Finalmente, se propone el uso de una red neuronal artificial multicapa (ANN) para reconocer e interpretar las diferentes formas y colores posibles con las que pueden venir las piezas.

Red neuronal artificial, Algoritmos, Segmentación de color, Extracción de características

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* Correspondence to Author (email: julio_kmpas@hotmail.com)
† Researcher contributing first author.

Introduction

The need for identification technologies and classification of parts in the manufacturing process has become relevant in recent years as a result of greater demand for quality by customers. The recognition of pieces can also play an important role in the fields of monitoring and process management, avoiding the loss of capital due to poor quality production and long manufacturing time. The recognition process proposed in this document is based on the use of extraction techniques of specific characteristics of digital images. Different automatic learning algorithms are tested in the data set of 150 vehicle front view images (70 good parts for training, 30 bad parts for training) and experiments are carried out to evaluate their performance.

Development

The proposed model is based on the capture of images by means of a camera, in this image a pattern is recognized with which the image is normalized, after that recognized piece is extracted personalized characteristics to be compared by a neural network which is trained with images of good and bad pieces to finally give a trial. In Figure 1 we can see the structure of the proposed model:

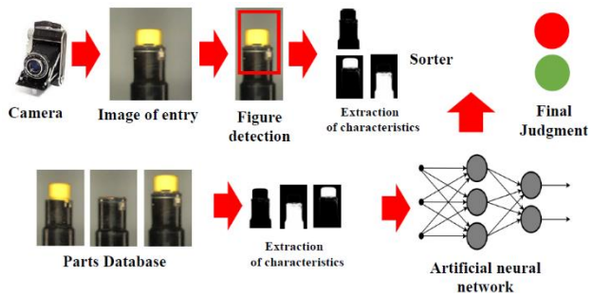

Figure 1 Proposed model structure

In the figure detection process, it is proposed to locate the region of interest (ROI) through the use of color segmentation algorithms. The camera will take an input image and the algorithm will detect a pattern of shapes which will cut out the region of interest to discard the rest of the photograph.

Figure 2 Detection process

Followed by this the model extracts from the remaining image three different images segmented by the same colors to obtain the characteristics of the image.

The algorithms proposed for this are:

Gaussian defocusing: performs n individual 3D convolutions with Gaussian cores with the n normal variations of sigma. The larger the radius, the more blurred the image will become until the pixels are homogeneous.

Gauss difference: calculates two fuzzy Gauss images of the original image and subtracts one from the other

Sobel filter: calculates an approximation of the gradient of the intensity of the image in each pixel. Gaussian defocuses with sigma varying as usual, are performed before the filter. From the original image the method will apply these algorithms for three different parts of the image.

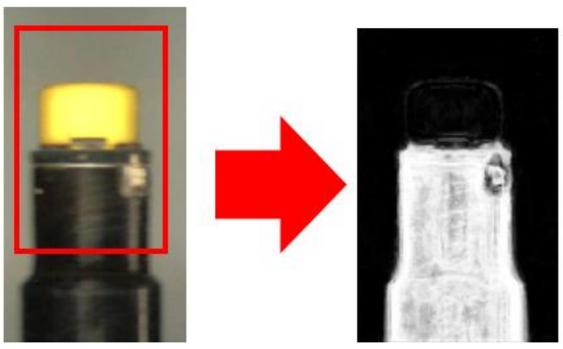

Figure 3 Image treatment

Integration

For the classification of good and bad parts, the use of a convolution neural network is proposed. For this system, the number of hidden neurons is set to 2. One trained for all the characteristics of a piece badly placed and another trained for all the characteristics of a well placed piece.

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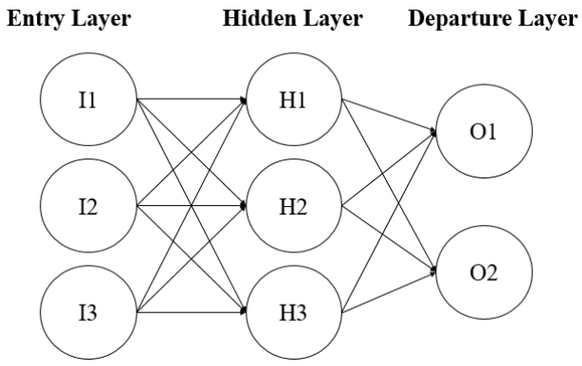

Figure 4 Neural network structure

All these algorithms were tested with the IMAGEJ program using the Weka Segmentation Trainable tool. This tool is used to segment the input image data (grayscale or 2D color), TWS transforms the segmentation problem into a pixel classification problem in which each pixel can be classified as belonging to a specific segment or class. A set of input pixels that has been tagged is represented in the space of the characteristic and then used as the training set for a selected classifier. Once the classifier is trained, it can be used to sort the rest of the input pixels or completely new image data. You can use all the available methods in WEKA.

Tests

The first image that results is the background highlighting in white, when applying the algorithms for this color the image remains blank for the whole background and in black for the rest.

Figure 5 background classification

The second image this time with the algorithms trained with other colors highlights the pin where the pieces of interest are placed, in this case the color of the pin highlights in white and the rest remains in black.

Figure 6 Pin classification

Finally, the same algorithms now trained to recognize the color of the good piece highlight the blank piece above all else.

Figure 7 Classification of piece

100 images were collected. The results obtained were the following using a BayesNet classifier In percentage divided to 66%. Therefore, only 44 instances were put to the test.

Instances correctly classified	97.72%
Instances classified incorrectly	2.27%

Table 1 Results

Conclusions

Thanks to the obtaining of characteristics and the contrast of colors it is quite marked to the neural network it is easier to classify the pieces between good or bad, in the proposed method there are only three characteristics that are proposed, but they can be more. As a method to detect presence or absence and color of dielectric is quite robust. With the results obtained, the neural network can be trained with these characteristics. The proposed model does not require a large investment, compared to the current vision systems and sensors of recognized brands.

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The sustainable technological model (DESUSTEC) as a tool in the development of software for the reduction of electronic waste

El modelo sustentable tecnológico (DESUSTEC) como herramienta en el desarrollo de software para la reducción de basura electrónica

CENDEJAS-VALDEZ, José Luis[1, 3]*, FERREIRA-MEDINA, Heberto[2]†, VANEGAS-CONTRERAS, Gustavo A.[3] and ACUÑA-LÓPEZ, Miguel Á.[3]

[1]*Universidad de Morelia. Posgrados Tecnologías de la Información*
[2]*Universidad Nacional Autónoma de México. Instituto de Investigaciones en Ecosistemas y sustentabilidad*
[3]*Universidad Tecnológica de Morelia. Tecnologías de la Información y Comunicación*

ID 1st Author: *José Luis, Cendejas-Valdez* / **ORC ID:** 0000-0002-4109-4053, **CVU CONACYT ID:** 345997

ID 1st Coauthor: *Heberto, Ferreira-Medina* / **ORC ID:** 0000-0003-0150-2355, **CVU CONACYT ID:** 67744

ID 2nd Coauthor: *Gustavo A, Vanegas-Contreras* / **ORC ID:** 0000-0003-0152-3682, **CVU CONACYT ID**: 644069

ID 3rd Coauthor: *Miguel Á, Acuña-López* / **ORC ID:** 0000-0002-6289-1713, **CVU CONACYT ID:** 644394

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Abstract

Currently technology is an engine for organizations and the human being to be more productive, based on this scoop there is a need for organizations to have areas that improve their processes through research, development and innovation (R + D + i). Enriching their ways of work, staff and society. However, in recent years, the lack of interest in caring for the environment and the lack of proper environmental education has resulted in not leaving a better living condition for future generations. The elements that contribute to this are the excessive use of technology, technological consumerism, the inappropriate use of computers and the disposal of mobile devices; What has resulted that the planet is affected every day with the generation of electronic garbage contributing directly to global warming. Companies that develop software require greater hardware resources so that their applications work in the best way, which generates a limited life time in the devices and that the software that is built requires more resources for its optimal operation; thus, advancing the useful life and becoming technological waste.

Software, Sustainability, Electronic waste, Social responsibility, DESUSTEC

Resumen

Actualmente la tecnología es un catalizador para que las organizaciones y el ser humano sean mas productivos, con base en esta primicia existe la necesidad de que las organizaciones cuenten con áreas que mejoren sus procesos a través de la investigación, desarrollo e innovación (I+D+i). Enriqueciendo así sus formas de trabajo, personal y social. Sin embargo, en los últimos años el desinterés en el cuidado del medio ambiente y la falta de una educación ambiental apropiada ha generado el no dejar una mejor condición de vida para las próximas generaciones. Los elementos que contribuyen en ello es el uso desmedido de tecnología, el consumismo tecnológico, el uso inadecuado de computadoras y el desecho de dispositivos móviles; lo que ha dado como resultado que día a día se afecte al planeta con la generación de basura electrónica contribuyendo de manera directa en el calentamiento global. Las empresas que desarrollan software exigen mayores recursos de hardware para que sus aplicaciones funcionen de la mejor manera, lo que genera un tiempo de vida limitado en los dispositivos y que el software que se construye exija mayores recursos para su óptimo funcionamiento; adelantando así la vida útil y convirtiéndose en basura tecnológica.

Software, Sustentabilidad, Basura electrónica, Responsabilidad social, DESUSTEC

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* Correspondence to Author (email: luiscendejas@hotmail.com)
† Researcher contributing first author

Introduction

Sustainability is increasingly important in the essential process of organizations, today it is necessary that the products or services that are marketed throughout the world bear the stamp of green technology, estimated according to data from the STEP initiative (Solving the e-waste problem) that each inhabitant in Mexico produces an estimated 7 to 9 kilograms of electronic waste per year, which is estimated that globally in 2018 generated 49.8 billion tons of electronic waste (STEP, 2015).

Including to a large extent those dedicated to software development, because the projects that are currently being developed require large amounts of hardware resources; which makes them have a useful life of a few years due to the demand for storage, consumption of memory and processing power.

Within the technological companies can be found the software factories which generate their products and services in the cloud based on methodologies and processes that traditionally do not take into account the economic or ecological sustainability of the same, which results in that the devices and electronic devices that they implement have a useful life of approximately 2 to 4 years, that is, they are manufactured with the idea that mobile devices are obsolete in a short time and therefore promote consumerism (Asociación Mexicana de Internet, 2014), (Ferreira, 2015), (Greenpeace, 2005), (Ramírez P. , 2012).

It has been observed that with the passage of time the software of the devices becomes obsolete and this no longer has any support to update itself. This study proposes the construction of a sustainable software development model that not only includes steps or stages to be followed under a sustainable approach; but the use of environmentally friendly technology that allows hardware devices to extend their lifespan by at least 10 years.

In addition to review methodological proposals, models and / or methodologies for the agile development of software that contribute with the programmers towards a social approach, which are oriented in the sustainability and the attributes that should have.

With this research, a proposal is presented so that the companies dedicated to software development have a methodological - technological framework (DESUSTEC) with a sustainable approach. DESUSTEC must meet the needs of the technological environment and care for the environment in a responsible manner, make use of technology and support sustainable development; so that it will allow the development of the means for future generations to inherit better natural resources than today. The demand in the market for the development of applications (software) that run on local computers (desktop computers) or on mobile devices (APPs), has fostered a boom in software development in the world. Therefore, there is a need to improve and innovate in any type of applications, which must be faster and easier to elaborate.

Therefore, there is a need to present a model that provides a dual role for society that is concerned about caring for the environment and immersed in the use of technology, on the one hand providing **1) sustainable elements** in both hardware and software, which will help generate a strategy or regulatory framework in the construction of custom software. In order to comply with one of the goals or objectives of this proposal, which is to build software with a useful life of more than ten years in the market, this will allow greater demands on more hardware resources (memory and processor speed) of the devices where the developed software is used. And on the other hand **2) contribute to the care of the environment** through the generation and reduction of electronic waste.

Literature Review

In this section a set of elements are integrated that allow building software in an agile and sustainable way, looking for the care of the environment accompanied by the reduction of electronic waste.

i. Global warming

From the industrial revolution, in the eighteenth century, human activities (industry, manufacturing, vehicles ...) have contributed dramatically to increase the presence of carbon dioxide (CO_2) in the atmosphere.

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The warming of the Earth has been generated due to these human activities to this phenomenon is called global warming. (Isaza D., 2007)

The term Global Warming refers to the gradual increase in the temperatures of the atmosphere and oceans of the Earth that has been detected at present, in addition to its continuous increase that is projected in the future. No one questions the increase in global temperature, which still generates controversy is the source and reason for this increase in temperature. Even so, most of the scientific community ensures that there is more than 90% certainty that the increase is due to greenhouse gas concentrations due to human activities such as deforestation and the burning of fossil fuels such as oil, coal and technological waste. These conclusions are supported by the science academies of most industrialized countries.

Other effects would include more frequent extreme weather, which includes droughts, heat waves, hurricanes and heavy rainfall. Extinction of species is expected due to temperature changes and strong variations in crop yield.

The increase in global average temperature is higher than 4ºC compared to pre-industrial temperatures, in many parts of the world and natural systems will not be able to adapt and therefore will not be able to support their surrounding populations. In short, there will be no natural resources to sustain human life under current conditions. In figure 1 it can be observed in which elements of the earth is where the warming of our planet concentrates most.

Where is the energy being stored?

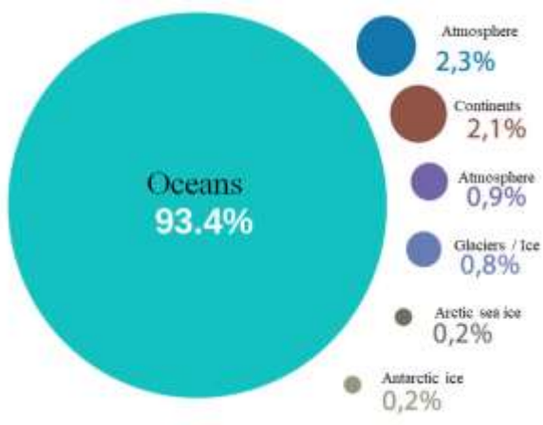

Figure 1 Concentration of global warming
Source: Moreno, Cerutti & Gutiérrez (2014)

Hence, there is a need to pay attention to this problem and attention to see how it can contribute to its solution and every time we discard, buy or make use of new technology contributes to the development of global warming.

ii. Earth Charter

The Earth Charter is a declaration of fundamental principles for the construction of a global society in the XXI Century, which is fair, sustainable and peaceful. In October 2003, the United Nations for Education (UNESCO) resolved "Recognize that the Earth Charter constitutes an important ethical reference for sustainable development, and express its support for the contents of said Charter".

For this reason, within the "UNESCO Decade for Sustainable Development (2005-2014)", approved in December 2002 by the General Assembly of the United Nations (UN), in April 2005 the Charter of the Earth has been incorporated into the International Application Project of the United Nations Decade of Education for Sustainable Development (ESD), as an invaluable educational tool. (Martín, 2005)

The Earth Charter initiative has entered a new phase, which focuses on bringing these principles into action. For this, the Mexican government declared its support during the World Summit for Sustainable Development, held in Johannesburg, South Africa, for which Mexico is the National Committee for the Earth Charter operated by a National Secretariat, with the purpose of crystallizing the objectives of the Type II Alliance, "Educating for a Sustainable Lifestyle with the Earth Charter".

Hence, in the XIV principle, the relationship between this document and the use of technology is very well linked, which says the following: Integrate in formal education and lifelong learning, skills, knowledge and values necessary for a sustainable way of life.

This is that not only should you buy and consume technology but be concerned about being responsible for the use that will be given to that technology after having taken advantage of it and giving it an appropriate use from cradle to death (recycling).

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iii. Sustainability

At this point comes a very important concept that is sustainable or sustainable, the concept that most interests, due to the relationship that information and communication technologies (ICT) have with companies and the environment is the concept of sustainability business "Business sustainability" is a new paradigm in the management of companies.

It is an alternative to the traditional growth model and maximization of profitability (Wilson, 2003). Sometimes this term is used as a whole and as a synonym of others such as sustainable development (DS) and corporate social responsibility (CSR). However, neither of these two concepts defines business sustainability on its own, but rather the combination of both that manages to formulate a new trend in companies (Portales y García-de-la- Torre, 2009).

There are different concepts of sustainability that have been modified in recent decades. But an intergenerational concept is the one presented by Sánchez, García & Ramírez (2004), where they comment that this focus on sustainable development refers to the need to preserve nature, so that future generations maximize their options in their use and increase your well-being.

The definition focuses on the responsibility of the current generation with respect to future ones. Sustainable development consists of being fair to the future, so that the present generation must develop the means for future generations to inherit the same resources that are now available. It is argued that it is natural for humanity to fight for the continued growth of production and consumption.

The basic idea is that economic growth is a necessary condition to increase protection and environmental renewal. Economic growth is considered vital for the sustainable development of the world. Sustainability includes some elements that must be taken into account for their optimal functioning, among them we find:

a. Resource efficiency

The concept of "efficient use of resources" generates more value by using less materials and consuming in a different way.

In this way, the risk of scarcity is reduced, and the environmental impacts will remain within the natural limits of our planet. 2020 aims to increase security for investment, innovation and create opportunities for sustainable economic growth, ensuring that all relevant policies take into account the efficiency of resources in a coherent manner. (Europea, 2011).

b. Quality of life

What is meant by the term Quality of life, the expression quality of life appears in public debates about the environment and the deterioration of urban living conditions. The concept can be used for a number of purposes, including the assessment of the needs of people and their levels of satisfaction. (Castillo, 2016).

c. Company - competitiveness

To improve competitiveness, companies must adapt their strategies and organizational structure to the dynamic environment of today's economy. The success of the company will depend to a large extent on its capacity to acquire adequate resources and skills to achieve new competitive advantages (quality, technological capacity, innovation, human capital, knowledge, etc.), with the permanent objective of growth and diversification. (Ponce, 2016).

d. Social responsability

The issue of Social Responsibility at an international and national level is becoming more and more popular among the Organizations due to the awareness and need to maintain a socially responsible behavior that allows contributing to Sustainable Development. (Romero, 2016)

iv. Impacto de la tecnología en el medio ambiente

In the context of current globalization, no industrial, commercial or service policy, like the social one, will succeed if it does not know the need to incorporate the principles of sustainable development as guides to economic growth. Many of the environmental technologies can help improve the natural environment while boosting the competitiveness of companies.

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However, there are still limitations in terms of its development, such as the complexity to move from traditional technologies to more modern ones, and access to capital.

The Science and Technology strategy has been considered fundamentally and important to lay the foundations for a new articulation between all sectors; including the environmental. Therefore, scientific and technological development should be oriented to improve the existing socioeconomic situation, using the human potential and the natural resources that are possessed with a long-term and integral vision. (Peñaloza, Arévalo & Daza, 2009).

Recently, the sociocultural environment of users has become important in the rethinking of the technological paradigm. Puchet & Bolaños (2005) describe ecotechnology within a conceptual framework of thought in which it is essential to take into account the life of the technological user, their individuality and their value judgments. In his proposal he exposes that technology is not universally adaptable and therefore needs to be designed according to human contexts in which subjectivity is present. In this way, it reinforces the idea that to introduce an ecotechnology to a specific context it is necessary to generate acceptance mechanisms that take into account the locality, culture and ways of living of the users.

Although the original conceptualization of ecotechnology focused on the management of ecosystems, the systemic vision was incorporated into the industry, later the attention jumped from the productive sector to the consumer sector and users of technology. The eco-technological discourse has thus benefited from different conceptual contributions and has evolved since its emergence, it is an area of exact, predictive and quantitative knowledge, towards a notion that involves social and economic criteria, as shown in Figure 2.

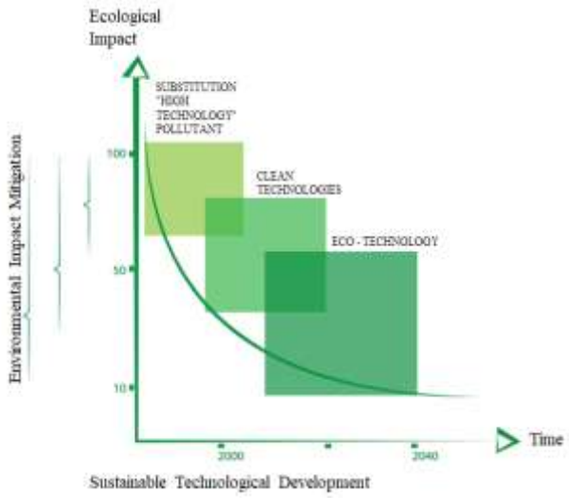

Figure 2 Technological transition proposed by MOSER
Source: MOSER (1996)

v. Research, development and innovation

Research and Development (R & D) are two scientific and technological activities of great value because they involve the creation of new knowledge, a key element for the general progress of society.

If we add to them the practical application of progress through Innovation, we will have the complete cycle of a research system. In the Knowledge Society, the Research, Development and Innovation cycle (R + D + i) occupies a strategic position, as it promotes economic growth and business competitiveness in a markedly dynamic international environment. (Pujol & Vivó, 2008)

The acquisition and generation of new or relevant knowledge for any organization can occur through:

- Development of research and experimentation: includes the creative work that is undertaken on a systematic basis in order to increase the knowledge pool. Most of the time, the most important experimental phase is the construction and testing of a prototype, that is, an original model that includes all the characteristics and technical achievements of a new product or process.

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- Acquisition of unincorporated technology and knowledge: includes obtaining external technology in the form of patents, non-patented inventions, licenses, disclosures of know-how, designs, trademarks, patterns, as well as computer services and other scientific services and technicians related to the implementation of innovations, in addition to the acquisition of software packages not classified elsewhere.

vi. Information and communication technologies

Information and Communication Technologies (ICT) are all those resources, tools and programs that are used to process, manage and share information through various technological supports, such as: computers, mobile phones, televisions, portable audio players and video or game consoles. (Puchet & Bolaños, 2015), within these technological tools, we can take into consideration some of them as they are:

a. Ecotechnologies

Ecotechnologies are defined as the use of technological means to manage ecosystems, based on an in-depth knowledge of the principles on which natural ecological systems are based and the transfer of this knowledge towards their management in a such that the damage caused to the environment is minimized.

Likewise, ecotechnologies are defined as techniques that attempt to solve the daily needs of the life of human beings with an ecological perspective; Its application aims at the optimal and efficient use of energy and the improvement of domestic, industrial and labor processes. (Barcenas, 2010).

b. Virtualization

In general terms, virtualization is a process and result of data processing through computer, information and knowledge. More specifically, virtualization consists of electronically and digitally representing objects and processes that we find in the real world.

In the university context, virtualization can include the representation of processes and objects associated with teaching and learning activities, research and management, as well as objects whose manipulation allows the user to perform various operations through the Internet, such as learning through the interaction with electronic courses, enroll in a course, consult documents in an electronic library, communicate with students and teachers and others. (QUÉAU, 1993)

c. Free software

With free software reference is made to the freedom of the users to execute, copy, distribute, study, change and improve the software. Free software is any program whose users enjoy these freedoms. So it should be free to redistribute copies with or without modifications for free or charge for distribution, to anyone and anywhere.

The freedom to use a program means that any individual or organization can execute it from any computer system, for any purpose and without the obligation to communicate it subsequently to the developer or to any specific entity. The freedom to redistribute copies supposes to include the binary or executable forms of the program and the source code of both the modified versions and the original ones.

Free software does not mean that it is "non-commercial". Any free program will be available for use, development and commercial distribution. The commercial development of free software has stopped being exceptional and in fact that commercial free software is very important. (Stallman, 2004).

vii. Model for the development of collaborative integral software (MDCIS)

In (Cendejas, Vega, Careta, Gutierrez & Ferreira, 2014) a Model for the Development of Collaborative Integral Software (MDCIS) is proposed, which is oriented to the rapid development of applications and that is a necessity of the micro, small and medium companies (SMEs) of the Central-West Zone of Mexico.

This model proposes an easy and simple way for the rapid development of applications and custom software, the objective of this methodology is to be a reference and enable competitiveness for the software factories in the region. This project presents the design of a methodology based on the experience of the industry in the Central-Western region of Mexico, the methodology will allow a development adhering to standards and the needs of companies that are immersed in this new type of development of software. Through MDCIS, quality products will be provided allowing the control and administration of the software project.

- Sustainable software
- Linking with software factories
- Impact on the productive sector
- Training of human resources

In Cendejas et al. (2014), it is mentioned that the main problem of software development is the development of quality products that meet the needs and objectives of organizations. In addition, the software that is developed is not aligned with the objectives and goals of the organization, ie the software is only developed by IT experts who are dedicated to perform an analysis, design and development of it, but never it is accompanied by experts from the organizational processes that benefit the development of the product in a formal way.

The model defines 5 different levels that provide the best practices for software development, using the best practices of the Project Management Institute (PMI) in planning, which allows generating quality software aligned with the strategy of the organization, see figure 3.

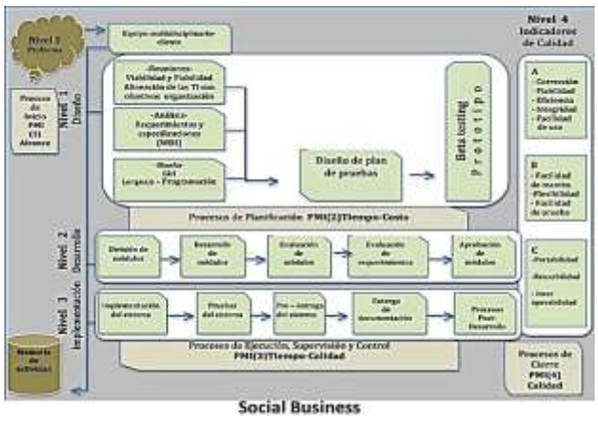

Figure 3 Integral, Collaborative Software Development Model (MDCIS)
Source: Cendejas et al. (2014)

MDCIS evaluates the quality of the software through indicators that validate its operation, these indicators are contemplated in international quality standards. Finally, the MDCIS seeks to generate a knowledge base through social business and social networks, generating an information bank that allows best practices in the development of software projects.

This model is called collaborative integral since the participation of the characters that intervene in the development should generate a collaborative and integral environment between the developers and the participants (stakeholders) of the project.

In the model, the first five PMI elements are integrated:

- Integration of projects.
- Scope.
- Weather.
- Cost.
- Quality.

With this, what is sought is to develop the best practices to open, develop and close a project. The model offers the following advantages to users:

- Organization by levels.
- Easy understanding of the processes.
- Easy application
- Integration of the analysis and design stage.
- Storage of information generated at all levels.
- Documentation generated from the activities of the levels.
- Prototype generation.
- Generation of test plan based on specifications obtained in the identification of the problem.
- Integration of development through modules.
- Quality assessment through indicators.

Methodology

Once the problem to be resolved has been identified and the objectives to be met have been established, this section describes the research context, in which the procedures required to obtain the necessary information and to structure or solve the research problem are defined.

i. Nature and approach of the investigation

Based on what is explained in the following sections, the nature of the research in this paper has a scope of type: **1) Transectional** because, as stated by Hernández, Fernández and Baptista (2006), the purpose of the research is to describe variables and analyze their incidence and interrelation at a given moment, that is, the research data will be collected only once. **2) Descriptive** involves the critical review and analysis of the most relevant results that have been achieved in previous research, the conceptual problems and their methodological limitations, the unresolved issues, the possibilities of future development and the directions in which progress must be made to produce an improved and broad knowledge (Sarabia Sánchez, 1999). **3) Correlational** is a type of descriptive study, which aims to determine the degree of relationship or non-causal association between two or more variables. It is characterized because it first measures the variables and then, performs the application of statistical techniques, which allows to measure the correlation. **4) Documentary**, this type of research is a process that, through the application of scientific methods, seeks to obtain relevant, reliable and impartial information to extend, verify, correct or apply knowledge. **5) Analysis - Synthesis**, all phenomena that are presented to the consideration of man are too complex if they are examined carefully. They are simple only at first sight. If you want to investigate the causes, it is necessary to separate the phenomenon in parts to study it in a better way. Scientific research is not immune to these procedures.

ii. Methodological model

The research design consists of generating a series of steps to follow to achieve the general objective and the goals set; which are the following:

1) Research proposal by research professors presenting the DESUSTEC model. As well as the Feasibility of the investigation, to know if the feasibility exists in developing this proposal in the context of Mexico and America.

2) Design of the research, make up the work team and the different stages in which the project will be developed.

3) Analysis - synthesis of the information that sustains the present investigation will be carried out (review of the literature).

4) Integration of sustainable tools, that do not harm the environment in a sustainable way.

5) DESUSTEC design, feedback and improvement adjustments**.**

6) Training of students with IT profile, creation of the software cell by students of the UDEM. Based on the foundations proposed for the research, the methodological model of the proposed research is presented in figure 4, as well as the stages to follow.

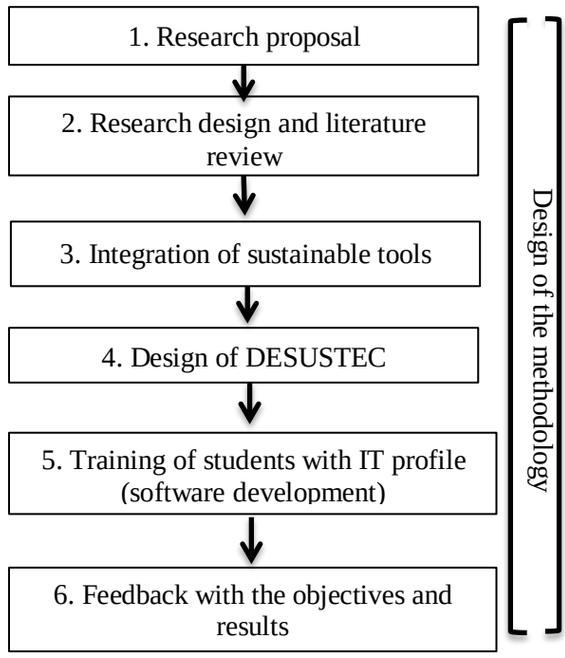

Figure 4 Research model - proposed
Source: propia (2015)

iii. Statistical study

Based on what was proposed by Álvarez (2017), in the study related to the construction of sustainable software, 72 professionals were interviewed in public and private universities in the central-western region of Mexico.

Once it was carried out, it was analyzed, where the coefficient of the Alfa Cronbach was obtained with a value of 0.737 which indicates an acceptable internal consistency in the results of the survey and through a study of Pearson correlations the most significant were obtained present values> = 0.5, which are detailed in table 1.

1. Direct contact with users and constant feedback.
2. Correct analysis of the problem to be solved and requirements.
3. Implementation of free software.
4. Use of ecotechnologies for saving in electricity consumption.
5. Reuse of materials and components (hardware).
6. Efficient use of natural resources.
7. That the software on the devices is kept updated.
8. Good management of risk management in planning.
9. Guarantee the useful life of the software at least 10 years of operation.
10. Compatibility even in old machines or different operating systems.
11. The support, the connection with other applications, maintenance and speed, stand out as quality indicators for the software.
12. The ease of use, utility, reliability, performance and compatibility should be a priority to develop software.
13. The correct planning and management of the same project should be carried out supported by tools to facilitate the tasks.
14. Definition of clear roles and objectives, each member of the development team must know what he has to do.
15. Management of previously established times in the planning, to obtain software with quality adhering to the planning.
16. Use of virtualization technologies that will allow to use virtual versions of devices, savings in energy consumption and hardware.

Table 1 Significant correlations in the construction of sustainable software
Source: Álvarez (2017)

Results

Based on the foundations presented previously in the present investigation, the five levels that make up the DESUSTEC model and the way it is integrated and should function are proposed.

The functioning of DESUSTEC begins through **a) Level 1**, which presents the conformation of a software cell formed by engineering students with a profile related to the area of tic's, which will receive previous training related to the development of custom software; this with the aim of serving as a specialized human resource for companies and factories that are dedicated to software development and to be trained in aspects related to the care of the environment and the responsible use of technological development.

b) Level 2, refers to the use of the model for the development of collaborative comprehensive software (MDCIS), which serves as a practical and agile guide that contributes to the development of custom software. This to be able to count on a methodological process that helps to obtain optimum levels of quality and the total satisfaction of the client.

c) Level 3, in a very special way, refers to the technological proposal, which reflects the use of three elements that are currently of vital importance and that help the development of software efficiently, with a sustainable approach and care for the environment. These elements are: **a) Use of solar energy** through solar panels that allow the turning on and powering of computers, mobile devices and Internet access necessary to develop software in an agile and customized way. **b) Use of virtualization and storage** through computers that integrate several processors and several storage volumes (hard disks) that allow the support of programming languages in different platforms (IOS, Android, Windows, Linux) and databases that avoid the excessive use of equipment, with the aim of impacting global warming with the work of different computers and mobile equipment. **c) Use of free software**, the main advantage that is had when generating software through this type of license is beneficial for the software industry since it is not required to make any payment for its use and / or license. In addition to that many of them have support and are powerful for the development of computer systems such as ERP, CRM and business systems. You can mention swift, android studio, php, mysql, perl, python, among others.

d) Level 4, it is important that after each software development based on the previously integrated elements the quality evaluation is carried out through eleven indicators that help to measure the efficiency of the manufactured software.

e) Level 5, at this level we seek to obtain software products that are friendly to the environment; this is that at least they have a useful life of at least ten years and that they avoid the use and waste of hardware elements of mobile devices; what will generate electronic garbage.

And finally the **f) Level 6** aims to reduce the amount of electronic garbage that is generated through cell phones, tablets, servers, laptops and personal computers; which are generated by the users due to the need for more resources required by the software in the equipment to be installed. The levels that integrate and base the DESUSTEC, are reflected in a graphic way in figure 5.

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Figure 5 DESUSTEC model - proposed
Source: Own (2019)

Conclusions

Electronic waste is a problem that must be addressed immediately and one solution is to be able to develop software under a sustainable approach; making use of ecotechnologies, virtualization - storage and open source programming languages (free software). What would allow to develop software tailored to quality and with a lifespan of at least ten years.

According to the methodologies and / or agile models consulted for software development, no one takes sustainability into account, so this represents an advantage with respect to them.

The technology developed under the proposed model may be marketed as a green technology. It encourages energy saving, implementing eco-technologies which represents a competitive advantage for organizations, as well as a reduction in production costs and time. Since one of the main pillars of the proposal is the code reuse to streamline the creation of software.

It is intended to generate a uniform infrastructure in the future that allows the creation of microservices in a sustainable manner, thus offering software as a service (SaaS), that is, a uniform architecture that encompasses all the technologies that are scattered today and that allow the generation of sustainability. in software development. Helping users to develop software quickly and with quality.

In turn, the proposed model may be a sustainability framework applicable to technological projects, even in other areas of knowledge. Nowadays, the legal framework begins to request in several countries that companies consider ethically and socially sustainability in their processes for the generation of their products and / or services.

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Augmented Reality (AR) in fingerprint systems for the inclusion in society of people with limited abilities (auditory and language)

La Realidad Aumentada (RA) en sistemas dactilológicos para la inclusión en la sociedad de personas con capacidades limitadas (auditivas y de lenguaje)

VANEGAS-CONTRERAS, Gustavo Abraham[1-2]†*, ACUÑA-LÓPEZ, Miguel Ángel[1-2], CENDEJAS-VALDEZ, José Luis[2] and BENÍTEZ-RAMÍREZ, María Elena[2]

[1]*Universidad de Morelia. Ingeniería en Videojuegos*
[2]*Universidad Tecnológica de Morelia, CA - PRODEP Transferencia Tecnológica para la Construcción de Software*

ID 1st Author: *Gustavo Abraham, Vanegas-Contreras* / **ORC ID:** 0000-0003-0152-3682, **CVU CONACYT ID**: 644069

ID 1st Coauthor: *Miguel Ángel, Acuña-López* / **ORC ID:** 0000-0002-6289-1713, **CVU CONACYT ID:** 644394

ID 2nd Coauthor: *José Luis, Cendejas-Valdez* / **ORC ID:** 0000-0002-4109-4053, **CVU CONACYT ID:** 345997

ID 3rd Coauthor: *María Elena, Benítez-Ramírez* / **ORC ID:** 0000-0002-8248-3610, **CVU CONACYT ID:** 689428

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Abstract

At present the various forms of communication are essential in addition to being a paramount parameter for the human being, since it allows and facilitates relating, expressing and, above all; transmit or exchange information. All of the living beings communicate in diverse ways, with the use of symbols, audio, images, movements and most importantly through a language composed of words. It is usual to encounter people with some type of physical or mental limitation. According to data from Instituto Nacional de Estadística y Geografía (INEGI), there is a great number of people with speech and hearing impediments, in Michoacán, for every 1,000 inhabitants there are 69 people with some kind of disability, from which approximately 19.4% of this population can relate directly with speech and communication problems. The majority of the people in any situation lack the ability and knowledge necessary to establish effective communication with people that suffer this type of limitation, like hearing and visual impediment. This is why the presented investigation aims to contribute a model proposal, through the Information and Communication Technologies (ICT's), with the tools of Augmented Reality (AR), that gives and permits the user manipulate accessible and intuitive interfaces, so that the people with hearing and speech disabilities can establish a visual-text communication without the need for intermediaries and with their own sign language.

ICT's, Dactilológico, Auditory Disability, Communication, Augmented Reality

Resumen

En la actualidad las diversas formas de comunicación resultan ser esenciales además de ser un parámetro primordial para el ser humano, ya que le permite y facilita relacionarse, expresarse y, sobre todo; transmitir o intercambiar información. Todos los seres vivos se comunican de diversas formas, haciendo uso de algunos distintivos como lo son los símbolos, las imágenes y los movimientos, sobresaliendo de forma notoria e importante el idioma compuesto principalmente de palabras. Es usual encontrar personas que padecen alguna limitación como una discapacidad física, así como una limitación referida a una enfermedad mental. Según datos del Instituto Nacional de Estadística y Geografía (INEGI), existe una gran cantidad de personas con capacidades auditivas y del habla limitadas, en Michoacán por cada 1,000 habitantes existen 69 personas con alguna discapacidad, de las cuales aproximadamente el 19.4% de esta población se relaciona de forma directa con problemas del habla o para comunicarse. La mayoría de las personas de diversas instancias carece de las habilidades y conocimientos necesarios para realizar una comunicación eficiente y eficaz con personas que padecen este tipo de limitación, como puede ser la discapacidad auditiva o visual. Por ello la presente investigación pretende aportar una propuesta de modelo, mediante las Tecnologías de la Información y Comunicación (TIC´s), a través de herramientas como la Realidad Aumentada (RA), que brinda y permite al usuario manipular interfaces accesibles e intuitivas, para que las personas con discapacidades auditivas y del habla pueda llevar a cabo una comunicación visual-texto sin necesidad de intermediarios y en su propio lenguaje de señas (dactilológico).

TIC´s, Dactilológico, Discapacidad Auditiva, Comunicación, Realidad Aumentada

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* Correspondence to Author (email: abraham_c50@hotmail.com)
† Researcher contributing first author

Introduction

The communication, is to transmit and receive messages in an alternative way, is based mainly on language. At present it is very common to find people who suffer from physical and mental limitations, communication with people belonging to this sector sometimes presents many difficulties, since most people in any field lack the necessary skills and knowledge To make effective communication with people who suffer from this type of limitation such as hearing or visual disability, the need to have an inclusive society in all senses requires the participation of citizens, government authorities and social organizations, including educational institutions, to benefit equity and equality as well as social justice with people excluded in education and society.

A population with a disability is one that is identified as having some type of physical or mental limitation for more than a period of six months or permanently, which makes it impossible for it to develop its activities within the margin that is identified as normal for a person. Likewise, language disability was defined as the loss or restriction of the ability to produce and transmit an understandable meaning through speech.

The implementation and use of Information and Communication Technologies (ICTs), are aimed at enhancing their use and access to them for all users without any distinctive, so that it improves the quality of life through various tools that provide accessible and intuitive interfaces such as the Augmented Reality (AR), which allows one of its many facets to capture specific sign language gestures made in front of a specialized device, thereby improving the accessibility of content for the people with limited capacities. Within this range of communication possibilities, we find several options such as the manual alphabet (dactilological) which is a system that allows communication to be carried out by highlighting its execution and visual or tactile communication.

Communication is mainly done through phonemes (sounds), sometimes it is not possible to use an auditory medium to establish communication, so alternatives are investigated to be able to establish such communication, an essential tool nowadays, using systems such as sign language among others.

Which indicates that the deterioration or lack of this auditory communication is not an impediment to achieve establish the process of transmission of information between one person and another, since you can establish a communication through other alternatives as they turn out to be visual elements, substituting oral or written language.

Therefore, communication is a barrier that must be faced by people with serious problems in their auditory and visual systems. In order to achieve effective communication, it is important to seek and find various alternatives, within which the use of touch, which becomes the most important resource, takes on special importance. The general objective of this research is to generate the design of a model as a proposal through the use of ICTs, in order to carry out the learning and use of sign language to establish effective communication with people with limited abilities auditory and language.

Theoretical Framework

Communication and information have become important tools today, are very important to be informed and communicated, in addition to allowing excel in the day to day in this competitive society, so there is a factor that stands out and plays a role Transcendental is communication, which is properly defined as the exchange of ideas, messages and information. (UNESCO, 2014), as illustrated in figure 1.

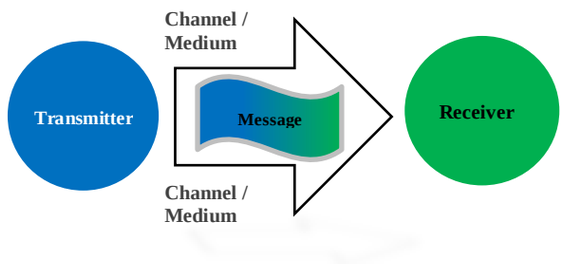

Figure 1 General context of the communication process
Source: Self made

The communication between people is based primarily on the language emphasizing the oral, which consists in transmitting and receiving messages in an alternative way. In general terms, communication is the process by which the Transmitter and the receiver establish a connection at a specific time and space to transmit, exchange or share ideas, information or meanings that are understandable to both. (Thompson, 2008).

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The language is the sum of various sections through which living beings can communicate ideas and / or feelings, either through speech, writing or other conventional signs, using all the senses to achieve communication. The language is of vital importance in the society, since it is an articulator system of conventions between individuals, that makes possible the social practice. Learning language is learning its different modes of occurrence. These modes of occurrence can be reactive or active in nature. (Ribes, 2007).

The main form of communication between human beings is the language spoken through signs (written), but this form is not always given, since for people with different abilities these means can not be used to make their needs or thoughts known. , which is why other means of visual communication are used such as signs, photographs, drawings, gestures, etc..

Languages (oral, written, corporal, gestural ...) influence the perspective of reality and can establish a criterion of the world. Languages build culture and this allows creating and identifying the various social groups. All people are unique, possessing diverse characteristics and living a life different from that of everyone else. More, however, most people have a set of common skills and abilities that usually occur in most people, in different situations and for different reasons, some of them lose or do not develop in the same way that most said skills. Therefore, these people may be affected due to various problems in different aspects of their lives, coping with different types of disability depending on the type of problems or skills or organs that show some variation.

A population with a disability is one that is characterized by presenting some physical or mental limitation for a period or permanently, which makes it impossible for it to develop its activities within the range considered normal for a human being. The General Law for the Inclusion of Persons with Disabilities defines a person with a disability as any person who, due to congenital or acquired reasons, has one or more deficiencies of a physical, mental, intellectual or sensory nature, whether permanent or temporary, and that when interacting.

With the barriers imposed by the social environment, can prevent their full and effective inclusion, on equal terms with others (Official Gazette of the Federation, 2016), it is essential to analyze the context of a person with disabilities (Figure 2), to understand and identify the needs of this sector.

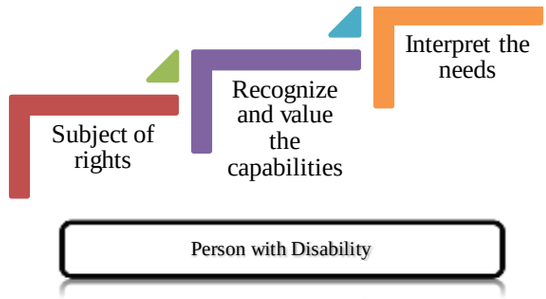

Figure 2 Description of the term person with disability
Source: Self made

The disability by state in Mexico, reflects significant numbers, according to the national survey of population dynamics 2014, it has a population rate with disability of 60 people on average per 1,000 inhabitants (Figure 3).

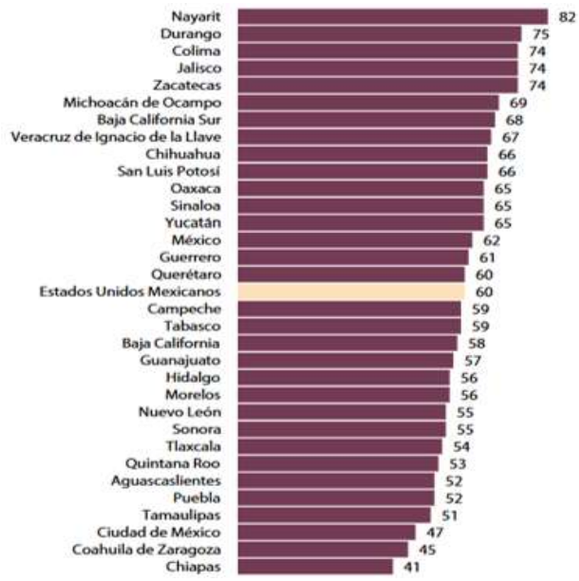

Figure 3 Rate of population with disabilities, by state 2014 (per 1,000 inhabitants)
Source: INEGI. National Survey of Demographic Dynamics 2014. Database. (INEGI, 2017)

There are several disabilities that afflict this sector of the population, among which may be mentioned, **1) physical or motor, 2) visual, 3) auditory or speech, 4) intellectual and 5) psychic**. (Gómez, 2005)

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Pointing out in a timely manner the people with hearing impairment, like other people, require equal opportunities to access all services on equal terms, also associated with language disability, which was defined as the loss or restriction of the ability to produce and convey an understandable meaning through speech.

There are several types of disabilities in the Mexican Republic, as shown in Figure 4, the percentage was calculated based on the total population with disabilities. (INEGI, 2017). The sum of the percentages is greater than 100, since a person can have more than one type of disability.

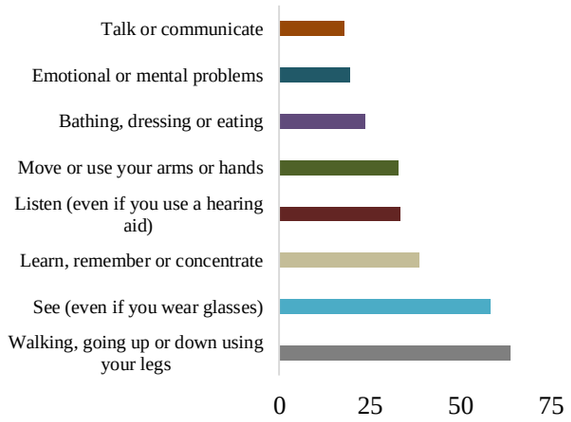

Figure 4 Percentage of population with disabilities, by type of disability 2014
Source: INEGI. National Survey of Demographic Dynamics 2014. Database. (INEGI, 2017)

The primary means of communication for people with hearing disabilities (PDA) is sign language (LS), although they use the textual form (that is, in written form) the disability impacts on the possibilities of educational access for people and approximately 29.9% of PDAs are illiterate. (Sánchez Orea, 2016).

According to the INEGI, 0.62% of Mexicans have difficulties to listen and, in addition to the discrimination and exclusion to which they are subjected, the biggest problem they face has to do with communication, because the vast majority of them did not learn their natural language since childhood, in adulthood they have affected their cognitive, educational, social and labor development.

The LS represents most of the time the only way of communication for this population. This language is sometimes unknown or there is simply little interest in learning it, which makes an important task for the integration of this population difficult because communication is essential for human relations, especially in the labor field.

The language used by deaf and blind people is an iconic language, also called sign language, which encompasses various forms of non-verbal communication, through body movements that have a specific meaning. Gesturing is another variant of non-linguistic communication based specifically on audio and touch.

There are tools to counteract the hearing disability such as the Mexican sign language, which is defined as the language of a deaf community, as shown in figure 5, consists of a series of gestural signs articulated with the hands and accompanied by facial expressions, intentional gaze and body movement, endowed with linguistic function, is part of the linguistic heritage of this community and is as rich and complex in grammar and vocabulary as any oral language. (Diario Oficial de la Federación, 2016).

Figure 5 Mexican Sign Language -Alphabet- (Seen by the viewer)
Source: (Lassal, 2014)

Within this range of possibilities we find the manual alphabet or dactylographic alphabet which is a communication system used by deafblind people, highlighted by its visual execution for deaf people (due to its visual or tactile communication), considered as a common communication system and unified.

The sign language (from the Greek "daktilos" -dedos-, and "logia" -science-, "science of the fingers") is a communication system that allows to know information through the technique of using the fingers of the hand. This system provides auxiliary support to the phonology of sign language, as well as artificial visual systems to disseminate information. Fingering is the technique of spelling and communicating with fingers or with the manual alphabet. (Del Real & Angel, 2014)

Information and Communication Technologies (ICT) are an invaluable tool at present, since it is considered indispensable in many areas, it provides people with quick access to a large amount of information, serving as a new communication channel that combines almost all media, such as writing, images and sound, is mass-produced, personalized and allows interaction between senders and receivers. ICT are conceptual theoretical tools, supports and channels that process, store, synthesize, recover and present information in the most varied way. (Corrales, 2009).

Likewise, technological resources coexist based on the use of ICT specifically designed to provide the possibility and faculty of accessibility to people with disabilities. Highlighting the use of technology in the creation of new tools to achieve an inclusive society, through innovative methods and techniques such as Augmented Reality (AR). The incorporation of Information and Communication Technologies in teaching and learning processes is gradually displacing traditional methods. (Martínez & Carracedo, 2012)

The RA systems use cameras or any other device that allows to capture the real world image and through another combine the image taken, with virtual objects, to later show by means of some device an image of mixed reality (real and virtual) towards the user, as shown in figure 6.

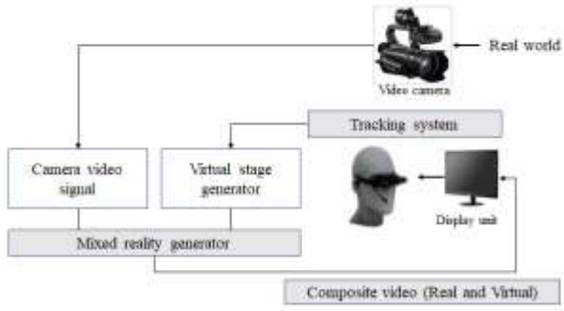

Figure 6 General scheme of augmented reality
Source: (Ponce, Ornelas, Lucio, Padilla, & Toscano, 2015)

The RA is a variation of virtual environments, in virtual reality the user is immersed in synthetic environments and is isolated from the real world that surrounds it. On the contrary, the augmented reality allows the user to see at all times the real world to which virtual objects are superimposed, coexisting both in the same space. (Martín & Brossy, 2017).

The development of the application will be carried out taking into consideration characteristics such as, iterative development, requirements management, use of the architecture (components), visual modeling and verification of the quality.

There are arbitrated documents that narrate a proposed solution to communication with people with hearing disabilities, using the sign language of Mexico, of which the following stand out: 1) The identification of signs using image processing techniques (Martínez Gutiérrez, Rojano Cáceres, Bárcenas Patiño , & Juárez Pérez, 2016) and 2) The Mexican sign language translator glove for deaf people (Hernández Sol, et al., 2017), providing the basis for the research carried out.

Methodology

To carry out the research, a study was designed that is based on eight stages, which include the 1) research proposal, in which the objectives and research questions are set out with the objective of identifying the scope and goals to be covered; followed by 2) feasibility of the investigation, stage where the relationships between the direct and indirect variables were identified and it was determined if it was feasible to carry out the proposed investigation.

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3) analysis of research and / or augmented reality models, analysis of PDA needs, people and interviews with experts, in this part of the investigation the analysis of the different proposals and technological tools that are immersed in the generation and RA creation, the needs of people with hearing impairment and the people with a link to them, as well as the views of experts in the generation of RA and LS; 4) Design, where the content, activities, evaluation and the analysis of the tools to be used for the 5) Development / Construction, through the creation of target (markers), was carried out to carry out the interactivity with the devices to perform the, 6) Evaluation / Testing, by the users, people and qualified personnel in the subject, for which part was given to the 7) Implementation, which provides society with an option to carry out the process teaching-learning of the Mexican sign language, besides specifically supporting people with limited abilities (auditory and language). 8) Augmented Reality (AR) in fingerprint systems, development of augmented reality for the inclusion in society of people with limited abilities (auditory and language), in order to achieve the objectives set.

These stages make up the methodological proposal proposed in this research, which is shown in Figure 7.

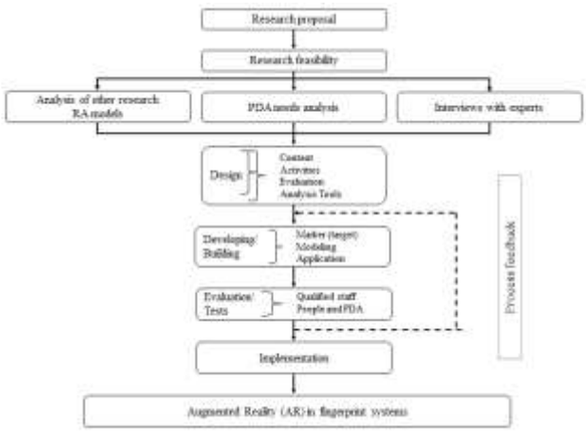

Figure 7 Methodological proposal for the development of augmented reality for fingerprint systems
Source: Self made

Given the multidisciplinary approach of the research, it was necessary to analyze and identify a methodology that would provide the opportunity to establish the development of the proposal for the generation of the application (APP), which resulted in the adoption of the Scrum methodology, used in software development as a quick and agile methodology.

The Scrum methodology is designed to achieve efficient and effective collaboration of teams in projects, which uses rules and defines roles that make up the structure necessary for its optimal functioning, as shown in Figure 8. Scrum uses an incremental approach that is based on the empirical process control theory. (Navarro Cadavid, Fernández Martínez, & Morales Vélez, 2013)

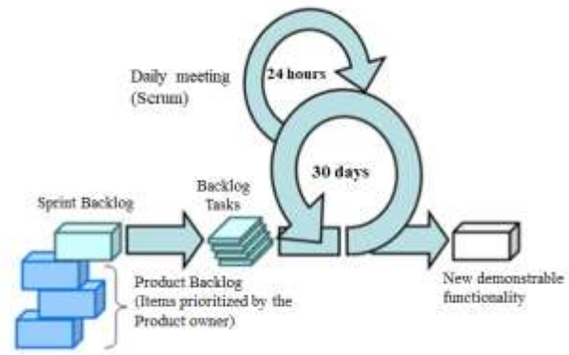

Figure 8 Scrum process
Source: (G. Caso, 2004)

Scrum is defined in a study based on 4 stages which include 1) requirements, for the development of the software the Product Backlog is established, which contains all the tasks necessary for the validation of the model, 2) analysis and design, planning the tasks that are carried out in the iterations defined in Scrum, as well as the choice of material for the RA application, 3) implementation, the tasks defined in the Sprint Backlog of the RA application, as well as the elaboration of the material that is not I could have obtained; at the end of each iteration the Sprint Review will be done to review the product and 4) Tests the application tests will be done before the Sprint Retrospective, once the software is finished, performing the validation of the technology.. (Solano Villanueva, Casas Díaz, & Guevara Bolaños, 2015)

Given the software's intangibility, obtaining requirements and / or requirements is the most important phase in order to interpret the need and therefore develop a solution. (Sommerville, 2005).

The importance of identifying the objects of study is essential to institute the set of descriptive features that will provide useful information in the process.

The technique used for the collection of information is the interview, which had as its main purpose to identify the needs of a proposed technological system supported with augmented reality to achieve the inclusion in society of people with limited hearing and speech capabilities.

The questions applied allowed us to identify the importance of creating an inclusive society, highlighting the problem of limited auditory or speech capacity, in a specific sector of the population, as well as identifying knowledge and availability to carry out learning and use of a sign language system, using for this purpose specific tools in the area of information technologies, such as augmented reality, linked to accessible technological devices, considering these as equipment or services that can be used to promote the functional capabilities of the people with disabilities in their daily lives as an independent and / or in their environment, supporting communication at all times with a sector of the population that has an auditory or speech limitation.

The collection of information was carried out in higher education institutions such as the University of Morelia, specifically in videogame engineering, applying the reagents to students and academic staff, as well as the Technological University of Morelia in information technology careers and communication, mechatronics and industrial maintenance.

The research investigates essential aspects such as knowledge of the subject, the difficulty of establishing a communication with this sector of the population, the perspective of carrying out the implementation of information technologies as a support tool for people with limited abilities.

The knowledge or manipulation of communication tools with people with hearing and language disabilities, with which the specific terms were detected as dactilological, allowing with the above to clearly identify the requirements and interested parties.

Having as a first stage resulting from the surveys, the proposal for the creation and design of a technological model to facilitate communication with this sector of the population supported by ICT's.

The software prototype to implement is an independent product created exclusively to achieve the communication of this sector with the rest of the population through the teaching-learning of the sign language. (sign language). The main function of this model proposal is to provide a technological tool for learning and teaching Mexican sign language (dactilological). Through the model and creation of friendly elements so that the application is usable. In addition, to identify that the proposal meets the requirements established for its development and for the user.

Results

The first element of the methodological proposal refers to the analysis of data that will allow to manage and compile the information collected for years, this allows to have the security of the information collected, identifying at the same time, the needs of the PDAs, as well as the different points from the perspective of experts in the field and of people who have innovated in this form of communication due to different circumstances, in such a way that the relationship of the various instances in the generation of augmented reality for the teaching process can be carried out learning in fingerprint systems.

After having carried out the design, the implementation and the RA generation process are combined, through the design of content such as phonemes, models, pronunciation and gesticulation to achieve in a definite way the necessary feedback to the user of being carried out. learning correctly, through the proposal of various applications and / or tools such as Unity, visual studio, blender, vuforia, adobe CC audition, linked with image capture devices such as webcam and smartphone.

The next stage is the development / construction through the creation of markers (target) consisting of defined images, which emanate with the conjugation of RA and Mixed Reality (MR), in hardware implemented in various image capture devices and movement, which allow obtaining models developed in Unity, programmed with Visual Studio and the assessment of our target created with the SDK (Software Development Kit) of Vuforia which provides a platform for the development of RA and MR applications, devices and applications used for the conformation of the RA are illustrated in table 1.

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Devices / Applications	
Hardware	Software
- Webcam - Kinect - Smartphone	- Unity - Vuforia (SDK) - Visual Studio - Blender - Adobe Audition CC - MySQL Server

Table 1 Computer tools devices and / or applications used for the generation of RA
Source: Self made

Figure 9 graphically describes some tools used, as well as tests performed to corroborate the function for the generation of augmented reality, which consisted of the use of selected technologies and implemented for the development of the RA, to perform the customization of the desired interface

Figure 9 graphically describes some tools used, as well as tests performed to corroborate the function for the generation of augmented reality, which consisted of the use of selected technologies and implemented for the development of the RA, to perform the customization of the desired interface.

Figure 9 Tools used for the implementation and RA generation process
Source: Own source

Initially, the identification of the markers based on the Mexican Sign Language (LSM) will be done, by means of which the image that will have as a background the marker can be selected, so that later it will be related to the personalized marker. Once the above is achieved, the evaluation of the users of the developed interfaces supported by technological tools such as the RA is carried out.

Next step will be the implementation in various devices with elements that facilitate and allow detecting movements and images to correctly identify the section and carry out the relationship for the teaching-learning process.

- **RA proposal in fingerprint systems**

The proposed operation of the augmented reality system (RA), will have as its main objective to evaluate if the user who is learning the sign language is correctly executing the Mexican sign language, so the system will allow the user practice both vowels and consonants as shown in figure 10.

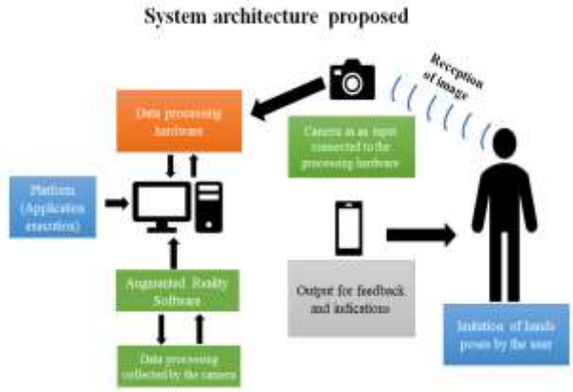

Figure 10 RA system proposal for learning of the Mexican sign language
Source: Self made

In the operation of the augmented reality system for the learning of the Mexican sign language, each one of the elements necessary for the operation of the system is identified, it is worth mentioning that its use by the user is also explained.

- **Hardware for data processing**

This device will store the augmented reality software (APP), in server mode, which will be interacting with each of the movements provided by the user, making the corresponding comparisons. It will have a database stored through MySQL server where each image will be saved and managed to carry out the comparison.

- **Camera**

It will act as input (data entry), be connected to the processing hardware, collect information provided by the movements that the user makes and send it to the data processing hardware, which in turn has the Augmented Reality platform installed and the base of data.

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- **Output**

This device can be a tablet or a smartphone, it will serve for feedback and instructions for the user, so it will have an RA system installed in client mode.

- **Data treatment**

a) Storage of personal data. - Through a database (MySQL) the user's data will be stored, such as his general profile and his progress in the advancement of learning.

b) Storage of images. - The images with which the movements made with the hand by the user will be compared, said images will be developed through models that will be carried out in Blender (application for 3D modeling), they will be stored in a database to later take to complete an evaluation. The images correspond to the vowels and consonants of the Mexican sign language.

- **Augmented reality software**

It will be the person in charge of processing the information, it will be installed both on the server and on the client, this application will be made through applications such as Unity and Vuforia, with the purpose of creating interactive experiences of RA, through a specific response generated by the interactivity of a target, which will allow the user to manipulate the application and at the same time receive feedback. The models to be implemented would be developed through the Blender application (modeling).

- **Operation by the user**

Then, in figure 11, the process of user interaction with augmented reality software is shown.

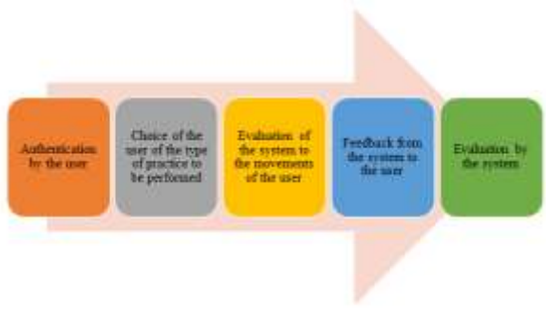

Figure 11 User-System RA interaction process
Source: Self made

Conclusions

Communication has become a primary weapon in society, research pursues the purpose of creating a methodological proposal with the use of information technologies, specifically augmented reality, which will support and encourage the learning of Mexican sign language (sign language).

The proposed general model consisting of eight stages allowed a proposal to be made, feasibility was approved, as well as the identification of other investigations in order to identify parameters and cases analyzed, also receiving the support of people related to PDA and the valuable opinion. of experts in the field to identify even the smallest characteristics to develop a proposed quality solution, leading the planning of a design that allowed identifying the content to be developed along with the activities necessary to achieve the learning of the LS with RA, the evaluation to identify a quality product, as well as the computer tools to be used in space-time movement capture hardware, such as Kinect, webcam, smartphone to name a few and in the software part the use of reconfigurable models by adaptation and learning used for recognition of patterns, such as Unity, Vuforia (SDK), visual studio, blender and audio editors, subsequently developing the RA model construction, which will lead to tests to identify inconsistencies on the part of PDAs, users and experts, performing the pertinent modifications taking the evaluation back to a useful outline, to carry out the implementation of Augmented Reality (AR) in signatory systems.

The research of theoretical sources focused on obtaining knowledge of the dactylological alphabet, helped to understand the way in which projects of this type with similar characteristics were developed. In addition to contributing with ideas about the development of the model to be implemented and finally the research contributed to understand the need that exists in developing applications of teaching the alphabet dactilológico (Sign Language Mexican).

Applications for mobile devices can help solve problems in society in various fields such as the individual or the general, due to its mobility and ubiquity characteristics.

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The use of augmented reality shows that the learning process can be much more effective if it is performed in a dynamic, fun, entertaining, or in a way that can clearly visualize the object of the study in question, in the case of learning of the Mexican sign language the user is interested in the basic knowledge of signs, its ease of use, the realization of tests that identify the interpretation of what has been learned, with the latest technology tools that provide portability and friendly interface.

At present, technological support provides one way or another to improve intrapersonal communication, and aspects related to the personal sphere. These technologies are created and adapted to benefit people in any field such as education, social, communication, and aspects related to the field of culture..

We must emphasize the description of the development of a system integrating hardware-software to automatically identify the fingerprint language used by PDA. The hardware in the development proposal for the system is composed of a device that captures the gestural movements of the hand of an individual, in terms of a series of signals in space time, the software poses a computational model for adaptation and learning, which allows the automatic recognition of said movements in terms of a particular sign language.

The model proposal aims to become a useful instance that guarantees reliability and effectiveness in the learning of the Mexican sign language, with a greater range of didactic content that allows the user to see and identify from different perspectives the signs that make up the sign language. Creating with it the bases to carry out the creation of an inclusive society with the support of avant-garde technological tools. Because the proposed model incorporates a mechanism for adaptation and supervised learning with feedback.

These gestural movements used will validate the recognition system when used for an individual without any limitations in the field of speech-listening, in addition and thanks to the wide range of temporal gestures used for the representation of the same vowel, the model can be used to be identified by any individual for the Mexican sign language.

The development of the model seeks the teaching-learning of sign language in a more interactive, dynamic and immediate way, in order to reaffirm an identity as a community of people with hearing impaired people and people who do not suffer from this limitation, with the abrasive the task of building an inclusive society. Through an application that also encourages the interaction of users, breaks with the classic passive learning experience providing a richer and more effective learning.

Without neglecting the constant assessment of qualified personnel, people closely linked to hearing impairment and PDA. With which it is intended to generate an application that far from those created to date allows to assess the teaching-learning process of users to achieve the correct communication with this sector and to be able to carry out the creation of an inclusive society.

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Design and simulation of a vertical wind generator

Diseño y simulación de un generador eólico vertical

CHÁVEZ-CANO, Omar†*, MUÑOZ-HERNÁNDEZ, Germán Ardul, TURIJÁN-ALTAMIRANO, Salomón Noé and RODRÍGUEZ-GONZÁLEZ, Julio

Tecnológico Nacional de Mexico / Instituto Tecnológico de Puebla

ID 1st Author: *Omar, Chávez-Cano* / **ORC ID:** 0000-0002-1883-1932, **CVU CONACYT ID:** 857314

ID 1st Coauthor: *German Ardul, Muñoz-Hernandez* / **ORC ID:** 0000-0003-4861-0345, **CVU CONACYT ID:** 122490

ID 2nd Coauthor: *Salomón Noé, Turiján-Altamirano* / **ORC ID:** 0000-0003-3790-7055, **CVU CONACYT ID:** 377682

ID 3rd Coauthor: *Julio, Rodríguez-González* / **ORC ID:** 0000-0003-0515-778X, **CVU CONACYT ID:** 78003

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Abstract

The present work describes the design of a Savonius vertical wind generator, low power; To generate electricity for everyday use, which will help the care of the environment. The design is based on the environmental conditions registered at the Technological Institute of Puebla, based on them the materials and components necessary to support the generator were selected, seeking to work efficiently.

Savonius, Generator, Wind, Low power

Resumen

El presente trabajo, describe el diseño de un generador eólico vertical tipo Savonius, de baja potencia; para generar energía eléctrica de uso cotidiano, con el cual contribuimos al cuidado del ambiente. El diseño está basado en las condiciones ambientales registradas en el Instituto Tecnológico de Puebla, con base en ellas se seleccionaron los materiales y componentes necesarios para dar soporte al generador, buscando que trabaje de manera eficiente.

Savonius, Generador, Viento, Baja potencia

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* Correspondence to Author (email: omarchavezkano@gmail.com)
†Investigador contribuyendo como primerAutor.

Introduction

Until a few centuries ago, humanity covered all its energy demands with solar radiation, the movement of water and wind was used to generate mechanical energy, while wood was an ideal converter of solar energy into storable chemistry, since it gave the heat necessary for homes and other technical applications [1].

According to Lewis, The use of wind generators brings with it some benefits such as: expanding the fields of development and research, increasing technological capabilities and producing less pollution when generating electricity [2].

The Savonius type vertical wind generator was developed in principle by Flettner, using a rotor that is formed from the cut of the cross section of a cylinder, and then rejoined and formed an "S" very similar to the one shown in the Figure 1. [3] [4]

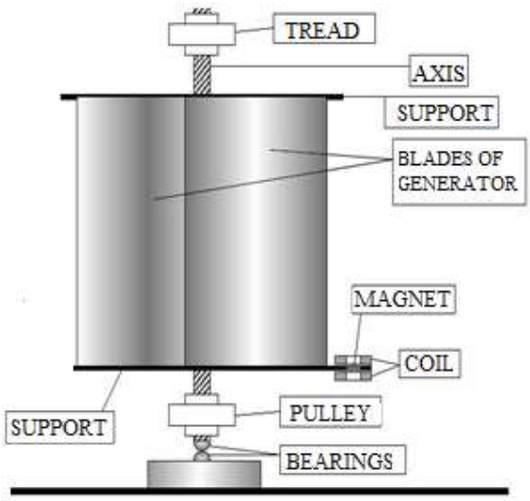

Figure 1 Savonius Generator

The need to take care of the environment has motivated people to look for new ways to generate electricity and with the exponential growth of the population it is important to create devices that work with alternative energies, to continue giving comfort to humanity.

There are many types of generators and many combinations between them, which work smoothly. Some in places with large air flows, but where the wind speed is very low, there are low power generators such as vertical axis.

There are two types:

a) Those of differential drag that take advantage of the difference in wind force between a concave and a convex surface (Savonius).

b) The cyclic incidence variation rotor (Diarreus), as observed in Figure 2.

The development of these mechanisms has been thanks to the research and application of new technologies, together with the selection of new materials, which give us new parameters for their construction and thus increase their efficiency in energy generation.

Figure 2 Vertical Generators
Source: Academia.E.Unavarra

Objective of the project

Design and simulate a low power Savonius wind generator in the flow simulation solidworks 2018 program.

Specific objectives

Design a savonius type generator capable of operating with a wind speed of 1.2 m / s at 2.5 m / s.

Simulate the Savonius type generator under the climatic conditions of the Technological Institute of Puebla.

Design methodology

The selection of the vertical wind generator is based on the environmental conditions of the place where it will be installed (Instituto Tecnologico de Puebla), with geographical location of **19°04′11″N 98°10′08″O**, as described below:

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- Average wind speed 2 m/s
- Altitude 2160 msnm.
- Air density 0.889 $\frac{km}{m^3}$.
- Class roughness 6 (table 2).
- Atmospheric pressure of 1017 hPa.

Savonius generators are rare mechanisms, since these are applied where the air currents are low or in places where electrification is sought to exist more easily.

Vertical axis generators present as the most relevant advantages:

a) A vertical symmetry, so they do not require guidance systems.

b) They have better accessibility, so maintenance tasks are facilitated.

c) They do not require start-up and step change mechanisms [1][6]

The average air speed is very low, as indicated by the Beutherford scale [5] in Table 1 and also because there is a lot of roughness in the environment, it is very difficult for the wind to circulate freely.

Degrees	V(km/h)	V(m/s)	Description
0	1	0.0-0.4	Calm
1	1-5	0.5-1.5	Very light wind
2	6-11	1.3-3.4	Wind light
3	12-19	3.5-5.5	Breeze
4	20-28	5.5-8.0	Moderate
5	29-38	8.1-10.9	Fresh wind

Table 1 Beutherford scale

According to the information obtained through the anemometer, used to collect the data, it follows that: the average of the minimum annual speed is 5.6 km / h and the annual maximum of 9 km / h as shown in Figure 3, which indicates the behavior of wind speed.

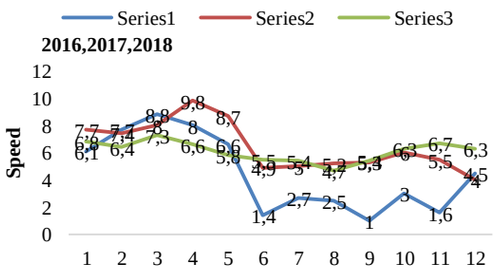

Figure 3 Speed chart

The power coefficient relates the extracted power and the total wind power. By Betz's Law, it is impossible for a machine to extract all the power of the wind. In this way, the power extracted by the wind turbine will depend on its power coefficient, which in turn depends largely on the shape of the blades.

Betz's Law postulates:

"Only less than 16/27 of the kinetic energy of the wind can be converted into mechanics using a wind turbine, approximately 59%.

Theoretically, not many equations have been developed that relate the power coefficient to the characteristics of the Savonius rotor. [7]

Experimentally, curves have been constructed where they explain the power coefficient as a function of the speed of the different air generators (Figure 4), which relate the power coefficient to the blade tip speed; where it has been found that the maximum power coefficient of a Savonius rotor reaches the value of 0.33. [5]

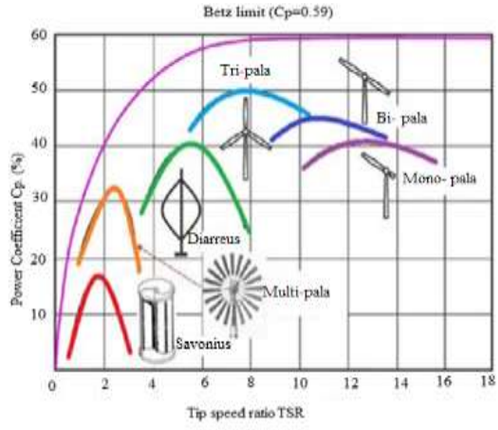

Figure 4 Power coefficient
Source: Villarubia Wind Engineering

In Figure 5, it is observed how the wind hits the place where we will place the wind generator, coupled with it, the direction in which the wind moves, which is from south to west, is indicated.

Figure 5 Speeds gradient

The data obtained in Figure 3 indicate the wind behavior, but in Figure 6 we observe the wind rose, which tells us how the wind moves and in which direction, although to us by the Savonius type generator that we select, it is indifferent since these types of generators work in any wind direction.

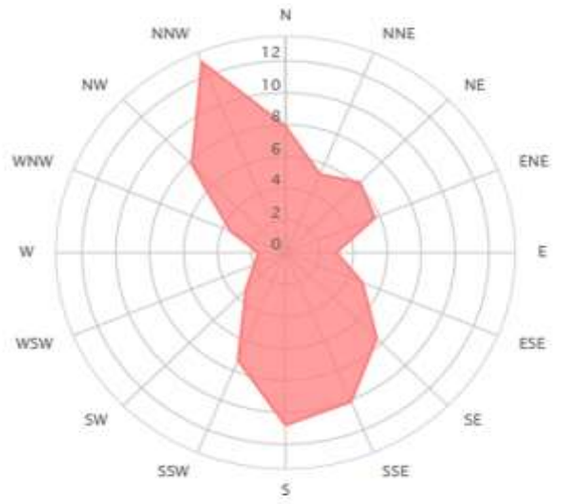

Figure 6 Wind distribution in the area of the Technological Institute of Puebla

It is important to define some parameters before starting the design of the wind turbine, which serve to take into account some structural and geometric characteristics, such as: the bearings, the arrow of the model to be designed, as well as the environment in which the wind machine will be installed; as seen in Table 2, which describes the roughness.

Class	M	Description
1	0.0009	Water free surface
2	0.005	Naked soil or with very little vegetation(.30m)
3	0.05	Soil covered with vegetation (2m),or naked floor
4	0.4	Low building
5	0.8	Alborea vegetation with heights over 4m.
6	1.0	High building

Table 2 Roughness of the environment

With the information collected, both from the environment and the power coefficient, we can design the Savonius generator. Considering the necessary data to calculate its dimensions shown in Figure 7, which generated the following data for its design:

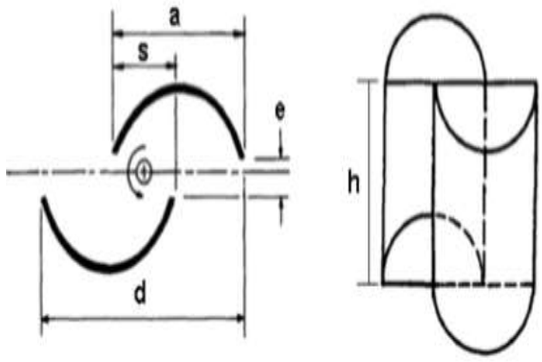

Figure 7 Savonius Generator, dimensions of blades

Generator Dimensions:

- Speed: 2.5m/s
- Air density 0.889 $\frac{km}{m^3}$
- Sweep area :0.50m
- d:0.50m
- h:1m
- e: 0 m
- s:0.075m

Total power extracted

The amount of wind energy that can transform an equipment into electricity, depends mainly on the wind speed at the site where the generator will be installed

For different reasons, as already mentioned above, it becomes difficult to extract all the kinetic energy existing in an air stream. The power that the system threw at us, taking the characteristics of the place are:

$$Pe = h_n h_e (c_p(\frac{1}{2}\rho A v^3) = 0.472w \quad (1)$$

The resultant rotation speed:

$$W = \frac{TSR.v}{r} = 8\ \frac{rad}{s} \quad (2)$$

And the system revolutions with the calculated speed is:

$$N = \frac{60.w}{2\pi} = 76.4\ rpm \quad (3)$$

Wind turbines that have a smaller blade tip speed are the ones with the highest torque values.

This makes them more recommended for applications that require a high initial torque, such as pumping systems or power generation.

The torque delivered to us by the system is:

$$T = \frac{Pe}{w} = .059Nm \quad (4)$$

The force of the wind that was calculated was:

$$Pv = \rho\ \frac{v^2}{2} = 2.7\ Pa \quad (5)$$

Generator material

The selected material meets the necessary characteristics to withstand the climatic conditions of the place, in addition to being resistant, light, economic and commercial. This material is shown in Table 3.

Materials	Weigth	Thickness	Blade size	Cost
Stainless	2.6 kg / m^2	0.3mm	1.22 x 3.05 m	6500
Galvanized sheet	----------	.5mm	0.91x4.27m	1800
Acrylic	----------	0.3mm	0.60 x120 m	1500
Carbon fiber	----------	.5mm	0.30x0.50m	7000

Table 3 Materials Matrix

The best option for characteristics of weight and workability was the acrylic with a thickness of 0.3mm, because it has:

a) Weather Resistance Mechanical strength. It has a resistance of 0.2 to 0.5. In comparison it is 6 times stronger than glass.

b) Chemical reactivity It is inert in contact with water, alkalis, aliphatic hydrocarbons and simple esters.

c) The selection of the materials of the structure was a half-inch square PTR square tube of steel to help withstand the force of winds and weather conditions, as seen in Figure 8.

Figure 8 Tubular structure

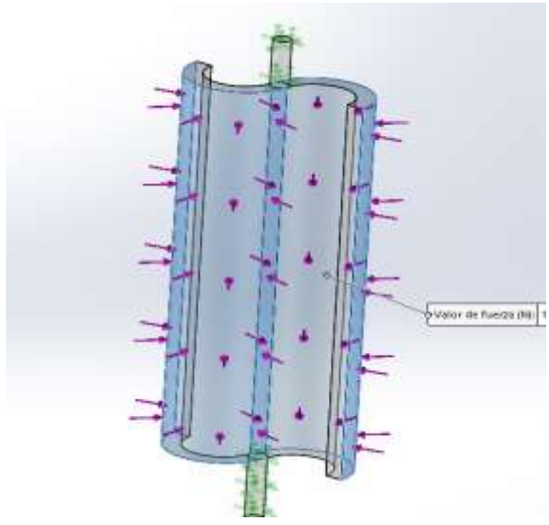

Figure 9 Total assembly

The generator design was built in solidWorks software where it was made part by part until assembled as shown in Figure 9.

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Figure 10 Arrow efforts

Mechanical simulation

To observe the efforts of the material due to the force of the wind, we used the simulation tool in SolidWorks that facilitated the identification of the contact points, as in the arrow that holds the blades together, which is half an inch aluminum to help the mechanism not to drag more weight, as seen in Figure 10. [7]

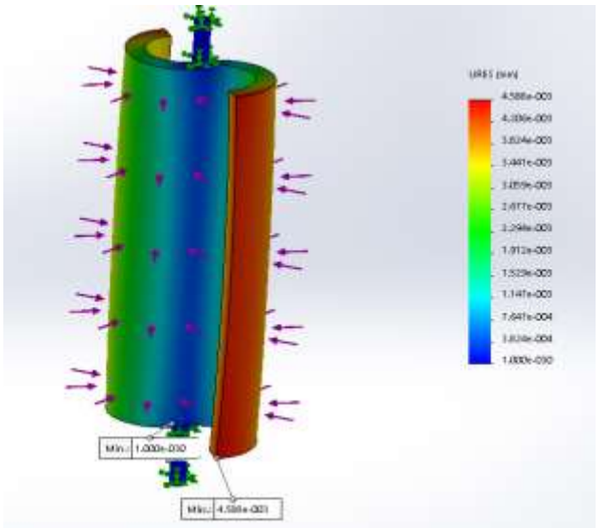

Figure 11 Material effort

Figure 11 shows the complete simulation with the wind force of 2.7 Pa on the Savonius generator passing through the blades, where the red part indicates that the greatest effort to which the savonius generator will be subjected is 4.500 $x10^{-3}$ N/m.

Minimal effort is 1.00 $x10^{-3}$N/m, considering the material that is 3mm thick acrylic and the dimensions previously obtained.

The simulation is carried out in Solidworks using the flow simulation tool in order to observe the behavior of the system affected by the air flow, which collides with the generator blades where the turbulence is shown (Figure 12).[9]

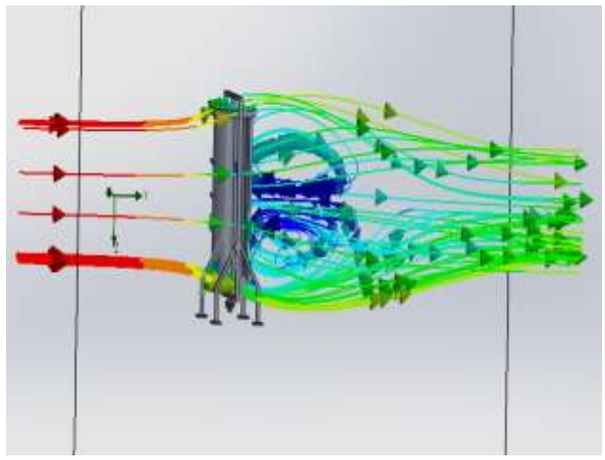

Figure 12 Turbulence simulation

Conclusions

The design of the Savonius vertical wind generator, gives us a mechanical power of 0.47 W with dimensions of 0.50m wide by 1.00m high; with these characteristics it is important to select a good material to face the climatic conditions of the place.

If the generator were placed in a higher place and with less roughness, this would give us more power and in turn would have more effort with respect to the air.

Both in the design and in the selection of the material it is important to understand that the air speed is very low, so that said material will have to be as light as possible, to help the system, making it have the least possible drag.

When increasing the power of the Savonius wind generator, a larger sweeping area would have to be managed, therefore the dimensions of the generator should be proportionally increased; as well as the design parameters.

When doing the simulations in the software, this shows us how the generator would behave with real work, with which we can take new ideas to build the prototype in the future.

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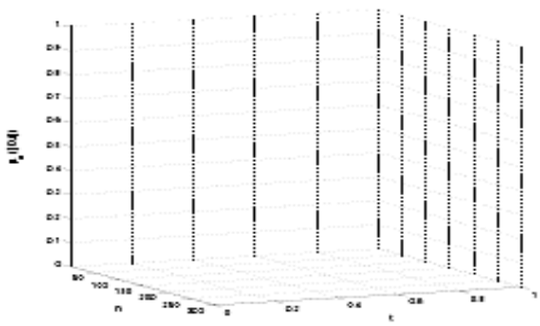

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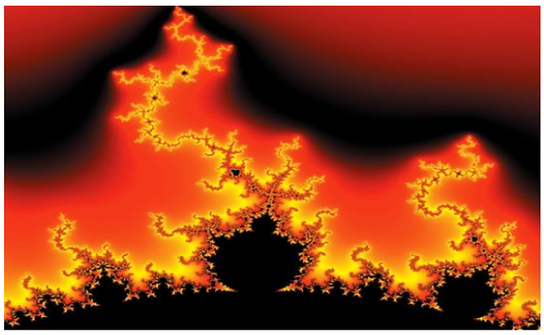

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21 Santa Lucía, CP-5220. Libertadores -Sucre–Bolivia. Phones: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; Email: contact@ecorfan.org www.ecorfan.org

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