ISSN 2531-2960

Journal of Technological Development

Volume 6, Issue 18 – July – December – 2022

ECORFAN®

Journal of Technological Development

Volume 6, Issue 18, July – December 2022, is a journal edited sixmonthly by ECORFAN. 38 Matacerquillas street, Postcode: 28411. Moralzarzal – Madrid WEB: www.ecorfan.org/spain, journal@ecorfan.org. Editor in Chief: BANERJEE, Bidisha. PhD, ISSN Online: 2531-2960. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda. PhD, LUNA-SOTO, Vladimir. PhD, 38 Matacerquillas street, Postcode: 28411. Moralzarzal –Madrid, last updated December 31, 2022.

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Presentation of the Content

In the first chapter we present, *Data analytics in the management of avocado export certificates*, by OCHOA-ORNELAS, Raquel, VARGAS-DUEÑAS, Annet and FIGUEROA-MILLÁN, Patricia Elizabeth, with ascription in the Instituto Tecnológico de Ciudad Guzmán and Instituto Tecnológico de Colima, as a second article we present, *Training dataset generation for semantic segmentation utilized unmanned aerial vehicles*, by LÁRRAGA-ALTAMIRANO, Hugo René, HERNÁNDEZ-LÓPEZ, Dalia Rosario, PIEDAD-RUBIO, Ana María and AVILÉS-GUERRERO, Carlos Leonardo, with ascription in the Tecnológico Nacional de México, Campus Ciudad Valles, as the following article we present, *Implementation of information technology in Colegio de Bachilleres de Chiapas*, by HERNÁNDEZ-GORDILLO, José Luis, HERNÁNDEZ-ZAMBRANO Luis Alberto and VELÁZQUEZ-GAMBOA, Pablo Salvador, with ascription in the Universidad de Ciencias y Artes de Chiapas, as the following article we present, *Photovoltaic system at UTNC*, by RINCÓN-MALTOS, Gerardo, MARTÍNEZ-SOTO, José Santiago, MARTÍNEZ-MERCADO, José Alfredo and DE LUNA-ALVAREZ, Rosendo, with ascription in the Universidad Tecnológica del Norte de Coahuila.

Content

Artícle **Journal of Technological Development**
December 2022, Vol.6 No.18 1-11

Data analytics in the management of avocado export certificates

Analítica de datos en la gestión de certificados de exportación de aguacate

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DOI: 10.35429/JTD.2022.18.6.1.11 Received July 10, 2022; Accepted December 30, 2022

Abstract

When issuing avocado export certificates, a high volume of data is generated. Consequently, its analysis is complex due to processing times. This paper presents a Web platform that can analyze and process sequences and comparative statistics with projections during the management of these certificates. During the development phase, interviews were conducted with users to gather the requirements by the Jalisco Avocado Growers and Exporters Association (APEAJAL), through a formal specification using the Unified Modeling Language (UML). Programming languages for coding such as Android Studio, PHP, JavaScript, HTML5, AJAX, jQuery, Bootstrap and MySQL were used. This project provides support for decision-making processes, favoring strategies in the association's senior management, contributing significantly to offering a reliable platform for the registration and monitoring of certificates.

Platform, Analysis, Data, Export, Projections, Strategies

Resumen

Al emitir certificados de exportación de aguacate se genera un alto volumen de datos. En consecuencia, su análisis es complejo debido a los tiempos de procesamiento. En este trabajo se presenta una plataforma Web que tiene la capacidad de analizar y procesar secuencias y estadísticas comparativas con proyecciones durante la gestión de estos certificados. Para el desarrollo, se realizaron entrevistas con los usuarios para recabar los requerimientos por parte de la Asociación de Productores Exportadores de Aguacate de Jalisco A.C. (APEAJAL), a través de una especificación formal por medio del Lenguaje Unificado de Modelado (UML). Se emplearon lenguajes de programación para la codificación como Android Studio, PHP, JavaScript, HTML5, AJAX, jQuery, Bootstrap y MySQL. Ese proyecto brinda apoyo a los procesos de toma de decisiones, favoreciendo estrategias en la alta dirección de la asociación, contribuyendo significativamente en ofrecer una plataforma confiable para el registro y seguimiento de certificados**.**

Plataforma, Análisis, Datos, Exportación, Proyecciones, Estrategias

Citation: OCHOA-ORNELAS, Raquel, VARGAS-DUEÑAS, Annet and FIGUEROA-MILLÁN, Patricia Elizabeth. Data analytics in the management of avocado export certificates. Journal of Technological Development. 2022. 6-18:1-11.

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Introduction

The avocado industry has grown internationally due to the rising market and consumption demand in America, Europe, and Asia, improving production and industrialization in areas capable for its cultivation. The main countries dedicated to avocado production are Mexico, Guatemala, Peru, Israel, the United States, Spain, South Africa, and Australia (Solís, 2022). Mexico is considered one of the main countries that cover demand avocado in Canada and the United States during the months of October to January (Cánepa et al., 2022). On the other hand, the European Union is one of the most important avocado export markets in Latin America, however, the European Green Deal represents a challenge to an ecological economy associated with greater safety and security control, which promotes greater competitiveness, generating challenges in different producing countries to enter this market (Collaguazo, 2022). The COVID-19 pandemic has adversely affected the food sector, because of this 85% of Mexican exporting companies established plans and implemented export strategies (Ramos et al., 2022). Moreover, the agricultural sector is one of the most affected by globalization, rising the costs of inputs and services without exclude financial services. In Mexico, bank financing has been affected by climate risk, as well as by the uncertainty in the legal environment. In addition, there is a culture of individual production, added to the fact that financial credits in the agricultural sector are established in long term, increasing the uncertainty in projects (Magallán, 2022).

Information systems play an important role in companies, since in addition to requiring processes and transactions to be carried out efficiently with suppliers and customers, it is essential to maintain competitiveness in the market with timely and accurate decisions. These store and manage data producing reports, enhancing databases over time for later access to accurate knowledge, which is made available to managers to establish strategies and make decisions (Araya et al., 2019). Currently, this data is generated massively, making it difficult to process and analyze, requiring the intervention of emerging technologies such as Big Data.

Big Data is present in the global economy and in different sectors, generating intelligence for organizations through the analysis of massive data that includes three important properties: volume, variety, and speed. The last property is related to the speed in generating and transmitting data through technologies and tools, models, and data analysis techniques, providing knowledge for decision making. From an analytics approach, data management includes retrieving, storing, analyzing, and displaying the results. Therefore, it is essential to integrate engineering principles so that the organization manages the flow of its data for subsequent analysis that generates results dynamically. Data engineering is responsible for the generation, collection, and storage. While data analysis includes the generation of mathematical and statistical models, implementation, and visualization (Rossi & Hirama, 2022).

This applied research is focused on the development and implementation of a computer platform in a Web environment at an administrative and managerial level that facilitates the processes in the acquisition, analysis, and comparative statistics of data from export certificates that are granted to avocado packing companies. Considering the above, at this administrative level monitoring and control functions are identified that require a strategic planning tool to examine opportunities that serve as a basis for decision-making (Araya et al., 2019). The developed platform allows the database to be consolidated in each operation or transaction that is registered to subsequently generate knowledge through data analytics, resulting in comparative statistics of production by seasons in the different periods. In addition, it incorporates the consultation and statistics section in a mobile application available to the directors of the association so that they have access to this information at any time.

Theoretical framework

Information systems

The most valuable asset for companies is to have immediately, accurate information, since it allows knowing the context of the horizon and situation, identifying opportunities to establish strategies and improvements (Carrillo et al., 2019).

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Information systems have evolved in recent years, covering user information requirements at the managerial level, acquiring greater complexity and commitment to the use of external information. The information is integrated into a corporative strategy, using current information technologies that allow competition and business growth based on support instruments that company managers require for assertive decision-making (de Pablos et al., 2019). Information systems in small and medium-sized companies represent a useful tool for their operational development and analysis of their situation, since they facilitate data acquisition and processing, as well as Systems must to adjust to the requirements of different users and levels of the organization.
(Cordero, et al., 2020).

Systems must adjust to the requirements of the different users and levels of the organization. Different levels are identified in management information systems, some focused on storing and processing data and others on monitoring and control. Management-level systems generate regular reports that relate to the periodic operations that are carried out. Transaction processing systems track the internal and external operations carried out by the company. Management systems are classified into decision support systems and management systems. As a functional perspective, support systems are contemplated in senior management whose purpose is to determine a forecast of trends. In middle management the interest is on the analysis of reports and in operational management the attention is focused on the processing of operations and transactions (Araya et al., 2019).

Carrillo et al. (2019) mention that the term Business Intelligence (BI) was used since 1958 by Hans Peter Luhn, defined as "collection and use of knowledge based on facts in order to improve business strategy and tactical sales in the market". In the 1960s and 1970s, when the first database applications emerged, there was a lack of adequate technologies for accessing and processing them. They consider BI as the set of techniques to integrate data for its exploitation, in order to acquire useful information to detect opportunities or problems based on the analysis of historical data, making comparisons, obtaining reports through an appropriate format and later the knowledge to alert atypical events or set strategies.

Intelligent business systems integrate BI tools that organize data to manage knowledge with analytical instruments. BI saves time to locate information of managerial interest and to generate graphics in a short time. It allows establishing goals by comparing historical and current financial results or those of other companies, generating future projections. The preparation of the data includes the ETL component (extraction transformation and loading). Extraction process retrieves information related to the problem. Meanwhile, transformation process involves placing the extracted information in a specific format. Finally, the load process refers to the knowledge that is obtained when processing and analyzing the data (Cordero, et al., 2020). Rossi & Hirama, (2022) explain that preprocessing with algorithms should be considered to eliminate noise, dirt or biases that may hinder the analysis. Other similar concepts are considered such as data mining, OLAP (online analytical processing), data warehouse, data mart (subset of data from a business line), reports, among others (Carrillo et al., 2019).

UML

UML describes the behavior and structure of a business system or process. It is implemented in the 1990s by Grady Booch, Ivar Jacobson, and James Rumbaugh to represent software development in a standard way. The main advantages are that it simplifies complexity, increasing the quality of work, reducing costs and time, keeping open communication between developers and users. UML diagrams are classified into structure diagrams and behavior diagrams to represent different types of scenarios (Microsoft, 2019).

MySQL

MySQL emerged in the 1990s as a relational database manager for simple Web projects, however, it gained strength with good performance on low-processing servers. In addition, it is stable and free and offers different communication protocols between the client and server, both locally and in a remote client. There are some variants of MySQL such as MariaDB that emerged in 2009 as an alternative to the Oracle version (Combaudon, 2018).

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PHP

Arias (2017) defines PHP as Hypertext Pre-Processor. It is an interpreted language that is considered among the first for the insertion of HTML documents, freely used for applications on the server side with dynamic content on the World Wide Web. PHP is used in applications from MediaWiki, Facebook, Drupal, Joomla, WordPress, among others. It appears for the first time in 1994, when Rasmus Lerdof creates a package of CGI programs to replace the Perl script, with the name of Personal Home Page.

JavaScript

Pérez (2019) states that in the 1990s the Internet connection reached a speed of up to 28.8 kbps and forms began to be included in increasingly complex applications. If the form was captured incorrectly, it was necessary to wait for the response from the server to display the errors. In 1995 programmer Brendan Eich solved the problem with existing technologies in the Netscape Navigator 2.0 browser, calling the LiveScript language. Netscape later signs a contract with Sun Microsystem to change the name to JavaScript, which was already built into Netscape Navigator 3.0. For its part, Microsoft releases JScript in the Internet Explorer 3 browser. Netscape standardized the language to JavaScript in 1997 by submitting the JavaScript 1.1 specification to the European Computer Manufacturers Association (ECMA), which named ECMAScript to refer to JavaScript.

Luna (2019) comments that JavaScript is an interpreted, typed, dynamic and object-oriented programming language. It is based on the C language, and in the latest versions, the language runs on both the client and server sides. Currently, it is integrated into the main navigation engines. JavaScript code can be embedded inside the HTML in the <script> tag, or outside the HTML by using an external file with a JS extension to embed it in the HTML in the src attribute of the <script>. It is also possible to use JavaScript through the console in Google Chrome from the developer tools.

AJAX

Castillo (2017) states that AJAX is the acronym for AsynchronousJavaScript and XML created by Jesse James Garrett in 2005, while the XMLHttpRequest object was introduced by Microsoft in 1999. AJAX is integrated into the Javascript language and allows requests to be made to the server without delay. to reload the HTML page. In the first versions, the XMLHttpRequest object was used, which included an onreadystateschange event handler.

jQuery

Parada (2019) defines jQuery as a JavaScript library that was created by John Resig in 2006 and that adds an AJAX interaction layer to handle events in Web applications. jQuery is free and open-source software that makes it easy to access and select Document Object Model (DOM) elements by offering plug-ins to developers through low-level animation and interaction abstractions and high-level advanced effects by generating code simplified compared to code with just JavaScript. It also allows you to develop complex scripts to validate forms before they are sent. Boduch, et al. (2017) comment that the jQuey library offers a general-purpose abstraction layer for Web scripts allowing to access the elements of a document, alter the content or appearance of the Web page, respond to user interaction, as well as display the change being made by retrieving information from the server without the need to refresh the page.

JSON

Afsari et al. (2017) defines JavaScript Object Notation (JSON) as a more efficient data exchange format than Extensible Markup Language (XML) using AJAX. Sourd (2022) explains that JSON was created by Douglas Crockford in 2002 as an alternative to XML and defines JSON as the representation of a lightweight format designed to exchange data, since it reduces the volume of data and consequently the size of the files to transmit. The format represents a subset of the JavaScript syntax, allowing JSON definitions to be accessed without any additional parsing.

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Zhou (2022) explains that JSON supports two types of structures, the object structure as key-value pairs separated by a comma and enclosed in {}, and the array structure of a set of multiple values. It also comments that to retrieve data, the string must be converted to a native JavaScript object, as it has a global JSON object with conversion methods. It is widely used in data mining. You can easily and quickly exchange data between applications developed in different languages. On Android, an application can interact with a database installed on a Web server, using the JSON format.

Bootstrap

Mercy (2019) explains that the Bootstrap library is made up of various components such as Accordion, Alert, Buttons, Carousel, Collapse, DataPicker, Modal, ToolTip, among others. These components contain properties and functionality that can be replicated in Web application development. Logrono et al. (2020) consider Bootstrap as an agile work environment in Web development. Ortega et al. (2019) explain that Bootstrap was developed by Mark Otto and Jacob Thornton, who also developed Twitter. It was created to drive consistency and speed up project development. In 2012 the first version of Bootstrap was released by Twitter as open source, under the "Apache 2 License" copyright 2013 Twitter. The library considers four types of grids for different resolutions, automatically adjusting the columns to the device. It includes style sheets that allow to give uniformity and good appearance to HTML elements, also containing reusable components and plugins based on JavaScript jQuery.

Android studio

In 2005, Google acquired Android Inc., a company dedicated to the production of mobile applications. Subsequently, the mobile-optimised Java virtual machine (Dalvik VM) was created. The Open Handset Alliance consortium was formed in 2007 by Google, Intel, Texas Instrument, Motorola, T-Mobile, Samsung, among others, with the aim of developing open standards for mobiles. Android consists of a Linux kernel, native libraries (System C Library, Media Framework Surface Manager, WebKt/Chromium, SGL, 3D libraries, Free Type, SQLite, SSL), the Dalvik or ART virtual machine with Core libraries, application environment (Views, Resource Manager, Activity Manager, Notification Manager, Content Providers) and applications (Gironés, 2019). The Android Studio Chipmunk version is available from 2021 (Android Studio, 2022).

2.11 Volley

Lachgar et al. (2018) states that Android applications uses a REST API (Representational State Transfer) to transfer data on the Web, in order to create, publish and consume Web services through JSON. Volley is one of the most widely used libraries for accessing Web REST APIs. This API is considered as an HTTP library created by Ficus Kirkpatrick at Google IO in 2013, allowing the execution of asynchronous, synchronous, simultaneous, ordered, and prioritized requests. In Figure 1 the Volley architecture is presented.

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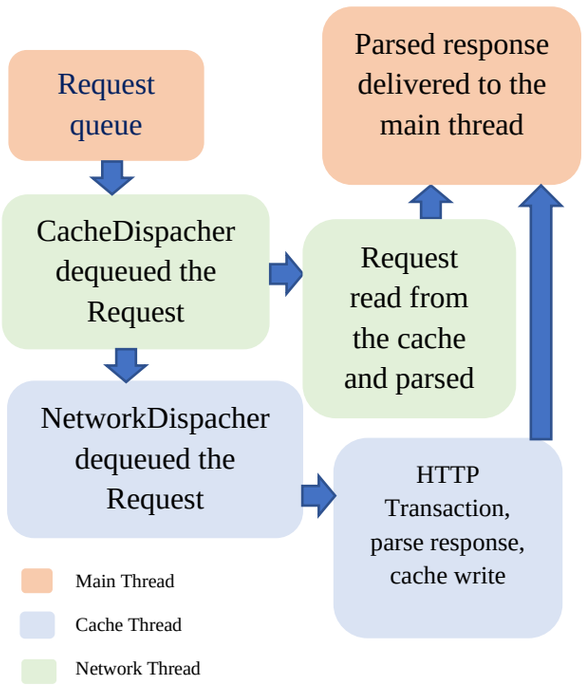

Figure 1 Volley architecture
Source: Lachgar et al. (2018)

Graph.js

Collaguazo et al. (2022) describe that the chart.js library is an open source tool that allows graph generation with filters and intuitive interactions since it has different presentations as bars, linear, pie, among others. It allows viewing metrics of interest in Web applications through the generation of Web services and the JSON format for the transfer of client and server data, to generate reports and establish timely actions.

MPAndroidChart

It is the most widely used graphics library in Android application development. It is integrated via dependency declarations in the project's Gradle build file, which allows the library to be included in the project. There are several documented guides available for implementation, including line charts, bar charts, column stacked bar charts, and others. It also includes scatter plots. It is required to configure styles, colors, and animations, as well as to contextualize the graph with labels. The library contains two layers: presentation and data. The presentation layer refers to the configuration of the view. The data layer provides a set of data that can be modified or updated and that generates the inputs to implement the graph. When data is updated, MP Android Chart is notified via the notify Dataset Changed and invalidate methods.

The separation between the layers allows dynamically update of graphics (Amarkumar Joshi, 2021).

Methodology

The project development was performed based on an incremental methodology, offers functionalities and improvements to the user until the implementation of the software product. During the process, the following phases that are repeated cyclically were attended:

1. Planning and requirements: The business model must define the way in which the data is integrated into the solution, as well as its acquisition, pre-processing, cleaning, processing, and presentation of results (Rossi & Hirama, 2022). Identify the problem to know the flow of the operational process and thus capture the requirements of the association, channel a proposal or strategy to solve the problem and prioritize the processes according to the arguments of those responsible for each area.

2. Analysis: Inspect data inputs, outputs, formats, policies, user levels, as well as establish the logic of the project. Figure 2 shows the general use case diagram of the Web platform.

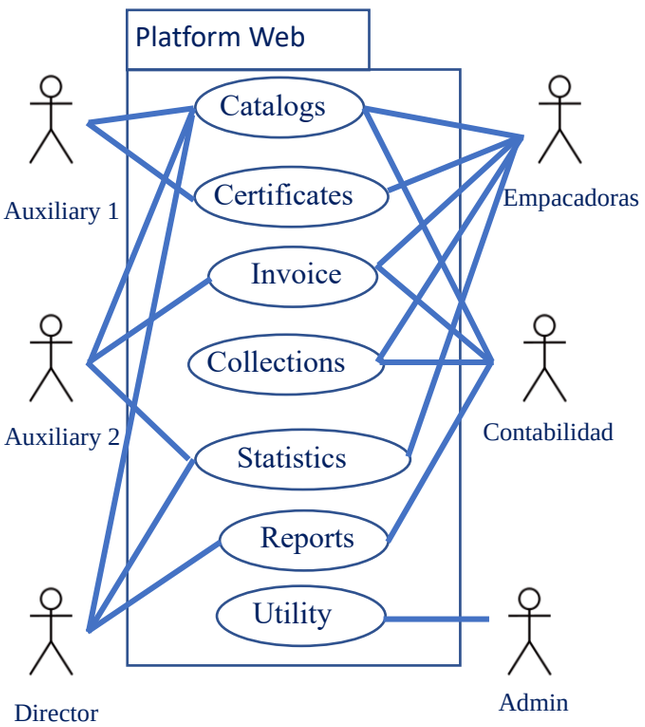

Figure 2 General use case diagram

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Figure 3 shows the usage diagram of the project in its two scenarios, Web application and mobile application.

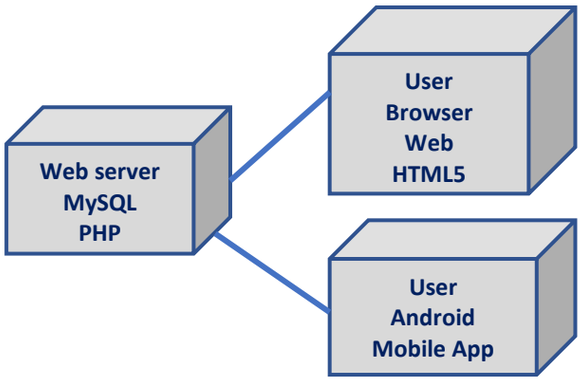

Figure 3 Implementation diagram

3. Design: Create the class diagram and generate the database in MySQL. Design the interfaces and reports for each use case for both the Web application and the mobile application.

4. Implementation: Codify each component of the platform, generating the connection to the database through PHP, JavaScript code implementation to define events and functions with AJAX and jQuery that allow maintaining usable and asynchronous interfaces during capture. Develop the application in Android Studio with connection to the database for the visualization of different queries and statistics.

5. Testing: Perform test cases for each of the components, detect failures and defects for error correction.

6. Implementation: Install the platform on a server in the cloud, performing integration tests.

Results

As a result, a mobile application and a Web platform were developed in order to allow the capture, validation, and monitoring of avocado export processes. Below are views of its development and implementation.

Figure 4 shows the mobile application login.

Figure 4 Mobile application login

Figure 5 shows the options of the mobile application, which consist of agendas for packers and suppliers in addition with a section for querying statistics.

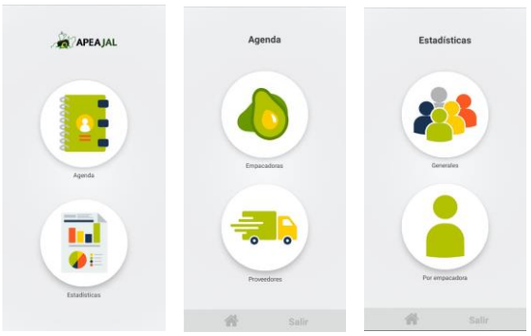

Figure 5 General application options

The information presented in the subsequent figures is obtained through a test data source for the validation of the different statistics. Figure 6 shows the historical and monthly statistics, both overall and by packer.

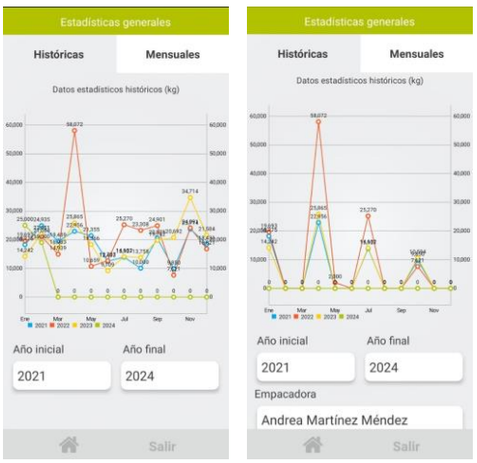

Figure 6 General statistics and by packer

Figure 7 displays the historical and monthly statistics in general bar format and by packer.

Figure 7 General monthly statistics and by packer

Figure 8 shows the historical export statistics obtained through the Web application.

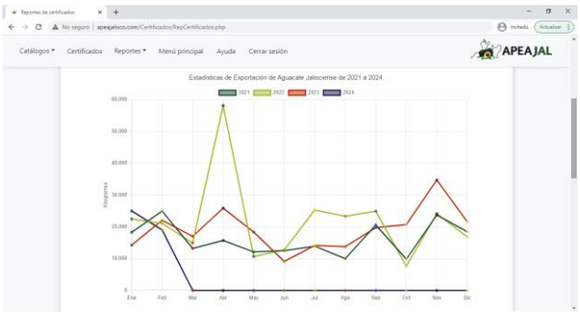

Figure 8 Historical export statistics

Figure 9 shows the historical export statistics in bar graphs.

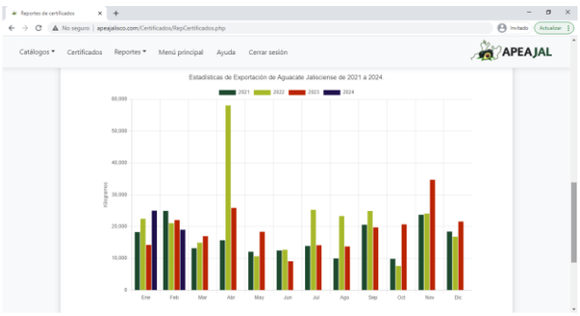

Figure 9 Historical export statistics

Figure 10 shows the monthly export statistics in bar graphs.

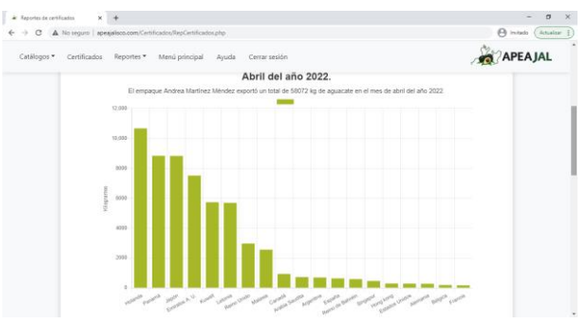

Figure 10 Monthly export statistics

Figure 11 presents a PDF report generated through the Web application.

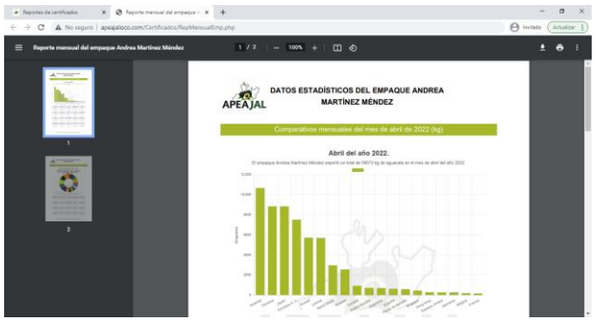

Figure 11 Monthly statistics pdf report

Figure 12 displays a comparative statistic by season in a range of years.

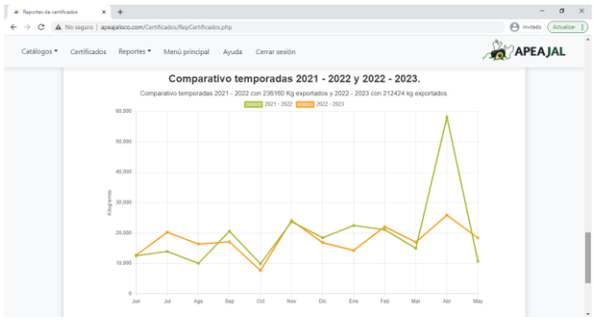

Figure 12 Comparative by season

Acknowledgements

This work has been funded by TECNM [15269.22-P].

Conclusions

Analytical engineering allows monitoring the processes of the company and acquire knowledge about its its direction, supporting management levels in strategic planning and decision making. The developed platform required analysis and design to cover each one of the requirements demanded by the different areas of the association, considering the enormous amount of data that can be generated during the avocado export processes. The project allows directors to understand what is happening in each of the areas and work together to achieve goals, providing support in decision-making processes, favoring the generation of future marketing and commercialization strategies.

ISSN 2531-2960

Future work

Analytical engineering optimizes times by improving strategies, considering the data generated inside and outside organizations, to enhance competitiveness. Historical data is available in Excel sheets collected since 2016, which will allow linear regression tests to be carried out with Machine Learning algorithm models and Neural Networks to select the model that best suits the association.

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Artícle **Journal of Technological Development**
December 2022, Vol.6 No.18 12-20

Training dataset generation for semantic segmentation utilized unmanned aerial vehicles

Generación de datos de entrenamiento para segmentación semántica usando vehículos aéreos no tripulados

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DOI: 10.35429/JTD.2022.18.6.12.20 Received July 20, 2022; Accepted December 30, 2022

Abstract

The present work focuses on the generation of training data for semantic segmentation using unmanned aerial vehicles, data acquisition was carried out, which were later processed, cut and labeled, generating the following results: datasets of sugar cane crops sugar for data analysis and field decision making. Use of geographic information system tools to increase the resolution of orthomosaics through interpolation. Design of a multivariate linear regression model to create a representative orthomosaic of the blue band.

Remote sensing, DataSet, UAV, Segmentation

Resumen

El presente trabajo expone una metodología para la construcción de datos de entrenamiento (dataset) en clasificadores supervisados utilizados para procesos de segmentación semántica. Los resultados muestran la adquisición de imágenes de cultivos de caña de azúcar obtenidas a través de vehículos aéreos no tripulados; la conformación de ortomosaicos, uso de sistemas de información geográfica para aumento de resolución por interpolación; el diseño de un modelo de regresión lineal multivariable para generación de datos sintéticos; el etiquetado de los mismos y el recorte de ortofotos.

Percepción remota, DataSet, VANT, Segmentación

Citation: LÁRRAGA-ALTAMIRANO, Hugo René, HERNÁNDEZ-LÓPEZ, Dalia Rosario, PIEDAD-RUBIO, Ana María and AVILÉS-GUERRERO, Carlos Leonardo. Training dataset generation for semantic segmentation utilized unmanned aerial vehicles. Journal of Technological Development. 2022. 6-18:12-20.

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Introduction

By means of remote sensing techniques it is possible to obtain information about an object or phenomenon without being in direct contact with it (Lira, 2003) (Lillesand & Kiefer, 2007). Remote sensing makes it possible to classify the types of crops that appear in the images and helps to know the phenological state of each crop through spectral signatures, so it can be used to: obtain crop surface statistics, evolution of the areas occupied by crops, monitoring the vegetative state of crops, management of irrigation water and control of its application, as well as precision agriculture (Arenas, 2016).

Remote sensing combines several elements for its application, such as: the platform (satellite, aircraft, or unmanned aerial vehicles known as UAVs or drones) (INEGI, 2014); the object to be observed (surface of the earth) and sensors (satellite system or sensor, -camera or video camera-) (Chuvieco, Teledetección ambiental: la observación desde el espacio, 2002).

In order to obtain quantifiable data from remotely sensed images, it is necessary to carry out processing that facilitates their conversion to biologically meaningful units and indices. This is achieved by processing and analysing the different variables represented by the pixels from different bands according to the sensors that have been used (Arivazhagan, 2013) (Bock, 2010).

For example, the infrared band of the electromagnetic spectrum has an important role in crop monitoring, as it provides information related to the biochemical processes of plants, so these values are used in the calculation of different vegetation indices such as the Normalised Difference Vegetation Index (NDVI) (Rueda, 2015). The analysis of these images has been useful to detect early stages of infections or diseases, nutrient deficiency and crop dehydration. This implies improvements in intervention, prevention and control of various problems associated with crop management. (Mahlein, 2016) (Grupta & Ibaraki, 2014).

Two techniques are used in land cover classification of remotely sensed images: supervised, the user preliminarily recognises known regions of interest in the land area, and the chosen algorithm extrapolates these spectral features to other regions of the image, thus performing the classification (Castillejo-Gonzalez, et al., 2009) and unsupervised classification aims to group cases by their relative spectral similarity, without field sampling (Foody, 2002).

Supervised classifiers have shown highly effective results in land cover classification, especially those in the area of deep learning (Kim, Lee, Han, Shin, & Im, 2018). Neural networks, particularly convolutional neural networks (CNNs) as deep learning techniques, are an effective tool for characterising, modelling and predicting a large number of non-linear processes with adequate results in decision making required in complex agricultural problems, including: prioritising and classifying products, pattern recognition, crop prediction and physical changes of their products (Figueredo-Ávila & Ballesteros-Ricaurte, 2016).

One of the challenges of supervised learning and consequently of CNN networks is that they require a large diversity of training data to achieve reliable accuracy levels when classifying an image (Hu, Luo, & Wei, 2020). In addition, data labelling is also a challenge of the training process of a supervised classifier. For this purpose, manual intervention, automatic or semi-automatic labelling or synthetic data emulating images are used (Donyavi & Asadi, 2020).

Therefore, this paper proposes a procedure for generating a dataset of images corresponding to sugarcane crops. It documents the acquisition of images using a UAV and a multispectral camera, the construction of RGB and multispectral orthomosaics, their adjustment to achieve a higher resolution, and the creation of a synthetic spectral band. Additionally, a binary labelling is proposed with the intention of identifying only the sugarcane crop on an orthomosaic. Finally, a cropping algorithm is described to extract sub-images from the orthophoto that integrate the dataset. It is important to mention that this data will be used as input for the training of a CNN to achieve a semantic segmentation.

ISSN 2531-2960

The basic process of semantic segmentation is to pre-process the image to extract the spatial or spectral features that will allow distinguishing each pixel and predict the belonging to a specific class (Zabawa, et al., 2020).

Metodology

Supervised classifiers exposed in machine learning and deep learning techniques, used to distinguish vegetation types such as: Random Forest and Convolutional Neural Networks respectively, require a large amount of training data to perform the task of classifying efficiently (Di Cicco, Potena, Grisetti , & Pretto, 2017). Moreover, the input data should be suitable for the pattern recognition task that is intended to be designed, i.e., diversity, labelling, cleanliness of the data are desirable features in the dataset integration task (Donyavi & Asadi, 2020).

Data acquisition

The use of UAVs has had great impact on agricultural activities, given their ability to observe through specialised sensors details in crops, which the human eye could not with the naked eye (Tripicchio , Satler , Dabisias, Ruffald, & Avizzano, 2015) (Tripicchio , Satler , Dabisias, Ruffald, & Avizzano, 2015). Flight plans are designed considering several factors to ensure the successful acquisition of the images avoiding the risk of an accident, the following factors are considered:

- Weather conditions: sufficient light, avoid cloudy or rainy days.
- Flying hours: morning flights, avoiding excessive solar radiation, between 8 and 10 am.
- Photogrammetric parameters: flight height up to 100 m, vehicle speed 10 m/s, splicing percentage 80-85%, camera angle 90 degrees.
- Equipment calibration: both the UAV and the multispectral camera should operate with optimal battery and calibration levels (Lyu , Vosselman , Xia , & Yilm, 2020).

Processing of the acquired images

The sensor used is a Sequoia multispectral camera from the manufacturer Parrot, figure 1, equipped with an RGB lens and four bands: red, green, near infrared (NIR) and red limit. The RGB lens has a resolution of 16 Mpx and the rest of the bands 1.2 Mpx. In addition, the sensor performs a radiometric calibration automatically.

Figure 1 Sequoia multispectral camera
Source: https://geoinstrumentoscol.com/product/parrot-sequoia/

The images obtained from the sugar cane crops are processed with Pix4D Mapper software. RGB and Multispectral projects are generated by applying the Ag RGB and Ag Multispectral templates respectively. In such a way that one RGB orthomosaic and 4 orthomosaics are created for each of the red, green, NIR and boundary red bands (Olsson, et al., 2021).

The spatial resolution (GSD, ground sample distance) is an important element when it comes to analysing the content of an image. The height of flight and the type of sensor determine the sharpness with which details in the image are visualised (Lee, Son, & Kim, 2022). To improve the resolution of orthomosaics, i.e. decrease the GSD value, interpolation operations are performed that decrease the pixel size without losing information (Guarneri & Weih, 2010).

There are no ground control points (GCP) to support the rectification of orthoimages, therefore, coming from different lenses, the angles and position of the images are not equal, which causes the RGB orthomosaic and multispectral ones to be misaligned (Vassilopoulou, Hurni, & Dietrich, 2002).

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Therefore, the blue band of the RGB orthomosaic cannot be used with the individual red and green bands. However, it is possible to generate a synthetic orthomosaic from the information contained in the 3-band orthomosaic. It is observed that the relationship between the red and green bands compared to the blue band is linear and considering that the images have been captured under the same atmospheric conditions, a multivariate linear regression model is designed to be used to create a new orthoimage with reflectance values in the blue band of the electromagnetic spectrum (Li, Hua, & Lu, 2021).

Orthomosaic cropping

The constructed orthoimages are arrays of thousands or millions of pixels that store digital reflectance values. Operating with images of these dimensions to train a classifier to perform semantic segmentation is not computationally possible. Therefore, orthomosaics are divided into 256 x 256 px subimages, generating a sufficient amount of training data for each cropped orthoimage (Ling, Cheng, Peng, Zhai, & Jiang, 2022).

Pixel tagging

This is one of the most challenging phases in dataset creation, especially when working on surface analysis and the training dataset is oriented towards supervised classifiers. The diversity of objects within an image and the spectral similarity between classes makes it a difficult task to label pixels (Lei & Peng, 2020).

In this study, a training dataset is integrated for binary classification. For this purpose, the NIR band is particularly valuable in the study of vegetation cover, such as crops in this case. High NIR values are related to the presence of vegetation, conversely the absence of vegetation is denoted by low NIR values (Gašparović, Zrinjski, Barković, & Radočaj, 2020).To label the two classes of interest a thresholding method is used, value one (1) corresponds to crop and value zero (0) to any other element which can be: barren soil, asphalt, buildings, among others (Gao, Xiao, & Jia, 2020).

Results

Data acquisition

A DJI Matrice 600 Pro drone was used to perform the flight, it was equipped with a Parrot Sequoia camera with light sensor and additional power source, figure 2.

Figure 2 Dji Matrice 600 Pro
Source: Own elaboration

The efficiency of the batteries is 22 min with a 100% charge considering 30% of the energy for the end of the flight. Both the drone and the camera were calibrated before the take-off operation, it was confirmed that the sensors, radio frequency and firmware were in adequate conditions, additionally the images of the calibration plate were captured for later correction, see figure 3.

Figure 3 Sequoia Radiometric Calibration Plate
Source: Own elaboration

The autonomous flight was programmed with the freely distributed Pix4D Capture software for Android and IOS platforms, figure 4. The configurable parameters are height, 80 m; vehicle speed 10 m/s; splice 80%. The multispectral camera was placed at a 90 degree angle to the ground with a capture time of 1.5s.

ISSN 2531-2960

Figure 4 Pix4D Capture, flight planning
Source: Own elaboration

Processing of acquired images

For the construction of the orthomosaics, Pix4D Mapper software was used to process two project types: RGB (figure 5) and multispectral.

Figure 5 RGB Orthomosaic
Source: Own elaboration

The latter results in orthophotos for each of the red, green, near infrared and boundary red bands (figure 6). The integration of each set of orthophotos per band into an orthomosaic was carried out with the help of the geographic information system (GIS) QGIS.

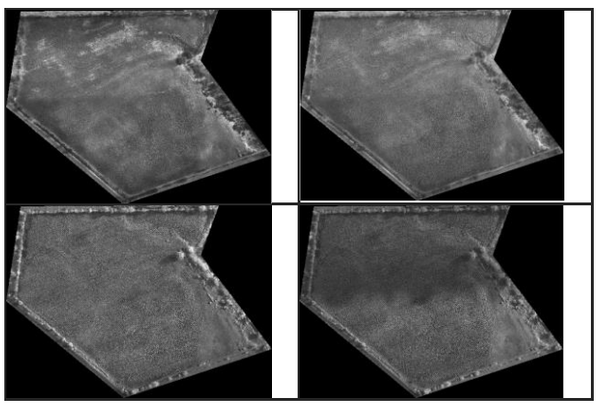

Figure 6 Orthomosaics red, green, near-infrared and boundary red bands
Source: Own elaboration

The GSD value of the orthomosaics differs by the resolution of the RGB lenses (16 Mpx) and the rest of the bands (1.2 Mp), being 2.22 and 8.81 respectively. QGIS through the georeferencing tool allows geometric corrections based on control points, so it can be used to decrease or increase the GSD of the orthophoto.

Several geographic points of the RGB orthomosaic were taken as control points to increase the resolution of the multispectrals, using a polynomial transformation, the nearest neighbour algorithm for resampling and the target resolution was set. After this processing the dimension and resolution of the orthomosaics is the same, width 26280 px and height 19223 px, with a GSD value of 2.22 cm/px, see figure 7.

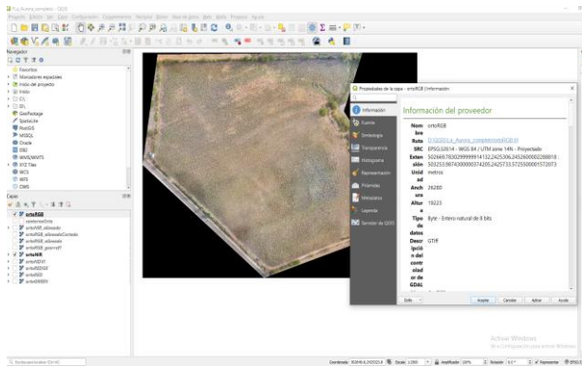

Figure 7 Orthomosaic processing in QGIS
Source: Own elaboration

Since the RTK equipment is not available to generate control points and thus obtain aligned RGB and multispectral orthomosaics, a synthetic blue-band orthomosaic was created to complement the red and green sensor of the Sequoia camera. A Multiple Linear Regression model was designed, given the linearity of the blue spectrum compared to the red and green, as shown in figure 8.

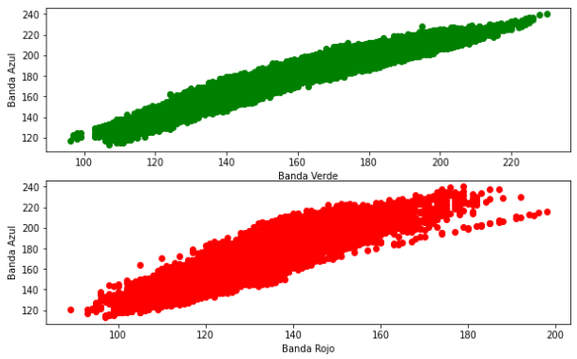

Figure 8 RGB orthomosaic scatter diagram
Source: Own elaboration

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The model was trained with the RGB orthomosaic data, as it is created under the same climatic and temporal conditions as the individual red and green orthomosaics of the Sequoia camera. The model recorded the following result parameters:

- Value of slopes or coefficients "a": [0.82965658 0.30154856]
- Value of intersection or coefficient "b": 2.984854941495797
- Value of the intersection or coefficient "b": 2.984854941495797
- Model accuracy: 0.974906969683250053

In this way, the model is applied by taking as input the red and green (individual) pixels and predicts the value corresponding to the blue pixel, creating an orthomosaic synthetically, see figure 9.

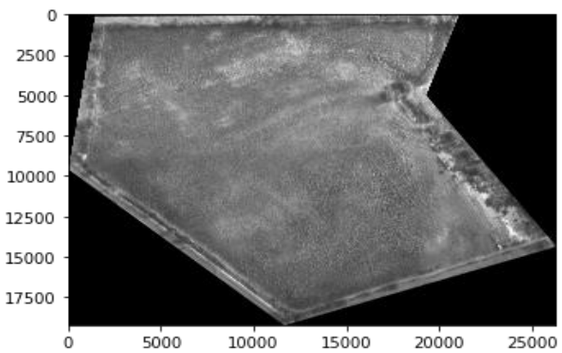

Figure 9 Blue band synthetic orthomosaic
Source: Own elaboration

Cutting out orthomosaics

Orthomosaics of sugar cane crops are extremely large images in the order of millions of pixels (26280 x 19223). Supervised learning in the training phase requires computationally processable inputs due to the number of operations performed during training. A program was designed in Python 3.8.8 using the Anaconda platform and the Jupyter NoteBook tool, whose objective is to extract sub-images with dimensions of 256 x 256 px that function as inputs to a supervised classifier. The algorithm works as a window that slides from the left margin of the orthoimage to the right boundary and from the top to the bottom, see figure 10.

Figure 10 Operation of the trimming algorithm
Source: Own elaboration

Pixel tagging

To generate the binary images of the sugar cane crops that the classifier uses to adjust the learning model, the cropped NIR orthomosaic was taken. The segmentation method implemented is thresholding, i.e., it is required to determine a value that works as a point of comparison, those values less than zero and those greater than 1.

The Otsu method was applied to determine the threshold in each sub-image, so that 7650 threshold values were obtained. The frequency graph (histogram) shows that from value 80 onwards the highest frequencies appear, which belong to the vegetation, mostly to the sugar cane crop, as can be seen in figure 11.

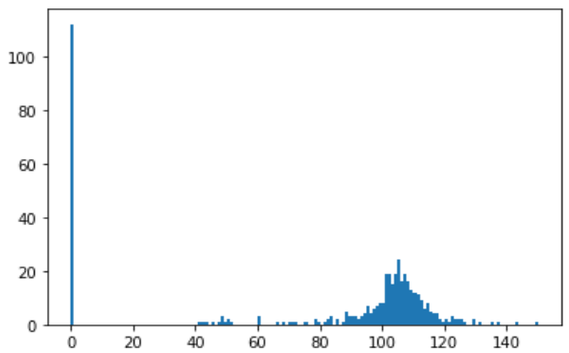

Figure 11 Histogram of thresholds NIR images
Source: Own elaboration

The result of binarisation with a threshold of 80 is effective, higher values (whites) represent vegetation while zero values identify other bodies in the image, see figure 12.

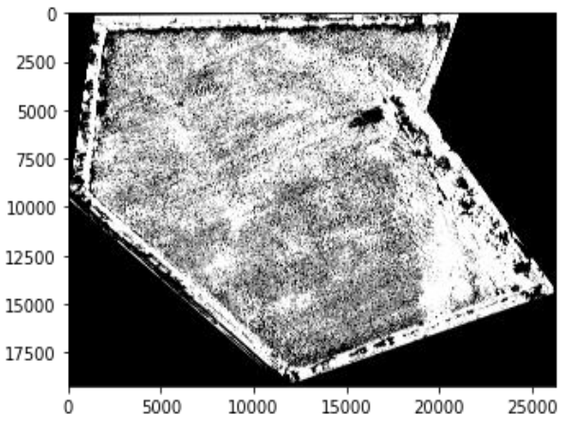

Figure 12 Binarised NIR orthomosaic
Source: Own elaboration

However, human intervention is necessary to edit the binary image. Although the NIR differentiates the vegetation from the rest of the image bodies, the image must show only the sugar cane. For this reason, pixels that do not represent the crop are removed using digital editing software, as shown in figure 13.

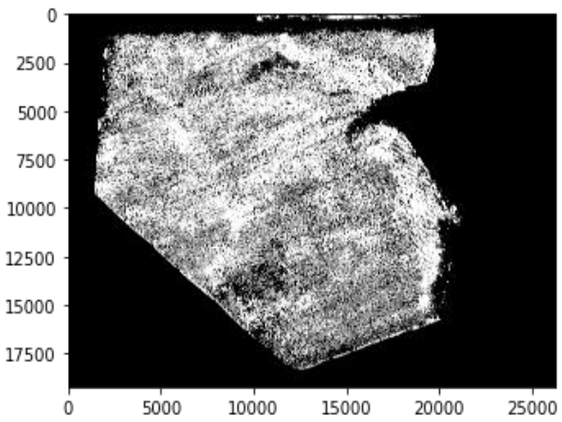

Figure 13 Binarised NIR orthomosaic, edited
Source: Own elaboration

Subsequently, it was processed with the clipping algorithm, like the rest of the orthomosaics. Images with binary labels are considered as part of the dataset and can be used to train convolutional neural networks dedicated to semantic segmentation.

Discussion of the results

It would be advisable to generate RTK control points in the photogrammetric flights to assist in the processing of the images and thus create rectified and aligned orthomosaics.

The multivariate linear regression model designed is suitable only for one flight, i.e. the model needs to be retrained with each RGB orthophoto to create the missing synthetic blue band, as atmospheric conditions change. The Otsu thresholding method does not effectively distinguish the other vegetation class and the crop, given their spectral similarity in the NIR band, other segmentation methods should be implemented to have better results.

Future work

Work is to be done on the multi-labelling of the images, considering 5 classes: null images, barren soil, asphalt, other vegetation and sugar cane cultivation.

The constructed dataset will be used for semantic segmentation tasks using convolutional neural networks. The objective with the binary training data is to identify the sugar cane crop in an orthomosaic. By having images with several labelled classes, the segmentation result would be a function of the number of classes.

Conclusions

The training dataset consists of 7650 images of sugar cane crops per lens of the Seqouia multispectral camera, plus an individual synthetic blue band. The described procedure for dataset construction can be replicated for crops other than sugar cane, or be used to generate new data for other semantic segmentation purposes. Remote sensing and data science provide a technology framework applicable to farm management, sustainability and sustainability of agriculture are two of the most important aspects of farmers' decision making. The most relevant contributions of this project are:

- Making sugar cane crop datasets available for field data analysis and decision making.
- The use of geographic information system tools to increase the resolution of orthomosaics through interpolation.
- The design of a multivariate linear regression model to create a representative orthomosaic of the blue band.

ISSN 2531-2960

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ISSN 2531-2960

Artícle **Journal of Technological Development**
December 2022, Vol.6 No.18 21-31

Implementation of information technology in Colegio de Bachilleres de Chiapas

Implementación de la tecnología de la información en el Colegio de Bachilleres de Chiapas

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DOI: 10.35429/JTD.2022.18.6.21.31 Received July 20, 2022; Accepted December 30, 2022

Abstract

The present investigation focuses on the vicissitudes of the implementation of information and communication technology (ICT) in the 338 schools of Colegio de Bachilleres de Chiapas (COBACH) distributed throughout the state of Chiapas.

One of the precepts in higher secondary education is to incorporate the use of ICT in high school education in order to optimize and digitize the teaching-learning process. Pretension that implies to analyze in the first place the rural orography in which the school centers are located and in second moment the condition in which the teacher assumes such intention of the educational policy. In addition to the fact that today's youth in addition to receiving the knowledge of the adult generations incorporates the series of information and knowledge generated in social networks and the Internet to the point of building their personal learning environment (PLE) and virtual learning environments (VLE).

In this regard, data are presented at the diagnostic level on the subject of ICT in COBACH obtained through the methodology of the logical framework. This being the base for the projection of proposals to include in the six-year academic program of secondary education.

Information technology, Equipment, Internet service

Resumen

La presente investigación se centra en las vicisitudes que representa para el Colegio de Bachilleres de Chiapas (COBACH) la implementación de la tecnologia de la información (TIC) en los 338 centros escolares distribuidos en el estado de Chiapas.

Uno de los preceptos en educación media superior es incorporar en la educación de los bachilleres el uso de la TIC, a fin de optimizar y digitalizar el proceso de enseñanza-aprendizaje. Pretensión que implica analizar en primer lugar la orografía agreste en la que se ubican los centros escolares y en segundo momento la condición en que el docente asume tal intención de la política educativa. Adicional al hecho de que la juventud actual, además de recibir el conocimiento de las generaciones adultas, incorpora la serie de información y conocimientos que se generan en las redes sociales e internet, al grado de construir su entorno personal de aprendizaje (PLE) y ambientes virtuales de aprendizaje (AVA).

En tal sentido, se presentan datos a nivel diagnóstico sobre el tema de TIC en el COBACH obtenida a través de de la metodología del marco lógico. Siendo la base para la proyección de propuestas a incluir en el programa académico sexenal de educación media.

Tecnologia de la información, equipamiento, servicio de internet

Citation: HERNÁNDEZ-GORDILLO, José Luis, HERNÁNDEZ-ZAMBRANO Luis Alberto and VELÁZQUEZ-GAMBOA, Pablo Salvador. Implementation of information technology in Colegio de Bachilleres de Chiapas. Journal of Technological Development. 2022. 6-18:21-31.

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Introduction

This document describes the vicissitudes of the working group composed of staff from schools, zone coordinating offices and central offices of the General Directorate of the Colegio de Bachilleres de Chiapas (COBACH). At the initiative of the current authorities of the subsystem in question, activities began in February 2019 to shape the 2019-2024 institutional work programme, a diagnostic phase with nine lines of action: demand, coverage and quality; teaching skills; comprehensive training; institutional linkage; strengthening infrastructure and equipment; implementation of information and communication technology (ICT); administrative regulations and institutional evaluation.

For the construction of the diagnosis, the logical framework methodology (LFM) was applied in the participatory modality of the action research method.

To retrieve data from the different bodies involved, the IT unit created the "COBACH systems" platform specifically for this purpose. This was used to analyse and contrast the information provided by the different participants in order to configure the situational diagnosis of the sub-system in the aforementioned areas. In general, the situation of teachers and administrative staff in relation to their school, zone coordination and central offices and vice versa is highlighted. Of the nine axes, this proposal focuses on the description of the prevailing situation in the field of information and communication technologies in COBACH.

Justification

At present, there are 27 high schools at national level, as shown in the following table:

No.	State	Campuses
1	Baja California	41
2	Baja California Sur	11
3	Campeche	37
4	Chiapas	338
5	Chihuahua	28
6	Coahuila	10
7	Durango	33
8	Guerrero	54
9	Hidalgo	132
10	Jalisco	85
11	Estado de México	87
12	Michoacán	113
13	Morelos	23
14	Nayarit	50
15	Oaxaca	68
16	Puebla	37
17	Querétaro	59
18	Quintana Roo	48
19	San Luis Potosí	69
20	Sinaloa	124
21	Sonora	34
22	Tabasco	114
23	Tamaulipas	58
24	Tlaxcala	24
25	Veracruz	71
26	Yucatán	72
27	Zacatecas	40
	Total	**1,861**

Table 1
Source: State Baccalaureate Colleges (2019). Planteles y matrícula del formato 911. https://www.copeems.mx/

Of these, the state of Chiapas stands out for having the largest number of schools, a condition that becomes more complex if we add to this the orography in which the schools are located. Since the creation of COBACH in 1978 to date, it has registered an excessive growth with 338 schools, divided into 128 school campuses and 210 Higher Secondary Education Centres (EMSaD). The difference in the previous denomination lies in the fact that the latter do not cover an enrolment of 200 students. For the purposes of academic and administrative attention, this population is distributed in nine zone co-ordinations:

Coordination	School centres
Altos	44
Fraylesca Centre	32
North Central	35
Coast	49
Isthmus coast	27
North	34
Jungle	38
Northern jungle	24
Border highlands	55
Total	**338**

Tabla 2 Area co-ordinations

Each zone coordination is responsible for following up on the administrative and academic needs and interests of the staff in the total number of schools assigned, in accordance with the regulations set out in the curriculum map of the general baccalaureate with an educational approach based on the development of competences (DGB, 2018).

Problem

The incorporation of ICT in the teaching-learning process is an unavoidable requirement for education in the digital era, where teachers and students manipulate information flows and networks or multimedia environments (Vázquez, 2009), expanding the traditional scheme of physical interaction to a relationship with multimedia and search engines for information and knowledge on the network. However, such a claim, when massified in an educational subsystem such as COBACH, becomes complex as it has an extensive universe of schools that serves a staff of 3,323 teachers, 2,207 in school-based campuses and 1,116 in EMSaD Centres (COBACH. Department of Human Resources, 2019) for an enrolment of 85,496 students (COBACH. Department of School Control, 2019) and with a total of 8,333 computers, with internet service coverage in 171 schools, equivalent to 50.60%, without considering the quality of the service. In this regard, Agüero Servín, M., Álvarez, S. I. M., & Mansilla, M. P. (2022) point out the lack of access to technologies as one of the alarming difficulties in urban, rural and indigenous educational scenarios, which not only hinder teaching but also the achievement of the student's graduation profile. Given this scenario, it is a major challenge to implement information and communication technology in the scenario described. The advantage identified in the diagnostic phase is the daily use of mobile devices by students, a favourable situation for producing this resource for didactic purposes in the strategy developed by the teacher.

Hypothesis

The specific establishment of the detections in terms of equipment and internet service will allow us to suggest intervention strategies that will contribute to the implementation of ICT according to the needs of the teaching staff and students.

Objectives

General objective

To describe the current status of information and communication technology implementation in the subsystem with regard to IT assets, conditions of use and Internet service.

Specific objectives

Identify the number of computers in relation to the existing enrolment of students in the subsystem.

To identify the quality of the Internet service offered in the subsystem's schools.

Theoretical framework

In the global age of digitised information, access to knowledge is relatively easy, immediate, ubiquitous and inexpensive. One can access the information network, follow whatever line of enquiry seems appropriate, without the control of someone called a teacher. Also, one can participate in multiple networks of people and collectives that share interests, information, projects and activities, without time, institutional or geographical limitations.

The current system of life is an era of vertiginous change, of global interdependence that generates radical alterations in the way of communicating, acting, thinking and expressing oneself.

An example of this is what Bauman (2013) calls "consumer society", the omnivorous capacity of markets, their uncanny ability to profit from each and every human problem, be it anxiety, apprehension, pain or suffering.

Another feature would be the issue of "individuality". Bauman (2013) jokingly posits that, in a society of individuals, members are anything but individual, distinct or unique. They are strikingly alike, as they must follow the same life strategy and use shared signs to convince others that they do so. As far as the question of individuality is concerned, there is no possibility of individual choice. There is no "to be or not to be" dilemma to be solved in that sense.

ISSN 2531-2960

Returning again to the idea of the digital era, scientific advances are taking place at breakneck speed, particularly in the area of technology, the changes are abrupt, radical, characterised by speed as a characteristic feature of the liquid society referred to by Bauman (2013).

Derived from scientific advances, the term technology emerges as a central axis to be analysed. What is understood as such? According to Castells (2006), technology refers to the use of scientific knowledge to specify ways of doing things in a reproducible way. The information technologies identified include microelectronics, computing (machines and software), telecommunications, radio, television and optoelectronics, and genetic engineering, which focuses on decoding, manipulating and ultimately reprogramming the information codes of living matter.

A sociological argument for incorporating ICTs into the educational context in the life of the adolescent is referred to by Hargreaves (2005), that today's youth are surrounded and enveloped by images.

This makes traditional exposures of practical and local interest irrelevant, as sources of teaching and motivation for underachieving students, it is now common for any young person to enter into more meaningful contact with someone who lives hundreds of miles away than with their parents, sister or brother sitting next to them in their own room.

Visual images of technology are a pervasive feature of young people's lives. Textbooks, worksheets and projectors have little to do with these other, more complex, instantaneous and sometimes spectacular modes of experience and learning. In this context, it is not difficult to understand the lack of concern of many students about their curriculum and teaching.

Teachers are being forced to become increasingly competent in relation to this world and the surrounding image culture. This makes great demands on them, both in terms of technological awareness and pedagogical change.

From the above, ICT is particularly taken up as "the set of processes derived from new hardware and software tools, media and communication channels related to the digitised storage, processing and transmission of information, which enable the acquisition, production, processing, communication, recording and presentation of information, in the form of voice, images and data contained in signals of an acoustic, optical or electro-magnetic nature" (Duncombe Heeks, 1999, p. 2).

It can be said that they execute processes in order to generate, integrate and transmit knowledge that will subsequently have an impact on the ways of life of societies, not only in a technical or specialised field, but mainly in the creation of new forms of communication and global coexistence.

ICTs represent a fundamental element for the population, even from international decrees that establish the use of this technology as a central axis of the new educational models, which is why national public policy incorporates the use of information technologies in its recent reforms for better development and training of students. It is intended that students "use information and communication technologies to research, solve problems, produce materials and transmit information" (Instituto Nacional para la Evaluación de la Educación INEE, 2018, p. 66).

Article 8 of the Secretarial Agreement 480 states that schools must have libraries, laboratories, workshops and the necessary equipment for the development of the teaching and learning process, as well as the use of Information and Communication Technologies, in accordance with the modality in which the educational service is provided (Instituto Nacional para la Evaluación de la Educación INEE, 2018, p. 64).

"ICT can be used as didactic tools as they allow teachers and students to develop creativity, innovation and a collaborative work environment in which it is possible to share and disseminate information and raise discussions and debates that involve the school and the community and link them in a globalised environment" (Instituto Nacional para la Evaluación de la Educación INEE, 2018, p. 66).

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It is important to remember that the mission of the educational subsystem is to train young people at the upper secondary level, with a comprehensive education to contribute to their life project and its vision is to be an institution that meets the educational demand with quality and is identified as the best option, which undoubtedly implies the incorporation of technological tools.

An analysis is made of the implementation of ICT in the areas of the central office and school centres under the themes of computer assets and conditions of use, computer laboratory, professional profile of the staff in charge of the laboratory, teachers and administrative staff, digital classrooms, Internet service, platforms and digital libraries.

Computer assets are devices that make up a technological equipment in terms of hardware, which contribute to the teaching-learning process, according to the (Secretaría de Educación media Superior SEMS, 2008) "they constitute resources with an increasing value for student learning. As mentioned above, students must be able to use the different tools provided by these technologies to search for, process and analyse information". (p. 55).

Methodology of the research

The present research is descriptive in nature, focusing on the opinions of users of computer equipment and internet service at the level of teaching and administrative staff.

Type of research

Participatory action research or action research is a methodology that is distinguished by the way in which it approaches the object of study, the intentions or purposes, the actions of the social actors involved in the research, the different procedures that are developed and the achievements that are attained.

In terms of the approach to the object of study, the starting point is an initial diagnosis, the consultation of different social actors in search of appreciations, points of view, opinions on a subject or problem that is susceptible to change.

Latorre (2005) points out that this method differs from other research in the following aspects: a) It requires action as an integral part of the research process itself. b) The focus is on the values of the professional, rather than on methodological considerations. c) It is research on the person, in the sense that professionals investigate their own actions. The goals of the method are: to improve and/or transform social and/or educational practice, while seeking a better understanding of this practice; to permanently articulate research, action and training; to get closer to reality by linking change and knowledge; and to make teachers the protagonists of the research.

Likewise, the social actors become active researchers, participating in the identification of needs or potential problems to be investigated, in the collection of information, in decision-making, in the processes of reflection and action. In terms of procedures, focused discussions, participant observation, forums, workshops, roundtable discussions, among others, are shared. From the above, it can be concluded that participatory action research has very particular characteristics that distinguish it from other methodological approaches and make it more viable for transforming social realities.

According to Lewin (cited in Rodríguez, 1999) there are four characteristics of this method: cyclical, recursive, because similar steps tend to be repeated in a similar sequence; participatory, because those involved become researchers and beneficiaries of the findings and solutions or proposals; qualitative, because it deals more with language than with numbers; and reflexive, because critical reflection on the process and results are important parts of each cycle.

Theoretical methods

Logical Framework Methodology (LFM) as a planning tool based on problem structuring and problem solving that allows for a systematic and logical presentation of programme objectives and their causal relationships, aligned to inclusive objectives. The LFM is aligned with the budgetary norms for the Public Administration of the state of Chiapas according to articles 59 (Fractions II, VI, VII, VIII, IX, XII). The LFA is supported by both the problem tree and the objective tree, which allow for the construction of the indicator matrix (Ministry of Finance and Public Credit, 2016).

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Strengths, Weaknesses, Opportunities, Opportunities and Threats (SWOT) analysis matrix, which allows visualising external and internal factors. If SWOT analysis is applied to a programme or project, it is possible to identify external factors, under the quadrants of threats and opportunities, which can be useful to specify some assumptions.

Checklist format of IT assets and conditions of use, computer lab, professional profile of the staff in charge of the computer lab, teachers and administrative staff, digital classrooms, Internet service, platforms and digital libraries.

Results

It was identified that the Departments have technological equipment for the fulfilment of the administrative processes, and as a weakness, the deficiency and duplication in the communication between central offices, Zone Coordination Offices and Campuses.

On the other hand, the IT Unit is in charge of evaluating, determining and providing maintenance for the equipment in central offices.

In the schools, the existing computer assets are intended to serve an enrolment of 85,496 students. The AR02c indicator for upper secondary education suggests that for every eight students there should be one computer in the school (Robles V., 2013, p. 164).

The above data constituted the reference to elucidate on the subject of ICT in the Colegio de Bachilleres.

The following is a list of all the school campuses and EMSaD Centres, as well as the computer assets existing in the nine Zone Coordinating Bodies:

Equipment of computers, projectors and printers

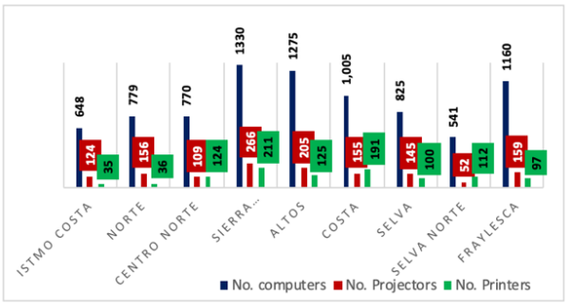

Figure 1 General Equipment by zone coordinations

The graph shows the IT equipment, consisting of computers, projectors and printers.

The Coordination of the Northern Jungle Zone has the lowest number of computers and projectors. It serves an enrolment of 7,148 students.

On the other hand, the Coordination of the Sierra Fronteriza Zone has the highest rate in this area, with an enrolment of 8,971 students.

The education authorities of the subsystem should focus on the transition from traditional teaching to the generation of virtual learning environments, as a process of the current information society.

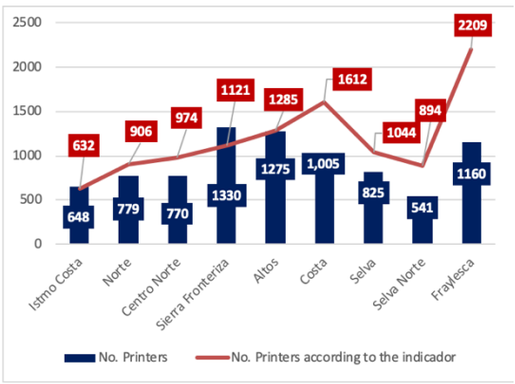

Figure 2 Number of suitable computer equipment per zone coordinating offices

The Coordination of the Sierra Fronteriza Zone complies with the number of computers it should have according to indicator AR02c (Robles V., 2013, p. 164), with 1,330 computers for an enrolment of 8,971 students, according to the number of students it should have 1,121 computers, it has a surplus of 209.

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The Coordination of the Fraylesca Central Zone has the lowest index with a total of 1,160 computers for an enrolment of 17,672 students with a shortage of 1,049 computers to meet the indicator. This is a constant feature in the rest of the Zone Co-ordination Offices.

In general terms, the number of computers available does not meet the number of students enrolled, hence the need to look for alternatives to solve this problem.

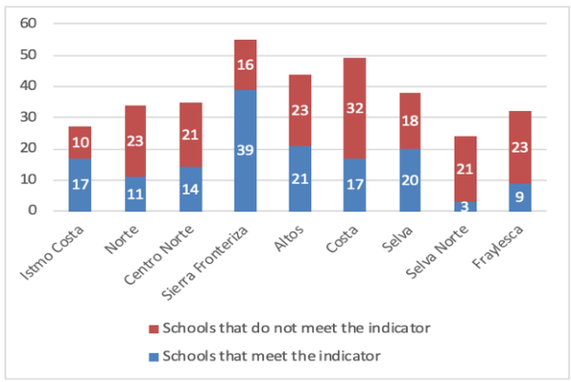

Figure 3 Number of campuses by zone coordinations that comply with indicator AR02c

In the Northern Selva Zone Coordination only three campuses manage to meet the indicator, while the Coastal Zone Coordination has the highest rate with 32 campuses that do not comply with the equipment.

The graph shows that more equipment is required to meet the goal proposed in Agreement 442 of the RIEMS, as only 44.67 per cent of the overall total meets the indicator in the subsystem.

Internet service

This service is a priority for teaching and administrative staff and for the entire student community in educational centres, as it allows access to information.

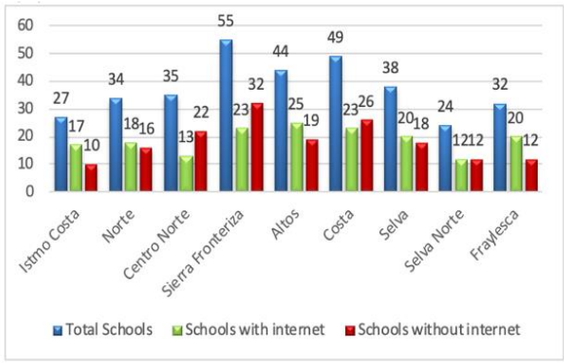

Figure 4 Number of campuses with Internet service by zone coordinating offices

Only 50.60 percent of schools have Internet access, regardless of the quality of service.

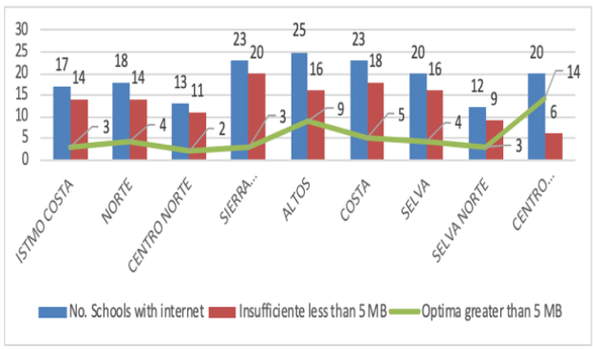

Figure 5 Number of campuses with optimal Internet service, by area co-ordination

Internet access is an essential tool that every educational centre must have in order to develop academic activities that help in the educational process. The optimum speed should be higher than 5 MB, which will allow adequate surfing of the net, and less than 5 MB makes it difficult to browse through the different pages of the net.

The graph indicates that 13.90 per cent, 47 educational centres, have optimal connectivity. It also refers to the inadequacy of this service in other schools, with poor navigation for users to access information.

Most of them do not have this optimal service due to the State's orography and the high cost involved. In schools and some EMSaD Centres this service is limited by the bandwidth of one or two megabytes and by the satellite connection (Mexico Connected) provided by the Federal Government.

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Condition of IT assets

From the campuses and Zone Coordination Offices, they report that the computer assets do not meet the hardware requirements (processor capacity, RAM memories, storage and connectivity units), and even present failures, in addition, they cannot be replaced due to lack of budget for equipment.

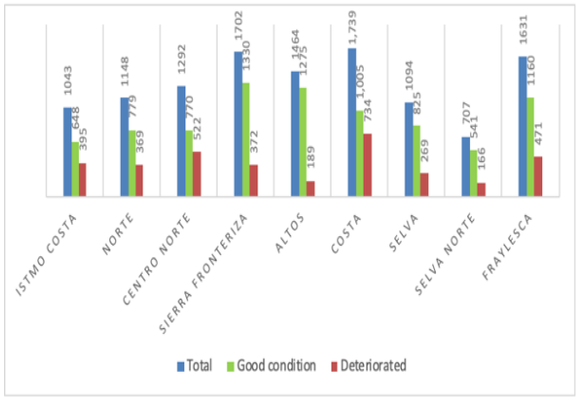

Figure 6 Computer equipment in good and bad condition, by zone coordinating offices

The total amount of computer equipment in all campuses is 1,820, of which 70.5 per cent is in optimal conditions. The graph shows that the Coordination of the North Central Zone has the least amount of equipment in optimal conditions.

Most of the computer equipment uses software for academic use; however, the budget allocated is insufficient to cover the requirements for antivirus licences, Office updates and others. Being a pending item to be attended.

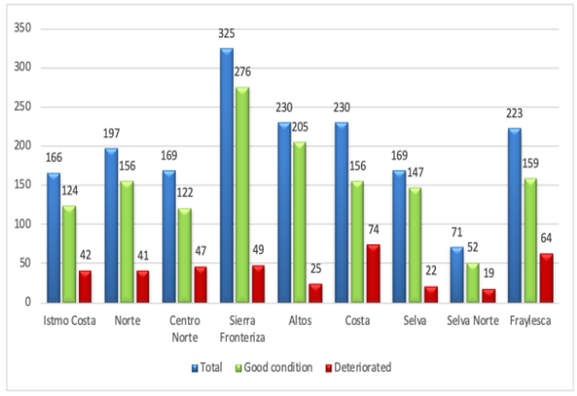

Figure 7 Projectors in good and bad condition, by zone co-ordinations

There are a total of 1,780 projectors distributed in all schools, 78.48 per cent of which are in optimal conditions. The use of the projector in the classroom is important for teachers and students to have a multimedia and interactive experience.

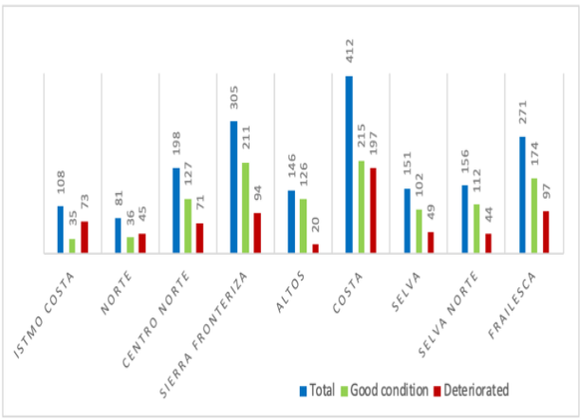

Figure 8 Printers in good and bad condition, by zone co-ordinations

A total of 1,828 printers are distributed in all schools, with 62.25 per cent in optimal conditions. Printers are important tools in the school process for high school students and are indispensable for administrative staff, therefore, it is necessary for schools to have this resource for better performance.

Types of computer labs

Within the system there are two types of laboratories: formal and adapted, the latter does not have the optimal conditions of installation and equipment.

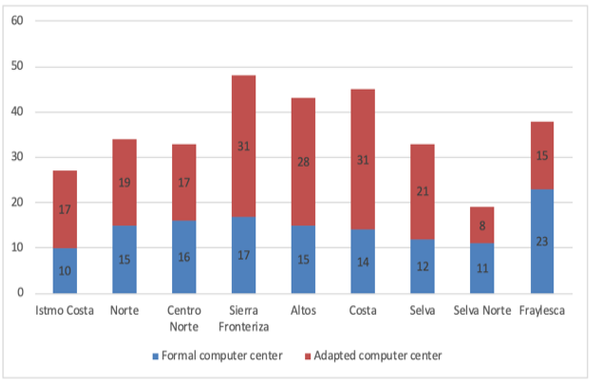

Figure 9 Formal and informal (adapted) laboratories, by area coordinations

The above graph shows that there are a total of 320 computer labs distributed across all campuses, of which 41.56 percent are formal.

Professional profile

It is the set of skills, abilities and competencies that a computer centre laboratorian must have in order to carry out the activities required and entrusted to him/her.

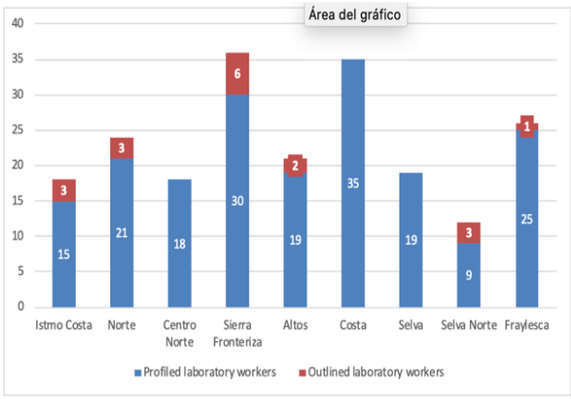

Figure 10 Laboratory technician with IT profile

Ninety-one per cent of the laboratorians have an IT profile, a condition that contributes to basic or preventive maintenance, characterised by cleaning, updating software and running antivirus programs.

With regard to corrective maintenance, it is the joint responsibility of the IT Unit and the area coordinating offices to schedule visits to the sites of the area coordinating offices to provide this service. However, the growth of the school makes it difficult to cover all the campuses due to the limited number of operational staff assigned to the task.

Conclusions

The diagnosis constitutes the initial part of any evaluation process or the start of any work proposal. It needs to be framed within a methodological process that guides and orients the phases that will make up the programme, project and work plan.

It takes on greater relevance and transcendence when the modality is participatory, at the same time as it requires individual and group commitment with a proactive attitude and above all that takes up and reflects the methodological and formative experience converging towards the same end, independently of personal paradigmatic positions.

In this sense, we began with the diagnostic phase of the COBACH academic programme in order to identify the series of problems and successes that characterise the work of administrative, management and teaching staff in central offices, zone coordinating offices and schools. In particular, the implementation of ICTs in the COBACH sub-system was described.

In the diagnosis, the vision of the actors involved was incorporated, not necessarily in agreement between the different instances, identifying this wealth of visions as responsible for the academic and administrative reality of the school life of the sub-system.

It is worth recognising that the quantitative growth of schools, the increase in the number of teaching and administrative staff has not necessarily been in line with the academic and administrative needs required by the baccalaureate for a comprehensive education. In the area of ICTs, the need to keep pace with this growth was evident: it is necessary to digitalise educational processes, improve equipment, and provide greater coverage and quality of internet service. In the case of communities with a high degree of marginalisation, it is utopian to think that this issue will be solved in the present administration; nevertheless, the strategy of incorporating the intranet modality to emulate the internet service was identified.

The "Planteles Vivientes" proposal has been identified and has been implemented in eighteen educational centres. Most of them are located in rural or marginal communities in the Central North, Isthmus Coast and North Coordination Units. It should be noted that in order to attend to each educational centre concerned, the immediate superior authority managed the support in notification letters for the Director involved so that the staff of the IT Collegiate could be absent from their work centre. Given that this activity was carried out on the members' own initiative, in some cases they received financial support in petrol from the director visited, using the teacher's personal vehicle or the vehicle of the Faculty of Human and Social Sciences of the University of Sciences and Arts of Chiapas.

ISSN 2531-2960

The diagnosis also identified the need to train, professionalise or specialise the existing human capital in the different educational spaces of the subsystem to incorporate the use of ICTs, as well as to break the institutional inertia characterised by a series of anachronistic and outdated practices.

More than 40 years after the founding of the College, the current social context of high school graduates with an individualised lifestyle sheltered in a consumer society, with family structures in transition, with personal learning environments in virtual learning environments, demand the rethinking and repositioning of what once constituted certainty for the College's working staff.

This is why it is so important to point out and specify the diagnosis in the work developed in this paper; making reality explicit or hiding it from our immediate gaze does not blur the reality per se that determines us without us necessarily being aware of it.

The reality encountered implies taking up again the strategies of collective work, working groups in a collegiate modality to attend to the context of the subsystem of the school. It places the working group in charge of the diagnosis and the current educational authorities in a different working scheme, assuming this position implies the responsibility of modifying what has been diagnosed. It requires transcending and moving from the traditional discourse to propositive and coordinated actions for the educational purpose framed in the new government's incipient educational proposal.

In order to achieve the previous precept, the working group needs to initiate methodological processes that allow it to break dogmas, ideologies and basic formative vices, since this puts us on the threshold of training the educational actors mentioned at the beginning of this paper.

It is necessary to identify that the educational theme is the one that unites us, and as such, from a philosophical point of view, it is an unfinished theme with ontologically undefined beings, under an institutional practice that needs to be reconsidered.

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Artícle **Journal of Technological Development**
December 2022, Vol.6 No.18 32-39

Photovoltaic system at UTNC

Sistema fotovoltaico aislado en la UTNC

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DOI: 10.35429/JTD.2022.18.6.32.39 Received July 30, 2022; Accepted December 30, 2022

Abstract

This article represents the work and research carried out for the implementation of a photovoltaic system at the Universidad Tecnológica del Norte de Coahuila. Setting the objective of avoiding high consumption of electrical energy caused by metallic additive-type luminaires in exterior corridors. The change to LED technology luminaires is proposed and these in turn are energized by a solar panel. It begins with the execution of a theoretical and practical study in order to find out what refers to a photovoltaic solar energy system in isolated mode, to evaluate the conditions in which it will work when carrying out this project. The area to be illuminated, the necessary light intensity, the type of LED reflector to be used, the terrain was dimensioned and the distance between each LED reflector was decided. For the proposal, a plan was prepared in AutoCAD and with the use of the DIALux program, the simulation of the lighting system was carried out, obtaining measurements in lux, in order to have a more precise result prior to authorization. Finally, when carrying out the implementation, the objective was met, so it will be sought to replicate it in other areas.

DIALux, Implementation, Off-grid PV system

Resumen

El presente artículo representa el trabajo e investigación realizado para la implementación de un sistema fotovoltaico en la Universidad Tecnológica del Norte de Coahuila. Marcando como objetivo el evitar consumos altos de energía eléctrica, ocasionados por luminarias del tipo aditivo metálico en pasillos exteriores. Se propone el cambio a luminarias de tecnología LED y estas a su vez sean energizadas por un panel solar. Se inicia por la ejecución de un estudio teórico y práctico con el fin de conocer lo referente a un sistema de energía solar fotovoltaica en modalidad aislada, para evaluar las condiciones en las que se trabajará al realizar este proyecto. Se determinó la zona a iluminar, la intensidad de luz necesaria, tipo de reflector LED a utilizar, se dimensionó el terreno y decidió la distancia entre cada reflector LED. Para la propuesta, se elaboró un plano en AutoCAD y con la utilización del programa DIALux se realizó la simulación del sistema de iluminación, obteniendo mediciones en lux, para tener un resultado más preciso previo a la autorización. Finalmente, al realizar la implementación se cumplió con el objetivo, por lo que se buscará replicar en otras áreas.

DIALux, implementación, Sistema fotovoltaico aislado

Citation: RINCÓN-MALTOS, Gerardo, MARTÍNEZ-SOTO, José Santiago, MARTÍNEZ-MERCADO, José Alfredo and DE LUNA-ALVAREZ, Rosendo. Photovoltaic system at UTNC. Journal of Technological Development. 2022. 6-18:32-39.

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Introduction

This project covers from the determination of the area, through the design of the circuit to its implementation in the area. An isolated photovoltaic system for the lighting of the back corridor of the library building of the Universidad Tecnológica del Norte de Coahuila (UTNC), seeking to achieve significant savings in electrical energy consumed by outdoor luminaires, without neglecting the proper lighting of the area. The metal additive lamps for exterior corridors in the University are widely used, however the use of this type of luminaire generates high consumption of electricity by the simple fact of what this technology represents, not having illuminated the corridors can cause accidents to students and teachers while passing through them in the evening shift, which ends at 21:30 pm, so removing the lights is not an option, however replace them with LED technology luminaires would lead to energy savings. Finally, it is intended that this will be replicated in the other corridors of the University once its effectiveness is demonstrated. The methodology section covers the review of information on photovoltaic systems, calculations and design, and the two-stage implementation of the system. The results section reports on both stages of implementation, while the discussion and conclusions sections address recommendations and analyze the fulfillment of the project's purpose.

Methodology

Literature review

Photovoltaic systems are divided into two types, one is isolated and the other is interconnected. Isolated PV systems are suitable for meeting specific energy needs, especially in remote or difficult to access locations (indisect, 2020).

A stand-alone system consists of a solar panel, charge controller, inverter, solar batteries (ecofener, 2019).

Solar panels exist in different capacities, i.e., there are some that are capable of producing from a small amount of energy to large amounts such as 810W (pv magazine, 2020). It should be considered that solar panels are designed to work together as well as individually, so depending on the user's need, the number and type of panels should be adjusted.

The charge regulators are designed under two different technologies, one of them is the PWM, which is the most economical, is more widely distributed, however, depending on the efficiency that is sought to achieve with the system, you can opt for the economic or the other type of technology that compared to the above is not as easy to achieve or as economical. The MPPT regulator allows an increase in energy productivity of up to 30% compared to other regulators (Sanz, 2021).

A power inverter's sole purpose is to receive the battery voltage and provide an output of 110-220 volts with which to power a load.

If there are different battery technologies, the recommended technology for use in photovoltaic systems is deep cycle technology. These are designed to be almost fully discharged and regularly lose between 50% and 80% of their capacity (ledsolar, 2020).

Applicable regulations

According to the Secretaría de Salud (2015):

Mexican Official Standards (NOM) are technical regulations of mandatory observance issued by the competent agencies, whose purpose is to establish the characteristics that processes or services must meet when they may constitute a risk to people's safety or harm human health; as well as those related to terminology and those that refer to their compliance and application.

Identifying applicable standards, one of them NOM-025-STPS-2008 Condiciones de iluminación en los centros de trabajo", la Secretaría del Trabajo y Previsión Social (2008) mentions that the minimum lighting levels that should affect the plane to move around walking should be 20 lux.

Current situation

The chosen corridor has a 400W metal additive type lamp with a luminous flux of 36,000 lumens; it has auxiliary equipment consisting of a 400W ballast and a 120-240V photoelectric switch, which sometimes does not turn on, as shown in Figure 1.

ISSN 2531-2960

Figure 1 Area to be illuminated on the right side
Source: Own elaboration

Once the corridor was chosen, measurements were taken of the area to be illuminated, obtaining measurements of 10 meters wide and 38 meters long, as shown in Figure 2.

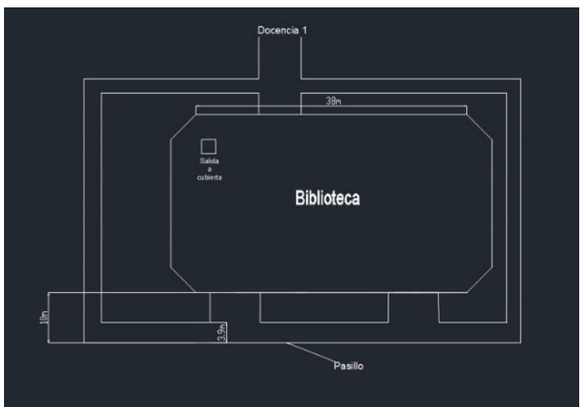

Figure 2 Plan of the area
Source: Own elaboration

Dimensioning of the system

Based on NOM-031-ENER-2012, "Eficiencia energética para luminarios con diodos emisores de luz (leds) destinados a vialidades y áreas exteriores públicas" (Energy efficiency for luminaires with light emitting diodes (leds) intended for roads and public outdoor areas), we seek to perform the necessary calculations to determine the appropriate materials for the project.

The first point is to determine where the luminaires will be installed, see Table 1.

Luminaire for to be installed in	Minimum luminous efficacy [lm/W]	Percentage of luminous flux in the zone, of total luminous flux
Wall	52	No more than 48% to the front in the zone of 60 and 80° (FH)
		No more than 3% forward in the 80 and 90° zone (FVH). 90° (FVH)
		0% in the 90 and 100° zone (UL) and in the above 100° zone (UH). above 100° (UH)
Post	70	At least 30% forward and backward in the 60 and 80° zone (FH + BH). 60 and 80° zone (FH + BH)
		No more than 20% above 80° (FVH + BVH + UL + UH)

Table 1 Minimum luminous efficacy and total luminous flux
Source: Secretaría de Energía (2012)

Since the lamps will be recessed in the building, the Secretaría de Energía (2012) suggests taking 52 lm/W as the minimum luminous efficacy. In order to replace the current lamp with an equivalent LED lamp, a 50W lamp was found, equivalent to a 500W lamp, with a luminous flux of 3500 lm, color temperature of 6000K and a luminous efficacy of 70 lm/W, thus complying with the minimum luminous efficacy specifications.

With the understanding that one lux is equivalent to one lumen per square meter (krealo, 2014), and for this project, for the moment only the dimensions of the space to be illuminated are known, as well as the minimum illumination levels, we proceed to calculate the lumens needed to cover that area, in equation (1).

$$\text{Lumens} = (20\ lx) * (380\ m2) = 7600\ lm \quad (1)$$

By dividing the total lumens required by the luminous efficacy we obtain the electrical power required in equation (2)

$$\text{Electrical power} = (7600\ \text{lm})/(70\ \text{lm/W}) = 108\text{W} \quad (2)$$

To know the number of lamps required, the total electrical power must be divided by the power offered by the lamp, as shown in equation (3).

$$\text{Number of lamps} = (108\ \text{W})/(50\ \text{W}) = 2.16 \quad (3)$$

For the calculation of the battery bank, we initially consider an energy consumption of the lamps of approximately 10 hours per day, time controlled by a photoelectric switch, and we take for calculation purposes a 30% of total losses by connections and conductors according to Alvarado and Cruz (2016). Equation (4) will indicate the required capacity.

$$\text{Battery} = ((100\ \text{W} * 10\ \text{h}) * 1.3)/12\ \text{V} = 108.3\ \text{Ah} \quad (4)$$

The battery that meets these 108.3 Ah, is the 115Ah, however, it would be performing almost total discharges, which is not recommended, as it decreases the life of the battery, so it is proposed the use of a timer to control the on time of the lamps to only 4 hours.

$$\text{Battery} = ((100\ \text{W} * 4\ \text{h}) * 1.3) / 12\ \text{V} = 43.3\ \text{Ah} \quad (5)$$

$$\text{Download} = \left(\frac{43.3\ \text{Ah}}{115\ \text{Ah}}\right) * 100 = 37.68\% \quad (6)$$

As shown in equation (6), the suggested action of controlling the ignition by means of a timer allows making good use of the battery, since it is possible to discharge the battery only 37% of its capacity, preserving its useful life.

To identify the panel capacity required for the system, the solar irradiation received by Piedras Negras is considered, this city obtains an annual average of 4.5 kWh/m2 per day according to Conermex (2016), so the photovoltaic power (PFV) required for the system is calculated as shown in equation (7).

$$\text{PFV} = ((100\text{W} * 4\ \text{h}) * 1.3) / 4.5 = 115.5\text{W} \quad (7)$$

Therefore, a panel providing a value higher than 115W is required.

In the case of the controller, it must support higher currents than the maximum currents generated by the panel. Similarly, the inverter must be higher than the loads fed by it.

Simulation of the project in DIALux

The location of the luminaires was made considering that the trees could block the passage of light.

With this type of simulation it is possible to observe by means of the false color technique, the representation of the illumination in lux, as shown in the color table under the design, in this way it is possible to visualize that the minimum of 20 lux is largely complied with.

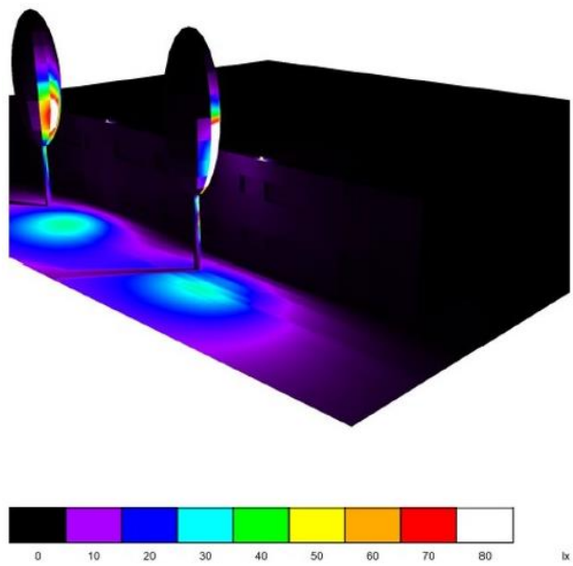

Figure 3 Simulation of the area to be illuminated with false color technique
Source: Own elaboration

Request for materials

The project was presented as a proposal to the University, which provided support with the purchase of materials necessary for the implementation.

Implementation stage one

The tools and materials available for the first stage were those indicated in Table 2.

Tools and materials needed		
Solar panel (270W)	Deep cycle battery (115 Ah)	2 LED spotlights
14 gauge wire	Charge controller (30 Amp)	Inverter (300W)
Pipe mt of 3 meters	3 meter metal angle	Welding
Drill	Clamps	Tube bender
Segueta	3/8" brush	Sockets
Nuts	Sanding Machine	Screws
Luxmeter	Battery terminals	Multimeter
Electric tongs	Timer	Insulating tape

Table 2 Tools and materials used in the implementation
Source: Own elaboration

Once the panel arrived at the University, measurements were taken to design a support as shown in Figure 4.

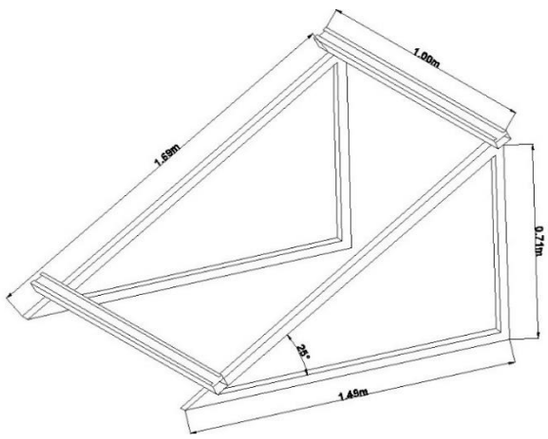

Figure 4 Solar panel support design
Source: Own elaboration

A height of 20 cm. was placed so that the panel does not touch the ground and to anchor the support to a safe part, as shown in Figure 5.

Figure 5 Panel with anchored support
Source: Own elaboration

The installation for this system consisted of connecting the solar panel to the charge controller with 14 gauge cable, the deep cycle battery to the charge controller to regulate the battery voltage and protect it from overload, then the charge inverter to the battery, to feed 110VAC to the reflectors, between the reflectors and the inverter was placed the timer already configured, all this embedded in a wooden base as shown in Figure 6.

Figure 6 Controller connected
Source: Own elaboration

Stage two implementation

After a few quarters of testing, it was considered viable to decrease the operation time of the lamps from 4 hours to only 2 hours, but increasing the lighting quality with 2 more lamps, to cover a little more area and the operation schedule was established from 8pm to 10pm, so the total consumption will remain the same as calculated in the first stage.

In terms of regulations for this time, NOM-031-ENER-2012, "Eficiencia energética para luminarios con diodos emisores de luz (leds) destinados a vialidades y áreas exteriores públicas" was cancelled and replaced by NOM-031-ENER-2019, but as the project was worked to comply with the standard, The new regulation, in which the Secretaría de Energía (2021) established the minimum required value at 75 lm/W, the initial calculations of the project were 70 lm/W, a result not too far off, however, this minimum must be covered in the other corridors of the university.

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Results

Measurements were taken with the luxmeter in stage one, obtaining values ranging from 41 lux to 6 lux in the corridor area, so work continues on finding the degrees of inclination for the luminaires and their optimal use (see figures 7, 8, 9, 10).

In stage two, the lamps were rearranged, since now with 4 lamps they had to be distributed at a shorter distance between them, resulting in a distance of 3 meters between each one (see figure 11).

Figure 7 Front illuminated area of stage one
Source: Own elaboration

Figure 8 Illuminated area on the right side of stage one
Source: Own elaboration

Figure 9 Stage one high luxmeter reading
Source: Own elaboration

Figure 10 Low stage one luxmeter reading
Source: Own elaboration

Figure 11 Illuminated area on the left side of stage two
Source: Own elaboration

Discussion

Following the recommendation of Haro and Ocampo (2019) to avoid voltage drops, short lengths were sought in the connections between battery-inverter, regulator-battery and as far as possible a short distance from the panel to the regulator; considering that although the panel is at the top of the building and the battery along with inverter-regulator are located inside.

Also, Haro and Ocampo (2019) suggest a discharge regime of 30%, to prolong the life of the battery, an issue that in the present project was considered and a discharge period of 37.68% was achieved.

Something that was also observed during the planning of the project, was mentioned by Haro and Ocampo (2019) where it mentions that it should be verified that the luminaires to be used are on the market, contributing to the previous comment, there is also the option of adapting a design to the simulation from standard lamps, modifying the properties of the lamp, with what can be obtained in the local market (as long as there is certainty of its technical data).

ISSN 2531-2960

Acknowledgements

This work has been possible thanks to the support of the Universidad Tecnológica del Norte de Coahuila.

Conclusions

The Universidad Tecnológica del Norte de Coahuila is an institution committed to the environment; among its actions is the recycling of PET containers coordinated by students of Industrial Processes, the planting of trees directed by the Ecological Club and, among others, it also supports improvement projects, such as the one described in this publication, that have an impact on the conservation of the environment and generate awareness in students and society.

The use of clean energy is in growing demand, due to the great savings in economic terms that it represents at the time of making the payment of the electric energy service, so it is a developing field of work and for which the student must be prepared.

During stage one, considering an identical operating time for the two types of lamps (4 hours), a single lamp of the metallic additive type that the school has to illuminate its corridors that communicate one building with another, has a consumption of 1600W per day, while 2 LED technology lamps consume only 25%, i.e. 400W; besides being an option with much less consumption, it is a load that is powered by a solar panel, so it can be concluded that 1600W per day will be subtracted from the CFE bill.

During stage two, considering an identical operating time for the two types of lamps (2 hours), a single lamp of the metallic additive type that the school has to illuminate its corridors that communicate one building with another, has a consumption of 800W per day, while 2 LED technology lamps consume only 50%, i.e. 400W; besides being an option with much less consumption, it is a load that is powered by a solar panel, so it can be concluded that 800W per day will be subtracted from the CFE bill.

It should also be taken into account that the photoelectric switches, which are the ones used in the institution until before this project, are sometimes activated in cloudy conditions, so sometimes energy is being consumed when it is not necessary, instead a timer tends to be a better option (taking into account that there are different models with higher or lower quality).

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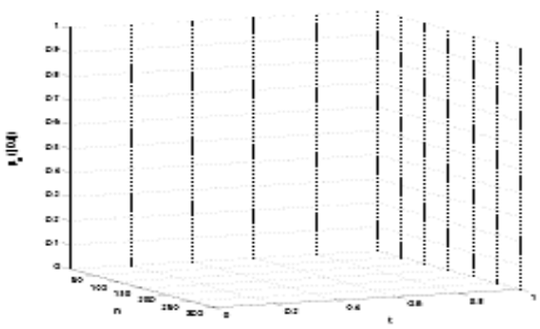

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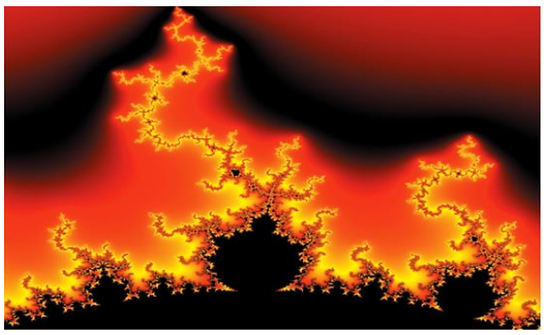

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