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Journal of Computational Technologies

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Presentation of the content

In the first article we present, *Internet of things prototype for water management in a house* by Sánchez-Delgado, Octavio, Vargas-Flores, Rosario, Noguerón-Soto, Alfonso and Alfaro-Herrera, Julio César, with adscription in the Universidad Tecnológica de Tehuacán, in the next article we present, *Frontend and Backend: The new approach to the development of a Web platform for automating the control and administration of degree processes at ITESI* by Rodríguez-Campos, Juan Carlos, Rico-Chagollán, Mariana, Chacón-Olivares, María del Carmen and Guzmán-Hernández, Manuel Alejandro, with adscription in the Tecnológico Nacional de México (TecNM) / Instituto Tecnológico Superior de Irapuato (ITESI), in the next article we present, *Technology transfer through the development of software for extracurricular workshops for ENOI* by Rodríguez-Campos, Juan Carlos, Rico-Chagollán, Mariana and Vidal-Ortiz, Gabriela, with adscription in the Tecnológico Nacional de México (TecNM) / Instituto Tecnológico Superior de Irapuato (ITESI), in the last article we present, *Linking students with marketing companies through IT Projects* by Duran-Belman, Israel, Magdaleno-Zavala, Juan Antonio and Gallardo-Alvarez, Dennise Ivonne, with adscription in the Tecnológico Nacional de México/ITS de Irapuato.

Content

Journal of Computational Technologies 8[21]1-9: e1821109
Article

Internet of things prototype for water management in a house

Prototipo de internet de las cosas para la gestión de agua en casa habitación

Sánchez-Delgado, Octavio*[a], Vargas-Flores, Rosario [b], Noguerón-Soto, Alfonso [c] and Alfaro-Herrera, Julio César [d]

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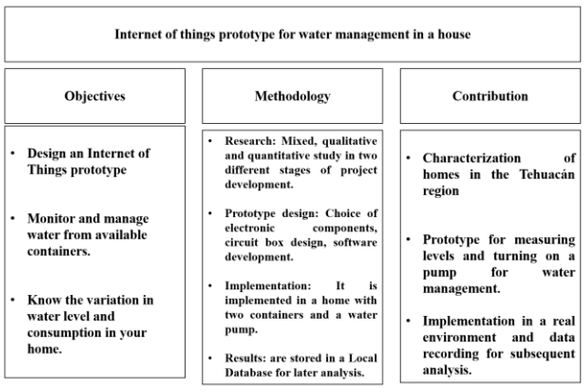
Abstract

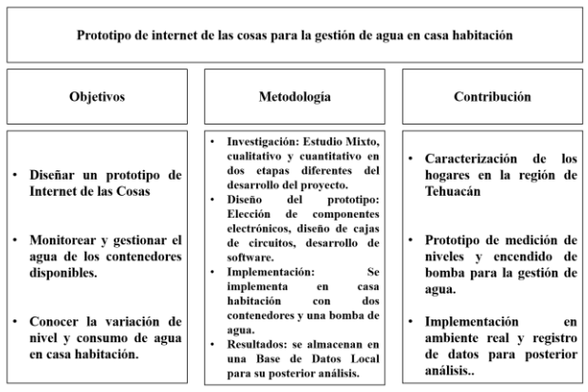
This article presents the results of the creation of an Internet of Things prototype that was implemented in a house in the municipality of Tehuacán, Puebla in Mexico, where the water of a social interest house is monitored. The prototype is developed with the objective of controlling the filling and emptying of the water containers and presenting this information in real time about the status of the filling of the water tanks. This work was developed with quantitative purposes since data collection is carried out that It can be analyzed later, so far the prototype is working, presenting information in real time to the user and data is being collected, the operation is as expected, fulfilling the function of monitoring and control of filling.



Internet of Things, Water Care, Water Management

Resumen

En este artículo se presentan los resultados de la creación de un prototipo de internet de las cosas que se implementó en una casa habitación en el municipio de Tehuacán, Puebla en México, donde se monitorea el agua de una casa de interés social. El prototipo se desarrolla con el objetivo de controlar el llenado y vaciado de los contendores de agua y presentar esta información en tiempo real sobre el estado del llenado de los tinacos, este trabajo se desarrolló con propósitos cuantitativos ya que se realiza la recolección de datos que podrá ser analizada posteriormente, hasta ahora se tiene el prototipo funcionando, presentando información en tiempo real al usuario y se están recolectando datos, el funcionamiento es el esperado cumpliendo con la función del monitoreo y control del llenado.



Internet de las Cosas, Cuidado del Agua, Gestión de Agua

Citation: Sánchez-Delgado, Octavio, Vargas-Flores, Rosario, Noguerón-Soto, Alfonso and Alfaro-Herrera, Julio César. [2024]. Internet of things prototype for water management in a house. Journal of Computational Technologies. 8[21]1-9: e1821109.

Introduction

This document describes a prototype of the internet of things built and implemented in a social housing in Tehuacan, Puebla, which seeks to present a monitoring system for the inhabitants of the house, where the water level of two containers is displayed in real time, raising awareness about the daily, weekly or monthly water consumption, as well as the use and control of the pump that is installed, so that from a full container, a second container is supplied.

This technological intervention seeks to address, through awareness-raising, the serious problem of water scarcity in the Tehuacán region, as people who have a fixed service installed, may pay a fixed fee or have a metered service, but are not aware of the amount of water consumed at home, nor of possible internal or external leaks.

The project seeks to be a technological tool that contributes to goal 6, Clean Water and Sanitation, in targets 6.4 which refers to the efficient use of water resources, 6.6b to strengthen the participation of communities in better water management, as well as 6.5 to implement integrated water resources management, which is part of the United Nations Sustainable Development Goals for 2030 (UNESCO, 2019).

It is also considered that this is not an isolated work, as it is included in technological trends such as Smart Water Systems (SWS), Smart Water Technologies (SWT) and Smart Water Infrastructure Technologies (SWIT) which involve Smart Metering, Regional Metering, Pressure Management, Leakage Management, Customer Relationship Systems, Geographic Information Systems, Hydraulic Modelling and Supervisory Control and Data Acquisition; in addition to involving new technological trends such as Artificial Intelligence, Big Data, Cloud Computing and the Internet of Things, thus achieving the digitisation of water (Arniella, 2017).

The proposed prototype uses affordable materials in terms of cost, with which it has been possible to build a prototype of the internet of things using sensors, actuators, controller, database connection and monitoring and / or manipulation of information through a web application.

This application is collecting information on levels and use of the water pump, with this information can be displayed in real time, with this information we seek to make the user aware of water consumption, however, the collection of information levels can be a future tool to improve the management of water in the home.

Materials and Methods

Project initiation

During the initial documentary research it was found that the United Nations (UN) in its Sustainable Development Goals for 2030, has established goals on water care, where the countries that make it up seek to care for and make more efficient use of this important resource for human beings, likewise, emerging technologies were identified that are being used for the same purpose, water care, and make more efficient use of this natural resource.

The Sustainable Development Goals of the UN are applicable worldwide, which corresponds to a large population, on the other hand at the business level and in large cities are taking measures for the efficient use of water but depends on large investments, is then considered that the proposal of this project should be raised at the most basic level of society, as is the family (United Nations, 2022), which develops in a house, a place where the vital liquid is essential. A survey was carried out on a representative sample of the population (29,314 inhabitants who are heads of household) considering a margin of error of 10%, with a confidence level of 90% and a sample percentage of 63%.

Five parts were considered in the survey: personal data, household information, information on water use habits, detection of leaks in the home, and technologies for automation and water care. Sections where they are asked about the characteristics of the family, the members and their water consumption habits, the characteristics of the house, the water containers present in the house and the white goods that require water to fulfil their function, as well as how interested they are in acquiring this technological tool or knowing if they have already implemented them in the house.

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The results show that 65% of the respondents do NOT have a water level detection system in their containers, 41% indicate that they have a manual water pump, which means that 51% have a cistern, 44% of the respondents indicate that they have drinking water service once or twice a week, while 39.5% indicate that when they have the service it is less than 10 hours a day; finally 81% of the respondents indicated that they are interested in having this technological tool in their homes, see Figure 1.

Box 1

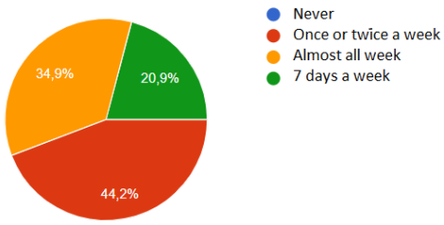

Figure 1
Survey Graph
Own Elaboration

The survey shows that households in the Tehuacán region have a drinking water service that is intermittent in its frequency during the week, as well as the short time that the service lasts, which is an indication of the management carried out by the Sistema Operador del Servicio de Agua Potable when rationing services in the region.

Also, the surveyed heads of household indicate that they have two or more containers, which may require the use of a manually operated pump, and in this sense they are interested in the use of technological tools for water management.

Circuit Design

The circuit is developed by implementing low-cost technology and with an internet of things approach through the use of free tools, with Wi-Fi wireless communication.

According to the survey carried out, two containers are considered, a water pump that serves to fill one container from another and a controller for interconnection and data collection.

The aim is to monitor the levels of both containers and turn on the pump, this can be done remotely or locally, which is considered using two ultrasonic sensors, with protection against liquids such as the JSN-SR04T ultrasonic sensors, connected by cable to the NodeMCU development board, which is based on the ESP8266 controller that has an antenna for wireless connection compatible with Wi-Fi, a button is also implemented that will be responsible for turning on the water pump with the help of a relay, offline monitoring is done through a 2x16 LCD display, as shown in Figure 2.

Box 2

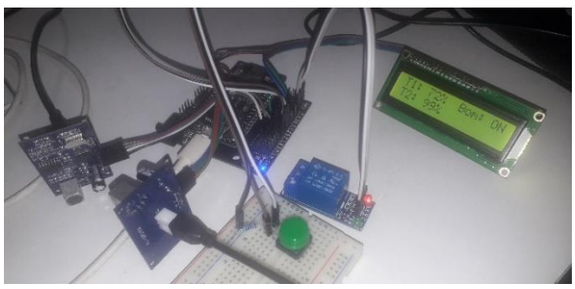

Figure 2
Circuit Design
Own Elaboration

Prototype programming and code debugging

The prototype programming is done with Arduino IDE, implementing the ESP8266 Community package version 3.0.2 for working with the NodeMCU development board, as well as the HCSR04 Ultrasonic Sensor library version 2.0.3 for the ultrasonic sensors, which allows the reading of several ultrasonic sensors simultaneously. The Liquid Crystal library version 1.0.7 for the management of the I2C interface of the 16x2 LCD Display. For the connection to the Firebase database, the Firebase_ESP8266_Client-4.3.7 library and the ESP8266HTTPClient library included in the libraries of the ESP8266 board used were used. Once the development board and the libraries are implemented, a coding is done to obtain the sensor readings, then the code is added to calculate the amount of water in the containers individually, as a next step the monitoring messages are shown on the LCD display, to continue with the management of the relay, which will control the water pump, along with the button for manual ignition (see Figure 3), after testing and correcting the code is considered to have the operation without internet connection.

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Box 3

```
21
22 void loop(){
23   unsigned long current_time = millis();
24   if (current_time - previous_time >= interval) {
25     previous_time = current_time;
26     Lectura(1,1);
27   }
28   digitalWrite(LED,estado);
29   //Serial.println(estado);
30 }
31 ICACHE_RAM_ATTR void EstadoBomba(){
32   if (millis() - TiempoInicio > TiempoPermitido){
33     TiempoInicio = millis();
34     estado = !estado;
35     ShowBomba(estado);
```

Figure 3

Code for obtaining data from sensors

Own Elaboration

For the connection to the wireless data network, the coding is done with the ESP8266WiFi.h library and a static connection to a wireless network is established, then it is coded so that the current measurement data are delivered to a real-time database, which is implemented in Firebase, a free cloud service.

The update is performed every 4 seconds when there are constant changes in water levels, otherwise the information is NOT updated in Firebase. With this implementation, the information is available for any device or application to consult or modify as required. The Firebase database is shown in Figure 4.

Box 4

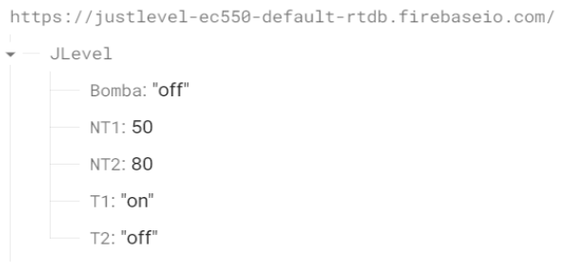

Figure 4

Firebase Database

Own Elaboration

3D Box Design

Each of the components of the circuit need to be protected against water, dust and involuntary modifications or disconnections, so it was necessary to design protection boxes for the circuits that make up the prototype, four boxes were designed, two for the ultrasonic sensor controllers, one for the water pump controller and one more that houses the main controller and concentrates the connections coming from the sensors and the water pump.

It should be noted that it was also necessary to design the sensor installation housings, as the sensor has a specific position and must be placed parallel to the water it is going to census, which is why it was necessary to design these attachments. The design of the elements was carried out with the help of Fusion 360 and Tinkercad.com, which are AutoDesk platforms.

Once the design was done, the parts were laminated with Ender Cura before printing (see Figure 5), which was done in PLA material with an Ender 3 printer, consuming 500 grams of filament and with a printing time of 30 hours.

Box 5

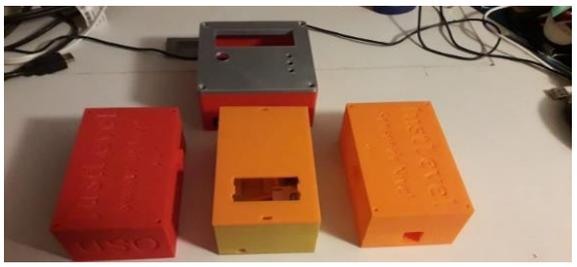

Figure 5

3D Printed Boxes

Own Elaboration

Installation in a real home environment

The installation was carried out in a house in the town of San Diego Chalma, belonging to the municipality of Tehuacan in the state of Puebla, the house is of social interest with some modifications, such as the main water tank or container on the roof of the first floor and a second water container on the roof of the first floor. The installation of the sensors was carried out by drilling a hole in the lid of the water tank as shown in Figure 6, looking for a space where the sensor would NOT interfere with the water falls and the float.

Box 6

Figure 6

Installation of the Ultrasonic Sensor in Tinaco

Own Elaboration

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The boxes were then placed with the sensor controller and its RJ45 jack connection, which was attached to the pipe that supplies water to the containers (see Figure 7).

The installation of the controller was done in the 3D printed box designed for this purpose, placed in a strategic location in the kitchen of the house, where you can see the values indicated by the display, the connection between the controller and the sensors of both containers was made, with the help of twisted pair cable (UTP) Cat5e, the cable crimping configuration was carried out under the ANSI/TIA-568B standard, at both ends of the cable, where the communication pins for the sensor are 2 and the other 2 pins are used to send electrical energy from the controller card, which sends 5. 0 volts output and have less than 50 meters of wiring for each sensor, it is considered an optimal connection.

Box 7

Figure 7
Sensor Controller Installation
Own Elaboration

The water pump requires a connection to 127~ Volts alternating current, which implies an additional adaptation, where a modified electrical extension is used, almost at the end of the cable a relay is installed that interrupts or allows the passage of electrical current, the extension ends with a contact, which allows the simple connection of the water pump.

The relay box for switching on the pump has a connection to the controller with UTP cable, very similar to those used by the sensors in the installed water tanks (Figure 8).

Box 8

Figure 8
Pump Control
Own Elaboration

Database implementation

Once the prototype was installed and working, it was necessary to implement a data storage model that allows to save the historical information, of the measurements obtained by the sensors, although the database in Firebase is of great help, the cost for constant use and storage of information could be activated, it is then that it is discarded to save historical data, remembering that it has the free plan.

It is then that MariaDB becomes the first option to store historical data, so its implementation is required.

MariaDB is a free database management system, which is implemented for the creation of Web systems, so it is implemented on a Raspberry Pi 4+, which is a small computer that runs its own operating system called Raspbian, which allows to implement a database server as MariaDB.

This is achieved through the management of the packages and versions of the program to be installed. Once installed, the database is created to store events, on and off of the water pump, as well as measurements, which stores the results of the calculations made in terms of the amount of water in the container, percentage of filling and the distance in cm obtained by the sensor during the measurement.

The structure of the database in MariaDB is shown in Figure 9.

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Box 9

```
MariaDB [JustLevelDB]> CREATE TABLE Bomba
    -> (id_evento BIGINT UNSIGNED AUTO_INCREMENT Primary key,
    -> momento TIMESTAMP NULL,
    -> evento int not null);
Query OK, 0 rows affected (0.030 sec)

MariaDB [JustLevelDB]> CREATE TABLE Eventos
    -> (id_evento BIGINT UNSIGNED AUTO_INCREMENT Primary key,
    -> momento TIMESTAMP NULL,
    -> Objeto NVARCHAR(50) NOT NULL,
    -> lectura int not null,
    -> porcentaje int not null,
    -> litros float not null);
Query OK, 0 rows affected (0.043 sec)
```

Figure 9

Creation of Database in MariaDB

Own Elaboration

It should be noted that it was necessary to modify the code of the controller, so that it would look for the database server and in this way the information could be entered in the corresponding table, thus maintaining the history of measurements during the operation of the prototype.

Web App implementation

Taking advantage of the fact that a small computer was considered for the database server, a web server was implemented there, which contains a web application, which allows the monitoring of the values delivered in real time about the current levels of the containers, as well as switches to activate or deactivate some of the sensors and the switching on or off of the water pump.

Likewise, a free version of a service called Remote.it (see Figure 10) was implemented, which is integrated into the Raspberry to make the web server public and can be consulted from any point on the internet.

Box 10

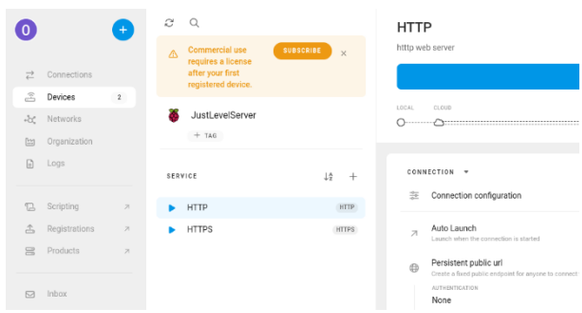

Figure 10

Web Server at Remote.it

Own Elaboration

The page was created with HTML, Java Script, CSS and some complements such as Bootstrap, jQuery and artyom, with which a WEB page with animations, effects and VOICE commands was achieved (see figure 11), which allows obtaining and providing information in a graphic and very concrete way, which focuses on the manipulation of some controls and allows the visualisation of information regarding the measurements of the levels in the tanks in real time that the prototype shows.

Box 11

Figure 11

Screenshot of WebApp

Own Elaboration

Data Collection

The prototype is working focusing on the control of the water pump, as well as on the monitoring of the water levels in the containers, keeping track of the events in the MariaDB database, where it is expected to collect basic information that allows the historical tracking of the operation of the equipment. It is important to note that if the prototype does not have a wireless network connection, it will NOT be able to record the information, but the operation with the LCD display and the button will NOT be affected, so the prototype will continue to be functional locally. Figure 12 shows the first records of the historical database.

Box 12

```
MariaDB [JustLevelDB]> select * from Bomba;
+-----------+---------------------+--------+
| id_evento | momento             | evento |
+-----------+---------------------+--------+
|         1 | 2023-11-29 16:12:58 |      1 |
|         2 | 2023-11-29 16:13:04 |      0 |
+-----------+---------------------+--------+
2 rows in set (0.001 sec)

MariaDB [JustLevelDB]> select * from Eventos;
+-----------+---------------------+--------+---------+------------+--------+
| id_evento | momento             | Objeto | lectura | porcentaje | litros |
+-----------+---------------------+--------+---------+------------+--------+
|         1 | 2023-11-29 16:05:43 | T1     |      79 |         30 |  145.3 |
|         2 | 2023-11-29 16:07:42 | T2     |      20 |        100 | 1098.2 |
+-----------+---------------------+--------+---------+------------+--------+
2 rows in set (0.001 sec)
```

Figure 12

Registration of events in the database

Own Elaboration

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Results and Discussion

In this research work, the development of an internet of things prototype is presented, which is implemented in a real working environment, it was installed in a two-storey house, which has two water containers and a pump for filling a container, as well as the drinking water service of the municipal network.

The prototype displays the current water levels in the containers and allows the water pump to be switched on and off locally and remotely. The results of this research work include a foundation of great impact such as the 2030 agenda of the UN, as well as emerging technologies applicable to water management, of course the statistical analysis of the survey responses applied to heads of households in Tehuacan Puebla; the realization of the prototype with the elements used that involved literature review and documentation of libraries for the ESP8266 and sensors.

During the creation process, some needs were found that are complementary to the prototype, such as the design and 3D printing of the housings to protect the components of the prototype, as well as the regulations for the UTP cabling for sending data and electrical energy.

During the documentary research, prototypes similar to the one presented in this document were found, but they do not have a theoretical basis, They are developed in laboratory environments and are only limited to the indication of water container levels, so the main differentiator with this work is the collection of data for future analysis, which will not be available for now, to complete at least 365 of operation, which is why the analysis is outside this first stage of the project where only the design and implementation was performed.

Conclusions

The results show that the creation of a functional Internet of Things prototype implemented in a real environment is not an easy task, as it requires knowledge of Microcontroller Programming, Computer Networks, Electronics, 3D Design and Printing, Electricity, Database, Web Servers, Operating Systems and Web Development, to mention a few areas of knowledge, without leaving aside the knowledge of basic sciences.

It is essential that the prototypes are tested in laboratory and controlled environments, however, the implementation in real environments should be a fundamental part of the development and testing, since, when facing external variables at runtime, errors are shown that strengthen the prototype and the knowledge of those who develop the prototypes, always seeking continuous improvement.

The absence of a considerable amount of data collected is an important factor in improving the performance of the device, so it is considered that the operation is as expected, is optimal and is generating data levels and variation of these during 24 hours a day, so that, by collecting sufficient information, the research work will continue.

During this development, there was no sponsorship or contributions from any sponsor or governmental financial support programme, so it was covered by the authors' own resources, who are willing to continue and improve the project with or without sponsorship or help.

Declarations

Conflict of Interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' Contributions

Sanchez-Delgado, Octavio: As project leader, designed the 3D models for the cases used, ensuring their functionality and aesthetics. In addition, he contributes to the development of the electronic systems and the programming of the devices involved. He supervised the integration of the services used and carried out the technological implementation, ensuring that all parts of the project worked in a cohesive manner.

Vargas-Flores, Rosario: Contributed to the writing of the article, structuring the content in a clear and professional manner. Designed the surveys used in the study, ensuring their relevance and validity for data collection.

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Noguerón-Soto, Alfonso: As an electronics engineer, developed and optimized the electronic circuits, providing key technical solutions to ensure hardware functionality. He collaborated closely in the integration of electronic components into the system.

Alfaro-Herrera, Julio César: Participated in the writing of the document, especially in the interpretation and presentation of the data obtained through the surveys. In addition, he led the implementation of the surveys in the field, supervising data quality and representativeness.

Data Availability

Currently, the data collected in this study are not available for publication. This is because they are under further analysis by the research team for future related studies. In addition, survey responses include sensitive and confidential participant information, which requires extensive review to ensure compliance with privacy regulations. Data release will be considered at a later stage, with consideration given to withholding sensitive information and data consolidation.

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Article

Frontend and Backend: The new approach to the development of a Web platform for automating the control and administration of degree processes at ITESI

Frontend y Backend: El nuevo enfoque para el desarrollo de una plataforma Web de automatización del control y administración de procesos de titulación en ITESI

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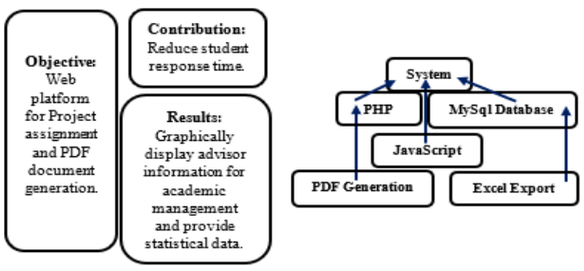
Abstract

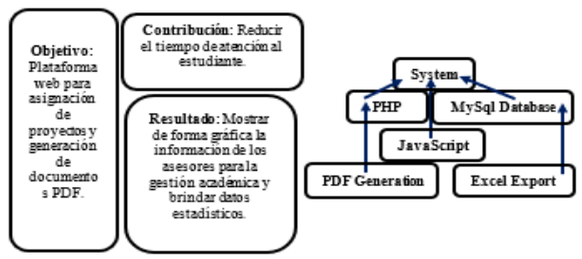
Technological advancements have enabled the development of information systems and the automation of educational processes. This project uses PHP, MySQL, and JavaScript to improve PDF report creation and data export to other platforms, storing all records in a MySQL database. The system offers basic CRUD functions (create, read, update, delete) for data such as projects, teachers, and students, and allows searches by student name, project, department, degree type, year, advisor, and deadline. The main objective is to automate and control the graduation processes, generate statistical reports and PDF documents, and export data to Excel for analysis. This program is a key tool in managing and tracking graduation processes.



Php, MySql, Administration, Software

Resumen

Los avances en tecnología han permitido desarrollar sistemas de información y automatizar procesos educativos. En este proyecto se usan PHP, MySQL y JavaScript para mejorar la creación de informes en PDF y la exportación de datos a otras plataformas, almacenando todos los registros en una base de datos MySQL. El sistema ofrece funciones ABC (altas, bajas, modificaciones, consultas) para datos como proyectos, docentes y alumnos, y permite búsquedas por nombre del estudiante, proyecto, departamento, tipo de carrera, año, asesor y fecha límite. El objetivo principal es automatizar y controlar procesos de titulación, generar reportes estadísticos y documentos PDF, y exportar datos a Excel para su análisis. Este programa es una herramienta clave en la gestión y seguimiento de los procesos de titulación.



Php, MySql, Administración, Software

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Introduction

In the higher education environment, the management and administration of academic processes, such as degree programmes, are fundamental to ensuring an efficient and satisfactory experience for both students and administrative staff.

However, in many institutions, the persistent reliance on manual methods in these processes has created a significant problem that affects the quality and efficiency of degree completion.

This project focuses on the implementation of an automated degree management system in a graduate school. The system seeks to address challenges such as inefficiency, lengthy process duration, the possibility of human error and mishandling of printing material.

Through the automation of these processes, it is expected to achieve a more agile and accurate management, reducing student attention times and improving the satisfaction of all parties involved.

In this context, this project is justified by the need to optimise the degree process, improve the operational efficiency of the educational institution and guarantee student satisfaction.

Throughout this proposal, the objectives of the project, the justification for its implementation and its feasibility from various perspectives will be explored in detail, with the aim of providing a comprehensive solution to the existing problems and significantly improving the degree process at the higher education institution.

Programming Language

A programming language, in simple words, is the set of instructions through which humans interact with computers.

A programming language allows us to communicate with computers through algorithms and instructions written in a syntax that the computer understands and interprets in machine language.

Html

HTML (HyperText Markup Language) is the most basic component of the Web. It defines the meaning and structure of web content. In addition to HTML, other technologies are generally used to describe the appearance/presentation of a web page (CSS) or the functionality/behaviour (JavaScript). MDN, HTML: (Hypertext Markup Language, 2022).

Software

Instructions (computer programs) that when executed provide the intended characteristics, function and performance; data structures that enable programs to properly manipulate information; descriptive information in both paper and virtual forms that describe the operation and use of programs.

Web browser

A computer program that allows the user to access the web pages he/she wants, provided he/she knows the URL address where it is located (for example: www.google.com) or clicks on a hyperlink that leads to that page.

JavaScript

A programming or scripting language that allows you to implement complex functions in web pages.

Php

PHP is a general-purpose programming language used primarily in the web development environment. This language is generally used to develop the backend of a website, the server side. Even so, it has numerous frontend utilities. This is why it is one of the main programming languages in the world of web programming.

Jquery

It is a fast and concise JavaScript library that simplifies HTML document, event handling, animation and AJAX interactions for web development.

Server

Definition Server (software): A software-based server is a program that provides a special service that other programs called clients can use locally or over a network.

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The type of service depends on the type of server software. The basis of communication is the client-server model and, as far as data exchange is concerned, service-specific transmission protocols come into play.

Database

A set of tables describing a larger entity. The tables may have relationships between them and be complementary. Typically, to describe or work with a system, it is necessary to have more than one table to understand the whole, and there are relationships between them.

Sql

Structured Query Language (SQL) is a standardised programming language used to manage relational databases and perform a variety of operations on the data they contain.

MySql

It is the name of a system that allows the management of databases. It is the most widely used option for web-based applications (Pérez Porto, 2019).

Visual Studio Code

Visual Studio Code is a lightweight but powerful source code editor that runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages (such as C++, C#, Java, Python, PHP, Go) and runtimes (such as .NET and Unity).

PhpMyAdmin

It is a tool written in PHP with the intention of managing the administration of MySQL through web pages, using the Internet, is available under the GPL (General Public License) and in more than 50 languages, this project is in force since 1998.

Xampp

XAMPP is the most popular PHP development environment. XAMPP is a completely free and easy to install Apache distribution containing MariaDB, PHP and Perl.

The XAMPP installation package has been designed to be incredibly easy to install and use.

Methodology

In this project, the waterfall lifecycle was used because it is suitable for the development of the web platform in the degree processes. It provides a clear and sequential structure that facilitates the planning and management of the project.

Each phase from requirements analysis, design, implementation, testing, to maintenance is completed before moving on to the next, which minimises the possibility of unforeseen changes and allows for better risk management.

Box 1

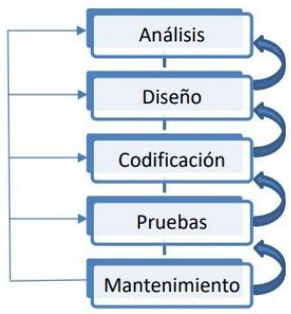

Figure 1
Cascading Life Cycle
Source: Own elaboration

Figure 1 shows the waterfall cycle methodology especially useful in projects where requirements are well defined and unlikely to change, as is often the case in administrative systems.

Therefore, when choosing the waterfall lifecycle, the activities are shown in the table below for the definition of the processes and their stages. This structured methodology ensures that each phase is completed before moving on to the next, allowing for an orderly and controlled development of the project. As shown in Table 1.

Box 2

Table 1
Activity and stages of the cycle

Activity	Stage	Layer
Analysis	Analysis	View
Design		
Implementation/ Verification	Programming	Processes
Maintenance	Implementation	Data and Visualisation

Source: Own elaboration

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Analysis

For the analysis of the degree project involving PHP, HTML, CSS, JavaScript and JSON technology, along with the creation of a website, requires a comprehensive combination of technical and project management skills. This process includes assessing user needs, defining system requirements, and planning the development stages.

The technical skills required range from programming in the above languages to interface design and JSON data manipulation. In addition, project management is crucial to coordinate teamwork, assign tasks, and ensure that deadlines and objectives are met, thus guaranteeing the quality and functionality of the final product.

In the first part, data collection is carried out with the following questionnaire, mentioned that the questions applied are not shown in their entirety.

1. **General Background**

- Could you briefly describe the current degree process at the institution?
- What are the main challenges or problems facing the current degree system?

2. **Current Functionalities**

- What functionalities does the degree system currently have?
- Which aspects of the system work well and which could be improved?

3. **Additional Requirements**

- What additional functionalities or features would you like to see implemented in the titration system?
- Are there any specific requirements that have been identified as important to improve the titration process?

4. **Users and Roles**

- Who are the main users of the degree system?
- What roles do these users play in the graduation process?

5. **Integration and Compatibility**

- Does the current degree system integrate with other systems or platforms used in the institution?
- Is it important that the new system is compatible with certain existing technologies or platforms?

Box 3

Figure 2
Database design
Source: Own elaboration

Figure 2 presents the general diagram of the database, without revealing the complete field and table information due to security and privacy considerations.

Programming and Visualisation

The project is developed under a 3-layer scheme; view, process and data.

Each layer separately employs and shares certain tools, which are described below.

1. VIEW Layer

a. HTML5 (for the structure, with responsive grid model)
b. CSS3 (for styling, form and multi-device adaptability)
c. PHP 8.0+ for server-side data uploading

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2. PROCESSING Layer

a. PHP 8.0+ (for reading data and transactions with Javascript and jQuery)
b. Javascript (for function execution, data transfer and display of modalities and alerts)

3. DATA layer

a. MySQL with engine version 5.0+ (for storing, querying, reading and controlling the data presented throughout all system processes and transactions)

Box 4

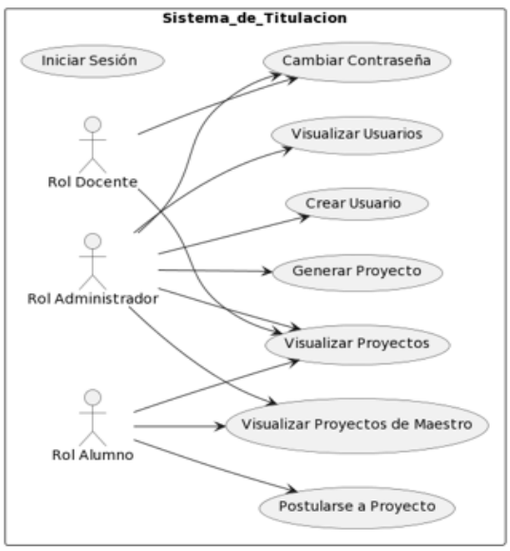

Figure 3
General system use case diagram
Source: Own elaboration

The diagram above involves three roles: teacher, administrator and student. Teachers can create projects, view their projects and change their password.

Administrators can generate projects, create users and view all elements of the system. Students can only view their projects and apply for them, as shown in Figure 3.

Box 5

```
C: > xampp > htdocs > NiceAdmin > ejemplo_grafica.php > ...
<!DOCTYPE html>
<html lang="es">
<head>
    <meta charset="UTF-8">
    <title>Gráficos con Chart.js</title>
    <!-- Incluimos Chart.js desde la CDN -->
    <script src="https://cdn.jsdelivr.net/npm/chart.js"></script>
    <style>
        /* Estilo para el contenedor del gráfico */
        .chart-container {
            width: 400px; /* Ancho deseado */
            margin: 10px; /* Margen para separar los gráficos */
            float: left; /* Alineación a la izquierda */
        }
        .clear {
            clear: both; /* Limpiar flotados */
        }
    </style>
</head>
<body>
    <!-- Contenedor de la primera gráfica (de líneas) -->
    <div class="chart-container">
        <canvas id="lineChart" width="400" height="300"></canvas>
    </div>

    <!-- Contenedor de la segunda gráfica (de barras) -->
    <div class="chart-container">
        <canvas id="barChart" width="400" height="300"></canvas>
    </div>
```

Figure 4
Coding (Backend)
Source: Own elaboration

Figure 4 shows part of the backend programming that handles the server logic, the database and the communication between the user and the server.

Results

Design

The design of the website includes various interfaces, such as the project creation screen, project assignment, release letter generation, and formats 31, 32 and 33. In addition, graphics and sections for teachers are presented, among other functionalities of the system. Figure 5 below shows the system login.

Box 6

Figure 5
System login
Source: Own elaboration

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The degree system facilitates comprehensive management from the administrator role, allowing efficient control over users, projects, formats, statistics and repositories.

Administrators can create, modify and delete user accounts, ensuring appropriate access according to specific roles. In addition, they have the ability to monitor and manage degree projects, ensuring that each complies with the established requirements. The system also includes tools for the creation and management of standardised formats, facilitating uniformity in documentation.

Through detailed statistics, administrators can analyse the progress and performance of projects, identifying areas for improvement. Finally, repository management ensures that all relevant information and documents are organised and easily accessible, thus supporting efficient and effective administration. As shown in Figure 6.

Box 7

Figure 6

General menu (Administrator role)

Source: Own elaboration

Box 8

Figure 7

Project registration

Source: Own elaboration

In Figure 7, the project registration in the degree system allows a detailed and organised management. In this section, you can select the degree course, the type of product, the start date of the project and the start date of the registration, as well as the number of students required to carry out the project. Students, from their role, can view the summary of each project and apply for those of interest to them. For their part, teachers have the ability to review the applications and select the most suitable students to participate in the projects, ensuring an effective assignment in accordance with the required profiles and skills.

The visualisation of assigned projects in the degree system allows teachers full control over the progress and management of each initiative. Teachers can finalise a project once students have completed it, ensuring a formal and orderly closure. In addition, they have the option to modify any necessary fields, such as participants, dates, career or correct incorrectly entered data, ensuring that information is always accurate and up to date.

The system also includes an advanced search functionality, which allows them to quickly locate any project using a variety of criteria, thus facilitating the management and tracking of all ongoing projects, as shown in Figure 8.

Box 9

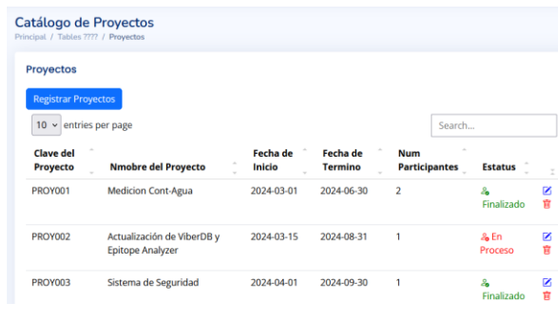

Figure 8

Consultation and modification of projects

Source: Own elaboration

The degree system allows the automatic generation of documents in PDF format, ensuring that all relevant information for the degree processes is properly compiled and organised. Among the documents generated is the release letter, essential to certify the successful completion of a project.

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When generating this letter, the system omits certain confidential data to ensure the security and privacy of the information. For example, the release letter includes the name of the project, the course, the key dates and the names of the participating students, but excludes sensitive personal data such as ID numbers or contact addresses.

This functionality not only streamlines the administrative process, but also ensures that the documents are consistent and comply with institutional standards. As seen in Figure 9 below.

Box 10

Figure 9

Generation of release letters

Source: Own elaboration

The degree system includes a robust functionality for the generation of statistical graphs, providing a clear and understandable visualisation of the most important data related to the degree processes.

These graphs allow you to analyse various aspects, such as the number of projects per degree programme, the percentage of students who have completed their degrees, the most common types of deliverables, and the average project completion time.

By transforming complex data into intuitive visual representations, the system facilitates informed and strategic decision-making by administrators and faculty, thus contributing to the continuous improvement of degree programmes. It is worth mentioning that the data shown in Figures 10, 11 and 12 are not actual data.

Box 11

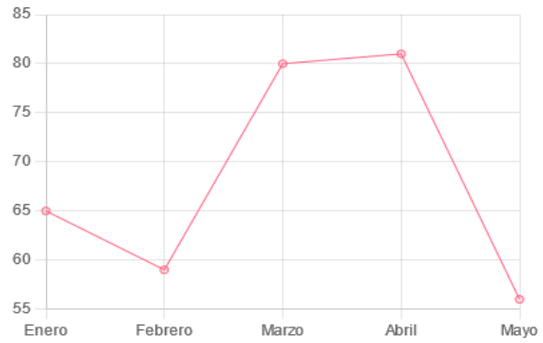

Figure 10

Progress chart

Source: Own elaboration

Box 12

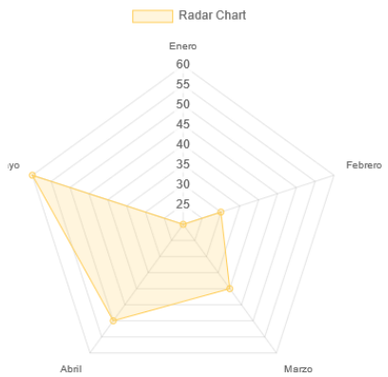

Figure 11

Radar graph

Source: Own elaboration

Box 13

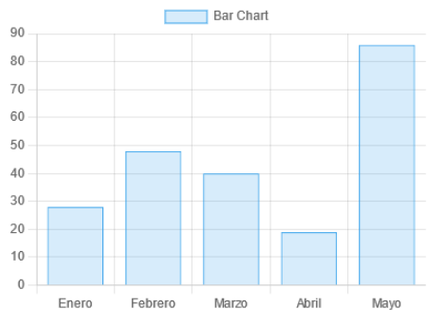

Figure 12

Bar chart

Source: Own elaboration

Conclusions

The modernisation and optimisation of the degree process at the Instituto Tecnológico Superior de Irapuato (ITESI) represents a crucial step towards the continuous improvement of educational quality and administrative efficiency.

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The problematic situation identified, characterised by the dependence on manual processes and the lack of automation, has generated a series of challenges that impact both students and administrative staff. In this context, the proposed project not only addresses the existing deficiencies, but also seeks to establish a solid basis for continuous innovation and adaptation in the future.

In conclusion, the successful implementation of this project will not only bring tangible benefits in terms of operational efficiency and student satisfaction, but will also lay the foundation for fostering a culture of continuous improvement and technological adaptation at the Instituto Tecnológico Superior de Irapuato (ITESI). By addressing the issues identified and adopting innovative systems, this project contributes significantly to the progress and modernisation of the institution in its constant search for educational and administrative excellence.

Furthermore, it represents a significant step towards the optimisation of the degree process at ITESI, as it not only addresses existing deficiencies, but also offers innovative solutions that guarantee a more efficient, accurate and satisfactory degree experience for both students and administrative staff.

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' contribution

Rodríguez-Campos, Juan Carlos: I contributed to the project idea, development, research method and editing.

Rico-Chagollán, Mariana: I contributed to the project idea, revision and editing, research method.

Chacón-Olivares, María del Carmen: I contributed to the revision and editing.

Guzmán-Hernández, Manuel Alejandro: I contributed to the project idea, data development and analysis.

Availability of data and materials

Further information on data availability or programming methodology during this study is available from the author.

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Acknowledgements

I am grateful to the TecNM campus ITESI, for giving me the opportunity to publish research and studies conducted within the institution.

Abbreviations

AJAX	Asynchronous JavaScript and XML
CSS	Cascading Style Sheets
HTML	HyperText Markup Language
ITESI	Higher Technology of Irapuato
JSON	JavaScript Object Notation
MySQL	My Structured Query Language
PHP	Hypertext Preprocessor
SQL	Structured Query Language
TecNM	Tecnológico Nacional de México

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Article

Technology transfer through the development of software for extracurricular workshops for ENOI

Transferencia de tecnología mediante el desarrollo de un software para talleres extracurriculares para ENOI

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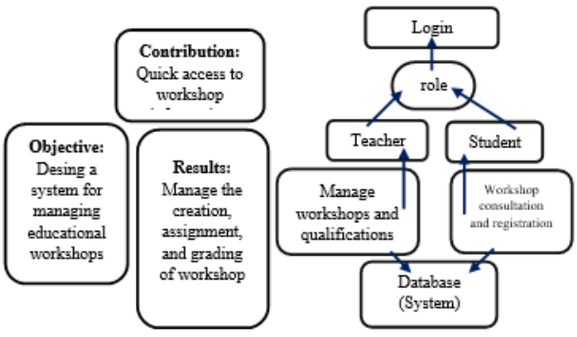
Resumen

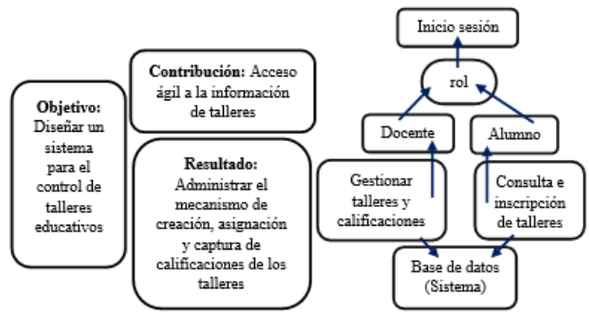
En la actualidad, el uso de herramientas tecnológicas es esencial en el ámbito educativo. Este proyecto es relevante para la Escuela Normal Oficial (ENOI), especialmente para el departamento de talleres, que carece de un sistema para gestionar los talleres impartidos por los docentes. Esta ausencia afecta a los estudiantes, que no tienen fácil acceso a la información de los talleres. El objetivo del proyecto es desarrollar un sistema web que permita asignar talleres, capturar calificaciones y recopilar información sobre talleres y docentes. Esto mejorará la gestión y accesibilidad de la información, beneficiando tanto a estudiantes como a docentes, y apoyará la toma de decisiones para el mejoramiento de la oferta educativa de la ENOI.



Workshops, Administration, Software

Abstract

Currently, the use of technological tools is essential in education. This project is relevant for the Escuela Normal Oficial (ENOI), especially for the workshops department, which lacks a system to manage the workshops given by teachers. This absence affects students, who do not have easy access to workshop information. The project's objective is to develop a web system to assign workshops, capture grades, and gather information about workshops and teachers. This will improve the management and accessibility of information, benefiting both students and teachers, and support decision-making for enhancing the educational offerings at ENOI.



Talleres, Administración, Software

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Introduction

The Escuela Normal Oficial de Irapuato (ENOI) is a consolidated institution of higher education with academic leadership and generator of innovative proposals in the initial training, professional development and updating of teachers.

Its commitment is to the educational quality of our society in the area that corresponds to it, carrying out its teaching work in an environment congruent with its philosophical principles, where its members have the opportunity to achieve an integral development. The history of the ENOI dates back to 1951, when Professor Juana Hidalgo Gómez, director of the school until 1974, took steps to establish an educational centre to prepare young men and women interested in the noble task of educating children.

Currently, the school control department of the ENOI does not have a system to provide or administer the workshops taught at the institution. For this reason, a control and administration system will be developed to allow the management of workshops, the assignment of grades and the registration of students. This will ensure better management and organisation of the workshops and facilitate access to information for students and teachers.

Programming Language

A programming language, simply put, is the set of instructions through which humans interact with computers.

A programming language allows us to communicate with computers through algorithms and instructions written in a syntax that the computer understands and interprets in machine language.

Html

HTML (HyperText Markup Language) is the most basic component of the Web. It defines the meaning and structure of web content. In addition to HTML, other technologies are generally used to describe the appearance/presentation of a web page (CSS) or the functionality/behaviour (JavaScript). MDN, HTML: (Hypertext Markup Language, 2022).

Css

CSS stands for Cascading Style Sheets. Basically, it is a language that handles the design and presentation of web pages, i.e. how they look when a user visits them. It works together with the HTML language that handles the basic content of the pages. They are called ‘cascading’ style sheets because you can have several sheets and one of them with properties inherited (or ‘cascaded’) from others.

JavaScript

JavaScript is a scripting or programming language that allows you to implement complex functions in web pages, any time a web page does more than just sit there and display static information for you to view, it displays timely content updates, interactive maps, 2D/3D Graphics animation, scrolling video player machines, etc., you can bet that JavaScript is probably involved. It's the third layer of the standard web technologies pie, two of which (HTML and CSS) we've covered in much more detail elsewhere in the Learning Area.

Php

PHP is a general-purpose programming language used primarily in the web development environment. This language is generally used to develop the backend of a website, the server side. Even so, it has numerous frontend utilities. This is why it is one of the main programming languages in the world of web programming.

Web page

We say web page to an electronic portal that contains multimedia information (textual, audiovisual, images, links, among others). A page of this type is adapted to what we know as WWW (World Wide Web) and can be found from a web browser. Web pages are usually in a format known as HTML and can link to other web pages.

Server

Definition Server (software): A software-based server is a program that provides a special service that other programs called clients can use locally or over a network.

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The type of service depends on the type of server software. The basis of communication is the client-server model and, as far as data exchange is concerned, service-specific transmission protocols come into play.

Database

A set of tables describing a larger entity. The tables may have relationships between them and be complementary.

Typically, to describe or work with a system, it is necessary to have more than one table to understand the whole, and there are relationships between them.

Sql

Structured Query Language (SQL) is a standardised programming language used to manage relational databases and perform a variety of operations on the data they contain.

MySql

It is the name of a system that allows the management of databases. It is the most widely used option for web-based applications (Pérez Porto, 2019).

Methodology

This project is an initiative to support the ENOI Educational Institution within the Computer Systems Engineering degree. It consists of developing a web page that allows to keep order in the school control department, providing teachers and students the facility to access and interact with a web platform.

To carry out this project, the waterfall model, also known as the classical life cycle, will be implemented. A systematic and sequential approach to software development is recommended, starting with the clarification of customer requirements, through planning, modelling, building and implementation, and ending with support for the finished software. As shown in Figure 1.

Box 1

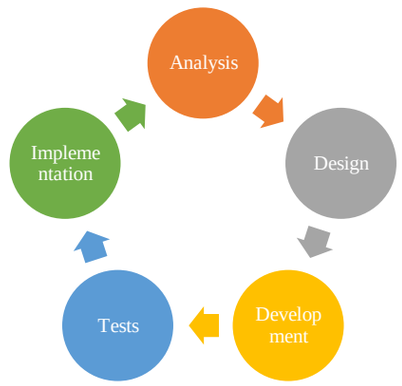

Figure 1
Cascading Life Cycle
Source: Own elaboration

It was decided to use the above life cycle, as it was considered sufficiently long and allowed end users to use the system for a relatively short period of time, taking into account three important parts of its development: programming, usability labs and proposals for improving the application. As shown in Table 1.

Box 2

Table 1
Activity and stages of the cycle.

Activity	Stage
Analysis	Analysis
Design	
Implementation/Verification	Programming
Maintenance	Final Presentation

Source: Own elaboration

Analysis

As a first step in the development of the system, the analysis must be taken into account. It is important because it meets the requirements that the system has to fulfil. In the first part, data collection is carried out with the following instruments:

- What type of system do you currently have?
- How are workshops allocated?
- How are workshops administered?
- How do teachers deliver grades?
- How do you generate the certificates and how are they handed out?

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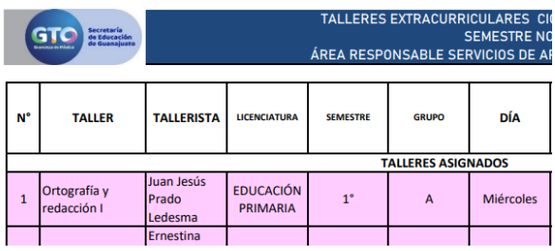
- How are students registered for open participation workshops?

- Where is student data stored?

- On which platform can learners view their status at the end of the workshop?

Box 3



TALLERES EXTRACURRICULARES CI
SEMESTRE NO
ÁREA RESPONSABLE SERVICIOS DE AP

N°	TALLER	TALLERISTA	LICENCIATURA	SEMESTRE	GRUPO	DÍA
TALLERES ASIGNADOS						
1	Ortografía y redacción I	Juan Jesús Prado Ledesma	EDUCACIÓN PRIMARIA	1°	A	Miércoles
		Ernestina				

Figure 2

Allocation of workshops

Source: Own elaboration

Extracurricular workshops, there are various data such as workshop, workshop leader (teachers), type of degree, semester, group, the day the workshop is given, unique timetable, assigned classroom, the total number of students enrolled (male and female), the mode of attendance (compulsory) or virtual (optional).

Another data to consider is the part of ‘optional workshops’ within the institution in which the student decides to take any of the workshops by making a registration. As shown in Figure 3. Optional Workshops.

Box 4

TALLERES DE PARTICIPACIÓN ABIERTA				
Participación Abierta	Sábado	9:00 - 11:00	N/A	REGISTRATE AQUÍ
Participación Abierta	Miércoles	9:00-10:50	23	REGISTRATE AQUÍ
Participación Abierta	Sábado	9:00 - 11:00	N/A	REGISTRATE AQUÍ
Participación Abierta	Sábado	9:00 - 11:00	Plaza Cívica	REGISTRATE AQUÍ
Participación abierta	Miércoles	9:00 - 10:50	Estacionamiento	REGISTRATE AQUÍ
Participación Abierta	Miércoles	9:00 - 10:50	20	REGISTRATE AQUÍ
Participación Abierta	Miércoles	9:00 - 10:50	21	REGISTRATE AQUÍ
Participación abierta	Miércoles	9:00 - 10:50	Sala de lectura	REGISTRATE AQUÍ
Participación Abierta	Miércoles	9:00 - 10:50	22	REGISTRATE AQUÍ
Participación Abierta	Miércoles	9:00 - 10:50	24	REGISTRATE AQUÍ

Figure 3

Workshop registration

Source: Own elaboration

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Programming and Visualisation

The analysis of the database that is required to operate the various data that will be used to make the registration part of the workshops functional was also carried out.

The database will be highly interrelated, so it must be well designed with reference to the requirements obtained through surveys of the institution's staff. The programme "**phpmyadmin** ’ will be used to access, manage and organise the database tables and records. As shown in Figure 4.

Box 5

Figure 4

Coding (Backend)

Source: Own elaboration

On the other hand, we show in Figure 5, the programming carried out to meet the requirements requested, implementing html.

Box 6

```
<!DOCTYPE html>
<html>
<head>
    <title>Workshop Management</title>
</head>
<body>
    <h1>Available Workshops</h1>
    <form method="POST">
        <label for="student_id">Student ID:</label>
        <input type="text" id="student_id" name="student_id" required><br><br>

        <label for="workshop_id">Select Workshop:</label>
        <select id="workshop_id" name="workshop_id" required>
            <?php
            if ($result->num_rows > 0) {
                while($row = $result->fetch_assoc()) {
                    echo "<option value='" . $row["id"] . "'>" . $row["title"] . "</
```

Figure 5

Basic structure and minimum functionality of the system

Source: Own elaboration

Results

Box 7

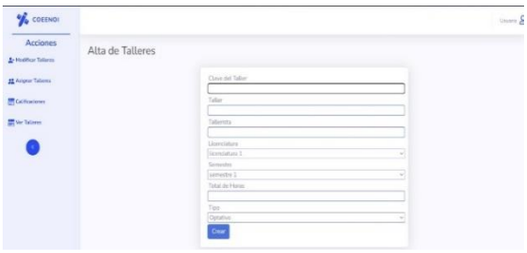

Figure 6
Workshop registration
Source: Own elaboration

The design of the website consists of different interfaces. The workshop creation screen is used to generate the necessary information from the various data requested. By registering each of these. Figure 6.

Box 8

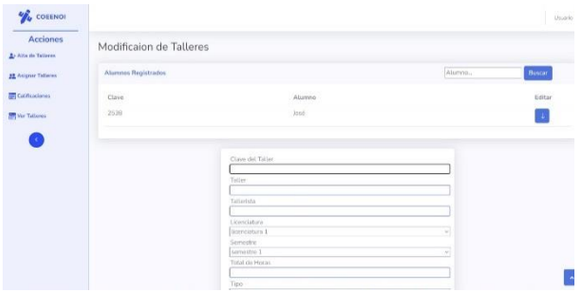

Figure 7
Edition of the workshops
Source: Own elaboration

The next screen shows Figure 7, workshop modification, which is used to update existing workshop information. Another interface shown is Figure 8, qualifications. Entering the status of each of the learners.

Box 9

Figure 8
Qualifications
Source: Own elaboration

The following interface shows the view of each workshop created where the user can edit each workshop or delete it if required by the administrator. As shown in Figure 9 Workshops View.

Box 10

Figura 9
Workshop view generation (Postulations)
Source: Own elaboration

It is also essential to have a certificate of completion of the workshop, where the data of the institution, the student and the workshop are specified, as follows, an example of the above mentioned document. Figure 10 Certificates.

Box 11

Figure 10
Generation of certificates
Source: Own elaboration

Conclusions

In conclusion, this software project has demonstrated that the use of technological tools is essential in academia. Although carrying out a project of this magnitude requires time and effort, the results obtained fully justify the hard work invested.

Thanks to this project, I have not only broadened my technical knowledge, but I have also acquired new practical skills in the development of web systems.

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This project has allowed me to strengthen my teamwork skills by collaborating in an organised and committed way with the team members.

It has also challenged me to step out of my comfort zone and develop new skills, which has enriched my professional and personal growth.

The experience has shown me the importance of dedication and commitment of the team to achieve the proposed objectives.

A significant learning experience has been identifying and leveraging the individual strengths of each team member. Recognising and maximising everyone's talents has been fundamental to the success of the project. This experience underlines the importance of making the most of all the possibilities that each individual can bring to the table.

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' contribution

Rodríguez-Campos, Juan Carlos: I contributed to the project idea, development, research and editing.

Rico-Chagollán, Mariana: I contributed to the development of the project.

Vidal-Ortiz, Gabriela: I contributed to the project idea, method, review, editing, data analysis.

Availability of data and materials

Further information on data availability or programming methodology during this study is available from the author.

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I am grateful to the TecNM campus ITESI for giving me the opportunity to publish research and studies conducted within the institution. I also thank the ENOI for allowing us to develop and implement the system, which has been fundamental to the success of the project.

Abbreviations

CSS	Cascading Style Sheets
ENOI	Escuela Normal Oficial de Irapuato
HTML	Hypertext Markup Language
ITESI	Tecnológico Superior de Irapuato
MySQL	My Structured Query Language
PHP	Hypertext Preprocessor
TecNM	Tecnológico Nacional de México

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Article

Linking students with marketing companies through IT Projects

Vinculación de estudiantes con empresas de mercadotecnia a través de Proyectos De TI

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Abstract

Traditional advertising methods, such as print media, radio, and television ads, have been fundamental for small businesses and medium-sized enterprises to gain visibility. However, as these businesses have grown, it has become necessary to explore new strategies to reach a broader audience. With technological advancements, especially in mobile devices, advertising has evolved, allowing companies to reach various sectors of the population more efficiently. The growth of social media usage has facilitated connections between people from different places, driving businesses to adopt new marketing techniques. This technological and social shift requires restructuring traditional marketing strategies, focusing on tools such as website development and the use of social media to attract new customers and enhance communication interaction.

Technology, Marketing, Project

Resumen

Los métodos publicitarios tradicionales, como anuncios en medios impresos, radio y televisión, han sido fundamentales para que pequeños negocios y medianas empresas se den a conocer. Sin embargo, a medida que estos negocios han crecido, se ha vuelto necesario explorar nuevas estrategias para alcanzar un público más amplio. Con los avances tecnológicos, especialmente en dispositivos móviles, la publicidad ha evolucionado, permitiendo a las empresas llegar a diversos sectores de la población de manera más eficiente. El crecimiento del uso de redes sociales ha facilitado la conexión entre personas de diferentes lugares, lo que impulsa a los negocios a adoptar nuevas técnicas de marketing. Este cambio tecnológico y social obliga a reestructurar las estrategias de marketing tradicionales, enfocándose en herramientas como el desarrollo de páginas web y el uso de redes sociales para captar nuevos clientes y mejorar la interacción en la comunicación.

Tecnología, Marketing, Proyecto

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Introduction

Currently, some companies try to attract customers using person-to-person techniques and, on some occasions, by setting up a stand at various events to increase their visibility. However, these methods are not suitable for professionally engaging potential customers. Different marketing methodologies have been studied to advertise and create a brand identity that identifies them and helps them reach more people.

However, in this search, it has been found that traditional marketing techniques are aggressive towards consumers, which ends up driving them away or creating an unfavorable image of the company due to third parties who have been negatively impacted and now hold a poor opinion of it. The communication channel used to raise awareness is not effective for positioning, and actions are needed to convert interested parties into clients and thus gain ground in the industry.

Technological innovation has developed rapidly, increasingly encompassing a myriad of users from different social groups with applications that simplify communication. More and more new applications are being created, but they are not correctly implemented in relation to business.

By reaching only a small portion of the population, its geographical limitation carries significant weight and negatively influences brand positioning. By not using appropriate techniques to gain recognition and being unable to use traditional methods due to their cost, the company sees its economic sustainability undermined.

In 1996, the number of Internet users was calculated for the first time, resulting in 40 million. By 2013, there are already more than 2.5 billion, most of whom reside in China. On the other hand, the expansion of the Internet was restricted for a time due to the difficulty posed by installing terrestrial telecommunications infrastructure in developing countries.

This changed with the boom in wireless communications at the beginning of the 21st century.

Thus, while in 1991 there were about 16 million wireless device subscribers in the world, by 2013, there are almost 7 billion (for a planet of 7.7 billion inhabitants). Considering the use of mobile phones in family and rural settings and the limited use of these devices among children under five years old, we can say that almost all of humanity is connected, albeit with significant differences in terms of bandwidth, service efficiency, and price.

The Internet, at the center of these communication networks, allows for the production, distribution, and use of digitized information in any format. According to a study published by Martin Hilbert in *Science* in 2010, 95% of all existing information on the planet is digitized and mostly accessible on the Internet and other computer networks.

The speed and scope of the transformation of communications as a result of the Internet and wireless networks have prompted a variety of utopian and dystopian considerations worldwide. (Castells, 2013)

The way people connect with each other, access, and share information is changing at an accelerated pace thanks to the advancements in science and technology that provide us with new devices and tools associated with Information and Communication Technologies. In 2018, 74.3 million people aged six and older in the country reported using the Internet (65.8% of the population).

This figure represents a 1.9 percent increase compared to 2017 data (63.9 percent).

The ratio of Internet access by Urban-Rural zone shows a difference of 32.5 percentage points, with results reflecting 73.1% in urban areas and 40.6% in rural areas. The main activities conducted on the Internet during 2018 are:

- For entertainment (90.5%)
- For communication (90.3%)
- For obtaining information (86.9%)

Other activities such as supporting education/training and accessing audiovisual content show percentages of 83.6% and 78.1%, respectively.

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For the Mexican population, access to the Internet has become commonplace and accompanies them in most of their activities, whether directly or indirectly. It is worth noting that frequent users—those who use the Internet one or more days per week—represent 97.1% of the total user population. Additionally, those who use it monthly (2.3%) combined with those who use the Internet one or more days per week reach a proportion of 99.4%. Users with lower frequency (less than once a month) represent 0.5 percent. (INEGI, 2019).

Materials and Methods

The project focuses on defining and implementing the information technologies used to restructure the marketing process by incorporating social networks such as Facebook, Google+, Instagram, Twitter, YouTube, and WhatsApp, as well as creating a website with a form and a database. Free and commercial tools in their freeware versions will be used to carry out some techniques shown in the process model and to monitor website traffic.

A technological platform will be developed and implemented with various software tools to promote the company's products or services. Additionally, the best of current marketing techniques will be identified, analyzed, and adopted to develop a structural methodology that will aid in strategic planning and decision-making within the company, laying the foundation for a process to follow in advertising so that the company can achieve its goals.

The system encompasses the use of various social networks for the attraction phase, which are used to direct users to the website so they can learn about the different activities the company carries out.

The most widely used social networks in Mexico will be taken as a reference to have a broader range of reach. Figure 1 shows the social networks with the most penetration in Mexico.

Box 1

Figure 1

Social Networks with the Most Penetration in Mexico

Facebook, WhatsApp, YouTube, Instagram, TikTok, and Twitter will be the social networks used, allowing the creation of contact lists to promote the company. In addition to creating profiles and making posts related to the company's services, users will be directed to the website.

Tools for project support and monitoring

Some of the techniques mentioned in the phases can be carried out with the help of software tools that automate or add extra features to make them possible.

- SendBlaster:

Software for sending email chains, it will be used in its free version. General and segmented contact lists will be created based on preferences to send newsletters and promotions to different types of company users.

- Social Networks:

To monitor social network activity, the metrics used will be "likes," "+1s," "retweets," and the number of times the company's posts have been shared. This will give us a measure of the company's reach and its acceptance among unknown users.

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- Web Page Trends:

Google Analytics will be used to monitor website traffic, using a script provided by Google that allows us to measure how many times someone has visited the page, how long they stayed on it, the device from which they accessed it, their geographical location, and much more data. However, the only metrics that will be considered are the number of visits and the type of device since the page is adaptive. This makes the visualization on different devices a factor to consider for improvement.

Tools for project development

Brackets was used as the code editor for its development. The website was built using HTML, CSS, jQuery, and JavaScript. Techniques were employed to make the page responsive and free of visual defects on different technological devices. The necessary files for database connection and data insertion were created in PHP.

- HTML, JAVASCRIPT, and CSS:

Markup language is used for building web pages; it is the foundation of their structure and will be used to create the company's website. Like any language, it has undergone revisions and version changes; currently, version 5 allows the use of semantic tags that make the organization and review of the site's structure easier.

However, it is only supported by modern browsers, although the standardization among them is not symmetrical, and some functions are not compatible with all. JavaScript was used to display alert messages on the website.

It was decided to use it only for this purpose because, despite being a powerful language, there is the inconvenience that users can disable its use in the browser, and everything done with it would stop working.

This could lead to security errors if, for example, form validations were done in JavaScript. Cascading Style Sheets (CSS) give originality to a website; they control the styles of text, images, and other elements that need a more specific visual change.

Very elaborate effects and even some types of animations can also be achieved. The current version of CSS is 3, and like HTML, compatibility with browsers is not fully achieved.

- PHP:

PHP is a server-side programming language that allows data or requests to be sent to the server and received for display in the browser. The latest stable version of this language is 7.0.12. It was chosen for its power, simplicity, varied documentation, and open access, meaning no license is required for its use, and because the hosting server works with Apache.

Technological platform

The developed marketing model is shown in Figure 2 and consists of four phases: attraction, conversion, closing, and loyalty. Users pass through each of these phases and acquire a category: strangers, visitors, potential customers, customers, and promoters.

Some techniques used in each phase have mechanisms to measure their reach. It should be noted that all techniques in each phase can be used, or only some, such as the stand at events, which is occasional. It should be considered that the fewer techniques used, the lower the reach of the corresponding phase.

Box 2

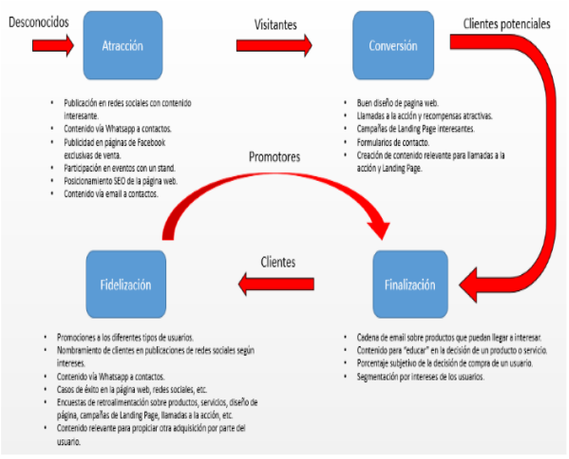

Figure 2
Marketing Model

Data Analysis

To measure the traffic generated on the website, the Google API called Google Analytics was used.

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This is a script with a unique identification number for the page that sends visit data to the control panel for management. This allows us to measure the effectiveness of converting strangers into customers.

Figure 3 shows the number of visitors the page received during a period from October 28, 2023, to November 6, 2023, during which a link to the website was advertised on social networks.

Box 3

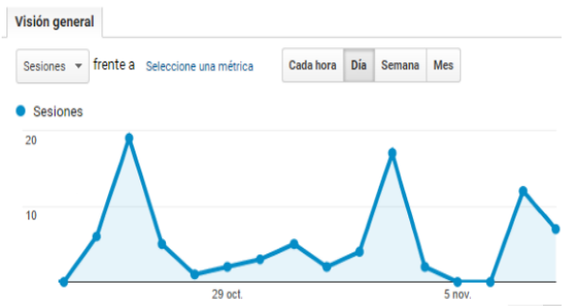

Figure 3
Number of Visitors

We can also obtain data about how many new visitors there have been or if they were users who had previously been on the website, as shown in Figure 4.

Box 4

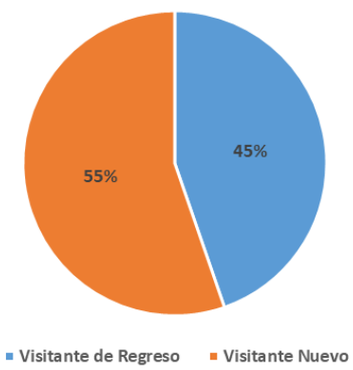

Figure 4
Website Visits

In Figure 5, we can see the type of device used to visit the website. This is important because the site design must provide a good experience for users regardless of the device they use to connect.

Box 5

Categoría de dispositivo	Sesiones
	85 % del total: 100,00 % (85)
1. mobile	44 (51,76 %)
2. desktop	41 (48,24 %)

Figure 5
Type of Access Device

A good way to promote a business is to integrate social networks, which was one of the important initiatives and steps considered to increase the company's publicity.

After creating and implementing social networks as an important part of the marketing strategy for this project, we obtained very favorable results, showing us the significant impact these technological tools have on people's daily lives and how they help more people get to know us. Figure 6 shows the percentage of activities performed by Facebook users with the content published by the company; this data was taken at different time periods.

Box 6

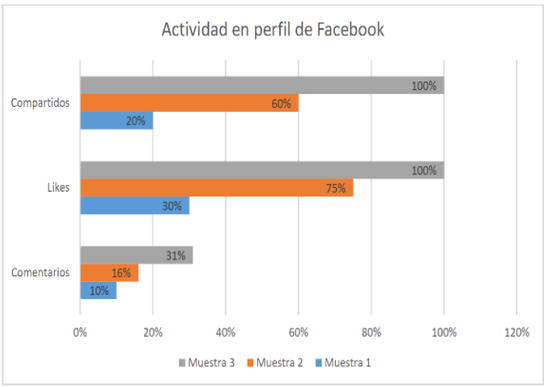

Figure 6
Activity Registered on Social Networks (Facebook)

To reach a broader audience, a YouTube account was created to showcase the content created to advertise to different customers. It was shown that there is also good acceptance through visual media, such as video creation. Figure 7 shows the percentage of "likes" based on the visits obtained.

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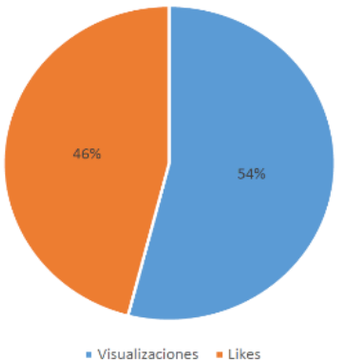

Figure 7
Percentage of Views and Likes

With the technological platform and client management in implementation, data was obtained to determine which of the hypotheses of this research was fulfilled, acquiring a total of 34 new customers, representing a 25% increase.

Box 8

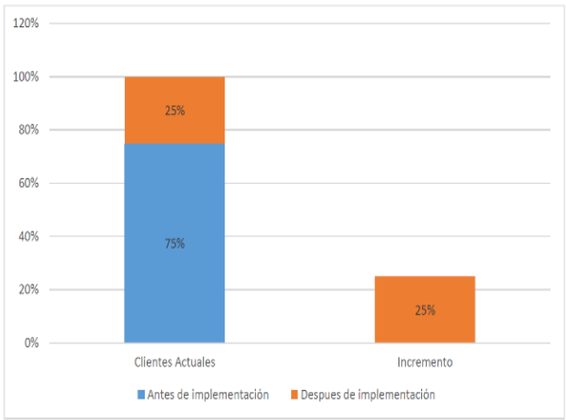

Figure 8
Increase in Customers

The company's customer portfolio increased with the implementation of the technological platform and the launch of marketing techniques.

However, it was noticed that the amount of traffic on the website to attract new customers only increases during promotion campaigns or new product launches.

This indicates that continuous work on new content and improvements is necessary to achieve even more significant results.

Box 9

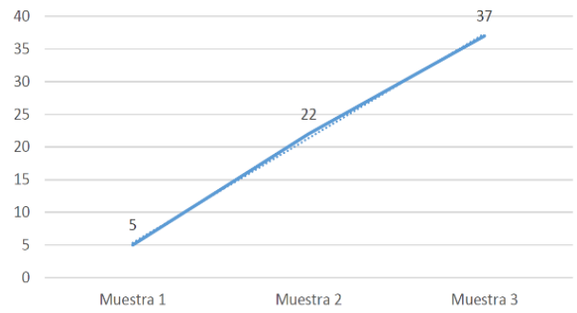

Figure 9
Registered Customers

Analyzing the data, it is found that 91.8% of users who registered became customers.

Conclusion

It is determined that continuous training is required to learn how to configure and adapt projects according to each team's needs. Regarding teamwork, it has been observed that when faced with this type of project, students leave their comfort zone and are forced to maintain constant communication to progress according to the initial plans.

This differs from the usual practice where each person develops a module separately and they are merged at the end.

Statements

Conflict of Interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

Authors' Contribution

Duran-Belman, Israel: contributed the project idea, technique, method and research.

Magdaleno-Zavala, Juan Antonio: contributed method, expert translator, writing of the article.

Gallardo-Álvarez, Dennise: expert graphic designer, article writing.

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Abbreviations

CSS Cascading Style Sheets
HTML HyperText Markup Language
PHP Hypertext Preprocessor
API Application Programming Interface

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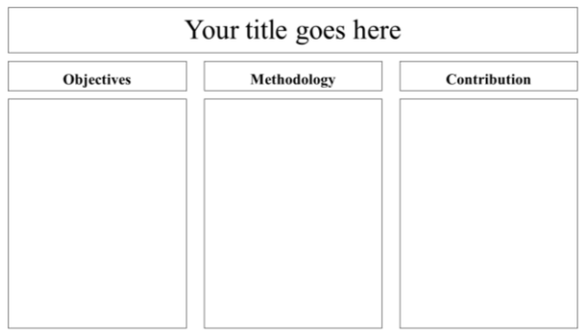

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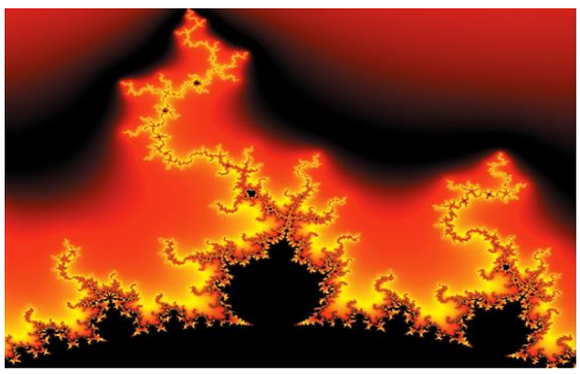

Figure 1

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Specify the contribution of each researcher in each of the points developed in this research.

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Benoit-Pauleter, Gerard: Contributed to the project idea, research method and technique.

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Indicate the availability of the data obtained in this research.

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Acknowledgements

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ANN	Artificial Neural Network

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