ISSN 2523-6814

Journal of Computational Technologies

Volume 5, Issue 15 – January – June - 2021

ECORFAN®

Journal of Computational Technologies, Volume 5, Issue 15, January - June 2021, is a journal edited six monthly by ECORFAN-Taiwan. Taiwan, Taipei. YongHe district, ZhongXin, Street 69. Postcode: 23445. WEB: www.ecorfan.org/taiwan, revista@ecorfan.org. Chief Editor: QUINTANILLA - CÓNDOR, Cerapio. PhD. ISSN-On line: 2523-6814. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda, PhD, LUNA-SOTO, Vladimir. PhD. Taiwan, Taipei. YongHe district, ZhongXin, Street 69, last updated June 30, 2021.

Journal of Computational Technologies

Definition of Research Journal

Scientific Objectives

Support the international scientific community in its written production Science, Technology and Innovation in the Field of Engineering and Technology, in Subdisciplines Digital skills standards for education, Learning projects through the use of information, Technologies and communication, Development of digital, Competencies teaching digital skills programs, Management of technological and educational, Consulting fields of technological training, Applied to education

ECORFAN-Mexico SC is a Scientific and Technological Company in contribution to the Human Resource training focused on the continuity in the critical analysis of International Research and is attached to CONACYT-RENIECYT number 1702902, its commitment is to disseminate research and contributions of the International Scientific Community, academic institutions, agencies and entities of the public and private sectors and contribute to the linking of researchers who carry out scientific activities, technological developments and training of specialized human resources with governments, companies and social organizations.

Encourage the interlocution of the International Scientific Community with other Study Centers in Mexico and abroad and promote a wide incorporation of academics, specialists and researchers to the publication in Science Structures of Autonomous Universities - State Public Universities - Federal IES - Polytechnic Universities - Technological Universities - Federal Technological Institutes - Normal Schools - Decentralized Technological Institutes - Intercultural Universities - S & T Councils - CONACYT Research Centers.

Scope, Coverage and Audience

Journal of Computational Technologies is a Research Journal edited by ECORFAN-Mexico S.C in its Holding with repository in Taiwan, is a scientific publication arbitrated and indexed with semester periods. It supports a wide range of contents that are evaluated by academic peers by the Double-Blind method, around subjects related to the theory and practice of Digital skills standards for education, Learning projects through the use of information, Technologies and communication, Development of digital, Competencies teaching digital skills programs, Management of technological and educational, Consulting fields of technological training, Applied to education with diverse approaches and perspectives, That contribute to the diffusion of the development of Science Technology and Innovation that allow the arguments related to the decision making and influence in the formulation of international policies in the Field of Engineering and Technology. The editorial horizon of ECORFAN-Mexico® extends beyond the academy and integrates other segments of research and analysis outside the scope, as long as they meet the requirements of rigorous argumentative and scientific, as well as addressing issues of general and current interest of the International Scientific Society.

Editorial Board

Arbitration Committee

Assignment of Rights

The sending of an Article to Journal of Computational Technologies emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Originality Format for its Article.

The authors sign the Authorization Format for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Taiwan considers pertinent for disclosure and diffusion of its Article its Rights of Work.

Declaration of Authorship

Indicate the Name of Author and Coauthors at most in the participation of the Article and indicate in extensive the Institutional Affiliation indicating the Department.

Identify the Name of Author and Coauthors at most with the CVU Scholarship Number-PNPC or SNI-CONACYT- Indicating the Researcher Level and their Google Scholar Profile to verify their Citation Level and H index.

Identify the Name of Author and Coauthors at most in the Science and Technology Profiles widely accepted by the International Scientific Community ORC ID - Researcher ID Thomson - arXiv Author ID - PubMed Author ID - Open ID respectively.

Indicate the contact for correspondence to the Author (Mail and Telephone) and indicate the Researcher who contributes as the first Author of the Article.

7.-Plagiarism Detection

All Articles will be tested by plagiarism software PLAGSCAN if a plagiarism level is detected Positive will not be sent to arbitration and will be rescinded of the reception of the Article notifying the Authors responsible, claiming that academic plagiarism is criminalized in the Penal Code.

Arbitration Process

All Articles will be evaluated by academic peers by the Double Blind method, the Arbitration Approval is a requirement for the Editorial Board to make a final decision that will be final in all cases. MARVID® is a derivative brand of ECORFAN® specialized in providing the expert evaluators all of them with Doctorate degree and distinction of International Researchers in the respective Councils of Science and Technology the counterpart of CONACYT for the chapters of America-Europe-Asia- Africa and Oceania. The identification of the authorship should only appear on a first removable page, in order to ensure that the Arbitration process is anonymous and covers the following stages: Identification of the Research Journal with its author occupation rate - Identification of Authors and Coauthors - Detection of plagiarism PLAGSCAN - Review of Formats of Authorization and Originality-Allocation to the Editorial Board- Allocation of the pair of Expert Arbitrators-Notification of Arbitration -Declaration of observations to the Author-Verification of Article Modified for Editing-Publication.

Instructions for Scientific, Technological and Innovation Publication

Knowledge Area

The works must be unpublished and refer to topics of Digital skills standards for education, Learning projects through the use of information, Technologies and communication, Development of digital, Competencies teaching digital skills programs, Management of technological and educational, Consulting fields of technological training, Applied to education and other topics related to Engineering and Technology

Presentation of the content

In the first article we present, *Development of a web management system for the internship process at the TecNM campus Lerdo*, by RODRÍGUEZ-LOZANO, Karla Verónica, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe, with adscription in the Instituto Tecnológico Superior de Lerdo, in the next article we present, *App design for teaching academic English vocabulary using spaced repetition method*, by MARTÍNEZ-VALENCIA, Ricardo Fabrizio, MONTERO-VALVERDE, José Antonio, MARTÍNEZ-ARROYO, Miriam and HERNÁNDEZ-BRAVO, Juan Miguel, with adscription in the Instituto Tecnológico Superior de Acapulco, in the next article we present, *Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function*, by AGUILERA-MENDEZ, José María, JUÁREZ-TOLEDO, Carlos, MARTÍNEZ-CARRILLO, Irma and FLORES VÁZQUEZ, Ana Lilia, with adscription in the Universidad Autónoma del Estado de México, in the next article we present, *Design of the operation of a rotating machine for the acquisition of multi-view stereoscopic images for the 3D reconstruction of objects*, by CORONA-PATRICIO, Cesar Agustin & RETA, Carolina, with adscription in the CONACYT-CIATEQ A. C. PICYT and CONACYT-CIATEQ A. C. Department of IT, Control, and Electronics.

Content

Article	Page
Development of a web management system for the internship process at the TecNM campus Lerdo RODRÍGUEZ-LOZANO, Karla Verónica, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe *Instituto Tecnológico Superior de Lerdo*	1-10
App design for teaching academic English vocabulary using spaced repetition method MARTÍNEZ-VALENCIA, Ricardo Fabrizio, MONTERO-VALVERDE, José Antonio, MARTÍNEZ-ARROYO, Miriam and HERNÁNDEZ-BRAVO, Juan Miguel *Instituto Tecnológico Superior de Acapulco*	11-20
Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function AGUILERA-MENDEZ, José María, JUÁREZ-TOLEDO, Carlos, MARTÍNEZ-CARRILLO, Irma and FLORES VÁZQUEZ, Ana Lilia *Universidad Autónoma del Estado de México*	21-28
Design of the operation of a rotating machine for the acquisition of multi-view stereoscopic images for the 3D reconstruction of objects CORONA-PATRICIO, Cesar Agustin & RETA, Carolina *CONACYT-CIATEQ A. C. PICYT* *CONACYT-CIATEQ A. C. Department of IT, Control, and Electronics*	29-36

Article **Journal of Computational Technologies**
June, 2021 Vol.5 No.15 1-10

Development of a web management system for the internship process at the TecNM campus Lerdo

Desarrollo del sistema web para la gestión del proceso de residencia del TecNM campus Lerdo

RODRÍGUEZ-LOZANO, Karla Verónica†*, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe

Tecnológico Nacional de México Campus Lerdo / Instituto Tecnológico Superior de Lerdo

ID 1st Author: *Karla Verónica, Rodríguez-Lozano* / **ORC ID**: 0000-0003-2832-4165, **CVU CONACYT ID**: 355351

ID 1st Co-author: *Elda, Moreno-Núñez* / **ORC ID**: 0000-0002-5912-082, **CVU CONACYT ID**: 654015

ID 2nd Co-author: *Juan Martín, Arzola-Monreal*/ **ORC ID**: 0000-0002-5829-7818, **CVU CONACYT ID**: 428245

ID 3rd Co-author: *María Guadalupe, Flores-Luévanos* / **ORC ID**: 0000-0003-2613-1431, **CVU CONACYT ID**: 450310

DOI: 10.35429/JOCT.2021.15.5.1.10 Received March 15, 2021; Accepted June 30, 2021

Abstract

The TecNM campus Lerdo is developing a Web Based System for the Management of the Residence Procedures (SIGEPRORE), in order to adhere to the ISO 9001:2015, which this institution of higher education currently operates under, for which it is necessary to automate the current professional residency quality management system. SIGEPRORE is an institutional software package designed to support all those involved in the professional residency procedure. It has a new and improved web design, which allows the integration of new modules, functionalities, and technological tools for increased user optimization. Participants in this project are students from the engineering degree in computer systems of the ITSL and professors' part of the academic body in consolidation "Software engineering applied to solutions". The agile methodology used as a guideline to develop the project was the SCRUM. The impact of the project is of great relevance as it is intended to establish a web system which will contain all the operating policies of the professional residence and quality management system.

Development, Software, Intership

Resumen

El TecNM campus Lerdo está desarrollando un Sistema Web para la Gestión del Proceso de Residencia (SIGEPRORE), con el fin de adherirse a la ISO 9001:2015, bajo la cual actualmente opera esta institución de educación superior, para lo que es necesario automatizar el actual sistema de gestión de la calidad de la residencia profesional. SIGEPRORE es un software institucional diseñado para apoyar a todos los involucrados en el trámite de residencia profesional. Cuenta con un nuevo y mejorado diseño web, que permite la integración de nuevos módulos, funcionalidades y herramientas tecnológicas para una mayor optimización del usuario. Los participantes en este proyecto son estudiantes de Ingeniería en Sistemas Computacionales del ITSL y los profesores pertenecientes al cuerpo académico en consolidación "Ingeniería de software aplicada a soluciones". La metodología ágil que se utilizó como guía para desarrollar el proyecto fue SCRUM. El impacto del proyecto es de gran relevancia ya que se pretende establecer un sistema web que contendrá todas las políticas operativas de la residencia profesional y el sistema de gestión de la calidad.

Desarrollo, Software, Práctica profesional

Citation: RODRÍGUEZ-LOZANO, Karla Verónica, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe. Development of a web management system for the internship process at the TecNM campus Lerdo. Journal of Computational Technologies. 2021. 5-15:1-10

* Author Correspondence: (e-mail: karla.rl@itslerdo.edu.mx)
† Researcher contributing as first author.

Introduction

Since 2006, the Instituto Tecnológico Superior de Lerdo has a quality management system, which is currently based on the ISO 9001: 2015 standard. This system is a model that allows to provide a quality educational service to students, and ranges from admission to graduation, strengthened with the process of linking.

The quality policy is to provide a service based on the Educational Model of the Tecnológico Nacional de México (TecNM) supported by a Quality Management System, for the satisfaction of its customers, continuous improvement and risk analysis according to the ISO 9001:2015 Standard.

The professional internship is an educational strategy of a curricular nature, which allows the student to undertake a theoretical-practical, analytical, reflective, critical and professional project; with the purpose of solving a specific problem of the social and productive reality, to strengthen and apply their professional skills.

As part of the quality management system, the TecNM campus Lerdo has a procedure for the management of the professional internship process, this procedure applies to all the study programs of the careers at the undergraduate level of the Instituto Tecnológico Superior de Lerdo in schooled modality, not schooled, distance schooling and mixed, there are four main actors within this process: Student, Linking Department, Academic Division and Internal Advisor.

The flow of the procedure is as follows, the academic division conducts an informative session, the student requests the cover letter to the Linking Department, which delivers it, the student seeks and manages the place and prepares a preliminary report, the academic division receives, reviews and authorizes the report, and if it is correct, assigns the internal advisor, the student develops the project and the internal advisor follows up, evaluates and issues a grade, finally the academic division receives the report of the finished project.

The quality management policy is based on the educational model of the Tecnológico Nacional de México, so this procedure is governed by the guidelines for the operation and accreditation of the professional internship defined in the Manual of Academic-Administrative Guidelines of the Tecnológico Nacional de México, in which all the operating policies of the actors of this process are defined, as well as the evaluation formats that advisors use to measure the intern´s performance and evaluate the final report. As a tool to support this process, an internal software has been developed to automate the professional internship procedure belonging to the quality management system based on ISO 9001:2015 that currently operates in this institute.

The objective of the project is to implement a web system for the management of the professional internship process of the TecNM Lerdo campus. Version 1.0 of the Internship Procedure Management System (SIGEPRORE) was released in January 2020. A year after its intensive use, derived from the Covid-19 pandemic, it has identified the need for improvements in its web design, integration of new modules with more functionalities for heads of divisions, academic director and advisors, as well as the use of technological tools that allow users to use a web system for the management of the professional internship process.

This technological development aims at the implementation of the Web System, based on all the features mentioned before, and adapting to the virtual way of working of all the staff and students involved in the process during the COVID-19 pandemic. The methodology proposed for this project is the SCRUM whose main objective is the fulfillment of expectations, flexibility to changes, time reduction and higher quality of the software.

For the construction of the web system, the PHP® programming language is implemented, which allows the creation of dynamic web pages and the development of server-side scripts, with the MySQL database manager for the programming of stored procedures that interact with web pages. The presentation of a website is an important factor that contributes to its usability. To achieve a simple and pleasing design to the end user, Bootstrap© is used.

This article describes the process of an applied research, which aimed to develop a Web System for the Management of the Internship Procedure of the TecNM campus Lerdo. The technical part details the methodology, the technological software tools that were used and the results obtained.

Methodology

Sommerville (2011) states that engineering consists of selecting the most appropriate method for a set of circumstances; To produce quality software, you need to choose a strategy that orders development activities and adapts to your team's context. The perspective of agile development recommends in the first instance the formation of a good team, which creates its own production environment, to facilitate the adoption of a methodology with this approach, since agile methods are more effective when the system manages to be designed with a small assigned team that communicates informally. "Agile methods are incremental development methods that focus on fast design, frequent software releases, reduced process expenses, and high-quality code production. They involve the customer directly in the development process" (Sommerville, 2011)

The internship process management system (SIGEPRORE) in its versions 1.0 and 2.0 has been developed under the responsibility of a team of less than 10 people, in which the interaction between the members and the fast development of small functionalities is privileged, freeing the end users for their test, in order to obtain feedback in the short term; when a problem has been reported, all team members contribute to the solution and one or two developers take care of its implementation, without affecting the development process.

Therefore, we have opted for the formal adoption of an agile method as a reference framework for project management specifically SCRUM, characterized by three phases: the first is the planning of the project and the design of the software architecture; the second, a series of *sprint* cycles and finally the conclusion phase of the project. The main feature of this method lies in the second phase, being the sprint cycles planning units delimited in time, in which they select the specifications to be developed, the increment is implemented to the system, and it is released to the participants. (Trigas, 2012)

The design of the software architecture was carried out by the project leader "SCRUM master", based on the needs expressed by the clients of the application and the contributions of the SCRUM developers of the project. The architecture is represented by class diagrams, which are part of the static modeling of the system.

In the design of the particularities that would be developed in each sprint, the modeling of the use cases has been a valuable tool that has contributed to the communication within the development team and with the users of the system.

The use cases provide insight from the customer's point of view, they are based on functional requirements, and do not capture the details of their implementation (Jacobson et al, 2013).

Figures 1 to 4 present the project's use case diagrams; Figure 1 shows the functions associated with the division chief, who can use the system to assign residents to advisors, view meeting logs, and download evaluation reports. He or she can also change his or her own password and watch a video tutorial of the system use.

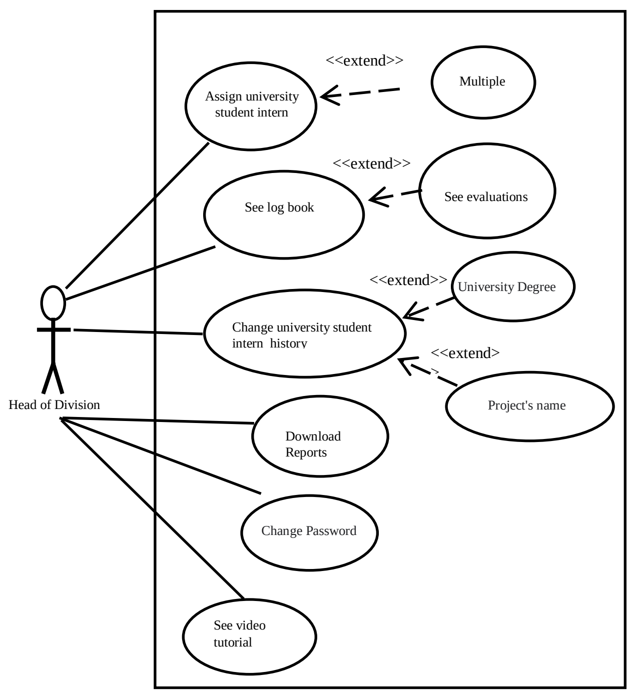


Figure 1 Diagram of division chief´s use cases
Source: Own Elaboration

Figure 2 shows the use cases of the academic director, who through the system can view the data of the professional internships, the logs of the meetings and validate the titles of the projects; it also has a video tutorial of the system use.

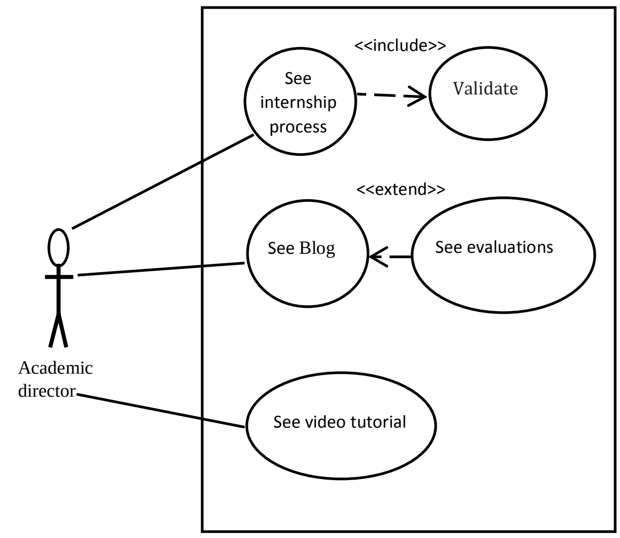


Figure 2 Academic director use case diagram
Source: Own Elaboration

Figure 3 shows the use cases associated with the internal advisor, who is the teacher assigned to follow up on the professional intern's project. The advisor is in charge of registering the data of the internship such as the name of the project, company, among others. It also records the logs of the meetings with the intern, makes the evaluations and downloads the reports.

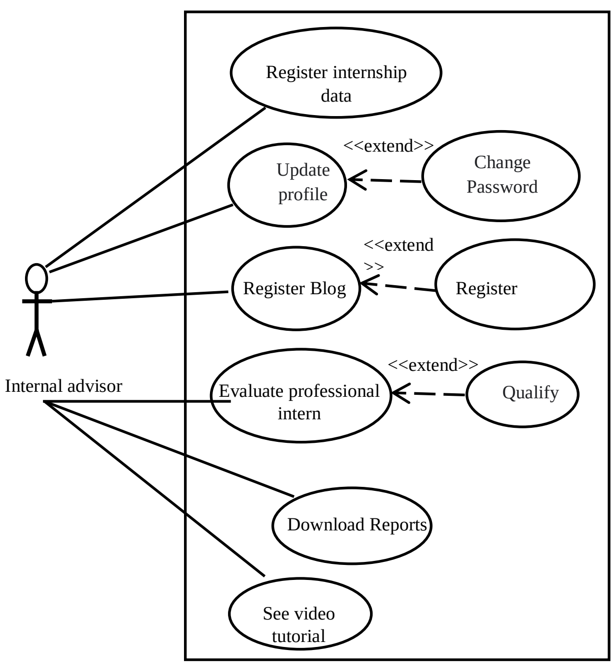


Figure 3. Diagram of internal advisor use cases
Source: Own Elaboration

Figure 4 shows the functions associated with the professional intern, who uses the system to view his or her project data and read the logs of advisory meetings. They can also modify their password to access SIGEPRORE and watch a video tutorial of its use.

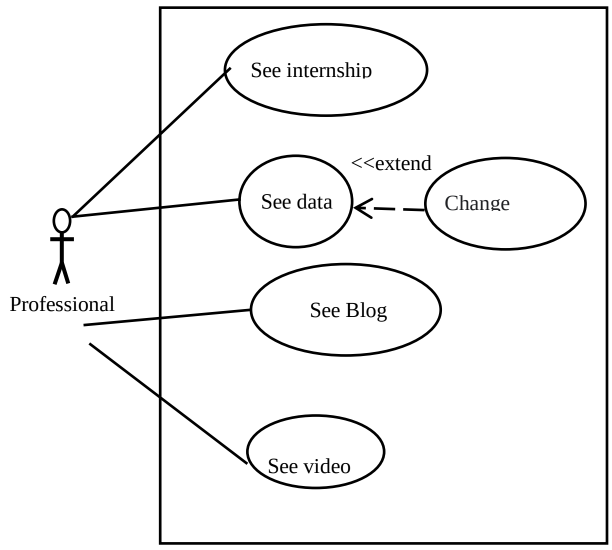


Figure 4. Diagram of professional intern use cases.
Source Own Elaboration

Construction of modules

Salazar (2009) It provides that the construction of software in modules is based on the aspects in which the designer pays greater attention such as functionality and attractiveness; coupled with the objective of building a site with clear, interesting information and an appropriate vocabulary for the user, in order to achieve an economic benefit or recognition for the owner of the site.

Results

SIGEPRORE, has two versions since its publication, Version 1.0 in 2020 and Version 2.0 in 2021. Version 2.0 of the system consists of five modules, 1) Head of Division, 2) External Advisor, 3) Internal Advisor, 4) Intern and 5) Academic Director. The system groups the uses already described in a modular way; each actor interacts with its module. Figure 5 lists the functionalities of each module.

Head of Division

- Assign interns to the internal advisor in a unitary and/or multiple way. The system will inform users and proceed to send mail with access instructions.
- Accept project´s name.
- Change the name of the project and the internal advisor on extemporaneous dates.
- Monitor the progress of the intern through the log and the evaluations generated by the advisors.
- Download the reports defined in the quality guideline.
- View the history of interns to update the status of their degree.

Internal Advisor

- Edit data of the internship, such as name of the project, day, time and place of the tutoring, name of the company and sector to which it belongs.
- Add the company's external advisor. The system will register the user and proceed to send an email with access instructions.
- Follow up with the intern, fill out the log weekly.
- Evaluate intern according to the guidelines of the TECNM.
- Conduct an interview with the external advisor, which will be displayed in the system.
- Download Report

Academic Director

- Accept project´s name.
- Monitor the intern´s progress through the log and the evaluations generated by the dvisors.
- See log book.
- See evaluations.

External Advisor

- Evaluate interns according to the guidelines of the TECNM
- Observe the follow-up log.
- Download reports

Intern

- To Know the general data of the internship and its tracking log.

Figure 5. Description of Functionalities
Source: Own Elaboration

In order to store and manipulate the data, the MySQL® management system was used. The Entity-Relationship model of the database is formed by 12 tables, one of them is the internship table, which stores all the data of the professional internship; this table is related to other entities corresponding to the different actors of the system. The criteria tables, evaluation and detailed evaluation, are used to manage the evaluation process by the intern´s advisors.

To keep track of the weekly follow-up to the intern and the interviews that are carried out to the external advisor, the advisory and interview tables were defined. The table that was incorporated in version 2.0, is the intern´s history table, in it all the historical data of internship will be stored to generate statistical reports. The database is also composed of five triggers and five stored procedures, which carry out the actions to save the information.

Figure 6 shows this relational model including only the name of the entities that make up this diagram.

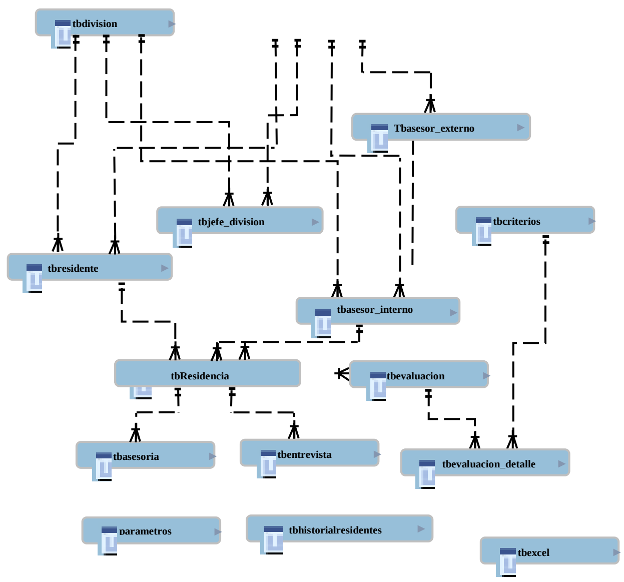


Figure 6. Entity Model – SIGEPRORE Relationship 2.0
Source: Own Elaboration

Head of Division Module

The head of division can access the internship section (figure 7), here is the information about the internship such as: Control number, name, date of advice, internal advisor, progress, accepted name, log, as well as whether or not the name of the project was already accepted by the academic director.

Figure 7 GUI Internship SIGEPRORE 2.0

In order to assign interns to internal advisers, it is necessary to know that students are already enrolled in the subject of professional internship. This process is performed automatically by the system through an API that connects the software to the institution's server. The process consists of the system sending the id of each career, this data is sent by means of POST to a server, which will process and send a response to the application using JSON notation, if the id of the career exists, the API returns all the students enrolled to internship and the system will proceed to save this information in their respective tables using a stored procedure. The assignment of interns can be done in two ways, the first is that for each intern is assigned an internal advisor, and the second is that for each internal advisor several interns are assigned, these processes are defined as simple assignment and multiple assignment respectively. Figures 8 and 9 show these assignments.

Figure 8 GUI. Simple assignment SIGEPRORE 2.0

Figure 9 GUI. multiple assignment SIGEPRORE 2.0

The head of division will be able to view the internal adviser's logbook and will be able to add comments. (Figure 10)

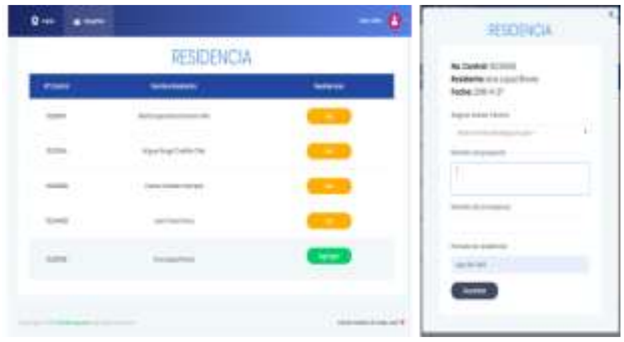


Figure 10 GUI. Blog SIGEPRORE 2.0

The system allows the head of division to download all the reports that the system generates according to the procedure and the guideline. Figure 11.

Figure 11 GUI. Reports SIGEPRORE 2.0

In the intern history section, the data of the interns already graduated is shown as the control number, name of the intern, semester, grades, period of internship, internal advisor, degree, information. etc. Filters can be applied to speed up the search for information and you can generate graphical reports of the internship history. Figure 12 shows an example of a chart.

Figure 12 GUI. Graphics SIGEPRORE 2.0

In figure 13, it is observed how the head of the division will be able to control the status of the graduate's degree process, selecting the option of accrediting a degree in case this procedure is concluded.

June, 2021 Vol.5 No.15 1-10

Figure 13 GUI. Obtained degree SIGEPRORE 2.0

Internal advisor

In the internship section, which is shown in Figure 14, the data of the internships are observed as: control number, intern´s name, project´s name, company´s name and status of the name of the project.

Figure 14 GUI. Internship SIGEPRORE 2.0

The internal advisor will be able to see the percentage of progress of the project, to later give the follow-up through the log. Figures 15 and 16 show it.

Figure 15 GUI. Internship SIGEPRORE 2.0

Figure 16 GUI. Blog SIGEPRORE 2.0

The internal advisor can view and edit the general data of the internship and add the external advisor of the company. The system will register the user and proceed to send an email with access indications.

The internal advisor performs two intern´s evaluations and a final evaluation of the report, these evaluations take into account the criteria defined in the TECNM guidelines manual. Figure 17 shows these evaluations.

Figure 17 GUI. Evaluation SIGEPRORE 2.0

The internal advisor also conducts the necessary interviews, capturing the interviewee's name and observations, as shown in the figure below.

Figure 18 GUI. Interview SIGEPRORE 2.0

The advisor will be able to view the evaluations and the log, through PDF reports as shown in Figure 19.

ISSN 2523-6814

RODRÍGUEZ-LOZANO, Karla Verónica, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe. Development of a web management system for the internship process at the TecNM campus Lerdo. Journal of Computational Technologies. 2021

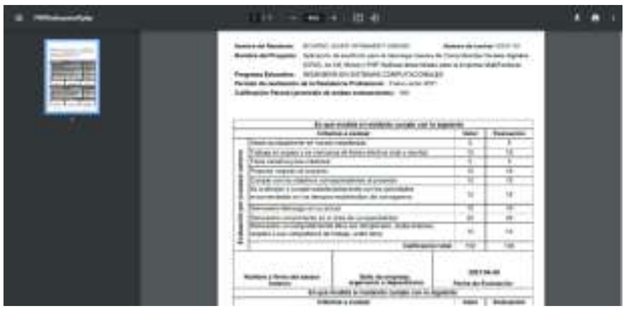


Figure 19 GUI. Evaluation Report SIGEPRORE 2.**0**

Academic Director

Figure 20 shows the interface, where the intern's data is shown, such as the control number, the intern's name, division, project progress and log and he or she can search for the interns by career and / or internal advisor.

Figure 20 GUI. Progress SIGEPRORE 2.0

Among the new functionalities, there is the process that the academic director performs for the acceptance of the name of the project, this point is important, because as long as the name is not accepted, the information cannot be sent to the school services department, to generate the forms. The internal advisor will be in charge of modifying the name until it is accepted. Figure 21 shows the name acceptance process.

Figure 21. GUI. Accepts name SIGEPRORE 2.0

External Advisor

The external advisor will be able to edit profile, see the progress and the follow-up log that the internal advisor fills, he will also be able to make his two evaluations, update them and view them in PDF document. Figures 22, 23 and 24 show some of these processes.

Figure 22 GUI Evaluation SIGEPRORE 2.0

Figure 23 GUI. progress SIGEPRORE 2.0

Figure 24 GUI. Blog SIGEPRORE 2.0

Quality assurance

In the tests carried out in SIGEPRORE 1.0, syntactic, design and some process errors were identified in the modules of Internal Advisor, External Advisor, Administrator, Head of Division and Intern.

By being released early, the development team managed to complete the changes quickly and efficiently to be used, as well as resolve the errors that arose when using the SIGEPRORE 1.0 system.

In the SIGEPRORE 2.0 system, the activities carried out during the internship process were complemented and facilitated and the desired requests for the SIGEPRORE 2.0 version were fulfilled.

The following were added:

– Security: users will be able to change the password of their login to the system and control access to their profile, as well as protect the data that is generated and used in the system processes by encrypting the user´s passwords in the database.
– Control: users will be able to keep track of the data with the generation of reports in PDF and Excel according to their type of user and privileges within the system.
– Restrictions: the system has restrictions to access information, make changes or delete some data, depending on the type of user and module to which it is entered.
– The system has deadlines for renaming the project and updating assessments.
– Access: the head of division will always have access to change the name of the internship project and change the internal advisors.
– Functionality: the system has all the processes that are carried out in the period of internship in an accessible way.
– Video tutorials were created for the understanding of usability and processes that are performed within the system.
– Practical: the system generates a practical way to carry out the entire internship process in a simple way.
– It generates searches of interns by their control number.
– Filters information when selecting a desired career.
– For division heads, an optimal way was generated by assigning internal advisors and creating internships.
– Decrease in Time: the time in the search for the information of the interns is reduced.
– New module: the Academic Director´s module is generated, where there is access to all active interns in internships, accept the names of the internship projects, make observations and obtain reports.
– Satisfaction: the system is a tool of great help to users, to work remotely the processes that must be carried out in the professional intership, during the health contingency due to Covid-19.

Display

The website was set on a server and is currently used by approximately 200 users every semester. The URL of the website is http://sigeprore.itslerdo.edu.mx/. Figure 25 shows the main screen of the site.

Figure 25 GUI. Index SIGEPRORE 2.0

Acknowledment

We thank the Tecnológico Nacional de México, the Government of the State of Durango, and the Instituto Tecnológico Superior de Lerdo for having financed this project; as well as the person in charge of the Professional internship procedure in the Quality Management system, Dora Ortiz Sifuentes and all the students who have been part of this project.

Conclusions

The importance of updating an institutional procedure with elements that allow optimizing and streamlining most of its activities is undoubtedly an aspect that improves the overall efficiency of this higher education institution.

The most relevant result of the elaboration of this project is that this system will be established in the operating policies of the professional internship procedure of the ITSL quality management system.

Another result is that all the tasks of the professional internship procedure that are carried out in a presence way, it is possible to perform them remotely, asynchronously and agilely; optimizing tasks, from the initial phase of the procedure with the generation of the project data, to the culmination of this process with the generation of the final reports.

The different stakeholders of the project obtain significant improvements, mainly in the organization and time dedicated to the tasks related to their respective profiles.

The improvement that can be seen from the above, it is that, it is possible to develop a system that in addition to running in a web environment, it is adapted for the main mobile platforms, in order to extend the operational range of a procedure of vital importance such as profesional internship.

References

Axarnet. (31 de Octubre de 2017). Bootstrap- ¿Qué es y Cómo funciona? Obtenido de Axarnet: https://www.axarnet.es/blog/bootstrap/

Beati, H. (2011). PHP Creación de páginas Web dinámicas. Buenos Aires: Alfaomega.

Gauchat, J. D. (2012). El gran libro de HTML5, CSS3 y Javascript. Marcombo. Barcelona.

Jacobson, I., Spence, I., Bittner, K., Salazar, C. L. A. & Zapata J.C. M. (2013). Casos de uso 2.0. La guía para ser exitoso con los casos de uso. Ivar Jacobson International S.A.

Pressman, R. S. (2011). Ingeniería del software. Un enfoque práctico. 7a edición Mc Graw Hill. México

Salazar Z. J. E., & Puentes A. O. (2009). Modulo Diseños de Sitios Web. UNAD. La plata, Huila Obtenido de wordpress.com: https://trabajodise.files.wordpress.com/2013/05/301122.pdf

Sommerville, I. (2011). Ingeniería de Software 9a Edición. Pearson Educación. México

Spona, H. (2010). Programación de bases de datos con MYSQL y PHP. Marcombo.

Trigas G. M. (2012). Metodología SCRUM. Obtenido de http://openaccess.uoc.edu/webapps/o2/bitstream/10609/17885/1/mtrigasTFC0612memoria.pdf

Guijarro, Á. P. (2012). Protocolo HTTP. Obtenido de https://alvaroprimoguijarro.files.wordpress.com/2012/01/ud04_http_alvaroprimoguijarro.pdf

JSON. (s.f.). Introducción al JSON. Obtenido de JSON: https://www.json.org/json-es.html

PHP. (2019). Introducción PDO. Obtenido de PHP: https://www.php.net/manual/es/intro.pdo.php

Tecnológico Nacional de México (2015). Manual de Lineamientos Académico-Administrativos del Tecnológico Nacional de México

Zúñiga, J. E., & Andrade, O. P. (10 de Diciembre de 2009). Modulo Diseños de Sitios Web. Obtenido de wordpress.vcom: https://trabajodise.files.wordpress.com/2013/05/301122.pdf

Article **Journal of Computational Technologies**
June, 2021 Vol.5 No.15 11-20

App design for teaching academic English vocabulary using spaced repetition method

Diseño de aplicación para la enseñanza de vocabulario académico Inglés utilizando el método de repetición espaciada

MARTÍNEZ-VALENCIA, Ricardo Fabrizio*†, MONTERO-VALVERDE, José Antonio, MARTÍNEZ-ARROYO, Miriam and HERNÁNDEZ-BRAVO, Juan Miguel

Tecnológico Nacional de México campus Acapulco

ID 1st Author: *Ricardo Fabrizio, Martínez-Valencia* / **ORC ID:** 0000-0003-3231-1981, **CVU CONACYT ID:** 800424

ID 1st Co-author: *José Antonio, Montero-Valverde* / **ORC ID:** 0000-0001-8452-7333

ID 2nd Co-author: *Miriam, Martínez-Arroyo* / **ORC ID:** 0000-0002-5685-1731

ID 3rd Co-author: *Juan Miguel, Hernández-Bravo* / **ORC ID:** 0000-0003-4892-3368

DOI: 10.35429/JOCT.2021.15.5.11.20 Received March 15, 2021; Accepted June 30, 2021

Abstract

In this paper, it is presented a proposal of app for teaching English vocabulary oriented to computer science field, using a spaced repetition method based on SuperMemo 2 (SM-2) algorithm, which allows reinforce the vocabulary acquired in previous studies, and dynamically generate a plan for learning the most appropriated words according to an easiness factor and word practice time interval. Also, an assessment instrument is presented, which can be used for demonstrating the acceptance of the technology throughout measuring use attitude to proposed app and usefulness perception from users. Through this learning way, students from many educational institutions can achieve a better vocabulary retention, which carries to having a better comprehension of academic texts that are required for acquiring more knowledge in their study fields.

Academic english vocabulary, Spaced repetition, Technology acceptance model

Resumen

En este trabajo, se presenta una propuesta de aplicación para la enseñanza de vocabulario inglés orientado al área de las ciencias computacionales, utilizando un método de enseñanza por repetición espaciada basado en el algoritmo SuperMemo 2 (SM-2), el cual, permite reforzar el aprendizaje de vocabulario estudiado previamente, y planear de manera dinámica las palabras más apropiadas a aprender en función de un factor de facilidad y el intervalo de tiempo en que estas se practican. También, se presenta un instrumento de evaluación con el cual se puede comprobar la aceptación de la tecnología a través de la medición de la actitud hacia el uso de la aplicación propuesta y la percepción de la utilidad de la misma por parte de los usuarios. A través de esta forma de aprendizaje se puede lograr que los estudiantes de instituciones educativas tengan una mayor retención de las palabras que aprenden, lo que conlleva a que tengan una mayor comprensión de los textos académicos que se requieren para adquirir mayores conocimientos en sus áreas de estudio.

Vocabulario académico inglés, Repetición espaciada, Modelo de aceptación de la tecnología

Citation: MARTÍNEZ-VALENCIA, Ricardo Fabrizio, MONTERO-VALVERDE, José Antonio, MARTÍNEZ-ARROYO, Miriam and HERNÁNDEZ-BRAVO, Juan Miguel. App design for teaching academic English vocabulary using spaced repetition method. Journal of Computational Technologies. 2021. 5-15:11-20

* Author Correspondence: (e-mail: ricardofabriziomv@gmail.com)
† Researcher contributing as first author.

Introduction

There is a strong relationship between proficiency of the English language and the competitiveness of a country. A high level of proficiency of this language translates into growth in all areas, mainly in the economy, innovation and the general well-being of inhabitants (IMCO, 2015).

In Mexico, population has difficulties for learning English. It is not only the fact of the low level, but also that it is decreasing year after year, compromising the level of competitiveness of the country.

This is reflected in the results of the Education First English Proficiency Index or EF EPI, where Mexico ranked 44th out of 80 countries evaluated in 2017; 57th place out of 88 in 2018; 67th out of 100 in 2019; and falling to 82th out of 100 in 2020, as well as 18th out of 19 in Latin America, only above Ecuador (Education First, 2020).

This situation is not only specific to Mexico. It is known that other countries present similar situations that are caused by different problems, such as low concentration on studying (Zou, 2019), lack of variety of teaching methods (Boyinbode and Tiamiyu, 2020), low learning autonomy by students (Chen and others, 2019), difficulty of comprehension and acquisition of vocabulary (Saragih, 2019), among others.

It is worth mentioning that EF EPI, as well as many other studies, have as a target population to high school and university students. Therefore, it is important to take into account, in addition to their general proficiency of the language, a sufficient proficiency of academic vocabulary, so that they are able to understand and use english academic resources in their study areas, that encourage them to acquire more knowledge and improve their professional skills.

But, as with general English, academic English also presents some learning obstacles for students. Some of these are the lack of motivation due to the use of traditional teaching techniques and equipment, the lack of inclusion of technology, and teaching not focused on the students' areas of interest (Farook and Mohamed, 2020).

In this sense, it is essential to generate proposals that integrate innovation factors and content personalization to increase the level of interest and motivation to learn the language.

LEVO APP is a proposal of a Progressive Web App or PWA, that can help to students on learning English according to their academic areas, using a spaced repetition algorithm and a word identification activity based on flashcards.

In the proposed design, it is used the Academic Vocabulary List or AVL proposed by Roesler (2020), which is oriented to the area of Computational Sciences, and, implemented as a teaching method, the spaced repetition algorithm called SuperMemo 2 (SM-2).

The intention of using this app is to obtain a positive impact on the attitude and intentionality of learning English academic vocabulary by students in the area of computer science.

As part of the content of this document, some related works referring to the use of technology for the teaching of English vocabulary are mentioned.

It is briefly addressed the academic vocabulary lists used for teaching English focused on academic areas, describing their characteristics and the benefits of their use. The SuperMemo 2 algorithm is also briefly described, as well as its interaction with vocabulary teaching process using flashcards.

Finally, it is explained the Technology Acceptance Model, which can be used for evaluating the attitude and intentionality of use of the proposed app.

Teaching English: Use of Technology and Academic Vocabulary

It is not surprising that a large number of projects related to English language teaching have been proposed for several years.

There is a general interest in offering to students the possibility of learning a language for getting professional advantages. Various approaches have been taken with the only aim of covering as many forms of teaching, and one of these is the use of technology.

It is known that the use of computer technologies has beneficial effects on learning a new language. For example, Yip and Kwan (2006) found that there is more preference in learning English vocabulary through the use of web applications, than learning on a face-to-face method with a teacher. Furthermore, those who use technological tools for learning English have a broader vocabulary and retain words for a longer time, unlike those who only learn with traditional methods in the classroom.

Basoglu and Akdemir (2010), identified that students who use mobile applications to learn a language, spend more time studying it, and at the same time, they perceive greater entertainment in the process.

Two things can be inferred from this, first, that both web technologies and mobile technologies allow increasing proficiency with English vocabulary; and second, that both influence the perception of greater utility against conventional methods, which facilitates the process while providing greater motivation and entertainment to students.

It is worth mentioning that nowadays it is possible of combining web technologies with mobile technologies, using Progressive Web Apps, which are web applications that integrate the characteristics of a native mobile app.

These kinds of apps can be installed in users' devices, using a minimum amount of space, which leads to a saving in the amount of available storage. They can also make use of some hardware interfaces from devices, work without internet connection, and receive notifications in real time (Tandel and Jamadar, 2018). Given the proven benefits of web and mobile technologies, progressive web apps are a good technology option for using on language teaching.

In addition to the use of technological tools, another factor that positively influences the learning of English is the personalization of contents according to students' topics of interest, since this provides greater motivation for them to acquire more knowledge (Manyak and Bauer, 2009).

Kohnke et al. (2020) found that it is possible to improve vocabulary retention, implementing within apps the process of teaching by disciplines, that is, grouping words related to students' academic areas of interest.

Various research works have been carried out. The objective is to find English word lists oriented to academic areas, for offering personalized and relevant content for students, and thus, help them improve their learning (Coxhead, 2000).

Roesler (2020), mentions that knowledge of academic vocabulary is vital for reading comprehension and academic success of those who aspire to access higher-level educational systems, where the correct interpretation of technical content related to a specific area is required.

Based on this, it can be identified the relevance of generating proposals of English teaching tools that use web and mobile technologies, mainly focusing on teaching content oriented to students' areas of interest, which leads to positively influence their learning process.

Learning with Spaced Repetition

Spaced repetition is a learning method that consists on incrementing or decreasing the time a person must practice again a previously studied resource, according to the retention level the person has at the time (Schroeder, 2017).

This method has proven to be very effective for learning vocabulary of a second language, both for traditional teaching methods (Schuetze, 2017; Namaziandost and others, 2019; Nakata and Elgort, 2021), as well as for the use of technological teaching language tools (Settles and Meeder, 2016; Altiner, 2019; Kohnke and others, 2019; Seibert and Brown, 2020).

Wozniak (1990) proposed a spaced repetition algorithm called SuperMemo, for teaching through the use of flashcards. In this, the calculation of inter-repetition intervals is carried out to review the content of cards on specific days.

The most popular version of this algorithm is version 2 (SM-2), which, in addition to calculating repetition intervals, integrates an easiness factor that helps to dynamically assign the backward or forward of the practice times of the cards, according to user responses.

The algorithm begins with the assignment of the first card repetition interval which is a one-day interval, the second a six-days interval, and since the third, the interval is calculated taking into account the previous value multiplied by the easiness factor or EF. This is determined by the pseudocode in Figure 1.

I(1) := 1
I(2) := 6
for *n>2 I(n) := I(n-1) * EF*

Where:

- *I(n)* is the inter-repetition interval after n-repeat (in days).
- *EF* is the factor that reflects the easiness of memorization and retention of a card content (also called *E-Factor*). Its values range from 0 to 5 inclusive, starting at 2.5, and decreasing or increasing according to the results of the user's responses.
- *EF* es el factor que refleja la facilidad de memorización y retención del contenido de una tarjeta (también llamado *E-Factor*). Sus valores van de 0 a 5 inclusive, iniciando en 2.5, y va disminuyendo o incrementando de acuerdo a los resultados de las respuestas del usuario.

Figure 1 Calculation of inter-repetition intervals in the SM-2 algorithm (Wozniak, 1990)

Each new EF value is calculated by:

$$EF' = f(EF, q) \quad (1)$$

Where:

EF' is the new value of *E-Factor*.
EF is the previous value of *E-Factor*.
q is the response quality.
f (*EF*, *q*) is the calculation function of *EF'*.

The calculation function of *EF'* is determined by:

$$f(EF, q) = EF - 0.8 + 0.28 * q - 0.02 * q * q \quad (2)$$

The value of *q* is obtained from scalar values ranging from 0 to 5 (the higher, the better quality) which represent the qualitative level of response quality, and is classified based on the following criteria:

5 - correct answer
4 - correct answer, with hesitation
3 - correct answer, with difficulties
2 - wrong answer, the correct one seemed easy to remember
1 - wrong answer, having it correctly in previous sessions
0 - could not answer

With all the values and calculations established, the SM-2 algorithm can be applied according to the steps in Figure 2.

1) Assign an *EF* value of 2.5 to all cards.
2) Practice the cards by setting an inter-repetition interval using the steps in Figure 1.
3) After each repetition, rate the quality of the response on a scale of 0 to 5.
4) After each repetition, and before calculating the new interval, modify the *EF* value of the current card practiced using Equation 1. If *EF'* is less than 1.3, assign *EF'* = 1.3.
5) If response quality of *q* was less than 3, then reset the repeat interval to 1, without changing the *EF* value (use the intervals *I(1)*, *I(2)*, etc., as if the card had not been practiced).
6) After session on a given day, repeat all the cards with a quality value *q* less than 4. Continue the repetitions until all the cards have a score of at least 4.

Figure 2 SM-2 algorithm execution (Wozniak, 1990)

Technology Acceptance Model

The main goal of developing software systems and apps is to provide tools that facilitate people's activities, in work, academic, or other kind of environments.

However, not all technology created is always well received by users, and there are two main traits that determine this: usefulness perception and ease-of-use perception.

If users perceive a technology is difficult to use and it is also not so useful for their purposes, they simply tend to have a negative attitude towards it, which translates into little or no use of the tool, and the loss of the potential benefits that can be obtained by making use of it.

The Technology Acceptance Model or TAM, is a model that evaluates the behavioral response to a technological tool (see Figure 3). According to Davis (1989) this answer is obtained by the following flow:

- Using a technological tool generates an external stimulus in the users, according to design characteristics of it.
- This stimulus results in a cognitive response, in which the users perceive the ease-of-use level, as well as the usefulness to achieve their objectives.
- These perceptions determine an affective response towards the tool, where a positive or negative attitude is obtained for its use.
- Which finally affects the behavioral response that is reflected in the actual use of the tool.

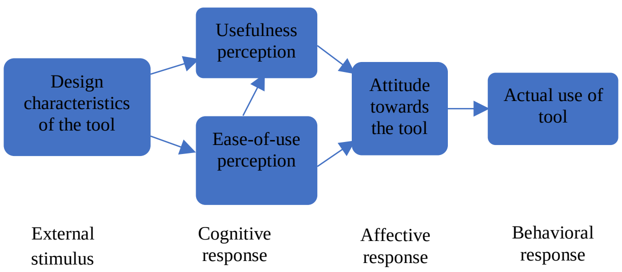


Figure 3 Technology Acceptance Model (Davis, 1989, p.3)

Venkatesh and Davis (2000) identified that the characteristics of the tools are not the only factor that determines user perceptions, but these are also affected by:

- Subjective norms. Which refers to the influence of the user's perception by external factors.
- Voluntariness. It indicates the attitude of the person to use the tool because he wishes to do so, without being forced by external factors.
- Experience. The ease-of-use that user perceives when using the tool, obtaining a good or bad experience at the end.
- Image. The way in which the user perceives that the use of the tool will give him greater status or recognition.
- Job relevance. The benefits that the user thinks they can obtain to improve the productivity, effectiveness and quality of their work by using the tool.
- Output quality. That refers to the quality of the information offered by the tool, and that the user can use for their specific purposes.
- Result demonstrability. The ease in how the user understands the benefits of using the system and the capacity to explain it.

These factors were integrated as an extension to the first TAM, forming a second version called TAM2 (see Figure 4).

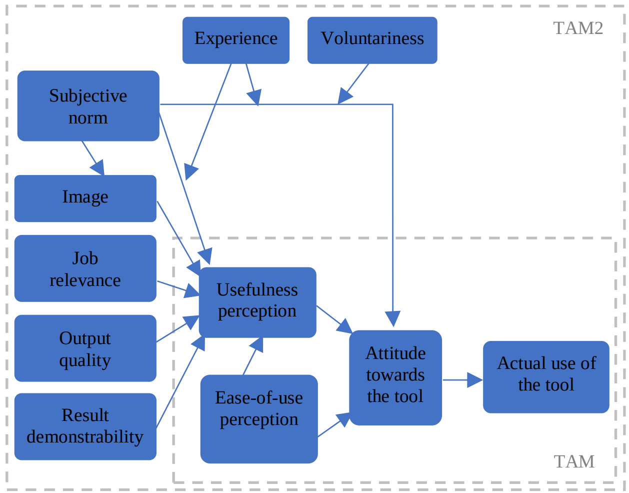


Figure 4 Technology Acceptance Model version 2 (Venkatesh y Davis, 2000, p.188)

With this version, it is possible to obtain a more precise evaluation of usefulness perception of a given technology.

It is worth mentioning that there is a third version of TAM, which includes factors that influence the ease-of-use perception, however, these are more oriented to user experience and user interfaces, which is not the main goal of the proposed app.

Methodology

The proposed app includes three stages, which are shown in Figure 5, and explained below.

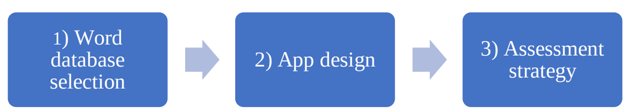


Figure 3 Stages of LEVO APP development

1) Word database selection

For the first stage, it was carried out a search of repositories that includes word lists in English categorized by academic areas. Given the extension of the number of available lists located, it was decided to take as a reference only one of these for the prototype design.

ISSN 2523-6814

As a reference, it is recommended to use an academic vocabulary list such as that proposed by Roesler (2020), because it is the most updated, and extends and improves the academic lists proposed by Coxhead (2000), Minshall (2013), Gardner and Davies (2014), and Lei and Liu (2016), being for this particular case, a list oriented to computer science area.

This list is made up of a main group of 904 words directly related to computer science, and a supplemental group of 702 indirectly related words, summing up 1,606 words in total.

The proposed design contemplates the use of a single vocabulary list for exemplification and testing purposes.

2) App design

It is proposed a simple design that implements a game based on flashcards, which consists of game rounds with ten words each, generated for a chosen academic area, these words are selected from inter-repetition intervals assigned to the previously practiced words. If no programmed words are found to practice, or there are not enough to complete a round of ten words, a selection is made by simple random sampling to complete the missing words of the round.

The app must present one by one, each of the ten words to the user, so that he tries to identify the translation of them, writing it in a text box. Response times are used based on the work of Schuster et al. (1990), where a 5 seconds interval is given for word analysis, and after this, a 15 seconds interval for giving an answer.

Response qualities for the SM-2 algorithm, are determined by these criteria:

- If the user answers correctly within the first 10 seconds, answer quality equals 5.
- If a correct answer is given within 11-15 seconds, answer quality equals 4.
- If a correct answer is given within 16-20 seconds, answer quality equals 3.
- If the user answers incorrectly and the word's *EF* value is below 2.5, answer quality equals 2.
- If it is answered incorrectly a word that was correctly answered in a previous session, answer quality equals 1.
- If 20 seconds interval ends before the user can answer, answer quality equals 0.

For each given answer, calculation of EF value is performed, so that the easiness value of the word can be varied, and the new inter-repetition interval can be established. The calculation process is repeated for each of the words, until the end of the game round. This is exemplified in Figure 6.

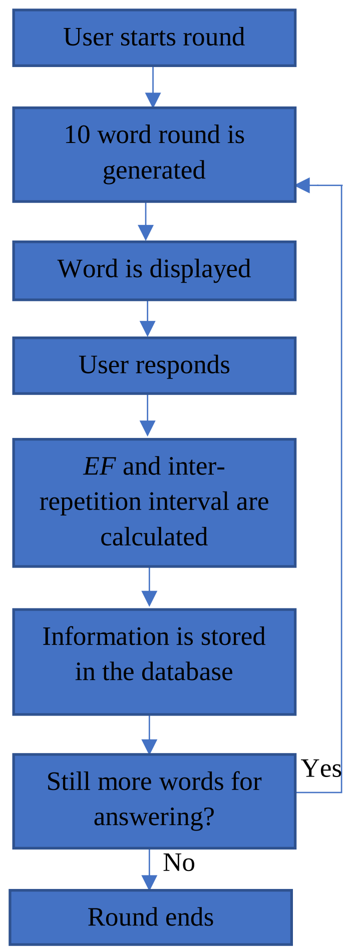


Figure 4 Word practice round process

As part of the practice process, the most relevant interface designs are presented in Figure 7. It is important to mention that is proposed a Spanish-based interface for making it easier to use by beginner-level English students.

a) Welcome screen. Where users can choose the authentication option. It is proposed to allow practicing as guests for temporarily saving the information generated, or with a registered user to keep track of the results obtained.

b) Academic area selection. Where the academic area to practice can be chosen.

ISSN 2523-6814

c) Practice round screen. That controls the flow of each round, includes in the upper part a sequential follow-up of the words of the round, a button to immediately restart a new round, a button to end the round, and a bar that indicates the remaining time to respond. The central part shows the word to be identified, and the text box where users can write their answers.

d) End of round. It shows a summary of the points obtained according to the quality scores obtained after each answer.

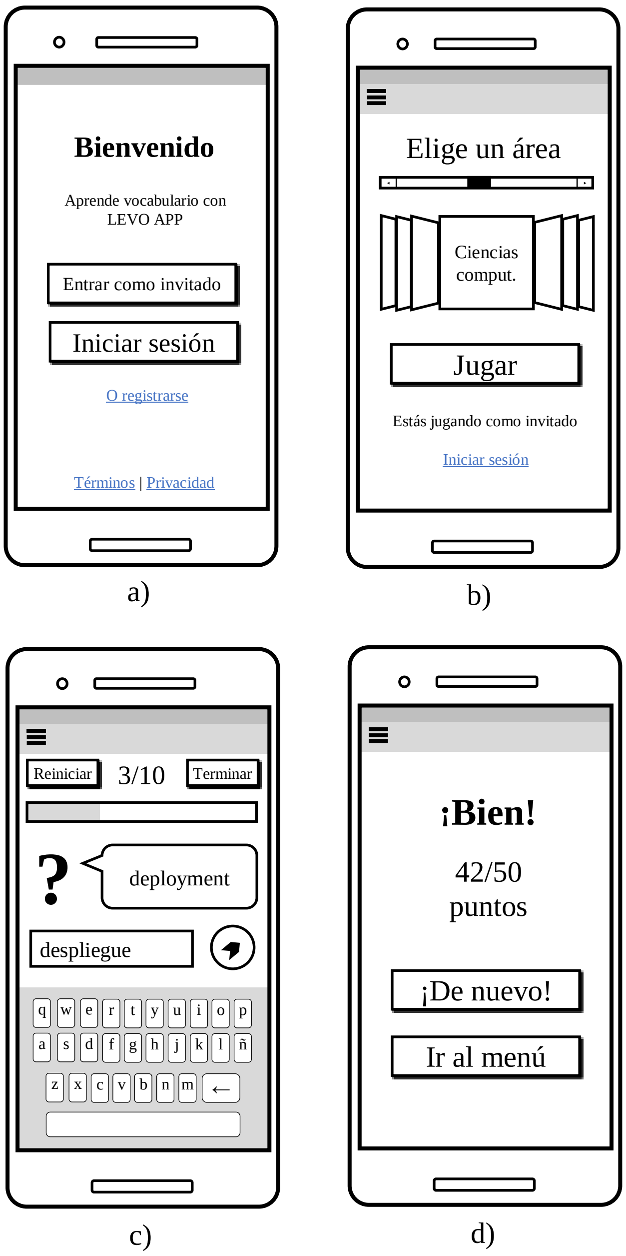


Figure 5 LEVO APP user interfaces

App construction must be realized using technologies adapted for the creation of PWAs, for that reason, it has been chosen to use the MEAN development stack, composed of the MongoDB, Express.js, Angular, and Node.js technologies, since are adapted for this type of apps. Its deployment requires a web server where the application code and the database can be hosted, so a client-server architecture is more than enough to make the product available to users, requiring an internet connection to access for the first time.

3) Assessment strategy

Third stage consists of evaluating the tool through TAM2, for which, the use of an adaptation of the evaluation instrument proposed by Venkatesh and Davis (2000) is proposed, which is made up of 26 items grouped into 9 sections.

Each item presents a sentence for which users must assign a concordance value, according to their perceptions about the app.

The proposed instrument is made up of sections identified by sections (a) to (i), each one containing their respective items, as shown next:

(a) Intention to use
– Assuming I have access to the app, I intend to use it.
– Given that I have access to the system, I predict that I would use it.

(b) Perceived usefulness
– Using the app, my academic English performance will increase.
– Using the app, I will increase my productivity on academic activities that require English language.
– Using the app, I enhance my effectiveness on academic activities that require English language.
– I find the app to be useful in my English learning process.

(c) Perceived ease of use
– My interaction with the app is clear and understandable.
– Interacting with the app does not require a lot of my mental heart.
– I find the app to be easy to use.
– I find it easy to get the app to do what I want it to do.

(d) Subjective norm

- People who influence my behavior think that I should use the app.
- People who are important to me think that I should use the app.

(e) Voluntariness

- My use of the app is voluntary.
- People does not require me to use the app.
- Although it might be helpful, using the app is certainly not compulsory in my academic activities.

(f) Image

- Students in my university who use the app have more prestige than those who do not.
- Students in my university who use the app have a high profile.
- Using the app is a status symbol in my university.

(g) Academic relevance

- In my academic activities, usage of the app is important
- In my academic activities, usage of the app is relevant.

(h) Output quality

- The quality of the output I get from the app is high.
- I have no problem with the quality of the app's output.

(i) Result demonstrability

- I have no difficulty telling others about the results of using the app.
- I believe I could communicate to others the consequences of using the app.
- The results of using the app are apparent to me.
- I would have difficulty explaining why using the system may or may not be beneficial.

Each item is measured by means of a scale that goes from zero to seven, which represent the following qualitative values:

1 = Strongly disagree
2 = Mostly disagree
3 = A little disagree
4 = Neutral (neither agree nor disagree)
5 = A little agree
6 = Mostly agree
7 = Strongly agree

The data set obtained can be modeled with a software tool such as SmartPLS to obtain the values for making a comparison and identify if there is a positive intention of using the proposed app.

Results

The proposed design, being based on elements whose benefits have been proven, allows identifying the results that can be obtained once it is implemented:

- Being a PWA, LEVO APP provides the benefits of this type of app, such as access from almost any device with an internet connection, security, responsive interface, operation without connectivity or low quality of internet connection, native mobile app behavior, continuous updating, small size and ease of installation (Tandel and Jamadar, 2018; Mhaske and others, 2018), in addition to serving as a form of encouragement and motivation, unlike traditional teaching methods.

- The use of flashcards for learning English vocabulary is very extensive, due to its simplicity, and in conjunction with a spaced repetition teaching method such as SM-2, greater data retention can be achieved, of around 90% of the information practiced (Wozniak, 1990).

- The use of a vocabulary personalized to the interests of the users, in this case, to academic areas, positively influences the retention of the words that are practiced.

From the above, it can be inferred that, by implementing these characteristics, a positive attitude can be obtained towards the use of the app, for learning academic English vocabulary.

Conclusions

English language proficiency is very relevant for the competitiveness of a country. Much of the learning of this language occurs in high school and university, and, it is at this time when students must have good proficiency of it, to be able to understand academic information that entails to learn more about the chosen academic area.

ISSN 2523-6814

Although there are apps for teaching English vocabulary, many of these focus on a general vocabulary, which, although it is of great importance to provide the foundations of a more advanced vocabulary, it is also necessary to have proposals that focus into a higher level of specialization, useful for people who study a certain area and who can generate more knowledge in the field. Also, the importance of using methodologies that help in a better way to retain the vocabulary learned is identified, without forcing the rigid memorization of words.

Spaced repetition method shows to be an effective gradual teaching method, which, combined with current technologies such as progressive web apps and simple teaching methodologies such as flashcards, generate solutions that are liked by users, which has a direct impact in their attitude towards the use of them and the perception of usefulness for their academic purposes.

Acknowledgements

To Consejo Nacional de Ciencia y Tecnología (CONACYT) for the financial support for the realization of this project, and to Tecnológico Nacional de México campus Acapulco for the infrastructure and technology facilities provided.

References

Altiner, C. (2019). Integrating a Computer-Based Flashcard Program into Academic Vocabulary Learning. *Turkish Online Journal of Educational Technology-TOJET*, 18(1), 44-62.

Arnold, B. A. (2019). The seven traits of a learning environment: a framework for evaluating mobile learning engagement. *Int. J. E-Education, e-Business, e-Management e-Learning*, 9, 54-60.

Basoglu, E. B., y Akdemir, O. (2010). A comparison of undergraduate students' English vocabulary learning: Using mobile phones and flash cards. *Turkish Online Journal of Educational Technology-TOJET*, 9(3), 1-7.

Boyinbode, O., y Tiamiyu, A. (2020). A Mobile Gamification English Vocabulary Learning System for Motivating English Learning. *IOSR Journal of Mobile Computing & Application (IOSR-JMCA)*, 7(2), 14-29.

Chen, C. M., Chen, L. C., y Yang, S. M. (2019). An English vocabulary learning app with self-regulated learning mechanism to improve learning performance and motivation. *Computer Assisted Language Learning*, 32(3), 237-260.

Coxhead, A. (2000). A new academic word list. TESOL quarterly, 34(2), 213-238.

Davis, F. D. (1989). Technology Acceptance Model: TAM. *Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption*, S, 205-219.

Education First. (2020). *EF English Proficiency Index*. Education First.

Farook, A. H. A., y Mohamed, R. N. G. (2020). Students’ Lack of Interest in Learning GCE Advanced Level (A/L) General English: Factors and Remedies. A Survey Research Based on GCE Advanced Level Students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 71(1), 174-181.

Goossens, N. A., Camp, G., Verkoeijen, P. P., Tabbers, H. K., y Zwaan, R. A. (2012). Spreading the words: A spacing effect in vocabulary learning. *Journal of Cognitive Psychology*, 24(8), 965-971.

Instituto Mexicano para la Competitividad. (2015). *Inglés es Posible. Propuesta de una Agenda Nacional*. IMCO.

Kohnke, L., Zhang, R., y Zou, D. (2019). Using mobile vocabulary learning apps as aids to knowledge retention: Business vocabulary acquisition. *Journal of Asia TEFL*, 16(2), 683.

Kohnke, L., Zou, D., y Zhang, R. (2020). Exploring Discipline-Specific Vocabulary Retention in L2 through App Design: Implications for Higher Education Students. *RELC Journal*, 0033688219899740.

Manyak, P. C., y Bauer, E. B. (2009). English vocabulary instruction for English learners. *The Reading Teacher*, 63(2), 174-176.

Mhaske, A., Bhattad, A., Khamkar, P., y More, R. (2018). Progressive Web App for Educational System. *International Research Journal of Engineering and Technology (IRJET)*, 5(1).

Nakata, T., y Elgort, I. (2021). Effects of spacing on contextual vocabulary learning: Spacing facilitates the acquisition of explicit, but not tacit, vocabulary knowledge. *Second Language Research*, 37(2), 233-260.

Namaziandost, E., Nasri, M., Esfahani, F. R., Keshmirshekan, M. H., y Agudo, J. D. D. M. (2019). The impacts of spaced and massed distribution instruction on EFL learners' vocabulary learning. *Cogent Education*, 6(1), 1661131.

Roesler, D. (2020). *A Computer Science Academic Vocabulary List*. Portland State University Library.

Saragih, E. (2019). The effect of semantic mapping technique on technical vocabulary mastery for Midwifery students. *Studies in English Language and Education*, 6(2), 333-342.

Schroeder, J. (2017). *Advanced persistent training: Take your security awareness program to the next level*. Apress.

Schuetze, U. (2017). Efficiency in second language vocabulary learning. *Die Unterrichtspraxis/Teaching German*, 50(1), 22-31.

Schuster, J. W., Stevens, K. B., & Doak, P. K. (1990). Using constant time delay to teach word definitions. *The Journal of Special Education*, 24(3), 306-318.

Seibert Hanson, A. E., y Brown, C. M. (2020). Enhancing L2 learning through a mobile assisted spaced-repetition tool: an effective but bitter pill?. *Computer Assisted Language Learning*, 33(1-2), 133-155.

Settles, B., y Meeder, B. (2016). A trainable spaced repetition model for language learning. *In Proceedings of the 54th annual meeting of the association for computational linguistics* (volume 1: long papers) (pp. 1848-1858).

Tandel, S. S., y Jamadar, A. (2018). Impact of progressive web apps on web app development. *International Journal of Innovative Research in Science, Engineering and Technology*, 7(9), 9439-9444.

Venkatesh, V., y Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science,* 46(2), 186-204.

Wozniak, P. A., y Gorzelanczyk, E. J. (1994). Optimization of repetition spacing in the practice of learning. *Acta neurobiologiae experimentalis*, 54, 59-59.

Wozniak, P. (1990). *Application of a computer to improve the results obtained in working with the SuperMemo method*. Tomado de: https://www.supermemo.com/en/archives1990-2015/english/ol/sm2.

Yip, F. W., y Kwan, A. C. (2006). Online vocabulary games as a tool for teaching and learning English vocabulary. *Educational media international*, 43(3), 233-249.

Zou, D., Huang, Y., y Xie, H. (2019). Digital game-based vocabulary learning: where are we and where are we going?. *Computer Assisted Language Learning*, 1-27.

Article **Journal of Computational Technologies**
June, 2021 Vol.5 No.15 21-28

Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function

Reconocimiento de patrones meteorológicos utilizando Redes Neuronales Artificiales programadas con la función de activación Swish

AGUILERA-MENDEZ, José María†, JUÁREZ-TOLEDO, Carlos*, MARTÍNEZ-CARRILLO, Irma and FLORES VÁZQUEZ, Ana Lilia

Universidad Autónoma del Estado de México

ID 1st Author: *José María, Aguilera-Méndez* / **ORC ID**: 0000-0002-9826-421X, **CVU CONACYT ID**: 66670

ID 1st Co-author: *Carlos, Juárez-Toledo* / **ORC ID**: 0000-0002-7440-3246, **Researcher ID Thomson**: C-1368-2016, **CVU CONACYT ID**: 39912

ID 2nd Co-author: *Irma, Martínez-Carrillo* / **ORC ID**: 0000-0002-7952-4418, **Researcher ID Thomson**: B-9264-2016, **CVU CONACYT ID**: 39914

ID 3rd Co-author: *Ana Lilia, Flores-Vázquez* / **ORC ID**: 0000-0003-0524-9764, **Researcher ID Thomson**: C-1325-2016, **CVU CONACYT ID**: 92382

DOI: 10.35429/JOCT.2021.15.5.21.28 Received March 15, 2021; Accepted June 30, 2021

Abstract

Artificial neural networks are a set of tools that are widely used for the information classification. Its expansion within artificial intelligence has been due to its use in the Machine Learning area. A fundamental part of the artificial neural networks algorithm is the so-called activation function, the above because it is the part that triggers the process as a whole and due to its result the neuron/perceptron sends its outputs. Back-propagation activation function of an artificial neural network is also described; this is artificial neural network with a simpler functioning whose adaptation has made it especially attractive to pattern recognition; also, a different algorithm such as Swish is introduced. As part of the pattern recognition study, three wind classifications present on the Mexican Republic Atlantic coast are formed, each group is made up of graphic files referring to meteorological maps with wind indicators in order to feed the network and as new maps are generated, the Artificial Neural Network will be an aid in the meteorological patterns detection.

Artificial Neural Network, Swish, Pattern recognition

Resumen

Las redes neuronales artificiales son un conjunto de herramientas que son ampliamente utilizadas para la clasificación de información. Su expansión dentro de la Inteligencia Artificial se ha debido a su utilización en el área de Aprendizaje Automático. Una parte fundamental del algoritmo es la llamada función de activación que tiene la función de disparar el proceso en su conjunto la cual debido a su resultado envía sus salidas. También se describe a la red neuronal artificial de retro-propagación o hacia atrás, tiene el funcionamiento más simple y cuya adaptación la ha hecho especialmente atractiva al reconocimiento de patrones y se da entrada a los diferentes algoritmos como el Swish. Como parte del estudio de reconocimiento de patrones se forman tres clasificaciones de los diferentes tipos de viento presentes en la costa Atlántica de la república mexicana, cada grupo se encuentra conformado por archivos gráficos referentes a mapas meteorológicos con indicadores de viento con el objetivo de alimentar la red y según se generen nuevos mapas, la red neuronal artificial resultante es un auxiliar en la detección de patrones meteorológicos.

Redes neuronales artificiales, Swish, Reconocimiento de patrones

Citation: AGUILERA-MENDEZ, José María, JUÁREZ-TOLEDO, Carlos, MARTÍNEZ-CARRILLO, Irma and FLORES VÁZQUEZ, Ana Lilia. Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function. Journal of Computational Technologies. 2021. 5-15: 21-28

* Author Correspondence: (e-mail: jaguileram001@alumno.uaemex.mx)
† Researcher contributing as first author.

Introduction

In the last twenty-five years, the use and advance of Artificial Neural Networks (ANN) within a great variety of fields of science has been well known; this document will first give an introduction to the theory of ANNs and their different types. Later, it will be explained why they are used to a great extent in the field of pattern recognition with the different algorithms that can build them in addition to the formulas that compose them; finally, it will be discussed its adequacy for the patterns recognition in images and its use in the detection of two meteorological phenomena types using the Swish activation function, which has shown, on other types of functions, a good performance in the recognition tasks as well as the feedback type and quality obtained on ANN learning.

Neural Networks and Deep Learning

Deep Learning (DL) is considered as a subset of Machine Learning (ML) in which multilayer ANN "learn" from the data that is entered. Within each ANN layer, the DL algorithms perform a series of calculations that allow them to progressively "learn" and, as far as possible, improve the results precision over time (Kim, 2019); this is a great advantage since learning does not depend on the model, but on the data quality and quantity that are entered into the algorithms.

In the field of Artificial Intelligence (AI), ANN is considered a ML tool widely used in DL as one of the supervised learning techniques, with the ability to solve large and increasingly complex pattern classification problems and regressions (BBVA, 2019; Mathworks, 2020) that now include voice recognition and moving patterns.

Method

As part of the study of Artificial Intelligence (AI), Artificial Neural Networks (ANN) have, within their neurons, the evaluation mechanisms that allow their learning. These mechanisms are known as activation functions, which are mathematical equations that are responsible to return a result from input values. It is sought that the range of the value delivered by an activation function is normalized and they are in the range between [-1, 1] or [0, 1].

The activation function must be designed, configured and programmed in an efficient way since it could become a point of failure due to the fact that it has control of the ANN complete operation; this is due to the large number of calculations that they carry out. So we have that an output function of a simple node would be:

$$Y = \sum (weight * input + bias) \quad (1)$$

With an output range of (-∞, ∞); so it is advisable to apply a function that limits the output values and sets them in the desired range.

$$Y = activation\ function(\sum (weight * input + bias)) \quad (2)$$

Then the activation function decides whether a neuron should be activated or not and it is a non-linear transformation that is done on the input before propagating it to the next layer of neurons or to finalize the output. Not all proposed functions can be activation functions as they must meet the following monotonous properties (Li & Yuan, 2017):

- Continuous
- Discriminating
- Polynomial (Non-Linear)
- Monotonously Increases

Currently three types of activation functions are recognized, which are described below.

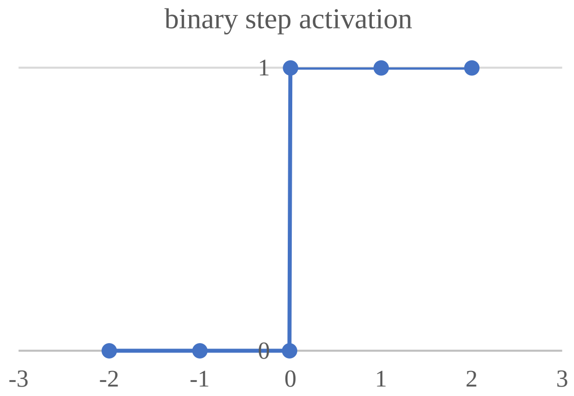
A. Binary step or unit step activation function: The function is mainly used in problems where the result can only have any of the values [0, 1] for any input value and is generally used in linear classification perceptrons; depending on the established threshold, the neuron is activated and sends the same signal to the next layer and so on; one of its limitations is that it does not allow the sending of multiple values. Its general formula is:

$$a_j^i = f(z_j^i) = \begin{cases} 0, if\ z_j^i < 0 \\ 1, if\ z_j^i > 1 \end{cases} \quad (3)$$

As an example, when the binary activation function is defined as

$$f(x) = \begin{cases} 0, if\ x < 0 \\ 1, if\ x > 1 \end{cases}$$

Its representation is shown in Graphic 1.

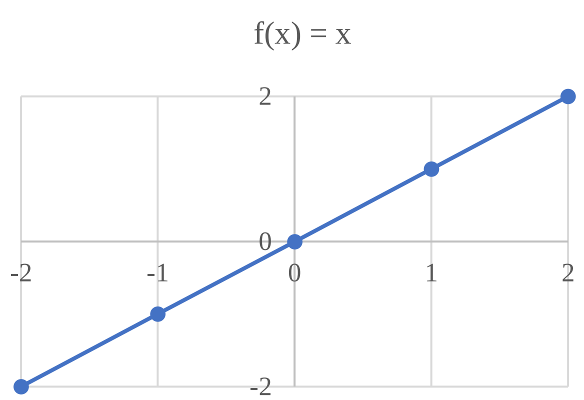


Graphic 1 Presentation of the binary step function.
Source: Own Elaboration

B. Linear activation function: Also known as the identity activation function, it allows the input to be equal to the output; so if you have a multilayer neural network and apply the linear function, it is said to be a linear regression. The linear activation function general form is:

$$f(x) = ax \quad (4)$$

Where the characteristics of (4) are: its domain and range take values (-∞, ∞); when calculating $\frac{d\,f(x)}{dx} = a$ you get a constant; therefore it cannot be optimized with gradient descent. Although its application could be interesting, this function has a couple of limitations that discourage its use: since the derivative is constant, the gradient has no relation to the input and, backward propagation is constant since the change is Δx as indicated in Graphic 2.



Graphic 2 Graph of linear or identity function
Source: Own Elaboration

C. Non-linear activation function: Modern ANNs use non-linear activation functions. They are highly complex since the inputs and outputs of the network and their assignments can process data such as images, video, audio and data sets that, as their definition indicates, are not linear, also called multidimensional; they can be of the following three types:

1. Sigmoid or logistic activation functions: Transform the entered values to a scale (0, 1), where high values tend asymptotically to 1 and very low values asymptotically tend to 0. Its general formula is:

$$f(x) = \frac{1}{1 + e^{-x}} \quad (5)$$

It is a function of slow convergence, bounded between 0 and 1, it is not centered at 0 and it has shown good performance in the ANN last layers. As part of the sigmoid functions, there is the so-called hyperbolic tangent, whose peculiarity consists in that it transforms the entered values to a scale (-1, 1), where high values tend asymptotically to 1 and low values tend asymptotically to -1. Its general formula is:

$$f(x) = \frac{2}{1 + e^{-2x}} - 1 \quad (6)$$

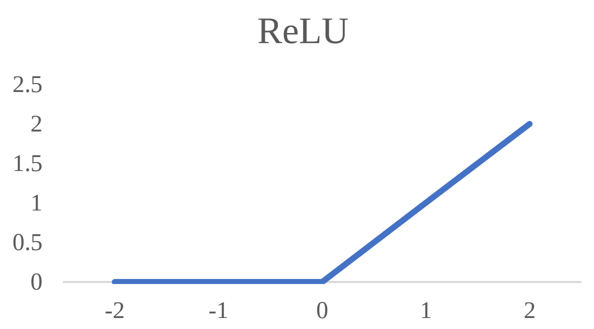
It is a function of slow convergence, bounded between -1 and 1, centered at 0 and has shown good performance in recurrent ANN. Sigmoid-based models have been developed, including the inverse hyperbolic tangent, whose peculiarity is that the output varies between [-pi/2, pi/2]. The softmax function, also known as the soft argmax function or multiple class logistic regression, in which case its use is recommended when the classes are mutually exclusive. The Gudermannian and Gaussian Error Linear Units (GELU) functions to mention a few (*A.I. Wiki*, 2021).

2. Rectified Lineal Unit (ReLU): Transform the inputs by converting negative values to 0, leaving positive values as they are entered.

$$ReLU = f(x) = \max(0, x) = \begin{cases} 0, when\ x < 0 \\ x, when\ x \geq 0 \end{cases} \quad (7)$$

ISSN 2523-6814

Among some of its characteristics are that they are only activated if the input values are positive as shown in Graphic 3; They are not limited and are recommended for use in imaging and convolutional ANNs. It might be the case that it looks like a linear function, but it is not and allows back propagation.



Graphic 3 Graph of a ReLU function
Source: Own Elaboration

In the event that ReLU contains as inputs a greater number of negative terms or zeroes, then ReLU would produce the output as zero and the ANN could not perform back propagation. This case is known as Dying ReLU. There are other variants that are ReLU based, such as Leaky ReLU, Parametric ReLU, Exponential Linear Unit (ELU), among others.

3. Complex non-linear activation functions: Although most of the functions' adaptations and modifications look for improvements in the processing and the way in which they can be activated, the so-called last generation of ANN (Kim, 2019) seeks to make more extensive use of functions such as the Scaled Exponential Linear Unit (SELU), Softplus or SmoothReLU, Swish, plus a couple of variants of the same Swish represented by the equation:

$$y = x * sigmoid(x), \text{ replacing}$$
$$y = x * \left(\frac{1}{1 + e^{-x}}\right) = \left(\frac{x}{1 + e^{-x}}\right) \quad (8)$$

The research phase in conjunction with the reports on the suitability and use of Swish (Google, 2021; Ramachandran et al., 2017) indicate better performance with more effective results compared to any other ReLU-based method.

Backward propagation Artificial Neural Networks

Backward propagating ANN is a gradient calculation method for learning; owe their recent success to the fact that they are considered computationally efficient and their fields of application lean towards pattern recognition (Wechsler, 1992). Its learning is supervised type with networks and multilayer perceptrons and with sets of instructions that define all the outputs and the values that are expected. In general, we seek to adjust the weights of each neuron in such a way that the error in the output is minimized because the algorithm indicates the intervention or weighting of each of the neurons within the total calculations; This is done by calculating the cost function partial derivatives with respect to each of the variables.

The method employs a two-phase cycle or propagation. When a value is inserted into the network, it is distributed or propagated from the first layer to the subsequent or hidden layers of the network, until it returns a result. The delivered result is compared with the expected result and an error signal is calculated for each of the outputs. The error outputs propagate backwards, starting from the output layer, towards the neurons in the hidden layer that contributed information to the output; in this way, the neurons in the hidden layers only receive a part of the total error signal, based on the approximate contribution that each neuron has made to the output. This process is cyclical, layer by layer, until all neurons in the network have received an error signal that relatively describes their contribution to Total Error. As the network is trained, the neurons in the hidden layers organize themselves in such a way that the neurons or perceptrons learn to recognize different characteristics of the total input space. After their training, by presenting them with a different input pattern, the neurons in the network hidden layer will respond with an active output if the new input contains a pattern that resembles that characteristic that individual neurons have learned to recognize.

Propagation Rule

The propagation rule determines the weighting resulting from the interaction of neuron i with the N neighboring neurons. The simplest and most widely used propagation rule consists of making a sum of the weighted inputs with their corresponding weights:

$$net_i(t) = \sum_{j=1}^{N} weight_{ij} * x_j(t) \quad (9)$$

In summary, a backward propagation algorithm has the general equation:

$$w_{ij}(t+1) = w_{ij}(t) + [\alpha * \delta_j^p * x_i^p(t) + +\beta \Delta w_{ij}(t)] \quad (10)$$

Being,

$$\delta_j^p = \begin{cases} \delta_j * f'\left(net_j^p(t)\right), \\ sif\ j\ is\ an\ output\ neuron \\ f'\left(red_j^p(t)\right) \sum_{k=1}^{M} \delta_k^p\, v_{kj}, \\ if\ j\ is\ a\ hidden\ neuron \end{cases} \quad (11)$$

In its simplest form, the algorithm operation is explained, using Figure 1 as follows:

1. Tickets X, arrive through a pre-connected route
2. The input is modeled using actual weights W. Weights are generally randomly selected.
3. Calculate the output for each neuron from the input layer, to the hidden layers, to the output layer.
4. Calculate the error of the outputs according to the relation:

$$Error_{propagation} = output_{expected} - output_{obtained}$$

5. Go back from the output layer to the hidden layer to adjust the weights to reduce the error.
6. Keep repeating the process until achieve the desired result.

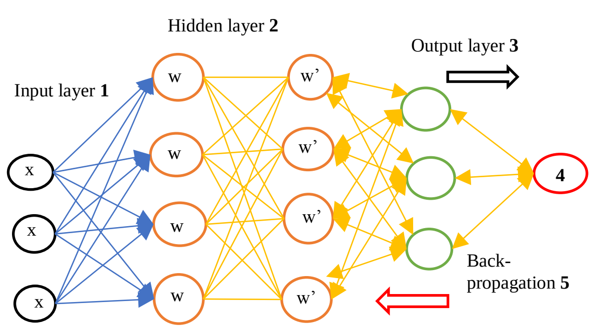


Figure 1 Backward propagation Artificial Neural Network
Source: Own Elaboration

Types of Backward propagation ANNs

There are two types of back-propagation networks:

1. Static Back-propagation: It is a type of back-propagation network that produces a mapping for both a static input and output. It is useful for solving classification problems of the static type such as optical character recognition.

2. Recurrent back-propagation: advances until a fixed value is reached; after that the error is calculated and propagated backwards. When the gradient is negative, the increase in weight decreases the error; if the gradient is positive, if the weight is decreased, the error decreases. Therefore, the algorithms must consider the existence of negative recurrence.

Meteorological phenomenon and numerical models

The Mexican Republic is geographically located in a convergence of climates that give rise to an exchange of warm, humid and polar winds in different magnitudes throughout the year; this air masses collision generates, in a large part of the territory especially on the coasts, gusts of wind with speeds exceeding 20 kilometers per hour with an average duration of 3 hours, which sometimes exceed 72 hours.

In recent decades, numerical models have been developed that have served to explain meteorological phenomena. Among some are the model Fifth-Generation Penn State/NCAR Mesoscale (MM5) and Weather Research and Forecasting (WRF), they are the most used in academic fields, and recently became open source. The models are intended to generate forecasts on various climate variables, such as rain, humidity, rainfall, winds, etc. (Coiffier, 2011; Fierro, 2020; Lorenc, 1986); whose data outputs are in tabular format, but through third-party software or utilities it is possible to generate the corresponding graphics as shown in Figure 2.

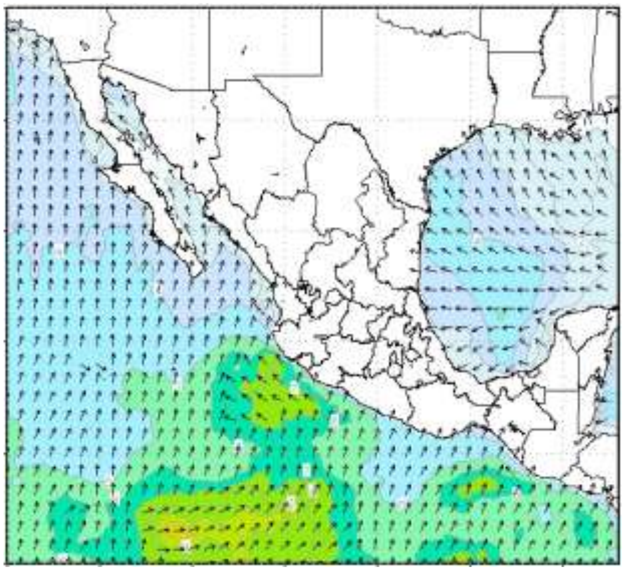


Figure 2 Wind forecast. Image generated by the MM5 model
Source: Own Elaboration

In recent years and thanks to the development of technologies that facilitate computational animation, the information visualization has become an added value for the end user, as shown in Figure 3, computer-generated images have gained attractiveness, but they have become complicated for automated sorting systems.

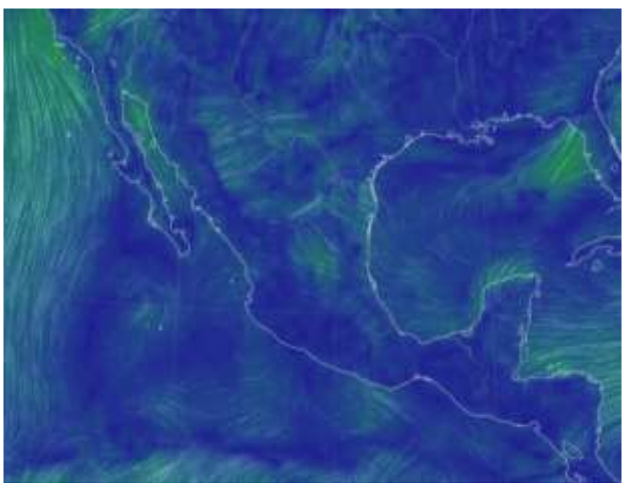


Figure 3 Map screen-shot with real-time movement of the wind variable according to the GFS model
Source: Own Elaboration

Development

The use of Mexican Republic images is proposed, with the same dimension of 640x480 pixels, they are processed by image recognition and it is indicated, depending on the area, if it could be a north event, deep sea, windy or polar event. Once learned, the subsequent forecasts analysis is proposed so that the researchers continue with the ANN training until it becomes automatic.

There is a reserve of 40 images per day from the month of December 2020. That is, it would be expected to feed the ANN as learning with approximately 3,600 images similar to Figure 4 and based on this, that its classification and performance for the new predictions has a greater effectiveness.

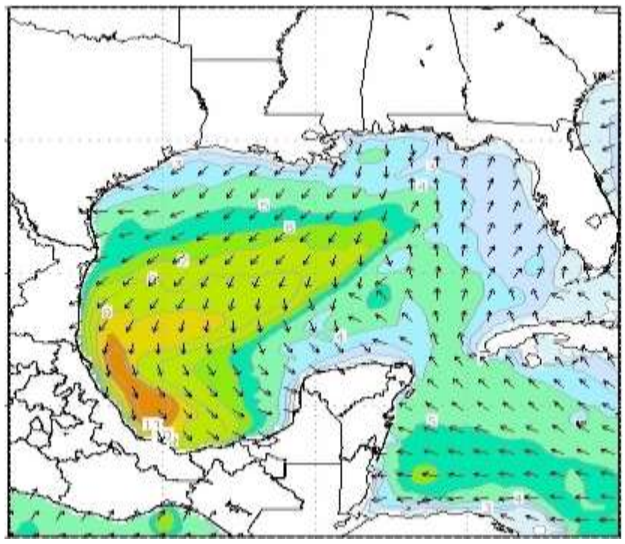


Figure 4 Wind forecast image showing the north wind event generated by the WWIII model. This images serve as input for ANN learning
Source: Own Elaboration

Data and groups

In this document only the ingestion of data to the ANN in graphic file format is contemplated since it is one of the typical outputs of the models that generate meteorological variables. It is intended to use the wind speed and direction variable maps to generate a learning that indicates the file (related to time) in which the wind speed and direction exceeds a danger threshold.

Wind references are sought in the Mexican Republic to identify three groups:

– North wind
– South wind
– Atlantic wind

Each group made up of at least 1,200 files with the images corresponding to the wind type that is to be evaluated within the national territory.

Process

The graphic files generated by the WWIII model are required for the execution of the experiment. We worked on the Atlantic Ocean coast due to the fact that there are three types of phenomena with different conditions: a north wind phenomenon; another one of south wind and finally one under normal conditions of Atlantic strong winds with the most significant result for the realization of the modeling.

Once the maps were downloaded, the TeachableMachine tool was used, which is enabled with the Swish activation function and is part of the Tensorflow libraries for JavaScript. Learning models base their performance on the time it takes to show a response and the quality of it, not on the time it takes to generate their learning.

Three classes were created: North, South and Normal; corresponding to each of the meteorological phenomena that occur in the Atlantic area. Once the images were loaded, the training parameters of the model were established as shown in Table 1.

Wind type	Number of images loaded
North	1,738
South	1,094
Normal	953

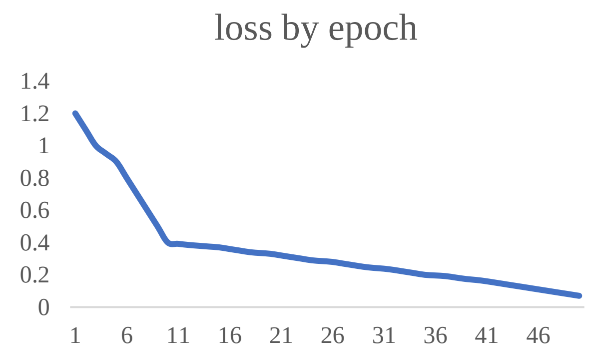
Table 1 Number of images loaded into ANN
Source: Own Elaboration

As part of the parameters, the size of the epoch or the number of times the data set would be processed was defined, it was established at 50. Batch, which corresponds to the number of elements that belong to a batch of elements that may or may not belong to the same classification, and whose proposed value is 16 and, finally, the learning rate at 0.001, which is the value proposed by developers. Teachablemachine divided the sample into two segments:

1. Preparation samples, which are 85% of the total samples and are used to train the model; epoch take the data from this sample.

2. Test samples, which correspond to the remaining 15% and are used to check the model performance.

Once the images were inserted, the ANN learning was carried out; to assess the learning degree, a confusion matrix is used showing the class of the samples on the y-axis and the x-axis the prediction or the class to which the model assigns the samples after learning. Loss measures the level of learning of a model when predicting the correct classification of a given set of samples. A good sampling should aim for zero, as shown in Graphic 4.



Graphic 4 Learning assess
Source: Own Elaboration

Another quality value is the precision by epoch, which is the percentage of classifications that a model hits during preparation. If the predictions are correct, the graph tends to one; otherwise it will be lower.

Results

Once the model was trained, the recognition performed by the ANN was tested with a batch of 300 images from different days and with different phenomena; with adequate results greater than 80%; which are indicated as shown in Figure 5.

A higher error rate was observed in situations where the maps of the phenomena converge in areas of the southern basin of Veracruz, that is, towards the coordinates with latitude 20ºN and longitude 96ºW. When detailing the images we find that the phenomena differ by the wind direction that originates them in previous days; resulting in classification errors. Hurricanes are another meteorological phenomenon that should be considered because they are frequent in the summer and autumn seasons; these generate gusts of wind in both directions that could increase the size of the expected error according to the confusion matrix.

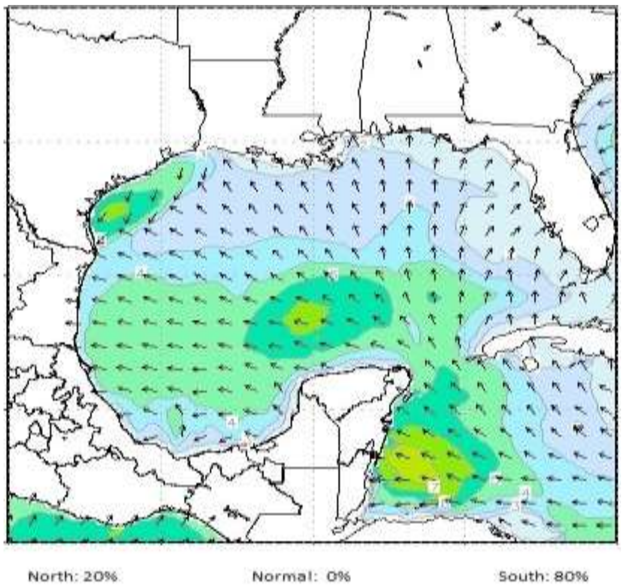


Figure 5 Result of the evaluation of an image by the trained ANN
Source: Own Elaboration

Conclusions

For an image that presented both the south and the north phenomena, the recognition was favored towards the north phenomenon, which was probably due to the fact that the sample of the north wind phenomenon is greater than that of the south wind phenomenon and, on the other hand, was a predicted error in the confusion matrix; for this reason, it is necessary to create historical records of the models executions until achieving a number of training images in similar quantities and achieving a balanced learning.

Also, it is necessary to use at least the wind direction variable to eliminate ambiguities in the decision, so the use of control vectors to aid recognition will be considered. The foregoing because the vectors available do not provide enough information to improve the ranking. As well as providing an additional value to the network that gives it a decisions memory that were made about the events in previous time (t-n) as one more element of ANN learning. Within the memory that should be considered is that of large meteorological phenomena that affect the forecast or recognition of the patterns already established, due to their similarity, but that have different origins and therefore different effects.

Acknowledgments

To Consejo Nacional de Ciencia y Tecnología (CONACYT) México.

References

A.I. Wiki. (2021). Pathmind, Inc. https://wiki.pathmind.com/neural-network

BBVA. (2019). *Machine learning: What is it and how does it work?* BBVA Artificial Intelligence. https://www.bbva.com/en/science-technology/technologies/artificial-intelligence/

Coiffier, J. (2011). *Fundamentals of numerical weather prediction*. Cambridge University Press. www.cambridge.org/9781107001039

Fierro, A. A. (2020). *Predicción de Series Temporales con Redes Neuronales*. Universidad Nacional de La Plata.

Google, I. (2021). *Teachable Machine* (2.4.1). https://teachablemachine.withgoogle.com/

Kim, K. G. (2019). Deep learning book review. *Nature*, *29*(7553), 1–73.

Li, Y., & Yuan, Y. (2017). Convergence Analysis of Two-layer Neural Networks with ReLU Activation. *Advances in Neural Information Processing Systems*, *2017-Decem*, 598–608. http://arxiv.org/abs/1705.09886

Lorenc, A. C. (1986). Analysis methods for numerical weather prediction. *Quarterly Journal of the Royal Meteorological Society*, *112*(474), 1177–1194.

Mathworks. (2020). Machine Learning with MATLAB. In *MathWorks*. https://uk.mathworks.com/solutions/machine-learning.html

Ramachandran, P., Zoph, B., & Le, Q. V. (2017). *Searching for Activation Functions*. http://arxiv.org/abs/1710.05941

Wechsler, H. (Ed.). (1992). *Neural Networks for Perception*. Elsevier. https://doi.org/10.1016/C2013-0-11676-5

ISSN 2523-6814

Article **Journal of Computational Technologies**
June, 2021 Vol.5 No.15 29-36

Design of the operation of a rotating machine for the acquisition of multi-view stereoscopic images for the 3D reconstruction of objects

Diseño de la operación de una máquina rotativa de adquisición de múltiples vistas de imágenes estereoscópicas para la reconstrucción 3D de Objetos

CORONA-PATRICIO, Cesar Agustin*[1] & RETA, Carolina[2]

[1]CONACYT-CIATEQ A. C. PICYT. San Agustín del Retablo 150, Constituyentes Fovissste, C.P. 76150 Santiago de Queretaro, Qro., Mexico.
[2]CONACYT-CIATEQ A. C. Department of IT, Control, and Electronics. Manzana 5, Lote 1, entre Gaza 30 y 40, C.P. 42162 San Agustin Tlaxiaca, Hgo., Mexico.

ID 1st Author: *Cesar-Agustin, Corona-Patricio* / **ORC ID**: 0000-0002-9105-9483, **CVU CONACYT ID**: 874048

ID 1st Co-author: *Carolina, Reta* / **ORC ID**: 0000-0002-0843-129X, **CVU CONACYT ID**: 235176

DOI: 10.35429/JOCT.2021.15.5.29.36 Received March 15, 2021; Accepted June 28, 2021

Abstract

This work presents a machine to locate a stereoscopic camera in different positions around an object to acquire a sequence of images that allows the reconstruction of such object through artificial vision algorithms. The GEMMA guide was used to define the modes of operation of the proposed machine. In addition, the mechanical and electronic elements that make up the machine and the programming logic for its control with PLC were also defined. It was demonstrated using a graphical interface that the mode of operation of the machine is carried out satisfactorily. Additionally, this work presents synthetic image results to represent a sequence of images acquired from different points of view considering different levels of elevation of the camera, showing the type of results obtained with the proposed machine.

Automation and control, Image acquisition, Multiple views, Stereo camera, 3D reconstruction

Resumen

En este trabajo se propone una máquina que permite posicionar una cámara estereoscópica en diferentes ubicaciones alrededor de un objeto para adquirir una secuencia de imágenes que al ser procesada por algoritmos de visión artificial permita la reconstrucción de dicho objeto. Para definir los modos de operación de la máquina propuesta se usó la guía GEMMA. También, se definieron los elementos mecánicos y electrónicos que componen la máquina, así como la lógica de programación para su control con PLC. Se demostró mediante una interfaz gráfica que el modo de operación de la máquina es llevado a cabo de manera satisfactoria. Adicionalmente, se presentaron resultados de imágenes sintéticas para representar una secuencia de imágenes adquirida desde diferentes puntos de vista considerando diferentes niveles de elevación de la cámara. Esto permitió mostrar el tipo de resultados que pueden obtenerse con la máquina propuesta.

Automatización y control, Adquisición de imágenes, Múltiples vistas, Cámara estéreo, Reconstrucción 3D

Citation: CORONA-PATRICIO, Cesar Agustin & RETA, Carolina. Design of the operation of a rotating machine for the acquisition of multi-view stereoscopic images for the 3D reconstruction of objects. Journal of Computational Technologies. 2021. 5-15: 29-36

* Author Correspondence: (e-mail: cesar.corona@ciateq.edu.mx)
† Researcher contributing as first author.

1. Introduction

3D reconstruction is a set of techniques that allow inferring the geometric and photometric information of a physical object from one or more images. The reconstruction of objects has many applications, including cultural heritage preservation, medicine, engineering, content creation for virtual environments, among others (Durou et al., 2020).

This paper covers the subject of image acquisition for 3D reconstruction from multiple views captured with a stereoscopic camera. Figure 1 shows the image capturing process, in which a camera moves around an object to generate images from multiple viewpoints. The captured images are obtained in the digital format provided by the stereoscopic camera. This process is fundamental to obtain the necessary information for the 3D reconstruction process.

In the literature exists different ways to capture the multiples views of an object. One way is having the camera fixed and rotate the object around it (Sheng et al., 2018; Wang & Hauser, 2019; Wu et al., 2019); the other option is to keep the object fixed and rotate the camera around it (Deris et al., 2017; Yücer et al., 2016). A limitation of the first approach is that a homogeneous background must be placed behind the object to have good reconstruction results.

The captured images can be processed by computer vision algorithms for 3D object reconstruction. There is free software such as Regard3D (Regard3D, 2021), OpenSFM (OpenSFM, 2021), and Meshroom (Allice Vision, 2021) that can be employed to obtain the 3D model of the object.

There are also approaches to capture the multiple views with multiple cameras (Kai-Browne et al., 2016; Li et al., 2019; Wu et al., 2019). However, similar results can be achieved efficiently and economically by employing only one camera.

A relevant work in the literature related to multi-view object image acquisition machines is OpenScan (OpenScan, 2021).

This is a DIY 3D scanner which is small (less than 50 cm), inexpensive, open design, Arduino or Raspberry Pi-based, that helps capture images to apply the 3D reconstruction process. OpenScan is designed so that the object to be reconstructed is rotated 360° in 3 different elevations, keeping fixed an RGB camera. Its main disadvantage is that the objects it can scan are small in size and must be light in weight. Other similar work for multi-view image acquisition can be found in (Collins et al., 2019; Emmitt et al., 2021; Evgenikou & Georgopoulos, 2015).

The rotating image acquisition machine proposed in this paper uses a stereoscopic camera, which is rotated around the object at three elevation levels. The advantage of the proposed machine is that it can scan medium-size objects and does not require placing any homogeneous background behind the objects.

This paper is organized as follows. In Section 2, the mechanical design of the image acquisition machine and the electronic design and control of the machine are proposed. In Section 3, the graphical interface for the machine operation and the visual results of the image acquisition process are presented. In Section 4, as Appendix, supplementary information regarding the control design of the proposed machine is presented. Finally, Section 5 presents the conclusions of the proposed work and discusses future work.

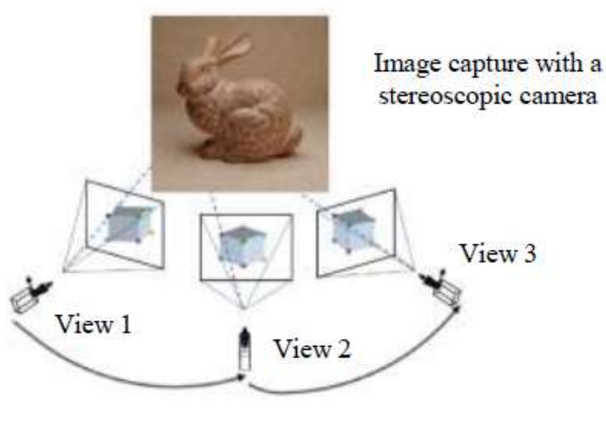


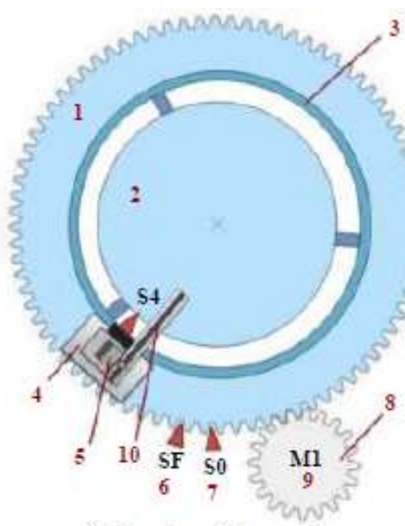
Figure 1 Multi-view image capturing process
Source: Own elaboration based on images of Cordes et al., 2012; Yilmaz & Karakus, 2013; Stanford University, 2014

2. Proposed method

In this work, a positioning machine that allows moving a stereoscopic camera so that visual characteristics of an object can be obtained from different viewpoints is proposed. The purpose of using this machine is to acquire the necessary information of the object for its 3D reconstruction. The main contents of this work: the mechanical design and the electronic design and control of the proposed machine, are presented in the following sections.

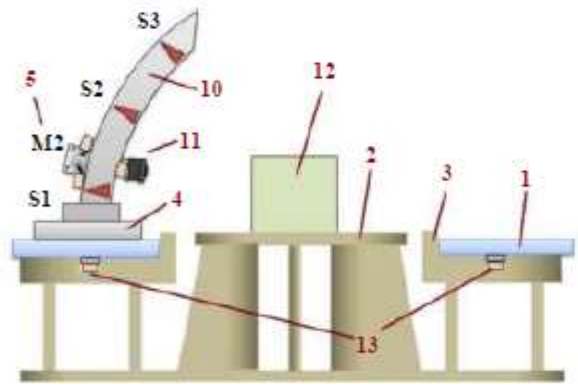
2.1 Mechanical design of the image acquisition machine

The proposed machine is presented in Figure 2. The camera is mounted on a base, resting on a rotary table. Motor M1 allows placing the camera around the object, and motor M2 allows setting the camera´s elevation. Sensors S1, S2, and S3 indicate the elevation levels of the camera. Sensors S0 and SF allow setting the initial position of the sequence to be performed in automatic mode. A proximity sensor S4 is used on the camera to detect strange objects near the camera that may introduce noise or collide with the camera. Figures 2a and 2b show the top view and frontal view of the machine, respectively. Figure 2c lists all the components of the proposed machine.



a) Top view of the machine.

1. Hollow rotary table
2. Base to place the object
3. Support for rotary table
4. Base where the camera can move 360°
5. Bipolar DC stepper motor (M2)
6. Auxiliary proximity sensor (SF)
7. Initial position proximity sensor (S0)
8. Gear to rotate table
9. Bipolar DC stepper motor (M1)



b) Frontal view of the machine.

10. Rail for moving up and down the camera
11. Stereo camera and support structure
12. Object to be digitized
13. Bearings where the table rests

S1, S2, S3. Proximity sensors for placing the camera at three different heights

S4. Proximity sensor to detect obstructions in front of the camera.

Figure 2 Views and components of the proposed image acquisition machine
Source: Own Elaboration

2.2 Electronic design and control of the machine

A DRV8825 driver is used to control the M1 and M2 motors. The DIR direction at which the motor rotates is controlled by a PLC; to send the pulses and move the motors, a signal is used to enable an external pulse generator connected to the driver. For the interface between the PLC and the external circuits, STEP-DOWN converters are used to step down from 24V to 5V or 3.3V, and STEP-UP converters are used for the opposite action. The external pulse generation circuits send to the PLC a FC signal for each motor, indicating that the frequency is within a suitable range to start operation; these are necessary conditions to go to the initial state.

To measure the speed of the M1 motor, an array of magnets is placed in its attached gear; a Hall effect sensor is used as a magnetic field detector to detect each magnet as it passes through the sensor, generating a train of pulses with which the revolutions per minute can be obtained (Doan, 2020). If the speed is too high or too low, signals are sent so that a visual alarm can be generated. Table 1 presents the signals used in the electronic design and control of the machine. This table describes the input and output signals used for control employing a PLC.

ISSN 2523-6814

In the input signals, the origin indicates where the signals come from. In the output signals the destination indicates where the signals go.

Inputs	Type	Description	Origin
INI	BOOL	start auto sequence	button
ESTOP	BOOL	emergency stop	switch
AUT	BOOL	automatic mode	selector
HOME	BOOL	set motors to home	button
FC_M1	BOOL	suitable motor frequency indicator of motor M1	ATTINY85 1
FC_M2	BOOL	suitable frequency indicator of motor M2	ATTINY85 2
VMAX_M1	BOOL	very high M1 motor speed indicator	ATTINY85 1
VMIN_M1	BOOL	very low M1 motor speed indicator	ATTINY85 1
S0	BOOL	starting position of motor M1	proximity sensor
SF	BOOL	auxiliary sensor to move motor M1	proximity sensor
S1	BOOL	bottom rail position of motor M2	proximity sensor
S2	BOOL	middle rail position of motor M2	proximity sensor
S3	BOOL	upper rail position of motor M2	proximity sensor
S4	BOOL	obstruction of the camera	proximity sensor
mDIS_M1	BOOL	disable motor M1	switch
mDIR_M1	BOOL	direction of motor M1	switch
mGP_M1	BOOL	enable pulse generator for motor M1	switch
mDIS_M2	BOOL	disable motor M2	switch
mDIR_M2	BOOL	direction of motor M2	switch
mGP_M2	BOOL	enable pulse generator for motor M2	switch
MS0_M1	BOOL	micro-step configuration of motor M1	pin MS0, driver motor M1
MS1_M1	BOOL	micro-step configuration of motor M1	pin MS1, driver motor M1
MS2_M1	BOOL	micro-step configuration of motor M1	pin MS2, driver motor M1
MS0_M2	BOOL	micro-step configuration of motor M2	pin MS0, driver motor M2
MS1_M2	BOOL	micro-step configuration of motor M2	pin MS1, driver motor M2
MS2_M2	BOOL	micro-step configuration of motor M2	pin MS2, driver motor M2
DIS_M1	BOOL	disable motor M1	pin EN, driver motor M1
DIR_M1	BOOL	direction of motor M1	pin DIR, driver motor M1
GP_M1	BOOL	enable pulse generator for motor M1	ATTINY85 1
DIS_M2	BOOL	disable motor M2	pin EN, driver motor M2
DIR_M2	BOOL	direction of motor M2	pin DIR, driver motor M2
GP_M2	BOOL	enable pulse generator for M2 motor	ATTINY85 2
CRIT	BOOL	alarm signal	LED

Table 1 PLC input and output signals
Source: Own elaboration

Figures 3 and 4 show the PLC operation logic. Figure 3 shows the PLC operation modes; Figure 4 presents the main GRAFCET diagram, which was designed following the GEMMA guide (Urrego, 2011).

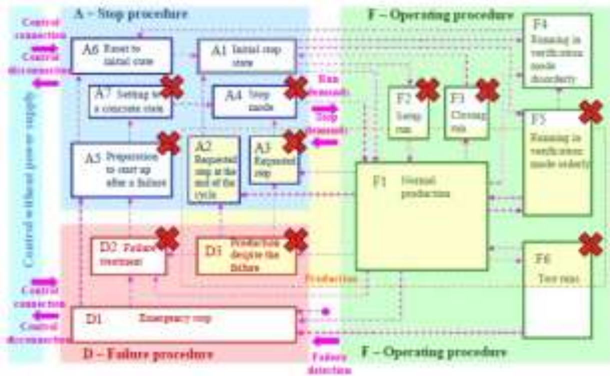


Figure 3 PLC operation modes
Source: CITCEA, 2021

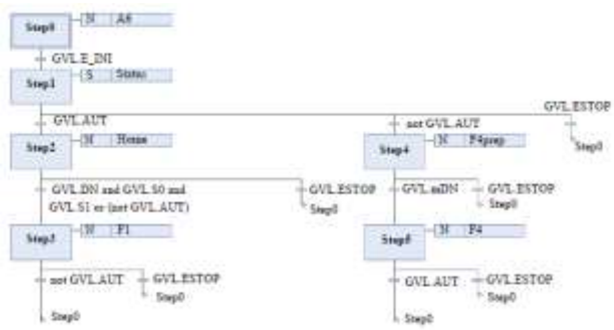


Figure 4 Main GRAFCET diagram
Source: Own Elaboration

The block diagram in Figure 3 shows a recommendation based on the GEMMA guide of different operating modes that an automation system can have depending on the combinations of input signals. It also defines how to switch from one operating mode to another (CITCEA, 2021). This diagram is used to visualize which modes of operation are relevant for the functionality required by the machine. Blocks with no cross marks were considered for the operation of the proposed image acquisition machine. The contemplated operation modes are: A1 initial stop state, F1 automatic operation, F4 manual operation, D1 emergency stop, and A6 reset to initial state.

The GRAFCET diagram presented in Figure 4 consists of 6 steps. Step0 is where the machine is reset to the initial state. In Step1, the verification of the speed of the motors is initiated, which allows displaying an alarm when speed limits are exceeded. Step2 is used to set the camera to the HOME position. It should be noted that the operation of the machine can be manual or automatic.

During Step3, the operation is automatic. During Step5, the operation is manual. Step4 is a preparation stage to enter manual mode. An emergency stop can be set at any time, where the machine is sent back to the initial state.

Note in Figure 4 the logic of the Boolean operations, which determines the state of the transitions of the GRAFCET diagram and allows controlling the different stages of the machine. The signals used in these operations have been presented in Table 1.

It is worth noting that GRAFCET diagrams made for each step (Step 0 - Step 5) describe the operation of the PLC. These diagrams are presented in the Appendix Section.

3. Results

A simulation was carried out in CODESYS software (3S-Smart Software Solutions GmbH., 2021) using a virtual PLC to verify the operation of the logic described in the GRAFCET diagram in Figure 4. A graphical interface was developed in the same software to carry out the simulation. This interface is presented in Figure 5; Section 3.1 presents more details of the interface. The proposed machine will allow acquiring a sequence of images from different viewpoints considering different elevation levels. A sample of the results that can be obtained with the proposed machine are presented in Section 3.2.

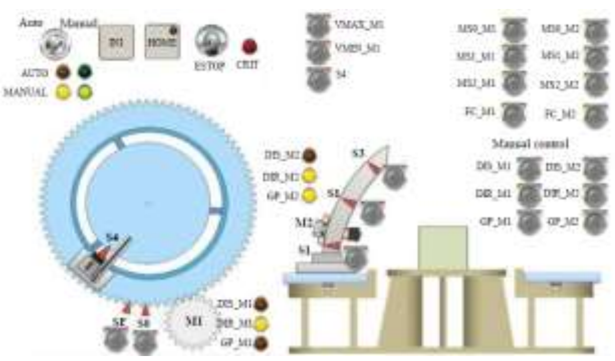


Figure 5 Graphical interface for machine operation
Source: Own Elaboration

3.1 Graphical interface for machine operation

Figure 5 shows the interface developed to validate the operation of the machine. The status of the input signals can be changed using buttons. The status of the output signals are displayed with LED indicators.

The simulation performed with this interface helped to verify the correct operation of the machine's manual, automatic, and emergency stop modes. At the start, the machine is in either manual or automatic mode, which is determined by the AUT selector. The image capture sequence is initiated by pressing the INI start button. In manual mode, switches are used to freely move the motors and control their rotation direction.

In automatic mode, the camera is first brought to an initial HOME position. From there, the well-defined capture sequence starts. If the emergency stop is activated, the motors are stopped but kept energized to maintain torque and prevent damage to the camera if it falls from the highest position.

3.2 Visual results of the image acquisition process

A sample of the results that can be obtained with the proposed machine is presented in Figure 6. The shown images are synthetic, created using Blender software (Community, B. O, 2021) to exemplify the acquisition from different points of view, considering three elevation levels.

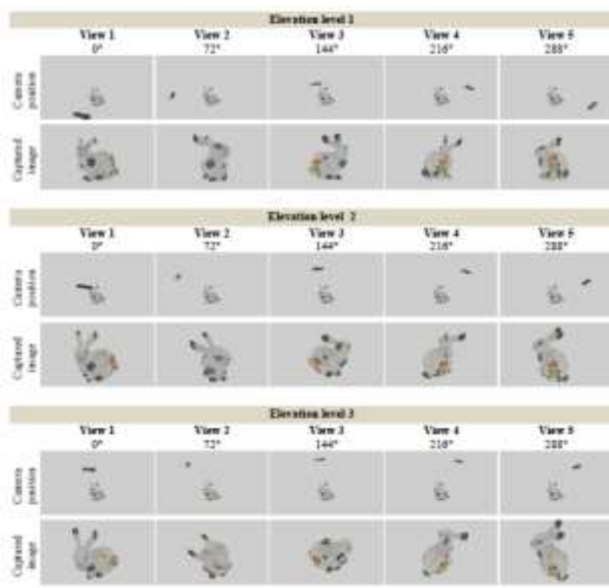


Figure 6 Visual representation of the acquisition process
Source: Own elaboration based on model of Zou, 2011

In Figure 6, the images are organized into three elevation levels. Each elevation level has five views. In each view, images are shown for both the camera position and the image captured from that position.

ISSN 2523-6814

The views are obtained by rotating the camera around the object with equal increments of 72° between each view, where view 1 is the starting position at 0° at each level.

4. Appendix

This section presents a description of the 6 stages of the image acquisition process of the proposed machine (illustrated in Figure 4 in Section 2.2) and the GRAFCET diagrams generated for each stage of the process.

Figure 7 shows the initial setup, in which the drivers are configured to work with micro-steps. The motors are enabled to maintain torque, and the necessary signals are reset to stop them in their last position.

Figure 8 shows a visual alarm. It is activated when the speed limits are exceeded or when a strange object is detected with the S4 sensor in front of the camera.

Figure 9 shows the process of going to the HOME position. First, the motor M2 is sent back to the bottom position of the rail. Then the motor M1 is brought to the HOME position, where sensor SF is deactivated and sensor S0 is activated.

Figure 10 shows the automatic control of the machine operation. From the HOME position, the table is rotated 360°. At the end of the rotation, the camera is raised until it reaches sensor S2. Then, the table is rotated 360°, and the process is repeated until the camera has risen to S3. At the end of the sequence, the machine is sent back to the HOME position and returns to the initial state waiting response of the INI start button.

Figure 11 shows the manual mode of the machine. Figure 11a shows the operation logic in manual mode. Figure 11b shows the initial conditions that allow the execution of the manual mode.

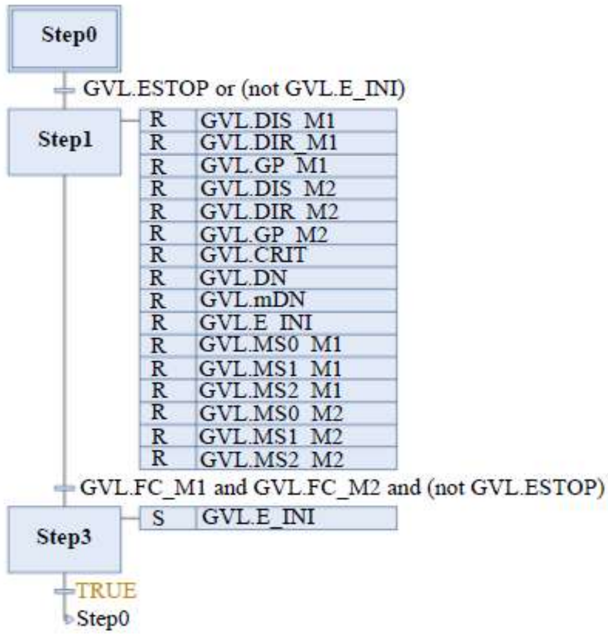


Figure 7 Initial state
Source: Own Elaboration

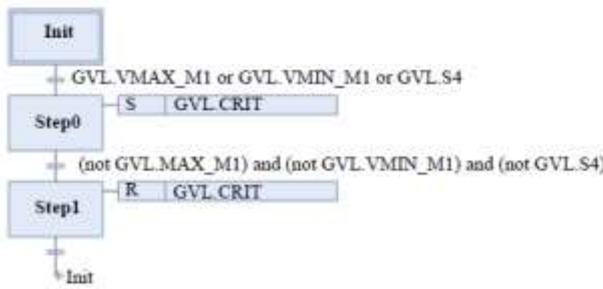


Figure 8 Visual alarm.
Source: Own Elaboration

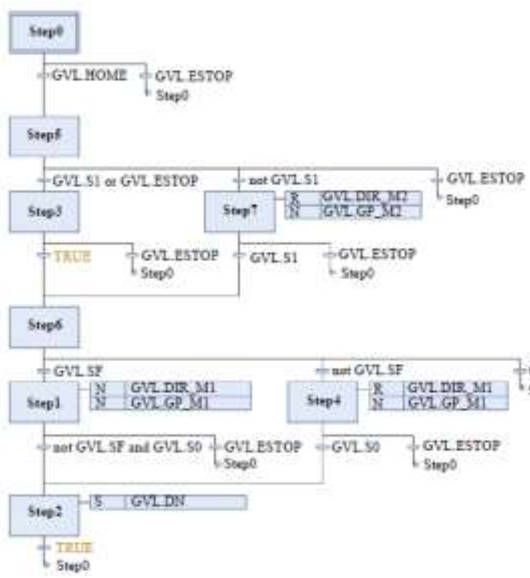


Figure 9 Return to initial position
Source: Own Elaboration

ISSN 2523-6814

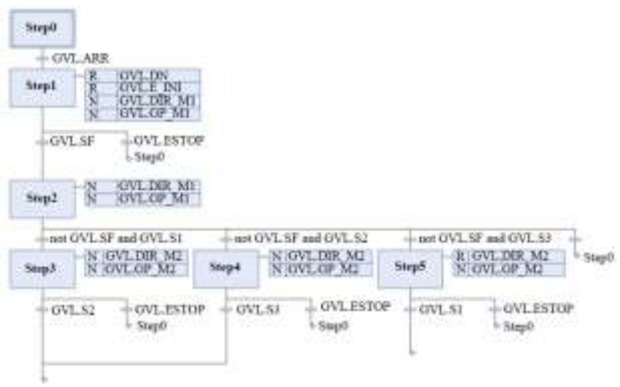


Figure 10 Operation in automatic mode
Source: Own Elaboration

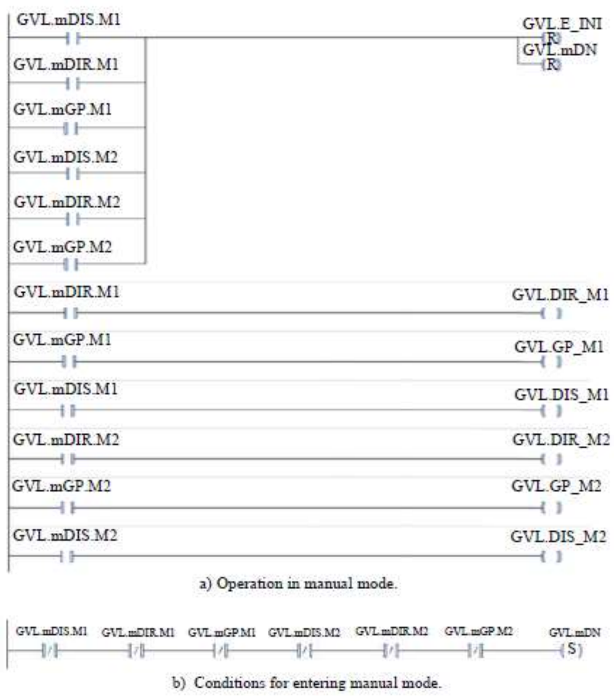


Figure 11 Manual mode
Source: Own Elaboration

5. Conclusions

This paper proposes a machine that allows the acquisition of images for a reconstruction process based on multiple views, where the object to be digitized is kept fixed, and the camera rotates around it. All the necessary components for its operation were defined as well as different operation modes and the programming logic of a virtual PLC to control it. A graphical interface was developed to simulate the operation of the proposed machine.

The simulation allowed verifying the operation of the manual and automatic operation modes and the conditions for emergency stop. An automated image capture sequence was proposed, which allows the camera to capture images at equally spaced intervals at three elevation levels.

The visual sample images of the acquisition process demonstrate that, with the proposed capture sequence, it is possible to collect images of the entire visible surface of the object, except for its base, since views are obtained from all around the object and at different heights.

As future work, the physical construction of the machine is proposed, defining the necessary materials and its dimensions. It is also suggested to propose techniques for the reconstruction of objects using the images acquired with this machine, as well as to explore opportunities for improvement by replacing the PLC with a microcontroller or an SBC card.

References

Allice Vision (2021). Meshroom: open-source 3D Reconstruction Software based on the AliceVision framework. Retrieved from https://alicevision.org/

CITCEA. (2021). Descripción de la guía GEMMA. Universidad Politécnica de Catalunya, España. Retrieved from https://recursos.citcea.upc.edu/grafcet/gemma/descrip.html

Collins, T., Woolley, S., Gehlken, E., & Ch'ng, E. (2019). Automated Low-Cost Photogrammetric Acquisition of 3D Models from Small Form-Factor Artefacts. Electronics, 8, 1441. https://doi.org/10.3390/electronics8121441

Community, B. O. (2021). Blender - a 3D modelling and rendering package. Stichting Blender Foundation, Amsterdam. Retrieved from http://www.blender.org

Cordes, K., Scheuermann, B., Rosenhahn, B., & Ostermann, J. (2012). Occlusion Handling for the Integration of Virtual Objects into Video. https://doi.org/10.13140/2.1.4896.4808

Deris, A., Trigonis, I., Aravanis, A., & Stathopoulou, E. (2017). DEPTH CAMERAS ON UAVs: A FIRST APPROACH. ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLII-2/W3, 231–236. https://doi.org/10.5194/isprs-archives-XLII-2-W3-231-2017

Doan, M., Kai, Y., & Obi, S. (2020). Twin Marine Hydrokinetic Cross-Flow Turbines in Counter Rotating Configurations: A Laboratory-Scaled Apparatus for Power Measurement. Journal of Marine Science and Engineering, 8, 918. https://doi.org/10.3390/jmse8110918

Durou, J.-D., Falcone, M., Quéau, Y., & Tozza, S. (2020). A Comprehensive Introduction to Photometric 3D-Reconstruction. Advances in Photometric 3D-Reconstruction (pp. 1–29). Springer International Publishing. https://doi.org/10.1007/978-3-030-51866-0_1

Emmitt, J., Mackrell, T., & Armstrong, J. (2021). Digital Modelling in Museum and Private Collections: A Case Study on Early Italic Armour. Journal of Computer Applications in Archaeology, 4, 63–78. https://doi.org/10.5334/jcaa.63

Evgenikou, V., & Georgopoulos, A. (2015). Investigating 3D reconstruction methods for small artifacts. ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XL-5/W4, 101–108. https://doi.org/10.5194/isprsarchives-XL-5-W4-101-2015

Kai-Browne, A., Kohlmeyer, K., Gonnella, J., Bremer, T., Brandhorst, S., Balda, F., Plesch, S., & Lehmann, D. (2016). 3D Acquisition, Processing and Visualization of Archaeological Artifacts. 397–408. https://doi.org/10.1007/978-3-319-48496-9_32

Li, W., Xiao, X., & Hahn, J. (2019). 3D Reconstruction and Texture Optimization Using a Sparse Set of RGB-D Cameras. 2019 IEEE Winter Conference on Applications of Computer Vision (WACV). https://doi.org/10.1109/WACV.2019.00155

OpenScan (2021). DIY 3D Scanner. Retrieved from https://en.openscan.eu

OpenSFM (2021). OpenSFM: An open-source Structure from Motion library that lets you build 3D models from images. Retrieved from https://www.opensfm.org/

Regard3D (2021). Regard3D: a free and open source structure-from-motion program. Retrieved from https://www.regard3d.org/

Sheng, B., Zhao, F., Yin, X., Zhang, C., Wang, H., & Huang, P. (2018). A Lightweight Surface Reconstruction Method for Online 3D Scanning Point Cloud Data Oriented toward 3D Printing. Mathematical Problems in Engineering, 2018, e4673849. https://doi.org/10.1155/2018/4673849

Stanford University (2014). The Stanford 3D Scanning Repository. Retrieved from http://graphics.stanford.edu/data/3Dscanrep/#bunny

3S-Smart Software Solutions GmbH. (2021). CODESYS. Retrieved from https://www.codesys.com

Urrego, L. (2011). GEMMA Una Herramienta Universal para la Automatización de Procesos. Ingenium, 12, 80–96.

Yilmaz, O., & Karakus, F. (2013). Stereo and kinect fusion for continuous 3D reconstruction and visual odometry. 2013 International Conference on Electronics, Computer and Computation (ICECCO), 115-118. https://doi.org/10.1109/ICECCO.2013.6718242

Yücer, K., Sorkine-Hornung, A., Wang, O., & Sorkine-Hornung, O. (2016). Efficient 3D Object Segmentation from Densely Sampled Light Fields with Applications to 3D Reconstruction. ACM Transactions on Graphics, 35(3), 1–15. https://doi.org/10.1145/2876504

Wang, F., & Hauser, K. (2019). In-hand Object Scanning via RGB-D Video Segmentation. 2019 International Conference on Robotics and Automation (ICRA), 3296–3302. https://doi.org/10.1109/ICRA.2019.8794467

Wu, J., Chen, H., Liu, X., Cao, L., Peng, X., & Jin, G. (2019). Unsupervised texture reconstruction method using bidirectional similarity function for 3-D measurements. Optics Communications, 439, 85–93. https://doi.org/10.1016/j.optcom.2019.01.051

Zou, K. (2011). Texturemontage Textured Models. Zhejiang University. Retrieved from http://www.kunzhou.net/tex-models.htm

[Title in Times New Roman and Bold No. 14 in English and Spanish]

Surname (IN UPPERCASE), Name 1st Author†*, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor

Institutional Affiliation of Author including Dependency (No.10 Times New Roman and Italic)

International Identification of Science - Technology and Innovation

ID 1st Author: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st author: (Scholar-PNPC or SNI-CONACYT) (No.10 Times New Roman)

ID 1st Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 2nd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 2nd coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 3rd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 3rd coauthor: (Scholar or SNI) (No.10 Times New Roman)

(Report Submission Date: Month, Day, and Year); Accepted (Insert date of Acceptance: Use Only ECORFAN)

Abstract (In English, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In English)

Indicate 3 keywords in Times New Roman and Bold No. 10

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In Spanish)

Indicate 3 keywords in Times New Roman and Bold No. 10

Citation: Surname (IN UPPERCASE), Name 1st Author, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor. Paper Title. Journal of Computational Technologies. Year 1-1: 1-11 [Times New Roman No.10]

* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

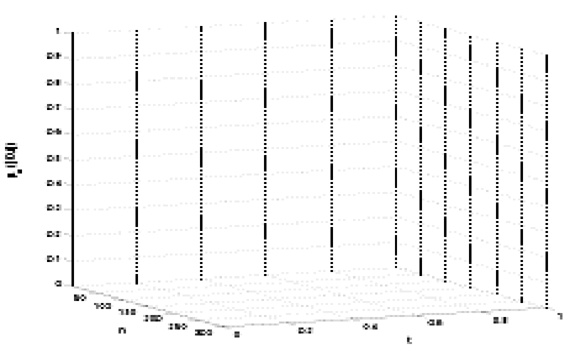
[Title No.12 in Times New Roman, single spaced and bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



Graphic 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

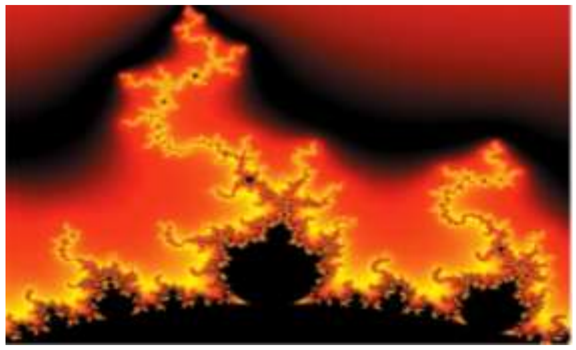


Figure 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Table 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Each article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \quad (1)$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources

Thanks

Indicate if they were financed by any institution, University or company.

Conclusions

Explain clearly the results and possibilities of improvement.

References

Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

Use Roman Alphabet, all references you have used must be in the Roman Alphabet, even if you have quoted an Article, book in any of the official languages of the United Nations (English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic), you must write the reference in Roman script and not in any of the official languages.

Technical Specifications

Each article must submit your dates into a Word document (.docx):

Journal Name
Article title
Abstract
Keywords
Article sections, for example:

1. Introduction
2. Description of the method
3. Analysis from the regression demand curve
4. Results
5. Thanks
6. Conclusions
7. References

Author Name (s)
Email Correspondence to Author
References

Intellectual Property Requirements for editing:

-Authentic Signature in Color of Originality Format Author and Coauthors

-Authentic Signature in Color of the Acceptance Format of Author and Coauthors

Reservation to Editorial Policy

Journal of Computational Technologies reserves the right to make editorial changes required to adapt the Articles to the Editorial Policy of the Research Journal. Once the Article is accepted in its final version, the Research Journal will send the author the proofs for review. ECORFAN® will only accept the correction of errata and errors or omissions arising from the editing process of the Research Journal, reserving in full the copyrights and content dissemination. No deletions, substitutions or additions that alter the formation of the Article will be accepted.

Code of Ethics - Good Practices and Declaration of Solution to Editorial Conflicts

Declaration of Originality and unpublished character of the Article, of Authors, on the obtaining of data and interpretation of results, Acknowledgments, Conflict of interests, Assignment of rights and Distribution.

The ECORFAN-Mexico, S.C Management claims to Authors of Articles that its content must be original, unpublished and of Scientific, Technological and Innovation content to be submitted for evaluation.

The Authors signing the Article must be the same that have contributed to its conception, realization and development, as well as obtaining the data, interpreting the results, drafting and reviewing it. The Corresponding Author of the proposed Article will request the form that follows.

Article title:

- The sending of an Article to Journal of Computational Technologies emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Format of Originality for its Article, unless it is rejected by the Arbitration Committee, it may be withdrawn.

- None of the data presented in this article has been plagiarized or invented. The original data are clearly distinguished from those already published. And it is known of the test in PLAGSCAN if a level of plagiarism is detected Positive will not proceed to arbitrate.

- References are cited on which the information contained in the Article is based, as well as theories and data from other previously published Articles.

- The authors sign the Format of Authorization for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Taiwan considers pertinent for disclosure and diffusion of its Article its Rights of Work.

- Consent has been obtained from those who have contributed unpublished data obtained through verbal or written communication, and such communication and Authorship are adequately identified.

- The Author and Co-Authors who sign this work have participated in its planning, design and execution, as well as in the interpretation of the results. They also critically reviewed the paper, approved its final version and agreed with its publication.

- No signature responsible for the work has been omitted and the criteria of Scientific Authorization are satisfied.

- The results of this Article have been interpreted objectively. Any results contrary to the point of view of those who sign are exposed and discussed in the Article.

Copyright and Access

The publication of this Article supposes the transfer of the copyright to ECORFAN-Mexico, SC in its Holding Taiwan for itsJournal of Computational Technologies, which reserves the right to distribute on the Web the published version of the Article and the making available of the Article in This format supposes for its Authors the fulfilment of what is established in the Law of Science and Technology of the United Mexican States, regarding the obligation to allow access to the results of Scientific Research.

Article Title:

Name and Surnames of the Contact Author and the Coauthors	Signature
1.	
2.	
3.	
4.	

Principles of Ethics and Declaration of Solution to Editorial Conflicts

Editor Responsibilities

The Publisher undertakes to guarantee the confidentiality of the evaluation process, it may not disclose to the Arbitrators the identity of the Authors, nor may it reveal the identity of the Arbitrators at any time.

The Editor assumes the responsibility to properly inform the Author of the stage of the editorial process in which the text is sent, as well as the resolutions of Double-Blind Review.

The Editor should evaluate manuscripts and their intellectual content without distinction of race, gender, sexual orientation, religious beliefs, ethnicity, nationality, or the political philosophy of the Authors.

The Editor and his editing team of ECORFAN® Holdings will not disclose any information about Articles submitted to anyone other than the corresponding Author.

The Editor should make fair and impartial decisions and ensure a fair Double-Blind Review.

Responsibilities of the Editorial Board

The description of the peer review processes is made known by the Editorial Board in order that the Authors know what the evaluation criteria are and will always be willing to justify any controversy in the evaluation process. In case of Plagiarism Detection to the Article the Committee notifies the Authors for Violation to the Right of Scientific, Technological and Innovation Authorization.

Responsibilities of the Arbitration Committee

The Arbitrators undertake to notify about any unethical conduct by the Authors and to indicate all the information that may be reason to reject the publication of the Articles. In addition, they must undertake to keep confidential information related to the Articles they evaluate.

Any manuscript received for your arbitration must be treated as confidential, should not be displayed or discussed with other experts, except with the permission of the Editor.

The Arbitrators must be conducted objectively, any personal criticism of the Author is inappropriate.

The Arbitrators must express their points of view with clarity and with valid arguments that contribute to the Scientific, Technological and Innovation of the Author.

The Arbitrators should not evaluate manuscripts in which they have conflicts of interest and have been notified to the Editor before submitting the Article for Double-Blind Review.

Responsibilities of the Authors

Authors must guarantee that their articles are the product of their original work and that the data has been obtained ethically.

Authors must ensure that they have not been previously published or that they are not considered in another serial publication.

Authors must strictly follow the rules for the publication of Defined Articles by the Editorial Board.

The authors have requested that the text in all its forms be an unethical editorial behavior and is unacceptable, consequently, any manuscript that incurs in plagiarism is eliminated and not considered for publication.

Authors should cite publications that have been influential in the nature of the Article submitted to arbitration.

Information services

Indexation - Bases and Repositories

RESEARCH GATE (Germany)
GOOGLE SCHOLAR (Citation indices-Google)
MENDELEY (Bibliographic References Manager)
REDIB (Ibero-American Network of Innovation and Scientific Knowledge- CSIC)
HISPANA (Information and Bibliographic Orientation-Spain)

Publishing Services

Citation and Index Identification H
Management of Originality Format and Authorization
Testing Article with PLAGSCAN
Article Evaluation
Certificate of Double-Blind Review
Article Edition
Web layout
Indexing and Repository
ArticleTranslation
Article Publication
Certificate of Article
Service Billing

Editorial Policy and Management

69 Street. YongHe district, ZhongXin. Taipei-Taiwan. Phones: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; Email: contact@ecorfan.org www.ecorfan.org

Journal of Computational Technologies

"Development of a web management system for the internship process at the TecNM campus Lerdo"

RODRÍGUEZ-LOZANO, Karla Verónica, MORENO-NÚÑEZ, Elda, ARZOLA-MONREAL, Juan Martín and FLORES-LUÉVANOS, María Guadalupe
Instituto Tecnológico Superior de Lerdo

"App design for teaching academic English vocabulary using spaced repetition method"

MARTÍNEZ-VALENCIA, Ricardo Fabrizio, MONTERO-VALVERDE, José Antonio, MARTÍNEZ-ARROYO, Miriam and HERNÁNDEZ-BRAVO, Juan Miguel
Instituto Tecnológico Superior de Acapulco

"Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function"

AGUILERA-MENDEZ, José María, JUÁREZ-TOLEDO, Carlos, MARTÍNEZ-CARRILLO, Irma and FLORES VÁZQUEZ, Ana Lilia
Universidad Autónoma del Estado de México

"Design of the operation of a rotating machine for the acquisition of multi-view stereoscopic images for the 3D reconstruction of objects"

CORONA-PATRICIO, Cesar Agustin & RETA, Carolina
CONACYT-CIATEQ A. C. PICYT
CONACYT-CIATEQ A. C. Department of IT, Control, and Electronics

2 5 2 3 6 8 1 4
ISSN 2523-6814
www.ecorfan.org