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Journal of Technology and Education

Definition of 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 Standards of digital skills for education, learning projects through the use of information and communication technologies, development of digital teaching skills, digital skills programs, management of technological and educational consultancy, technological training fields applied to education.

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Knowledge Area

The works must be unpublished and refer to topics of Standards of digital skills for education, learning projects through the use of information and communication technologies, development of digital teaching skills, digital skills programs, management of technological and educational consultancy, technological training fields applied to education and other topics related to Engineering and Technology.

Content Presentation

As first article we present, *Teaching of the subjects of Ecological Engineering and Air conditioning and refrigeration of the career of Electrical Mechanical Engineer of the FES Cuautitlán in the distance and mixed modality*, by HERNÁNDEZ-GÓMEZ, Víctor Hugo & CHAVARRÍA-ORTIZ, Gilberto, with adscription in the Universidad Nacional Autónoma de México, as second article we present, *Animatronic system for promoting the learning of the nahuatl language*, by CASTILLO-QUIROZ, Gregorio, LIMON-DIAZ, Miguel Ángel, SAMPAYO-CARCAMO, Matilde and ROJAS-BALBUENA, Dorian, with adscription in the Instituto Tecnológico Superior de Huauchinango, as the third article we present, *Signal and biosignal acquisition system for teaching in education: conditioning and analysis methods with embedded devices*, by SAMANO-FLORES, Yosafat Jetsemani, SERRANO-RAMIREZ, Tomás, LOPEZ-RODRIGUEZ, Pedro and MANDUJANO-NAVA, Arturo, with affiliation at the Universidad Politécnica de Guanajuato, as last article we present, *Analysis of a web system for the management of professional practices in a higher education institution*, by DÍAZ-SARMIENTO, Bibiana, SÁNCHEZ-JIMÉNEZ, Daniel Antonio, AGUILAR-ORTIZ, Gabriela and MORALES-HERNÁNDEZ, Maricela, with affiliation at the Instituto Tecnológico de Oaxaca.

Content

Article **Journal of Technology and Education**
June 2022, Vol.6 No.15 1-7

Teaching of the subjects of Ecological Engineering and Air conditioning and refrigeration of the career of Electrical Mechanical Engineer of the FES Cuautitlán in the distance and mixed modality

Enseñanza de las asignaturas de Ingeniería ecológica y Aire acondicionado y refrigeración de la carrera de Ingeniero mecánico electricista de la FES Cuautitlán en la modalidad a distancia y mixta

HERNÁNDEZ-GÓMEZ, Víctor Hugo†* & CHAVARRÍA-ORTIZ, Gilberto

Universidad Nacional Autónoma de México, FES Cuautitlán, Estado de México, México

ID 1st Author: *Víctor Hugo, Hernández-Gómez* / **ORC ID:** 0000-0001-9315-5869, **Researcher ID Thomson:** S-6575-2018, **CVU CONACYT ID:** 122247

ID 1st Co-author: *Gilberto, Chavarría-Ortiz* / **ORC ID:** 0000-0002-5358-4260, **CVU CONACYT ID:** 1204605

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Abstract

This article describes the teaching method of the subjects of Ecological Engineering and Air Conditioning and Refrigeration of the Electrical Mechanical Engineer career at FES Cuautitlán, for the distance and mixed modality. New didactic resources were developed to improve the teaching-learning process, such as class videos, notes, videos and support texts, infographics, mind maps, word search puzzles, crossword puzzles, to name a few, for each topic of the subjects. To concentrate the information and make it available to students at any time of the day, virtual classrooms were created in Classroom and Moodle. A section of practical activities that can be done from home, using easy-to-find and even recycled materials, was included. The virtual classrooms were tested during the 2022-2 semester, giving good opinions from the students who took the subjects, since, although the class was taught by zoom, if they could not take the class for work reasons, they could be regularized with the videos. of the class and of support to the subject, in the moment that they had free.

Moodle, Classroom, Mixed teaching

Resumen

En este artículo se describe el método de enseñanza de las asignaturas de Ingeniería ecológica y Aire acondicionado y refrigeración de la carrera de Ingeniero mecánico electricista de la FES Cuautitlán, para la modalidad a distancia y mixta. Se desarrollaron nuevos recursos didácticos para mejorar el proceso de enseñanza aprendizaje como videos de clase, apuntes, videos y textos de apoyo, infografías, mapas mentales, sopa de letras, crucigramas, por mencionar algunas, para cada tema de las asignaturas. Para concentrar la información y que estuviera disponible para los alumnos a cualquier hora del día, se elaboraron aulas virtuales en Classroom y Moodle. Se incluyó una sección de actividades prácticas que pueden realizar desde su casa, empleando materiales fáciles de encontrar e inclusive reciclados. Las aulas virtuales se probaron durante el semestre 2022-2 dando buenas opiniones por parte de los estudiantes que cursaron las asignaturas, ya que, aunque se daba la clase mediante zoom, si por cuestiones laborales no podían tomar la clase, podían regularizarse con los videos de la clase y de apoyo al tema, en el momento que tuviesen libre.

Moodle, Classroom, Enseñanza mixta

Citation: HERNÁNDEZ-GÓMEZ, Víctor Hugo & CHAVARRÍA-ORTIZ, Gilberto. Teaching of the subjects of Ecological Engineering and Air conditioning and refrigeration of the career of Electrical Mechanical Engineer of the FES Cuautitlán in the distance and mixed modality. Journal of Technology and Education. 2022. 6-15:1-7.

* Correspondence of the Author (E-mail: vichugo@unam.mx)
† Researcher contributing as first author.

Introduction

Due to the escalation of contagions registered in China, Europe and mainly the United States, the Mexican government, through the Ministry of Health, took the decision to declare 23 March 2020, the National Day of Healthy Distance, where health and social distancing measures were put into action to reduce the contagions caused by the SARS-CoV-2 coronavirus.

From that moment on, all on-site classes were suspended in all educational centres in Mexico. In the first instance, the Ministry of Public Education (SEP) established that all students should be at home, bringing forward the Easter holidays with the intention of developing an emergency plan to continue distance education.

The Universidad Nacional Autónoma de México (UNAM) followed the same guidelines adopted by the SEP, except that it brought forward the suspension a week earlier, due to calculations made by UNAM researchers regarding the number of predicted infections.

With the global health emergency, distance education had to be implemented as an emergency measure, which meant that the content of the syllabus was not covered. The SEP started to broadcast via internet, radio and television, so that the majority of students would have access to this knowledge.

In the case of the University, some of us professors contacted the students and held videoconferences through synchronous platforms such as Zoom or Meet, and classes were taught as much as possible. The problem with doing it this way is that not all students had access to this technology, either because they don't have it, couldn't rent an hour of internet, didn't have wifi or because they couldn't connect at that time.

To help reduce this situation, the PAPIME project "New didactic resources to improve the teaching-learning process for the subjects of Ecological Engineering and Air Conditioning and Refrigeration for the online and blended modalities, of the FESC's Mechanical and Electrical Engineering degree programme, code PE100222, was created with the aim of generating new didactic resources to improve the teaching-learning process for the aforementioned subjects, to be used in the online and blended modalities.

This includes creating virtual classrooms, so that students can use it without any time restrictions (asynchronous mode) and can keep track of the subject. The didactic material was developed in such a way that when we return to normality, it can be used to teach our classes in mixed or face-to-face mode.

We also have laboratory practices, notes and experimental prototypes that were developed in the PAPIME PE102015 and PE101218 projects, which were revised and updated, and the experimental prototypes were maintained. To complement the knowledge, educational resources from different UNAM repositories and other open access platforms were integrated.

It is worth mentioning that prior to the development of this project, during the pandemic it was necessary for the participants to take different courses, seminars and conferences on the generation of didactic material, evaluation methods and administration of the virtual classroom.

Dr. Víctor Hugo Hernández Gómez and Eng. Gilberto Chavarría Ortiz teach the Ecological Engineering subject in the Mechanical and Electrical Engineering course, from the 2012 curriculum. For several years they have been in constant communication to standardise the classes that each of them teaches to the students, the first action was in the extraordinary exams and then in the way of teaching the subject, which is now materialising during the pandemic through this project. In addition, Dr. Hernández established the same procedures for the other subject he teaches, Air Conditioning and Refrigeration.

To give the students a variety of platforms to use, Mr. Chavarría chose Moodle and Dr. Hernández chose Classroom. Once the platform was selected, they registered in the CUAIEED's Virtual Classroom database [I], reviewed the videos included in the page and logged in to each platform.

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Ecological Engineering course in Moodle

The virtual classroom was registered and started with a welcome message, then the objective of the subject, the course topics and the respective practices were generated. In this same section, the link to access the Zoom platform and connect in real time (online class) was embedded. This prevents the student from losing the link to access the Zoom platform and losing the possibility of having a remote link to the class. Figure 1 shows the objective and welcome to the course.

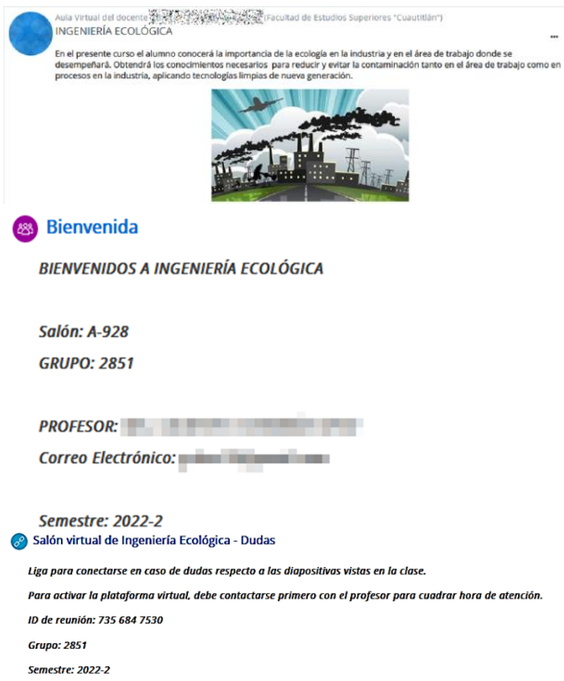

Figure 1 View of the presentation of the Ecological Engineering course created in Moodle
Source: Own elaboration

In the welcome section, important notices can be attached, both from the course itself and from the faculty. The exams that will be administered online are also embedded, with the instructions that must be followed in order to take them, as well as their grades, both partial and final. The teacher has the ability to activate or not such notices, since Moodle has this option.

The topics contained in the virtual classroom are the contents of the syllabus of the subject:

- General Aspects of Ecology and Environmental Contamination.
- Air Pollution.
- Water Pollution.
- Soil Pollution.
- Clean Energy.
- Thermal Pollution.
- Noise Pollution.
- Radioactive Pollution.

Moodle shows all the topics with their respective summary and an image according to the corresponding topic, as shown in figure 2.

Figure 2 View of the first topic of the course visualised by the student
Source: Own elaboration

Figure 3 shows a brief example of the content corresponding to the topic "Water pollution" that the ecological engineering student visualises.

Figure 3 View of the presentation of the topic "Water pollution"
Source: Own elaboration

The content published on the platform for each topic is as follows:

Slides presented in the virtual or face-to-face classes that serve as study guides for the student to supplement it with their class notes.

Research tasks.

Links of interest so that the student can complement what has been seen in the online classes. In this section it is possible for the student to collaborate to enrich the collection of articles, reports, reports, etc., which are of interest to both the teacher and the student.

Videos as complements to the topics seen in the online (or face-to-face) classes.

Laboratory practicals. Consists of five practicals, which are developed throughout the semester.

For the evaluation, different exams were generated and uploaded to the platform. During the exams, Moodle allows us:

- Real-time monitoring of the exam.
- Verify the number of students who have accessed the platform.
- View the grade obtained in the exam by the student.
- Review the student's exam manually.
- Download the grading table in an Excel format.

Figure 4 shows an example of an online exam tracking.

Figure 4 View of the presentation of the Water Pollution topic
Source: Own elaboration

When the exam is reviewed manually, Moodle indicates, for each question that makes up the exam, the answer history where the following data can be observed:

- Start time - time at which the student accessed the question.
- Time saved - time in which the student finished answering the question.
- Time of completed attempt - time at which the learner finished answering the quiz.

It is important to note that Moodle issues a warning message when the student is late in answering any of the quiz questions. When this happens, it means that the student opened a window outside the exam, which translates into the student reviewing the notes on the topics covered in the test.

Subjects Ecological Engineering and Air Conditioning and Refrigeration in the Classroom.

Figure 5 shows the virtual classrooms of each subject.

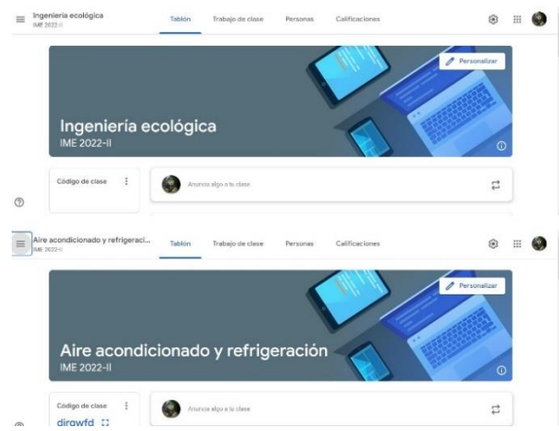

Figure 5 Virtual classroom in Classroom of the subjects involved
Source: Own elaboration

In the class work section, the following sections were included in each classroom:

Air conditioning and refrigeration:

End of semester

Presentation, agenda and references:

1. General Concepts
2. Psychrometric Processes
3. Characteristics of Supplied Air
4. Comfort Conditions
5. Calculation of Space Heat Load
6. Air conditioning alternatives
7. Heating and Cooling

Practical activities

Ecological Engineering.

End of semester

Presentation, syllabus and references.

1. General aspects of ecology and environmental pollution
2. Air pollution
3. Water pollution
4. Soil pollution
5. Clean energy
6. Thermal pollution
7. Noise pollution
8. Radioactive pollution

Practical activities

Figure 6 shows the sections of the Ecological Engineering course, as an example.

In the "Presentation, syllabus and bibliography" section, a video presentation of the course and the teacher, the syllabus of the subject, the UNAM and FESC semester calendar, instructions for the use of the Zoom and Classroom tools and the link to access the UNAM digital library were included.

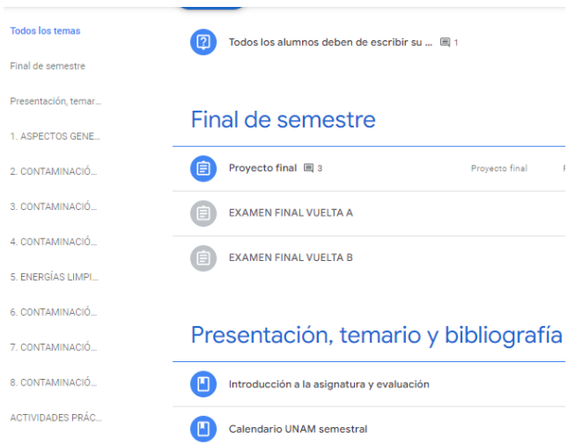

Figure 6 Classroom sections for the Ecological Engineering subject
Source: Own elaboration

In addition, in the case of the Air Conditioning and Refrigeration subject, the form, psychrometric tables and links to the support software were included. Figure 7 shows the breakdown of this section for the Air Conditioning and Refrigeration subject.

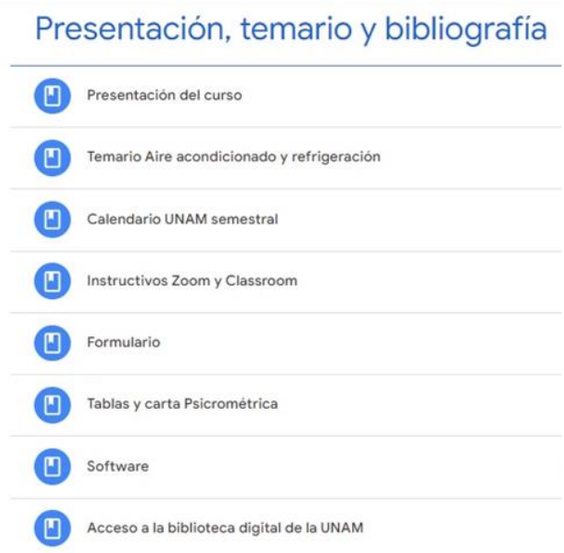

Figure 7 Presentation, syllabus and bibliography section of the Air Conditioning and Refrigeration subject
Source: Own elaboration

In each of the sections corresponding to the subject's syllabus, the video of the class, the presentation used in the video, the developed notes on the subject, links to support material such as UNAM repositories, YouTube, etc., asynchronous activities to be carried out by the students and a questionnaire on the subject were included. Figure 8 shows an example of the material included in each topic.

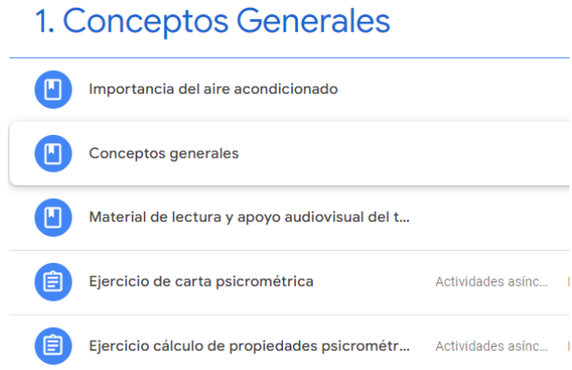

Figure 8 Material included in the General Concepts section of the Air Conditioning and Refrigeration subject
Source: Own elaboration

Figure 9 shows the material included in the sections "Importance of air conditioning" and "General concepts" in figure 8.

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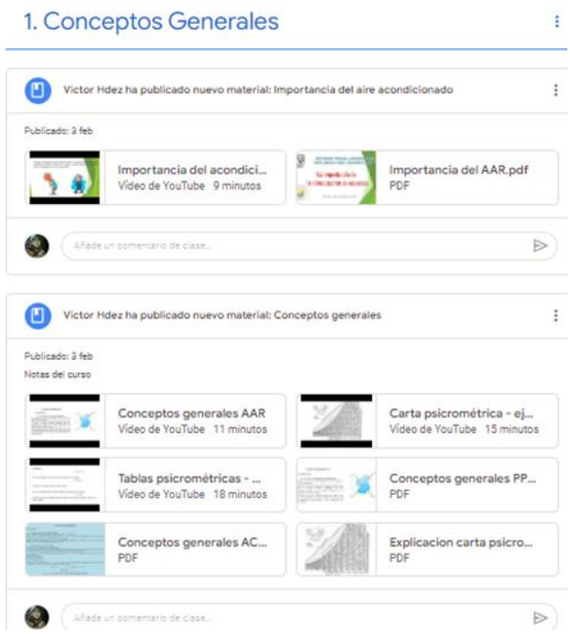
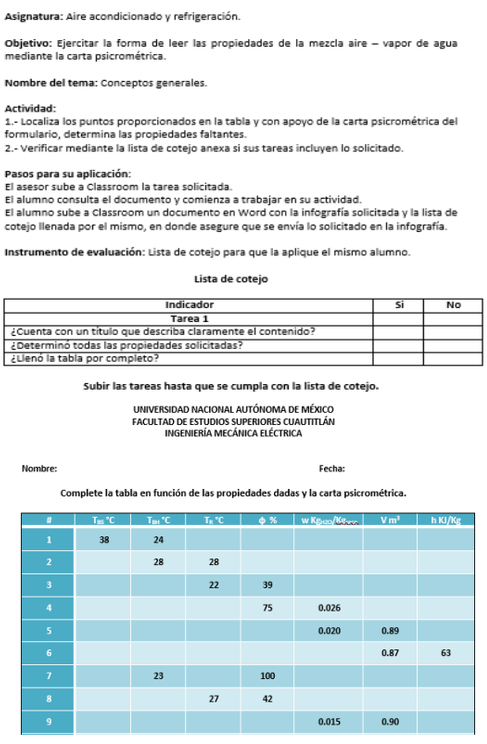


Figure 9 Material included in the sections "Importance of air conditioning" and "General concepts"
Source: Own elaboration

In the asynchronous activities, they were asked to solve crossword puzzles and word searches, explain a news item related to the topic, elaborate mind maps and infographics on each topic, and in each activity they were given a checklist to check that their activity included what was requested in the instructions.

Figure 10 shows an example of the asynchronous activities of the Air Conditioning and Refrigeration subject.



Asignatura: Aire acondicionado y refrigeración.

Objetivo: Ejercitar la forma de leer las propiedades de la mezcla aire – vapor de agua mediante la carta psicrométrica.

Nombre del tema: Conceptos generales.

Actividad:
1.- Localiza los puntos proporcionados en la tabla y con apoyo de la carta psicrométrica del formulario, determina las propiedades faltantes.
2.- Verificar mediante la lista de cotejo anexa si sus tareas incluyen lo solicitado.

Pasos para su aplicación:
El asesor sube a Classroom la tarea solicitada.
El alumno consulta el documento y comienza a trabajar en su actividad.
El alumno sube a Classroom un documento en Word con la infografía solicitada y la lista de cotejo llenada por el mismo, en donde asegure que se envía lo solicitado en la infografía.

Instrumento de evaluación: Lista de cotejo para que la aplique el mismo alumno.

Lista de cotejo

Indicador	Si	No
Tarea 1		
¿Cuenta con un título que describa claramente el contenido?		
¿Determinó todas las propiedades solicitadas?		
¿Llenó la tabla por completo?		

Subir las tareas hasta que se cumpla con la lista de cotejo.

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Nombre: Fecha:

Complete la tabla en función de las propiedades dadas y la carta psicrométrica.

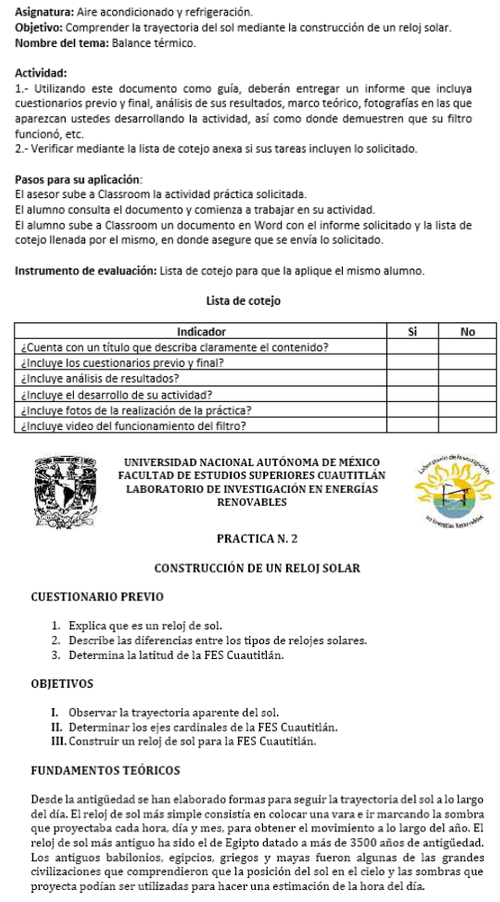
#	T_{BS} °C	T_{BH} °C	T_R °C	ϕ %	w Kg$_{H_2O}$/Kg$_{a.s.}$	V m³	h kJ/Kg
1	38	24					
2		28	28				
3			22	39			
4				75	0.026		
5					0.020	0.89	
6						0.87	63
7		23		100			
8			27	42			
9					0.015	0.90	

Figure 10 Asynchronous activity of the General Concepts section
Source: Own elaboration

In the practical activities section, the instructions to develop the practical were included and also the checklist was given so that they could make sure to deliver what was requested in the practical.

Figure 11 shows the practical activities of the Air Conditioning and Refrigeration subject and figure 12 shows an example of a practical with its respective checklist.

Figure 11 Practical activities of the subject Air conditioning and refrigeration
Source: Own elaboration



Asignatura: Aire acondicionado y refrigeración.
Objetivo: Comprender la trayectoria del sol mediante la construcción de un reloj solar.
Nombre del tema: Balance térmico.

Actividad:
1.- Utilizando este documento como guía, deberán entregar un informe que incluya cuestionarios previo y final, análisis de sus resultados, marco teórico, fotografías en las que aparezcan ustedes desarrollando la actividad, así como donde demuestren que su filtro funcionó, etc.
2.- Verificar mediante la lista de cotejo anexa si sus tareas incluyen lo solicitado.

Pasos para su aplicación:
El asesor sube a Classroom la actividad práctica solicitada.
El alumno consulta el documento y comienza a trabajar en su actividad.
El alumno sube a Classroom un documento en Word con el informe solicitado y la lista de cotejo llenada por el mismo, en donde asegure que se envía lo solicitado.

Instrumento de evaluación: Lista de cotejo para que la aplique el mismo alumno.

Lista de cotejo

Indicador	Si	No
¿Cuenta con un título que describa claramente el contenido?		
¿Incluye los cuestionarios previo y final?		
¿Incluye análisis de resultados?		
¿Incluye el desarrollo de su actividad?		
¿Incluye fotos de la realización de la práctica?		
¿Incluye video del funcionamiento del filtro?		

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LABORATORIO DE INVESTIGACIÓN EN ENERGÍAS RENOVABLES

PRACTICA N. 2

CONSTRUCCIÓN DE UN RELOJ SOLAR

CUESTIONARIO PREVIO

1. Explica que es un reloj de sol.
2. Describe las diferencias entre los tipos de relojes solares.
3. Determina la latitud de la FES Cuautitlán.

OBJETIVOS

I. Observar la trayectoria aparente del sol.
II. Determinar los ejes cardinales de la FES Cuautitlán.
III. Construir un reloj de sol para la FES Cuautitlán.

FUNDAMENTOS TEÓRICOS

Desde la antigüedad se han elaborado formas para seguir la trayectoria del sol a lo largo del día. El reloj de sol más simple consistía en colocar una vara e ir marcando la sombra que proyectaba cada hora, día y mes, para obtener el movimiento a lo largo del año. El reloj de sol más antiguo ha sido el de Egipto datado a más de 3500 años de antigüedad. Los antiguos babilonios, egipcios, griegos y mayas fueron algunas de las grandes civilizaciones que comprendieron que la posición del sol en el cielo y las sombras que proyecta podían ser utilizadas para hacer una estimación de la hora del día.

Figure 12 Example of practice and checklist
Source: Own elaboration

In the final project section, students are left with an integrative project, which considers that the student uses all the knowledge acquired during the semester to solve a problem related to the subject, for example in Ecological Engineering they are asked to solve a pollution or energy saving problem and in the case of Air Conditioning and Refrigeration, they are asked to come up with a proposal to solve the air conditioning of a space considering conventional equipment and passive techniques (reduction of the thermal load using thermal insulation, renewable energies and energy saving). Figure 13 shows an example of a project together with its evaluation rubric.

Results

There is a virtual classroom for each subject in which the didactic material generated is included, such as class videos, infographics, power point presentations, photos, mind maps, concept maps, timelines, exercises, etc., and for the evaluation of the subjects, exams, rubrics, questionnaires, integrating activities and problem-solving activities similar to real situations, which can be individual or in teams, were generated. In addition, the evaluation of some of the activities is contemplated to be carried out by the teacher and among students.

Asignatura: Ingeniería Ecológica.

Objetivo: Aplicar los conocimientos adquiridos durante el semestre.

Nombre del tema: Proyecto Final.

Actividad:
1.- Generar o construir un prototipo referente a los temas de la asignatura, el cual debe funcionar (no maqueta).
2.- Verificar mediante la rúbrica que contiene lo solicitado.

Pasos para su aplicación:
El asesor sube a Classroom la tarea solicitada.
El alumno consulta el documento y comienza a trabajar en su actividad.
El alumno sube a Classroom un documento en pdf con la información solicitada.

Instrumento de evaluación: Rúbrica.

Criterio\Porcentaje	100	75	50	25	0
Funcionamiento 2 puntos	El prototipo sirve y cumple con el objetivo del proyecto.	El prototipo no funciona y cumple con el objetivo del proyecto.	El prototipo funciona y no cumple con el objetivo del proyecto.	-	No incluye prototipo
Prototipo 3 punto	Incluye el diseño croquis o planos, memoria de cálculo de ser necesario, materiales de construcción y propuestas de mejora.	Incluye el diseño croquis o planos, memoria de cálculo de ser necesario y materiales de construcción.	Incluye el diseño croquis o planos, memoria de cálculo de ser necesario o materiales de construcción.	Incluye el diseño croquis o planos o materiales de construcción.	No incluye casi nada
Documento 3 puntos	Contiene resumen, justificación, planteamiento del problema, objetivos, marco teórico si se requiere, procedimiento, fotos de la elaboración del proyecto, fotos del funcionamiento de este, resultados y conclusiones.	Contiene resumen, justificación, planteamiento del problema, objetivos, marco teórico si se requiere, procedimiento, fotos de la elaboración del proyecto o del funcionamiento de este, resultados y conclusiones.	Contiene planteamiento del problema, objetivos, marco teórico si se requiere, procedimiento, fotos de la elaboración del proyecto y conclusiones.	Contiene planteamiento del problema u objetivos, procedimiento, fotos de la elaboración del proyecto.	No incluye casi nada
Memoria fotográfica 2 puntos	Incluye video y fotografías del funcionamiento del prototipo y del proceso de construcción donde se observa al alumno participar en la actividad.	Incluye fotografías del funcionamiento del prototipo y del proceso de construcción donde se observa al alumno participar en la actividad.	Incluye fotografías del funcionamiento del prototipo o del proceso de construcción donde se observa al alumno participar en la actividad.	Incluye fotografías del funcionamiento del prototipo o del proceso de construcción pero no se observa al alumno en ellas.	No incluye fotografías ni video

Figure 13 Final project of the subject Air conditioning and refrigeration
Source: Own elaboration

The virtual classroom as presented in this document was used by the students enrolled in semester 2022-2, who commented on the advantage of having the videos of the explanation of the subjects, the notes and the support material, since if they could not attend the zoom session because they were working, they could review the videos of the subject in their free time so as not to fall behind.

Conclusion

Today's communication technologies have given us the possibility to open up new avenues for students' academic development. In addition, we must continue to develop new tactics to encourage students to learn, taking advantage of what this pandemic has taught us.

Acknowledgements

We are grateful to the Programa de Apoyo a Proyectos para la Innovación y Mejoramiento de la Enseñanza (PAPIME-UNAM) for the support provided through project PE100222.

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Animatronic system for promoting the learning of the nahuatl language

Sistema animatrónico para el fomento del aprendizaje de la lengua nahuatl

CASTILLO-QUIROZ, Gregorio†*, LIMON-DIAZ, Miguel Ángel, SAMPAYO-CARCAMO, Matilde and ROJAS-BALBUENA, Dorian

Tecnológico Nacional de México, Instituto Tecnológico Superior de Huauchinango, Ingeniería Mecatrónica, México.

ID 1st Author: *Gregorio, Castillo-Quiroz* / **ORC ID:** 0000-0002-1904-4172, **Researcher ID Thomson:** H-9402-2018, **CVU CONACYT ID:** 162009

ID 1st Co-author: *Miguel Angel, Limon-Diaz* / **ORC ID:** 0000-0002-7578-7077, **Researcher ID Thomson:** T-6486-2017, **CVU CONACYT ID:** 349952

ID 2nd Co-author: *Matilde, Sampayo-Carcamo* / **ORC ID:** 0000-0003-4506-5396, **CVU CONACYT ID:** 368456

ID 3rd Co-author: *Dorian, Rojas-Balbuena* / **ORC ID:** 0000-0002-4770-8669, **Researcher ID Thomson:** AAN-1530-2020, **CVU CONACYT ID:** 299726

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Abstract

Currently, communication in the Nahuatl language in the Sierra Norte region of the State of Puebla is a minority language, that is to say, it is only spoken by adults and is mixed with Spanish words. The objective of this project is to develop an animatronic system as a didactic material for the diffusion and promotion of a native language "nahuatl", by means of an animatronic puppet in the shape of a child, which allows the user to identify himself with the attire and characteristics of a Nahua person of the region, it also has a sound emission in nahuatl language and Spanish: words, phrases and dialogues. The main part consists of various electromechanical systems that allow it to perform synchronized movements with the sounds emitted, providing an expressive, friendly and attractive communication. With the development of this project, the personification of a prototype for the teaching of the Nahuatl language was achieved in order to promote the learning of a language that was being lost.

Indigenous population, Nahuatl, Teaching

Resumen

Actualmente la comunicación en lengua nahuatl en la Región de la Sierra Norte del Estado de Puebla es muy minoritario, es decir solo lo hablan las personas adultas, además está mezclada con palabras del idioma español. El presente proyecto tiene como objetivo desarrollar un sistema animatrónico como material didáctico para la difusión y fomento de una lengua materna "nahuatl", mediante un títere animatrónico en forma de un niño, que permita al usuario identificarse con el atuendo y características de una persona Nahua de la región, además posee una emisión de sonido en lengua nahuatl y español: palabras, frases y diálogos. La parte principal consta de diversos sistemas electromecánicos que le permiten realizar movimientos sincronizados con los sonidos emitidos, proporcionando una comunicación expresiva, amistosa y atrayente. Con el desarrollo de este proyecto se logró la personificación de un prototipo para la enseñanza del lenguaje náhuatl para el fomento del aprendizaje de un idioma que se estaba perdiendo.

Población indígena, Nahuatl, Enseñanza

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* Correspondence of the Author (E-mail: gcquiroz1977@gmail.com)
† Researcher contributing as first author.

Introduction

In Mexico, 364 linguistic variants are spoken, grouped into 68 groupings and 11 linguistic families according to the National Institute of Indigenous Languages (INALI) Chiapas, Oaxaca, Veracruz, Puebla, Yucatan, Guerrero, Quintana Roo, Hidalgo, Campeche and San Luis Potosi are the states with the largest number of speakers of indigenous languages: Nahuatl, Maya, Mixteco, Tseltal, Zapoteco, Tzotzil, Otomi, Totonaco and Mazateco (INALI, 2015). This makes it one of the countries with the greatest linguistic diversity in the American continent (CENEJYD, 2010), i.e., a cultural heritage of all Mexicans, which we all have the task of caring for and promoting.

There are indigenous peoples who have already accepted that their language will disappear and thus think that part of their culture will be dispersed and that they will only be able to communicate in Spanish. However, others wish to reverse this trend of the disappearance of their languages and struggle to preserve and strengthen them in many different ways (INALI, 2012). Faced with this problem, INALI has implemented various strategies to prevent their extinction, such as standardization, which is the rescue of the language spoken in each village to put it in a position similar to the dominant language, in this case Spanish. Another project carried out by INALI for the defense and promotion of Mexican indigenous languages is the launching of a compact disc with popular music translated into 12 indigenous languages: Otomí, Zapoteco, Totonaco, Paipai, Tsotsil, Zoque, Maya, Nahuatl, Huichol, Seri, Mixteco and Purépecha (INALI, 2015).

During the last few years there have been several proposals that try to reverse this trend of the disappearance of mother tongues in our country. Among those that stand out are the new technologies that have allowed for greater interaction and communication between people and the possibility of sharing information. These advantages have been taken advantage of by different sectors related to education in Mexico, since they make it possible to expand the school coverage of existing models or to implement a different model (Heredia, 2010).

In 2016, researchers from the Universidad de la Sierra Juárez in the state of Oaxaca proposed a Native Language Learning System, which consists of a collaborative web application to collect, preserve and promote the use of native (or mother) languages of the regions of the State of Oaxaca in the medium term (Valdez et al., 2016). An important contribution in this context was proposed by researchers from the Instituto Tecnológico Superior de Huatusco, which developed a mobile application as a learning tool for Nahuatl in the Orizabese variant, with specific functionalities that help, along with the use of the senses such as sight and hearing, to have a better understanding of the Nahuatl language in the Orizabense variant (Mirón, et al., 2017). Another application to preserve the Mexican cultural baggage, is the Tozcatl application with which you can learn Nahuatl at a basic level and was created by the poblanos Daniel Cuaxiloa and Rigoberto Dominguez, which is composed of 5 levels and the vocabulary is divided into topics such as: greetings, colors, animals, family and everything necessary to begin to understand and speak this language (Axcan, 2016) and (Flounas, 2019). Later, another even more didactic application was developed, since it shows a scenario with various drawings where animals, kitchen utensils or places of a village are shown. Touching each drawing plays an audio where you can hear a word in Nahuatl (Apkpure, 2018).

Regarding the educational aspect, researchers from the National Institute of Astrophysics, Optics and Electronics (INAOE) designed a collection of dolls for the learning of native languages among children from indigenous communities. The dolls are aimed at children between 2 and 4 years old with various types of games. When turned on, the dolls greet and start interacting (INAOE, 2018). Similarly, engineers from the Instituto Tecnológico Superior de Acatlán de Osorio created an electronic doll to disseminate the Mixteco language and safeguard the cultural heritage of the lower Mixteca region of the state of Puebla (Fuentes, et al., 2021). It is clear that it is important to establish educational programs for the preservation of indigenous languages, where the focus is on the educational aspect.

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This project aims to cause great impact in the social area of the state of Puebla with a focus on the Sierra Norte de Puebla. Giving a proposed solution to the problem of the loss of the Nahuatl language in this region, providing the Nahuas a work using innovation and technology, which will make it more attractive to young people encouraging them to rescue their mother tongue, planting in them the seed for academic study, which will be an inspiration to not feel excluded by ethnicity demonstrating that they can also carry out projects with a focus on their roots. It is important to preserve the Nahuatl language in our region avoiding the loss of a cultural heritage, preserving the identity of the Nahuas without them feeling excluded by discrimination, motivating them to preserve their roots at all times, using the process of unified development resulting in an animatronic with characteristics of a child, which is manufactured to speak Nahuatl and Spanish through practical activities such as greeting, numbering, parts of the human body, everyday words, sentences and dialogues.

The development of this project is divided into the following sections:

Methodology

The steps followed for the development of the project are described.

Results

This section analyzes the results to determine whether the aforementioned objective has been achieved.

Acknowledgments

We would like to thank the people and institutions that made this research possible.

Conclusions

The objectives satisfactorily achieved are discussed.

Methodology

The main objective of this project is to provide an animatronic that is able to speak the Nahuatl language at a basic level, to provide communities with an alternative, to prevent the extinction of the language, as well as contribute to the rescue, dissemination, preservation, development, teaching and learning of the Nahuatl language of the region. For the development of the prototype, the Rational Unified Process (Rational Unified Process) was chosen as a methodology, which is a software development process and together with the Unified Modeling Language (UML) constitutes a standard methodology for object-oriented analysis and documentation, see Figure 1.

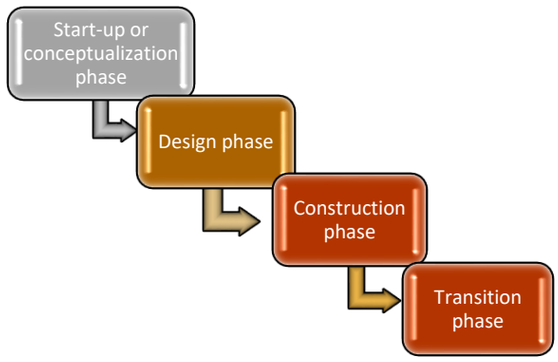

Figure 1 Block diagram of the procedure to follow
Source: own elaboration

Start-up or conceptualization phase

At this stage, through ideas, the ideal concepts were generated for the animatronic system to comply with the following characteristics: it should have the shape of a child (humanoid shape), with a cartoon design that would be acceptable to children, as well as automatic movements in the eyes, eyelids and mouth and a mechanical movement of the head and upper and lower limbs, in addition to a friendly expression and attire of the Nahua group from the northern region of the State of Puebla (see Figure 2).

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Figure 2 Conceptualization of animatronics
Source: own elaboration

For the design of the head, it was considered that it should resemble a cartoon image simulating the body of a Nahua child between 8 and 10 years of age, with a dark complexion, black hair, expressive eyes, and head proportionally larger than the body, bare hands and feet.

A. Design phase

The animatronic is mainly composed of the head containing control and audio systems, which is placed on a base (the body). The animatronic has automatic movements in the eyes, eyelids and mouth and a mechanical movement of the head and upper and lower extremities, see Figure 3.

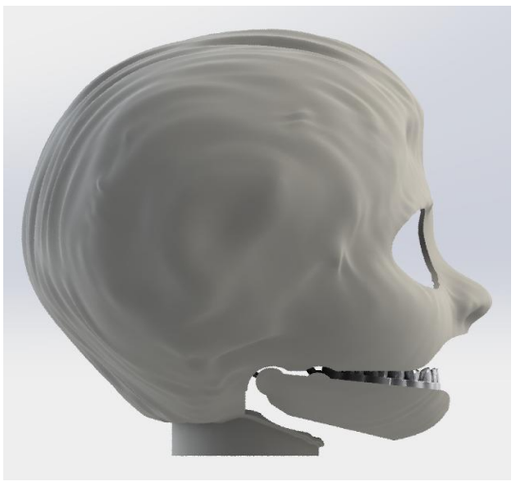

Figure 3 Preview of the animatronic head design
Source: Own elaboration

And to make the animatronic more eye-catching, a system was developed that is able to perform a synchronized jaw movement with the sound, simulating that the animatronic is talking. Finally, in the **¡Error! No se e ncuentra el origen de la referencia.** 4 shows the complete assembly of the aforementioned pieces, resulting in the design of the animatronic head.

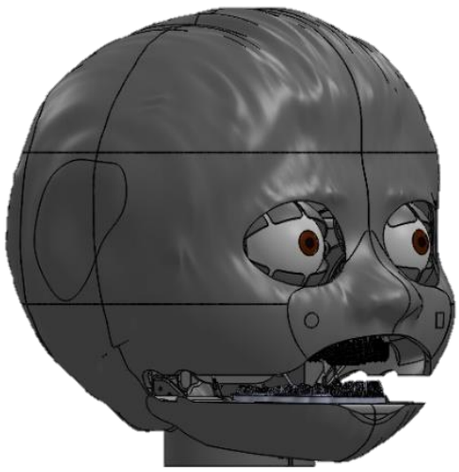

Figure 4 Final view of animatronic head
Source: own elaboration

B. Construction phase

The entire head structure of the animatronic system was manufactured with a polymeric material, PLA (polylactic acid) is a polymer with properties similar to PET with biodegradable qualities, in addition, the thermoplastic contains base materials obtained from corn, cassava or sugar cane starch, which makes our product environmentally friendly (See Figure 5).

Figure 5 Animatronic head general assembly
Source: own elaboration

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To give the animatronic an aesthetic view, a humanistic customization of the puppet was made, a silicone mask was made, the eyes were finished as real as possible and a body was created in which an analog study of the character had to be done first to determine proportions, scales and real dimensions.

Figure 6 Silicone mask for the animatronics
Source: own elaboration

Fulfilling the objective of giving physical features to the animatronic, the mask was created, starting with the sculpting of the shell and then applying a clay asilation to be able to fill with silicone and make the negative of the mold, to place the negative, a rigid shell was made to be filled with silicone with 25% stretch and finally a transportation shell was made. Once the pertinent corrections were made to the mask, it was given an aesthetic finish by adding eyebrows, eye finish, makeup, hair and real eyelid finish, see Figure 7.

Figure 7 Front view of the animatronic
Source: own elaboration

For the body, the hands and feet were manufactured with finger movement in order to interact more closely with the animatronic, the torso and limbs were filled with rigid foam to give it a soft feeling when touched. Before the complete assembly, the typical clothes of the Nahua people of the northern highlands of the state of Puebla were made for the animatronic puppet using quadrillé, considering the opinions obtained from the inhabitants of the region, see Figure 8.

Figure 8 Animatronic puppet's clothing
Source: own elaboration

C. Transition phase

The use tests of the animatronic system included design tests, manufacturing tests (filling, 3D printing time, assembly, assembly time and amount of material used), user tests comprising the operation of the animatronic and audio tests for the pronunciation of the Nahuatl and Spanish languages. In addition, it was verified that it had the capacity to perform a synchronized movement of the jaw with the sound, simulating that the animatronic is speaking. At this stage, an analysis of the verification results was carried out to detect any relevant error in order to make the necessary adjustments to the design. These analyses gave the possibility to correct some details of design, manufacturing, electronic and control design.

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Results

Once corrected all the pertinent corrections in the design, manufacture, electronic system, audio and control, the animatronic system was manufactured again, obtaining as final result the 3D design and manufacture of the animatronic puppet, which can perform routines in the eyes, eyelids and mouth automatically and a mechanical movement of the head and upper and lower limbs, It also has a friendly expression with an attire of the region with physical characteristics of the Nahua people of the Sierra Norte de Puebla, as shown in Figure 9.

Figure 9 Animatronic system for the promotion of Nahuatl language learning
Source: own elaboration

The proposed animatronic system is an alternative to teach Nahuatl in an attractive way. An outstanding aspect that the device has is the ability to promote the Nahuatl language, which has 5 levels of teaching, starting from words such as body parts, numbers, names of objects, to the reproduction of phrases to introduce themselves, stories and legends, for children and people who want or need to start learning the language, or for those who wish to identify themselves with a character that speaks their own language and does it with pride, where the configuration of the characteristic structural elements of the animatronic allows to offer the advantage of teaching Nahuatl in a fun and participatory way, it also has functions that allow to observe expressions of joy while phrases are reproduced in the Nahuatl language.

Without limiting the scope of the animatronic system, the device can also count with the integration of a reprogrammable media processor that allows it to be adapted to the needs of each audience, in levels of complexity, so it could be presented to an audience that does not master any of the Nahuatl language or on the contrary with an audience that is a 100% Nahuatl speaker.

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Conclusions

The animatronic built, meets the proposed objective, since it allows experimental tests with microcontrollers and servomotors. And with this, the personification of a prototype for the teaching of the Nahuatl language was achieved.

The final result of the animatronic gives a view of how mechatronic engineering can contribute in many areas, and as seen in this case, it comes to be a preservation of a language that, as time goes by, less people are interested in knowing. With the help of the animatronic, the indigenous language of the northern highlands of Puebla will be taught to future generations in exhibitions and school visits, hoping that people will be interested in learning more about the language, as well as in the design of the animatronic, which involved a varied use of knowledge of various kinds, but all focused on the automation of the animatronic.

Although the animatronic still has small details such as the uneven movement of the eyes, it is functional to fulfill its purpose, future corrections and additions will be made, such as adding the audio analyzer to synchronize the jaw with the captured audio frequencies, the use of the new board for the components for a better organization of the electronics, use of voltage regulators instead of UBEC for the servo controller board and changes in speeds within the programming, all this will be done to perfect the design and be an educational conduit for learning the Nahuatl language.

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Signal and biosignal acquisition system for teaching in education: conditioning and analysis methods with embedded devices

Sistema de adquisición de señales y bioseñales para la enseñanza en educación superior: métodos de acondicionamiento y análisis mediante dispositivos embebidos

SAMANO-FLORES, Yosafat Jetsemani†*, SERRANO-RAMIREZ, Tomás, LOPEZ-RODRIGUEZ, Pedro and MANDUJANO-NAVA, Arturo

Universidad Politécnica de Guanajuato, Ingeniería Automotriz, México.

ID 1st Author: *Yosafat Jetsemaní, Sámano-Flores* / **ORC ID**: 0000-0003-4173-6236, **CVU CONACYT ID**: 444850

ID 1st Co-author: *Tomás, Serrano-Ramírez* / **ORC ID**: 0000-0001-6118-3830, **Researcher ID Thomson:** G-6039-2018, **CVU CONACYT ID:** 493323

ID 2nd Co-author: *Pedro López-Rodriguez* / **ORC ID**: 0000-0003-2300-8083,**CVU CONACYT ID**: 495754

ID 3rd Co-author: *Arturo, Mandujano-Nava* / **ORC ID**: 0000-0003-2022-4397, **CVU CONACYT ID**: 270254

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Abstract

The use of signals of different types in engineering is important since technological development is based on the knowledge and treatment of these, such as EMG and ECG biopotentials in biomedicine or fuel mixture and air flow signals in the automotive industry. The objectives of these projects are to offer an integrated signal acquisition and visualization system that serves as a basis for the learning of higher education students in areas such as biomedical and automotive. Designing a low-cost digital system programmed in an embedded system with sensors and visualization software. This contributes to the development of students in the treatment of signals in different areas, signals such as biological and automotive

Biomedicine, Acquisition, Embedded systems

Resumen

El uso de las señales de diferentes tipos en la ingeniería es importante ya que del conocimiento y tratamiento de estas se basa el desarrollo tecnológico como por ejemplo los biopotenciales EMG y ECG en biomédica o las señales mezcla de combustible y flujo de aire en automotriz. Los objetivos de este proyecto es ofrecer un sistema integrado de adquisición y visualización de señales que sirva como base para el aprendizaje de alumnos de educación superior en áreas como biomédica y automotriz. Diseñando un sistema digital de bajo costo programado en un sistema embebido con sensores y software de visualización. Contribuyendo así con el desarrollo de los alumnos en el tratamiento de señales en diferentes áreas, señales como las biológicas y las automotrices

Biomedicina, Adquisición y Sistemas embebidos

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* Correspondence of the Author (E-mail: ysamano@upgto.edu.mx)
† Researcher contributing as first author.

Introduction

In history of México the education always suffering due to low investment in the sector. This has caused an important gap in the teaching levels. Is a problem that affect to student life of people.

One of the most affected levels is higher education due to this level is the transition of the student between their education and their insertion into working life. The students have problems when they want to apply their abilities in their jobs because they have never had the necessary equipment and tools for their preparation.

Most of the universities don't have the minimum infrastructure, laboratories, equipment and space for the correct education. Because the students can't adapt to their working life and the reason was, they didn't acquire the practice knowledge necessary to the work.

Another reason is the little percentage of university engineering graduated students and the Mexican development of technology is deficient. The national engineers don't have the necessary skills to afront world challenges.

Because of that is necessarily have versatile and low-cost tools that give the student the enough and basic knowledge to their career application.

For above we generate a system capable of acquire a preprocessing signal and biosignals for the different areas of engineering. The signals in the engineering are very important because are the parameter with the technology interacts with the environment.

All kind of signals are a familiar parameter for the academic sector, especially in engineering.

Engineering area	Signal type
Biomedical	ECG, EMG and EEG
Automotive	Gas mixture and oxygen
Electronic	Ultrasonic and Optics
Mechanical	Movements

Table 1 Signal types

Are needed systems for acquire and provide this signals types to the engineering students, the signals are saved and then used for control and processing applications. These signals can be showed and used in their treatment for specific areas.

The technologies developed in this work proposes the use of integrate embedded devices that provide the possibility to interacting, processing and analysis the signals.

The system in this work is a system that incorporate several electric ang biological sensors which are connected to a FPGA, the system made a signal ang conditioning signals for student work. These signals are showed in MATLAB where the students can do a processing with specific objective.

The system offers the signals for engineering work. Is needed offer to the market more efficient and accessible devices that motivated it use and have a better work culture

State of the art

More complicate signals are the biological ones because it is the signal with less amplitude and that made not any sensor or device can detect it. Because of that. the system in the first stage work for EMC, ECG and EEG acquisition. Subsequently we will work with automotive signals only changing the acquisition sensor.

Next only showed the estate of art for biosignals because we work with the most complicate acquisition and that is the biological acquisition, this will replicate in mechanical, electric and all kind of signals.

In the figures 1, 2 and 3 are showed the most used acquisition arrays for sEMG Signals. Output of these array can use for a biomedical amount applications like medical valuations, processing to diagnosis, and prothesis control [1] [2].

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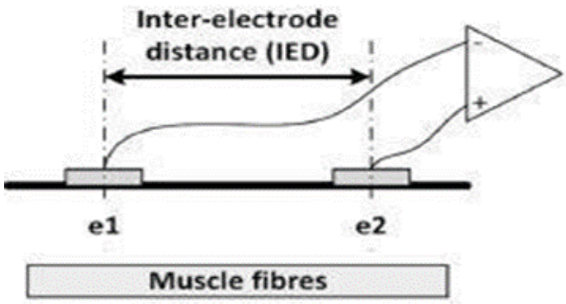

Figure 1 General acquisition array sEMG

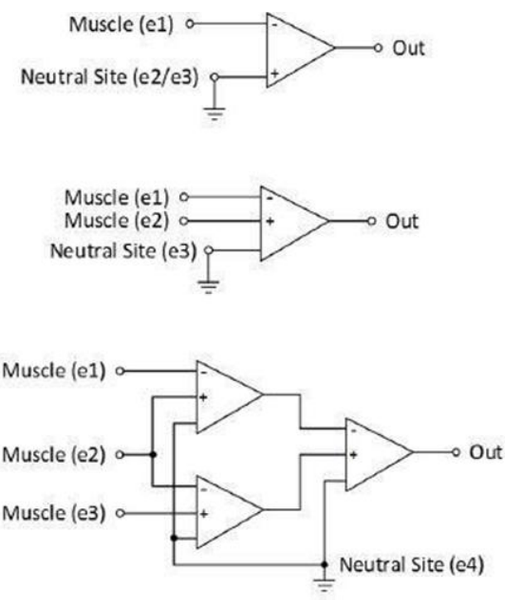

Figure 2 General acquisition sEMG several derivations

One-line biosignal acquisition

This system shows only one biosignal, using a sensor, embedded device and visualization software.

Used method is a 2D electrode matrix band based and conditioning in Bandmyo system

A Dell OptiPlex server was developed (Intel Xeon E5-2640 / 64-GB RAM / Tesla K80 Black GPU with 24 GB of GDDR5 and MATLAB R2016A and Phython 3.5.2 processing software, responsible for processing information through a deep learning method and neural networks, the sEMG signal is broken down, segmented, and with this, images of muscle activation are generated, which serve as input to the neural network with the aim of recognizing gestures in the corresponding software [4].

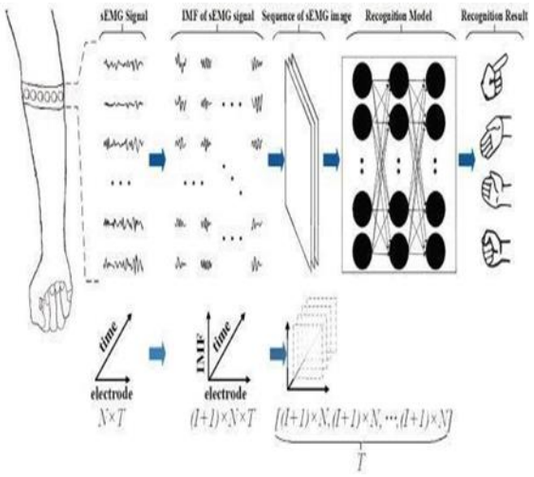

Figure 3 Gesture recognition through Bandmyo

This system shows the visualization in intelligent device that makes the system more versatile for the applications as shown in Figure 4 [6].

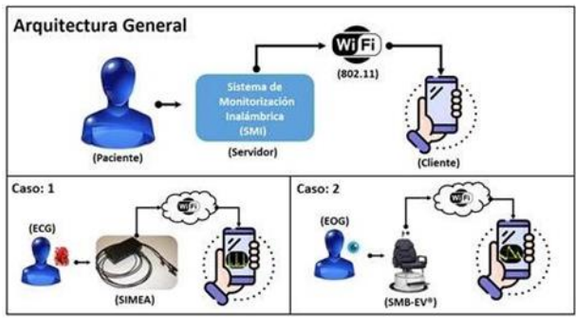

Figure 4 Visualización inalámbrica de biopotenciales

The above projected in used applications can serve to detect or alarm the state of the human body as shown in Figure 5 [7].

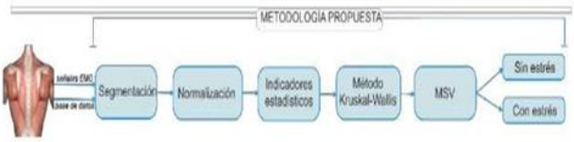

Figure 5 Detection of stress in the human body based on biopotentials

Several lines biosignals acquisition

This system shows the several biosignals acquisition using a sensor, embedded device and display software. ECC-PDMS electrodes were used in a 4X1 surface matrix and conditioned with a 50Hz notch filter and 30-20 Hz bandpass, the main objective of the system shown in Figure 2.6 is sEMG classification using RMS, LABVIEW and sEMG visualization [5].

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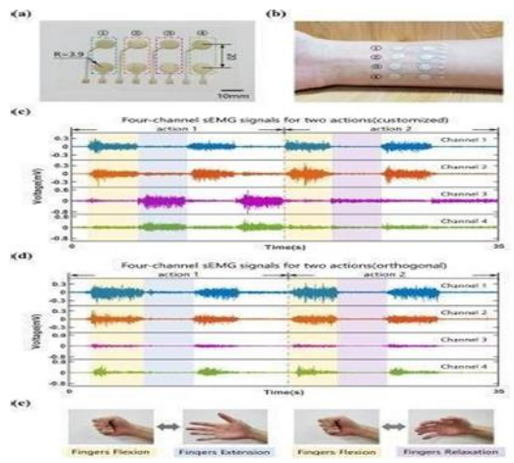

Figure 6 Electrodes, sEMG and gesture

Larger or different arrays can be positioned somewhere on the body to get more information

In the system shown in Figure 7, a multichannel array of 64 electrodes is applied in a grid. And it is filtered with amplifiers and a bandpass filter.

The objective of the research is to generate activation images of muscle areas that are then spatially filtered for feature extraction using MATLAB processing software [3].

The result are images in MATLAB and their feature extraction with spatial filters [3].

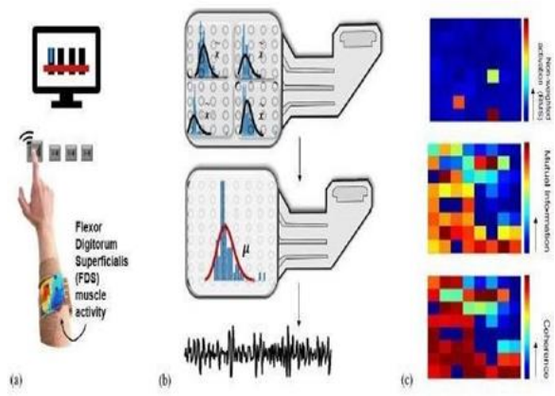

Figure 7 Noise reduction through spatial filtering

State of art analysis

Figure 8 shows a diagram that compiles the information on the state of the art in recent years where we can see that the systems have certain trends in two parameters, the acquisition arrangement and the processing hardware and software, their applications too.

These trends mark common factors in the arrangements and devices that are used to carry out the stated objectives and oriented to applications mainly of statistics, control and pattern recognition.

The systems in their acquisition stage makes their efforts to the measurement of certain parts of the body, the most common and which the measurement can be better considered.

In the conditioning stage, the instrumentation amplifiers of different gains and most of the systems converge in the development of filters for noise elimination and bandpass filters.

In the processing stage, there is more incidence in the microcontrollers regarding the hardware and the MATLAB platform regarding the software.

This diagram is an x-ray or an overview of the paths and directions of signal processor research and clarifies the horizon for the development of new applications as shown in Figure 8.

Although there are acquisition and visualization systems in different areas, very few of them are oriented towards education.

All the benefits shown in Figure 8 will be applied in the teaching of students with this project.

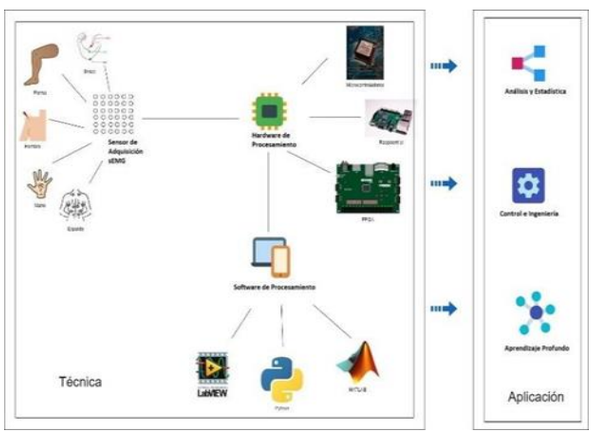

Figure 8 State of art analysis

System development

A system with 3 fundamental parts is proposed. Sensors, development board and visualization as shown in Figure 9.

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The objective is a system that collects information in the form of signals from the environment where it is working through different types of sensors, this information goes to preprocessing through in the FPGA and deliver to the student preprocessed signals and visualized in MATLAB so that they can work with them.

The process and implementation of hardware, acquisition of signals, processing and visualization is shown in the block diagram of Figure 9.

Figure 9 Project Block diagram

The communication interface between sensor and FPGA, FPGA y MATLAB is showed in Figure 10. Is used Arduino as a digital analog converter with 10-bit resolution.

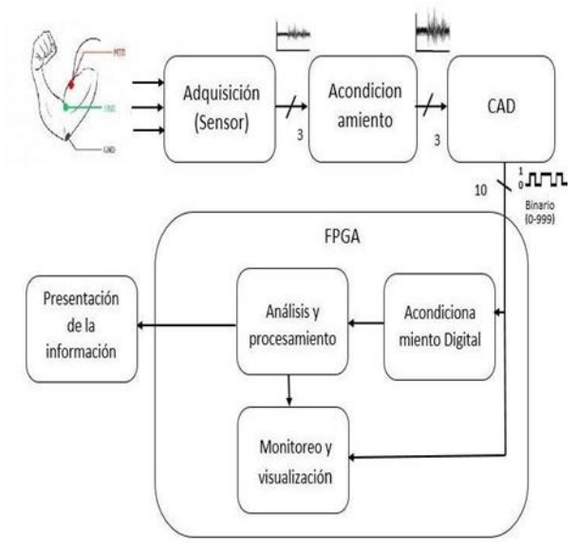


Figure 10 Interface and communication block diagram

The physic implementation of proposed system is showed in Figure 12 and 13. The signal sEMG of biceps in this case is acquire by sensor and electrodes, then is communicated with an analog digital converter and then transferred to FPGA as shown in Figure 13. In FPGA showed in Figure 12 is digitally incorporate a decimal data 0 -999 because of the resolution converter, this data is showed too in the FPGA displays.

This signal is mapped and adapted to a 0-3.9 voltage level, that corresponding to a power source of FPGA.

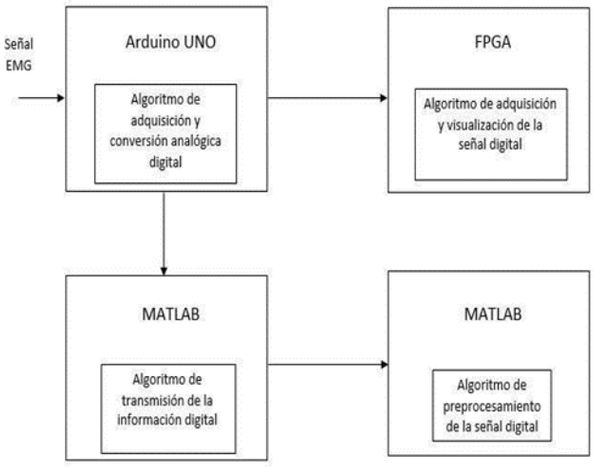


Figure 11 FPGA Xilinx Nexys 4

The diagram is visualized in Figures 12 and 13. The digital signal is transferred to computer where is made a preprocessing with MATLAB software and showed in MATLAB plotter.

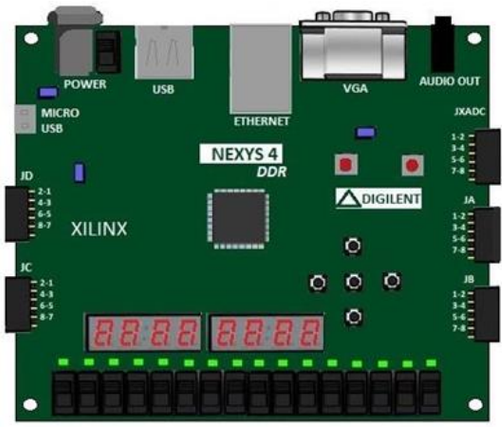


Figure 12 Schematic prototype of system

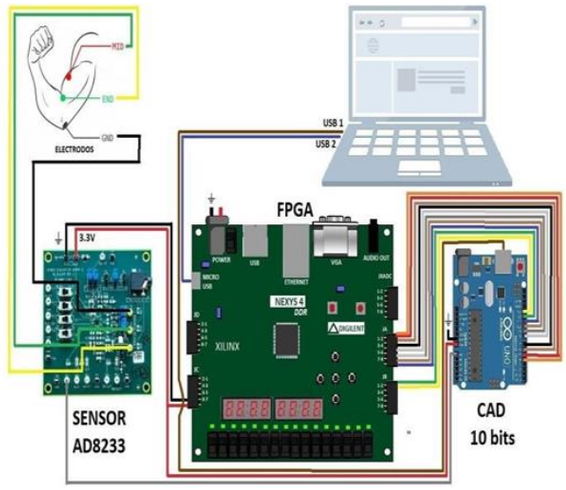


Figure 13 Signal connection

Results

We can visualize signal or data provide to students in 3 different stages. The first stage in analog sensor output through oscilloscope for the student can visualize the original signal as showed in Figures 14, 15, 16 and 17, this signal is acquired with the biopotential sensor.

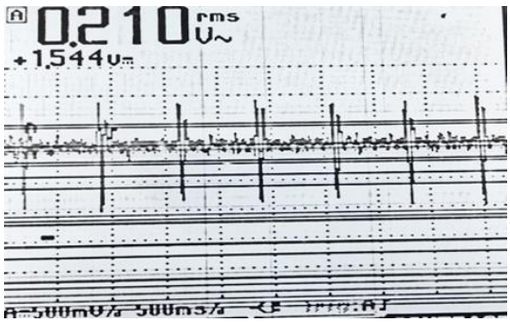


Figure 14 Analog signal ECG acquire with sensor

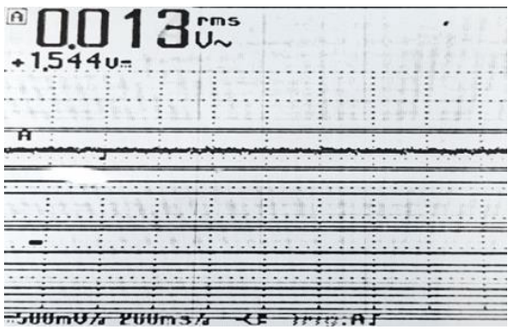


Figure 15 Relax analog signal ECG acquire with sensor

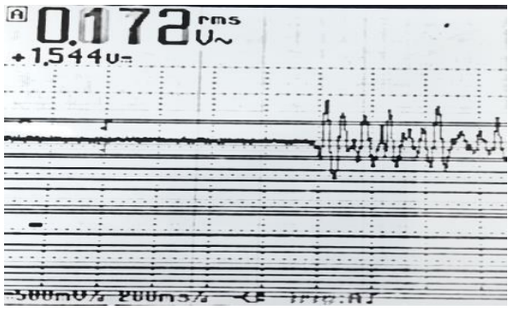


Figure 16 Relax-strength analog signal ECG acquire with sensor

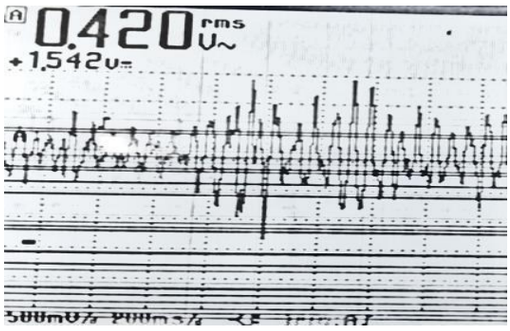


Figure 17 Strength analog signal ECG acquire with sensor

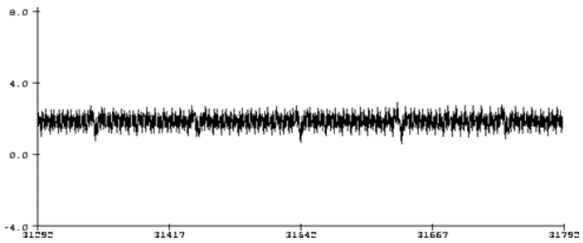
In the second stage can visualize as a numeric data in 3 digits as shown in the FPGA displays as shown in Figure 18 and 19. The numeric data is 0-999 range. This range is because the 10-bit converter resolution. This data is useful for all statistics problems and mathematics equations for analysis.

Figure 18 FPGA digital display

Figure 19 Numeric data display

In the final stage the software MATLAB provide images that the student can visualize as shown in Figures 9, 10, 11 and 12 where is delivered a preprocessed signal ready to the specific work in every engineering area.

These signals are showed in Arduino plotter too, is an option for reduce the cost of the system and the student can visualize a preprocessed signal too as shown in Graphics 14, 15 and 16. The first data and signal acquisition and transfer results are show in MATLAB and the FPGA in Figures 5.5, 5.6 and Graphics 5.4, 5.5 and 5.6.



Graphic 1 Arduino ECG digital signal

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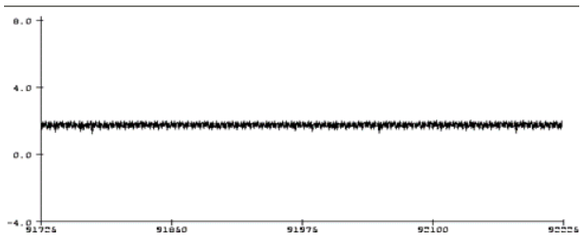
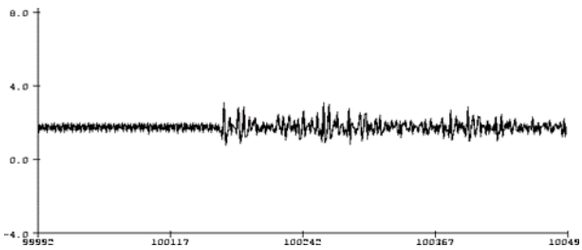
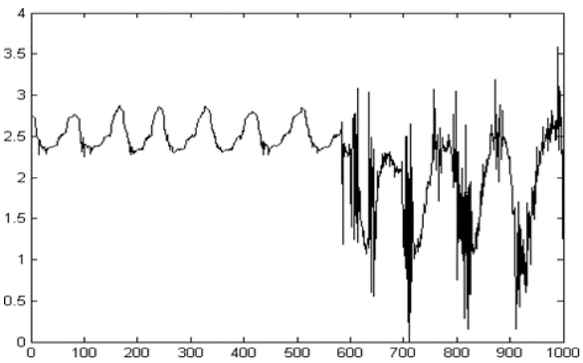


Graphic 2 Arduino EMG digital signal (relax)

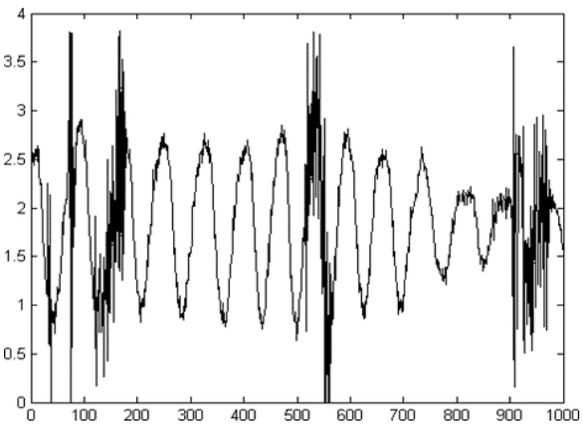


Graphic 3 Arduino EMG digital signal (strength)

The Graphics 4, 5, 6 and 7 was obtained in a relax-strength bicep routine, the part highlighted in black represents the muscular effort and its duration.



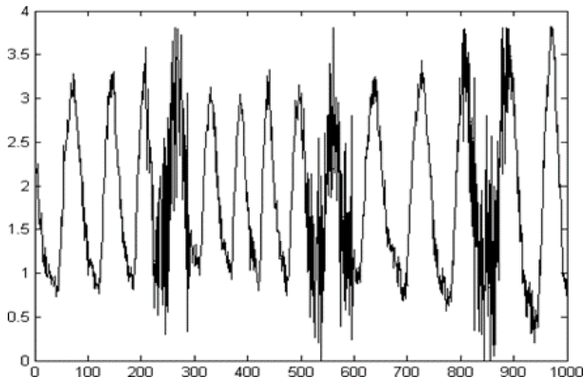
Graphic 4 MATLAB digital signal 1



Graphic 5 MATLAB digital signal 2

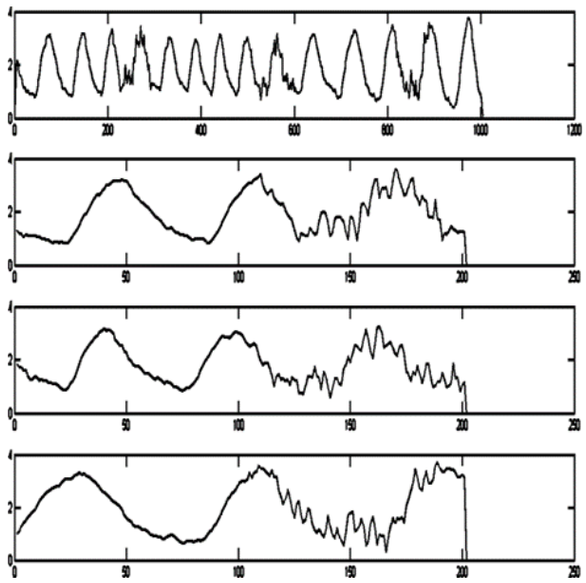
MATLAB generates a vector where sabe 100 samples of sEMG signal as shown in Graphics 5, 6 and 7.

In the image showed in Graphic 6 is show a movement routine where the muscle made a relax-strength routine in three times, this movements was realized between 100-300, 400-600 and 700-800 samples, the highlighted port of the signa represent the flexing of muscle.



Graphic 6 MATLAB digital signal 3

Later they were extracted the signals segments where the muscle realizes the strength, in these segmented signals was apply a media filter od 3 samples and the results as shown in Graphic 7.



Graphic 7 Preprocessed, segment and compare EMG digital signal in MATLAB

We can note how signal get better in amplitude with the filter and you can better appreciate the change in EMG due to muscle effort as shown in Graphic 7. The signal and vector characteristics are saved and can be configurated in basis of the specific need in the several engineering areas and depends of every signature.

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Conclusions

This project offers a good number of tools (Sensors, Arduino, FPGA, Arduino viewer and MATLAB) that the student can use to generate their own knowledge and thus achieve the objective of the subjects they are studying.

The use of versatile and easily accessible platforms such as the one presented in this project brings the student closer to the application of their knowledge in the areas for which they are preparing.

This system reduces the deficiency gap caused by the lack of equipment for practical applications and strengthens students' abilities Universities will have easier access to specialized equipment because this type of platform is low cost. It is imperative that these types of technologies become more common because in modern time access to specialized equipment increasingly will be harder every time.

Financing

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Analysis of a web system for the management of professional practices in a higher education institution

Análisis de un sistema web para la gestión de prácticas profesionales en una institución de enseñanza superior

DÍAZ-SARMIENTO, Bibiana†*, SÁNCHEZ-JIMÉNEZ, Daniel Antonio, AGUILAR-ORTIZ, Gabriela and MORALES-HERNÁNDEZ, Maricela

Instituto Tecnológico de Oaxaca, Departamento de Sistemas y Computación, Avenida Ing. Victor Bravo Ahuja No. 125 Esquina Calzada Tecnológico, C.P. 68030, México.

ID 1est Author: *Bibiana, Díaz-Sarmiento* / **ORC ID**: 0000-0003-4350-6311, **CVU CONACYT ID**:820776

ID 1st Co-author: *Daniel Antonio, Sánchez-Jiménez* / **ORC ID:** 0000-0003-4386-8291, **CVU CONACYT ID:**1148683

ID 2nd Co-author: *Gabriela, Aguilar-Ortíz* / **ORC ID:** 0000-0003-3055-5712, **CVU CONACYT ID:** 730590

ID 3rd Co-author: *Maricela, Morales-Hernández* / **ORC ID:** 0000-0002-3521-2041, **CVU CONACYT ID:** 731036

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Abstract

Students of Higher Education Institutions (IES), to finish their degree must carry out professional practices (professional residence), getting into practice the knowledge acquired during the degree, developing a project for the benefit of the company and IES. The development of a Web System for the management of professional practices in an HEI aims to implement a Web System that manages the professional practices of Engineering in Technological Innovation of an IES. The methodology for the development of the Web System is Incremental considering the stages: Communication, Planning, Modeling, Construction and Deployment. This article allows the reader to identify the steps, know the development methodology, analyze the activities developed and the implementation of the aforementioned Web System. You can also identify the contribution that the article has for the HEIs where in many cases the process of professional practices is carried out by hand, there is no control of the activities carried out by the student, the procedure is slow, the process is unknown, the importance of this last subject or activity to finish the degree is not given, being a requirement on many occasions to be titled.

Practices, Methodology, IES

Resumen

Los estudiantes de Instituciones de Educación Superior (IES), para finalizar su carrera deben realizar prácticas profesionales (residencia profesional), poniendo en práctica los conocimientos adquiridos durante la carrera, desarrollando un proyecto en beneficio de la empresa y IES. El desarrollo de un Sistema de Web para la gestión de prácticas profesionales en una IES tiene como objetivo implementar un Sistema Web que gestione las prácticas profesionales de la Ingeniería en Innovación Tecnológica de una IES. La metodología para el desarrollo del Sistema Web es Incremental considerando las etapas: Comunicación, Planeación, Modelado, Construcción y Despliegue. El presente artículo permite al lector identificar los pasos, conocer la metodología de desarrollo, analizar las actividades desarrolladas y la implementación del Sistema Web antes mencionado. También puede identificar la contribución que tiene el artículo para las IES donde en muchas ocasiones el proceso de prácticas profesionales se lleva a mano, no existe un control de las actividades que realiza el estudiante, el trámite es lento, se desconoce el proceso, no se da la importancia que tiene esta última materia o actividad para finalizar la carrera, siendo requisito en muchas ocasiones para titularse.

Prácticas, Metodología, IES

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† Researcher contributing as first author.

Introduction

The Analysis of the Web System for the management of professional practices of a Higher Education Institution, developed during the year 2021 in the distance modality due to the COVID-19 pandemic, allows to identify the importance of carrying out an adequate management of the administrative processes immersed in the professional practices.

Processes where the student, academic coordinator, coordinator of professional practices and director of the IES are involved. Sometimes, these processes are carried out manually, but with the pandemic several activities were developed virtually.

This article allows the reader to know the Analysis of the development of a Web System for the management of professional practices, to have an overview of the methodology used and the phases through which the project passed to reach the implementation stage.

The stages of the incremental methodology in software development and the techniques that were necessary to collect the information during the period of realization in the pandemic are identified. Previously the student developer was presented in the company of 4 to 6 hours a day to develop the System, due to the isolation by COVID-19 it was necessary to work with various technological tools to carry out the development of the system.

The characteristics that can be identified in the article are: Identification of the problem, Analysis of the methodology used and activities for the development of the software.

With the Web System for the Management of Professional Practices, a solution is given to the problem of carrying out the management in person, since the student can enter the system from the comfort of their home and carry out the administrative procedures to start, develop and conclude the professional practices, without having to attend school, avoiding contagion by COVID-19.

The article consists of the following sections: Project Overview, Problem Statement, Methodology, Development, Results, Acknowledgements, Conclusions and References.

Project overview

The Web System for the management of professional practices is developed in the city of Oaxaca de Juárez, in a Higher Education Institution, in the Department of Professional Practices belonging to the Academic Coordination, figure 1.

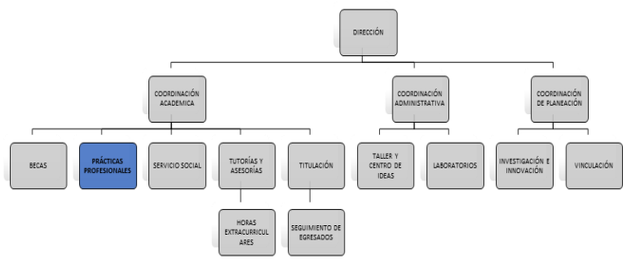

Figure 1 Organization chart
Source: Website of an IES

The processes that are carried out in the department of Professional Practices for the development of these are synthesized in 10 steps, figure 2.

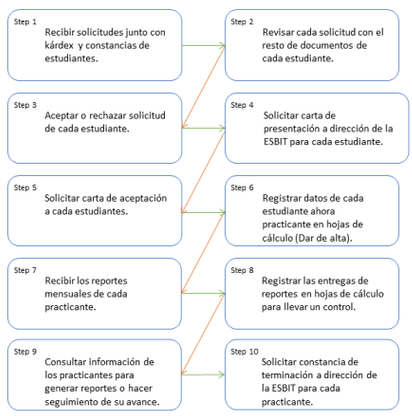

Figure 2 Process for professional practices
Source: Own elaboration

The process starts from receiving applications, kardex (generated by the school control system) and study certificates, once the documentation is reviewed the application is accepted or rejected, this information is recorded in an Excel file, this being the only control that the administrative staff has to keep track of those students who are studying professional practices.

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During the development of the Web System, the following activities were carried out:

Phase 1. General analysis

- Requirements.
- Business Modeling.
- Defining iterations.

Phase 2. Development of increments

- Increments
- Communication
- Planning
- Modeling (Analysis, Design)
- Construction (Coding, validation)
- Deployment

Phase 3. Final delivery

- Application validation
- Deploying the application

Problem statement

In the school of Biological Systems and Technological Innovation of an IES in Oaxaca, the problem of not having a system that allows managing professional practices, neither locally nor at a distance, was identified. There are delays in the progress of administrative procedures, storage of physical or digital documents, difficulty in making queries, loss of information, documents, inconsistency or delays in the progress of student´s professional practices.

There are delays in the progress of administrative procedures, storage of physical or digital documents, difficulty in making queries, loss of information, documents, inconsistency or delays in the progress of students' professional practices.

This problem was aggravated due to the SARS-CoV-2 (COVID-19) pandemic, since the attention on the part of the Educational Institution to carry out the professional practices was null. On the other hand, there is a list of government organizations to carry out professional practices, there is no list of SMEs so that students have a range of opportunities in the development of this activity.

It is worth mentioning that the development of professional practices is a requirement for the student to conclude their career and graduate.

Methodology

"A methodology is a collection of procedures, techniques, tools, and supporting documents that assist software developers in their efforts to implement new information systems." (Amaya, 2013).

For the development of the Web System, traditional and agile development methodologies, characteristics, phases, number of increments, advantages, disadvantages and appropriate scenario were analyzed. The methodologies analyzed were: Incremental, Spiral, XP and Scrum (Kendall, 2005).

The Incremental Methodology met the characteristics according to the project, the user's requirements are prioritized, we work from 1 to 4 phases, depending on the difficulty you can have 1 or more increments, in each increment the client will have at his disposal a prototype that reflects part of the requirements, it is useful when the personnel is not enough for the complete implementation of the system. Figure 3 shows the stages of the incremental model.

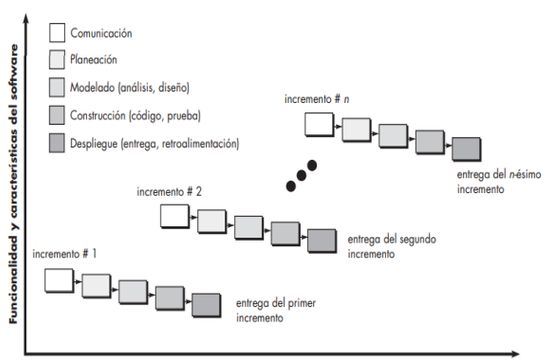

Figure 3 Stages of the incremental model
Source: Pressman, 2010

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It was also necessary to work with different terms, these are:

UML: is a standard for object-oriented modeling, use cases and obtaining requirements based on use cases are increasingly used to obtain requirements, Sommerville 2011.

Web Engineering: allows systems to fulfill the functions for which they were developed, this is achieved because Web Engineering is more rigorous than traditional, Pressman 2010.

Cervantes 2017 mentions that: "A Web application runs on a server under the control of special software, which is also called a server"

For Cobo 2005, the programs reside next to the web page on the server, but are transferred to the client for execution. Java, JavaScript, VBScript are client-side programming languages."

Development

Based on the Incremental Methodology (Laudon, 2005), the following activities were developed:

1st Phase. General analysis.

The actors involved in this phase are: Academic Coordinator, Student, Coordinator of professional practices, and director.

In this phase, the Day tool was used for the elaboration of UML diagrams. Figure 4 shows the Diagram: Processes for the realization of professional practices, where the actors are identified: Academic Coordinator, Student, Coordinator of professional practices and director. In this diagram you can identify the current processes for Professional Practices.

Figure 4 Use case diagrams: Professional practices.
Source: Own elaboration.

In this phase, different business use cases were also carried out:

- Business use case: Kardex request and delivery.
- Request and delivery of the total proof of credits.
- Kardex review and constancy.
- Review of internship application.
- Application and delivery of cover letter.
- Application and delivery of letter of acceptance.
- Review of the monthly report.
- Review of termination letter.
- Request and delivery of proof of release.
- Make record of attentions.
- Request and delivery of letters of acceptance.
- Application and delivery of final certificates of internship.

Also made increments, in Table 1, the number of Increments and the activities developed by each one are shown, all depending on the development of the Web System.

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Increment	Activity
First	Database development. Capturing student information. Application and delivery of Kardex and total proof of credits. Business contact list.
Second	Filling of student requirements (pre-application) Application for professional internships.
Third	Management and monitoring of professional practices.
Room	Liberation of professional practices.

Table 1 Definition of increments
Source: Own elaboration

2nd Phase. Realization of increments

Each increment takes up the requirements obtained from the first phase, analyze them in a specific way, better identifying the problem, creating Models (M), Views (V) and Controllers (C). The MVCs that are created will be tested independently and then in integration with the rest of the system.

Results

The Web System for the management of professional practices in an IES, allows the control and monitoring of this activity aimed at students who are about to conclude their professional career; for this system the software development methodology called Incremental Model is carried out, where four increments were made during the development of the project.

Each of these increments has the following phases: Communication, Planning, Modeling, Construction and Deployment (Pressman, 2010). With this methodology you can see sections already built, which are improved in each increment.

Below are the results obtained in each increment.

First increment.

Communication: doubts are clarified by asking questions about what was identified in the requirements obtained from the first phase.

Planning: the tools to be used for the development of the system were selected, which include tools that facilitate modeling (analysis and design) and construction (code and testing).

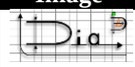
Name	Image	Description
Dia		Free software under the terms of the Dia, the GPLv2, general purpose for the creation of UML diagrams.
MySQL Workbench		Software that provides data modeling, SQL development, and comprehensive management tools for server configuration, user management, backup, and more.

Table 2 Tools for the modeling stage
Source: Tools websites

Tools for the construction stage

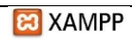
Name	Image	Description
PHP		Open source language suitable for web development that is focused on server-side script programming.
Laravel		Framework open source for developing web applications and services with PHP, which uses the MVC pattern.
Composer		Composer is a tool for managing dependencies in PHP.
Node js		It's a runtime environment for JavaScript built with Chrome's JavaScript V8 engine.
XAMPP		It is a development tool that allows you to test your web development based on PHP on your own computer without having to have access to the internet, this software is from an Apache distribution that includes different free software.
Visual Studio Code		It is a source code editor, which includes support for debugging, built-in Git control, syntax highlighting, intelligent code completion, snippets, and code refactoring.

Table 3 Tools for the construction stage
Source: Tools websites

Modeling: Requirements analysis and modeling was developed in this iteration using more detailed use case diagrams than was obtained in the first phase, for the purpose of identifying user activities in the system.

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Construction: Laravel 8 was used, allowing the structured and orderly development of software, this framework uses the model-view-controller. Also in this first increase, the authentication and account registration forms for students were programmed.

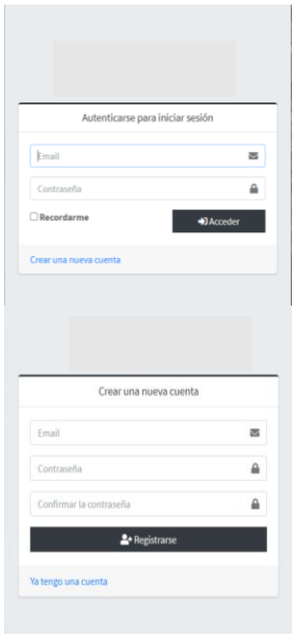

Figure 5 Login and new account creation
Source: Own elaboration

Figure 6 Consultation of personal and school data
Source: Own elaboration

.

Deployment: In the first deployment, the system was presented to the coordinator of professional practices, using a local server, accessing through the Google Chrome browser and the Microsoft Edge browser.

Second increase

It allows students to enter information about the project they will carry out and the company where they will carry it out. Also the advisor who will accompany them for the duration of the project. During this increase, the communication, planning, modeling, construction and deployment phases are carried out again.

In the Construction phase of this second increase, the complementary Registration /Company Data is carried out.

Figure 7 Supplementary registration/Company data.
Source: Own elaboration

Figure 8 Recording project information.
Source: Own elaboration

Third increase

It is focused on attending the procedures corresponding to the process of delivering monthly reports. The phases of Communication, Planning, Modeling, Construction and Deployment are covered. In the Construction phase you can identify the first monthly report of professional practices, the student must deliver 4 monthly reports during the professional practices.

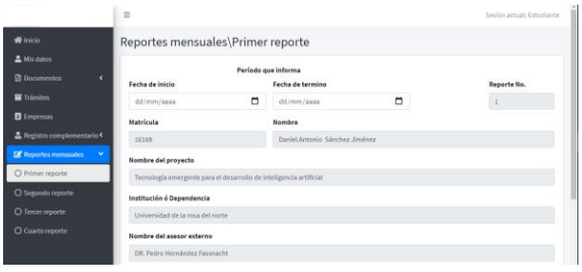

Figure 9 Consultation of personal and school data
Source: Own elaboration

Fourth increment

Once the four monthly reports have been delivered by the student, he is informed that he can already request from the company the letter of completion of professional practices where it is stated that he has completed 300 hours.

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This document must be delivered to the coordinator of professional practices to request the director of the IES the certificates of release, the proof of release of professional practices is an internal document.

During the construction phase, in the student's account, the Certificate of Release of professional practices is observed in the documents section.

Figure 10 Download the Release Certificate.
Source: Own elaboration

Gratitude

The research carried out was not funded, however, thanks are given to the following institutions:

Universidad Autónoma Benito Juárez de Oaxaca.

Tecnológico Nacional de México - Instituto Tecnológico de Oaxaca – Departamento de Sistemas y Computación.

Conclusions

For the elaboration of the project, it was essential to establish direct communication with those interested in the professional residence project entitled "Web system of control, management and monitoring of the professional practices of the Engineering in Technological Innovation of the ESBIT", where a student of the career of Engineering in Computer Systems of the Tecnológico Nacional de México – Instituto Tecnológico de Oaxaca became interested in working with the project. It is worth mentioning that our students must study the Professional Residence developing a project that meets a problem raised in an organization (Manual de Lineamientos Académico-Administrativos del Tecnológico Nacional de México, 2015).

In the Analysis of a Web System for the management of professional practices of a Higher Education Institution, various tools and web technologies were used for the development of the system, providing a solution to the problem raised.

It is important to perform an analysis of software development methodologies to identify characteristics, advantages and disadvantages, I am helping to choose the methodology according to the project. The incremental methodology was adapted to the needs of the project, in it a functional software product was obtained, each increment was adjusted to the requirements requested by the Coordinator of professional practices, also during the testing phase in each increment processes were improved, errors corrected and validations were added in the MVC that give operation to the system.

It was necessary to make frame increments. It was also valuable to model with use case diagrams and make the respective BPMN diagram where the processes were represented schematically and functionally, contributing to the improvement made in the development stage.

Currently the project is implemented with testing phase with real data.

This project has improvement options, where a mobile application can be developed and implemented where actors enter from anywhere and operate the system from their mobile device.

It is important to continue in the continuous improvement once the software is implemented, remember that the needs are constantly changing, due to the pandemic by SARS-CoV-2 (COVID-19) many traditional systems of carrying the information had to migrate to web systems or mobile applications.

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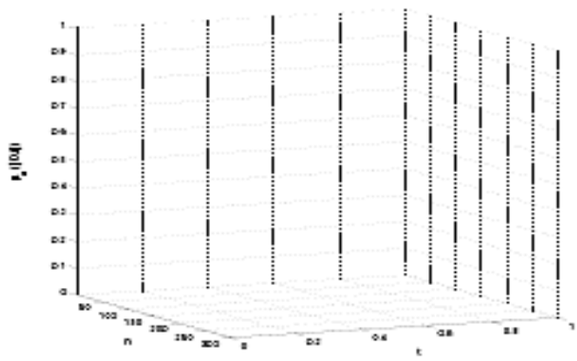

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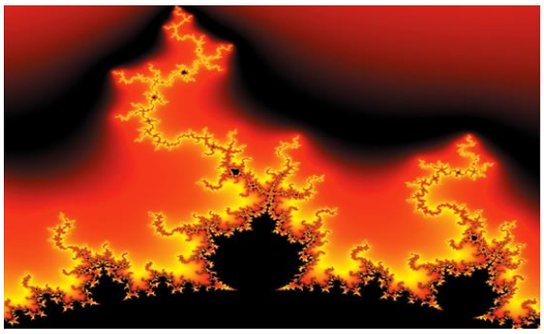

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1047 La Raza Avenue -Santa Ana, Cusco-Peru. Phones: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; Email: contact@ecorfan.org www.ecorfan.org

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