ISSN 2523-6865

Volume 6, Issue 16 – July – December – 2022

Journal Computational Simulation

ECORFAN®

Journal Computational Simulation, Volume 6, Issue 16, December 2022, is a journal published biannually by ECORFAN-Taiwan. Taiwan, Taipei. YongHe district, Zhong Xin, Street 69. Postcode: 23445. WEB: www.ecorfan.org/taiwan, revista@ecorfan.org. Editor-in-Chief: QUINTANILLA - CÓNDOR, Cerapio. PhD. ISSN: 2523-6865. Responsible for the last update of this issue of the ECORFAN Informatics Unit. ESCAMILLA-BOUCHÁN, Imelda, LUNA-SOTO, Vladimir, updated 31 December 2022.

Journal Computational Simulation

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 of telemetry, diffuse interval, electrical stimulation, diffuse controller, mobile application, communications network, web platform, production control, computer technology, computer electronics, control devices, programming languages and automated production systems.

ECORFAN-Mexico, S.C. 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 Computational Simulation is a 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 telemetry, diffuse interval, electrical stimulation, diffuse controller, mobile application, communications network, web platform, production control, computer technology, computer electronics, control devices, programming languages and automated production systems 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 Computational Simulation 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.

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 telemetry, diffuse interval, electrical stimulation, diffuse controller, mobile application, communications network, web platform, production control, computer technology, computer electronics, control devices, programming languages and automated production systems and other topics related to Engineering and Technology.

Presentation of Content

The first article presents, *Structural analysis of stresses and deformations of a lump-sifting machine*, by AMARO-BALANZAR, Jovanni, SÁNCHEZ-TEXIS, Fernando, IBARRA-BONILLA, Mariana Natalia and EUSEBIO-GRANDE, Raúl, with a secondment at the Instituto Tecnológico Superior de Atlixco, as the next article is *Tool design with augmented reality for the reactivation of regional museums*, by TOVAR-ROSAS, Claudia Rocío, SERRANO-MACHADO, Ana Cristina, AGUILAR-ARELLANO, Felisa Josefina and RODRÍGUEZ-ALANIS, Francisco de Borja, with a secondment at the Universidad Politécnica de Gómez Palacio, as the next article is *Enclosure maximum capacity control in pandemic time, using artificial vision*, by HERNÁNDEZ-VILLANUEVA, Mario Alejandro, MORALES-HERNÁNDEZ, Maricela, CASTELLANOS-BALTAZAR, Roberto Tamar and RAFAEL-PÉREZ, Eva, on secondment to the Universidad Tecnológica de los Valles Centrales de Oaxaca and Instituto Tecnológico de Oaxaca, as the next article is *Web application with smart interface*, by QUIÑONES-GARCÍA, Pedro Eduardo, GONZÁLEZ-RAMÍREZ, Claudia Teresa, VIÑAS-ALVAREZ, Samuel Efrén and GARNICA-PATRICIO, Mariana, with a secondment at the Instituto Tecnológico de México campus Zitácuaro.

Content

Article **Journal Computational Simulation**
December 2022, Vol.6 No.16 1-9

Structural analysis of stresses and deformations of a lump-sifting machine

Análisis estructural de esfuerzos y deformaciones de una máquina desterronadora – cernidora

AMARO-BALANZAR, Jovanni†*, SÁNCHEZ-TEXIS, Fernando, IBARRA-BONILLA, Mariana Natalia and EUSEBIO-GRANDE, Raúl

Tecnológico Nacional de México. Instituto Tecnológico Superior de Atlixco, México.

ID 1st Author: *Jovanni, Amaro-Balanzar* / **ORC ID:** 0000-0002-2646-7659, **CVU CONACYT ID:** 515242

ID 1st Co-author: *Fernando, Sanchez-Texis* / **ORC ID:** 0000-0002-1792-8855, **CVU CONACYT ID:** 95289

ID 2nd Co-author: *Mariana Natalia, Ibarra-Bonilla* / **ORC ID:** 0000-0001-7123-9105, **CVU CONACYT ID:** 237756

ID 3rd Co-author: *Raul, Eusebio-Grande* / **ORC ID:** 0000-0001-7062-3244, **CVU CONACYT ID:** 1000358

DOI: 10.35429/JCS.2022.16.6.1.9 Received: July 10, 2022; Accepted December 30, 2022

Abstract

In this paper, the 3D modeling and structural analysis of a lump-sieving machine is presented, using the Von Mises maximum distortion energy criteria. The study is carried out by the finite element method using the CAD design software SolidWorks. The objective of the study focuses on analyzing the structure of the machine, the blades, and the rotation axis of the clay lump breaker. The results show that the efforts and deformation in the trituration elements, the square axis of rotation and the structure of the machine, in addition to the resistive forces generated by the raw material which, in this case, is clay. According to the results obtained by the CAD software, the elements satisfy a safety factor greater than 1.5, it is verified that the pieces will not fail under normal working conditions. Therefore, the development of this machine will contribute to improving the process (time and quality of raw material) and reducing the physical exhaustion and tear carried out by the artisans of the municipality of Cohuecan.

Von Mises, Modeling, Structural analysis

Resumen

En este trabajo, se presenta el modelado 3D y el análisis estructural de una máquina desterronadora-cernidora, usando el criterio de máxima energía de distorsión de Von Mises. El estudio se realiza mediante el método de elemento finito usando el software de diseño CAD llamado SolidWorks. El objetivo del estudio se centra en analizar la estructura de la máquina, las aspas y el eje de giro de la desterronadora. Los resultados muestran los esfuerzos presentes y la deformación en los elementos de trituración, el eje de giro cuadrado y la estructura de la maquinaria, además, de las fuerzas resistivas generadas por la materia prima que, para este caso, es la arcilla. De acuerdo a los resultados obtenidos por el software CAD los elementos satisfacen un factor de seguridad mayor de 1.5 se comprobó que las piezas no fallaran bajo condiciones de trabajo normales. En consecuencia, el desarrollo de esta máquina contribuirá a mejorar el proceso (tiempo y calidad de materia prima) y a reducir el desgaste físico realizado por los artesanos del municipio de Cohuecan.

Von Mises, Modelado, Análisis estructural

Citation: AMARO-BALANZAR, Jovanni, SÁNCHEZ-TEXIS, Fernando, IBARRA-BONILLA, Mariana Natalia and EUSEBIO-GRANDE, Raúl. Structural analysis of stresses and deformations of a lump-sifting machine. Journal Computational Simulation. 2022. 6-16:1-9.

* Correspondence to the author (E-mail: jovanni.orama@itsatlixco.edu.mx)
† Researcher contributing as first author.

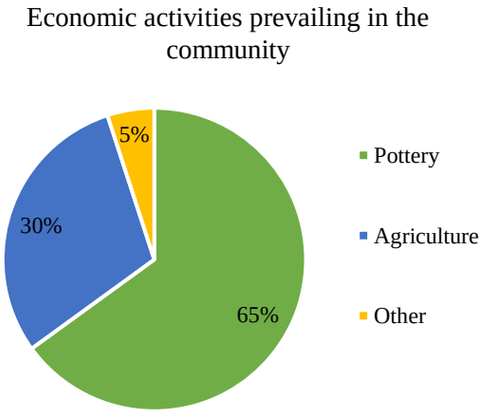
Introduction

Economic activities are called all those activities through which human beings satisfy their needs, and that generate profits within the market for their producers. (Cáceres, 2013)

We can distinguish primary, secondary and tertiary economic activities. Craft activities are secondary in their classification according to their function, modifying the raw material, and in the state of Puebla alone, it involves more than 50,000 people, who live from crafts as their first or second source of income. (Cáceres, 2013)

There are various craft techniques ranging from ceramics and pottery to jewelry. Pottery is the art of making clay pots and is considered the oldest industry; however, today this activity has an economic burden in different municipalities of the state of Puebla, among which is the municipality of Cohuecan.

Cohuecan is located in the center-west part of the state of Puebla where, according to the results of the 386 surveys applied by collaborators from the Higher Technological Institute of Atlixco (ITSA), the Higher Technological Institute of Acatlán de Osorio (ITSAO) and the University Technological Institute of Izúcar de Matamoros (UTIM), the main economic activity of its inhabitants is pottery with 65% (Graphic 1).



Graphic 1 Economic activity with the greatest impact in the municipality of Cohuecan
Source: Own elaboration

For the pots, plates, glasses, and an endless list of pieces to reach the hands of the final consumers, the potters need to carry out a whole previous process that basically consists of five stages: (Brito, 2017).

- Lumpy.
- Sifting.
- Making of the raw material.
- Kneading.
- Cut and flattened.

Currently (Figure 1), most of the families dedicated to pottery carry out the first phase of the process with the help of a basic lump-breaker with a maximum capacity of 5 kg or, in more limited conditions, the lump-breaking is done manually with the help of a shovel or a hammer mill. When they go to the sifting stage, they use a fine mesh sieve to separate the finest part of the clay once it has been clodded.

The other three stages contemplate the mixture of clay with water to prepare the raw material that, later, will be kneaded manually by the potters. Finally, the dough is cut and flattened according to the piece to be made and thus, the final craft is made.

Figure 1 Diagram of the process of making clay pieces in the municipality of Cohuecan Puebla
Source: Own elaboration

Although the pottery process consists of five stages, this article only focuses on the first two of the process, that is, the breaking up and sifting of the raw material. For this reason, the present work consists of presenting the mechanical design and static analysis of the structure of a lump-sieving machine to verify the viability of the materials to be used in its construction. Consequently, the article is divided into different sections where the material used, the methodology implemented, the results obtained, and conclusions are discussed.

ISSN 2523-6865

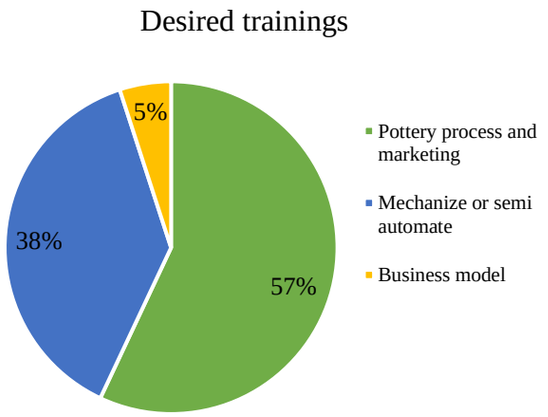
Lump breaker

Lump shakers are machines intended for the dissolution of lumps and agglomerations, they are always used when in a process, due to storage, sedimentation or pressure reasons, there are (in most cases) large pieces/lumps of product (unwanted) that must be crushed to certain sizes. (Armas, 2020)

Sifter

A sieve is nothing more than a machine that performs the function of a sieve, it serves to separate the powders, or in this case the clay, of different thicknesses. (Calderón, 2020).

There are independent lumping and sifting machines on the market, which have various advantages and disadvantages such as sound insulation and low vibration frequency; However, there is no general machine that can simultaneously carry out two stages of the artisanal process, such as the breaking up and sifting of the clay, and that, in addition, they are provided with training to be able to operate the machine since, According to the graph shown in figure 3, of the 386 people surveyed, 57% would like to be trained in the pottery process.



Graphic 2 Identification of the needs of the inhabitants of the municipality of Cohuecan
Source: Own elaboration

In addition to the above, the analysis of the mechanical elements, as well as the selection of the material, is sometimes not taken into account when these machines are designed independently. (Faires, 2003; Gómez, 2018).

Material

The material used in the structure of the machine is the galvanized steel PTR; because it is a very dense material it provides ease of welding and moderate cutting, molding and machining. Likewise, it has a greater weight, tenacity; it has a resistance to corrosion and extreme temperatures; and has superior machinability.

Table 1 shows the properties of galvanized steel of special interest for the project. (Hibbeler, 2011).

Property	Amount	Units
Elastic module	2e + 11	$\frac{N}{m^2}$
Poisson's ratio	0.29	$\frac{N}{D}$
Mass density	7870	$\frac{Kg}{m^3}$
Traction limit	356900674.5	$\frac{N}{m^2}$
Elastic limit	203943242.6	$\frac{N}{m^2}$

Table 1 Specifications of galvanized steel
Source: Own elaboration

Methodology

Structure

Simulation:

The following structure (Figure 2) will be subjected to a numerical analysis using the finite element method and a static stress-strain analysis using the Von Mises criterion.

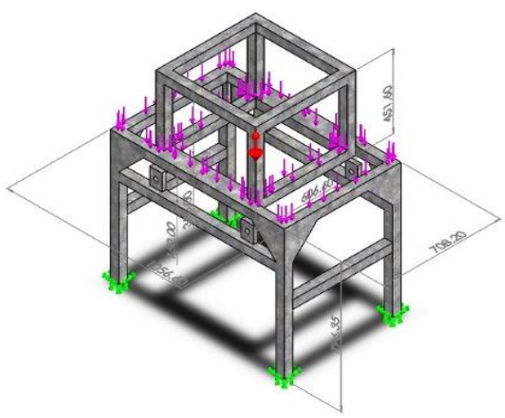


Figure 2 Structure
Source: Own elaboration

ISSN 2523-6865

Gravity:

In this part, our reference point is the plant (the structure, which is the part that receives the greatest force due to the sifting process), which is subjected to a gravity force of 9.81 m/s^2.

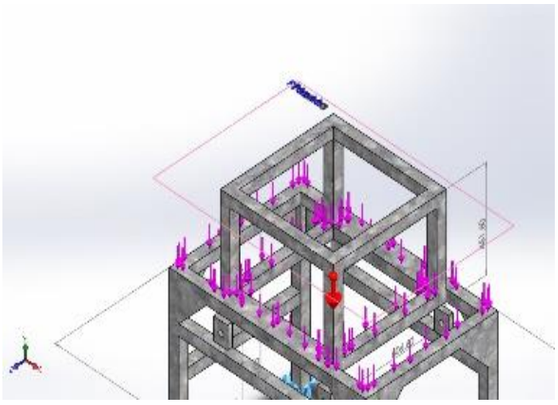


Figure 3 The red arrow in the image indicates the gravity applied to the structure
Source: Own elaboration

To apply the loads to the structure, two areas were chosen where the greatest amount of force is applied due to the back-and-forth movement that the sifting machine will perform once placed.

Load 1:

In figure 4 it can be seen in blue the first face of the structure subjected to a normal force of 1000 N; these loads (represented by blue arrows) are distributed along the selected face of the structure. In reality, the structure is designed to support up to 50 kg of clay (500 N of force), however, in the analysis a safety factor of 1.5 is being considered to limit the nominal load that it will actually support to 100 kg. its useful life the structure.

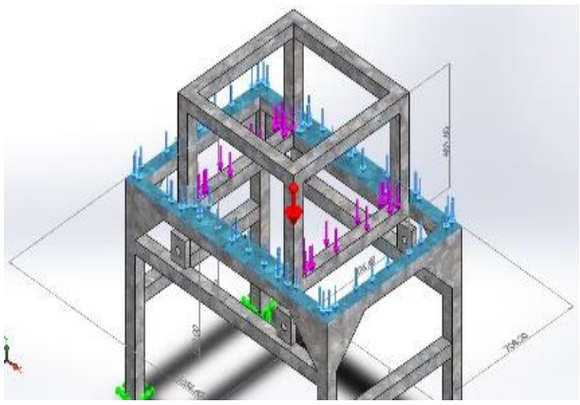


Figure 4 Distribution of forces on one face of the structure
Source: Own elaboration

Load 2:

For force two, the total subjected force of 1000 N is distributed to two faces of the structure as shown in the figure; these forces are also marked with blue arrows.

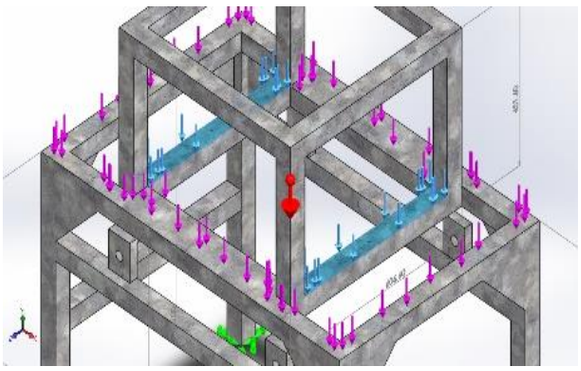


Figure 5 Distribution of forces in the second section of the structure
Source: Own elaboration

Numerical analysis

Figure 6 represents the resulting mesh after applying the numerical analysis by the finite element method with the computer software. The method can be applied in the resolution and diagnosis of structural analysis problems to obtain displacements, deformations and stresses. In this analysis, the entities can be in contact or at a small distance from each other, they are of various types, the one used is of the rigid union type and compatible meshing.

Thus, we have a standard solid mesh type, with an element size of 35.8595mm and a tolerance of 1.79298mm, as well as a total number of nodes of 15649 and a total number of elements of 7637.

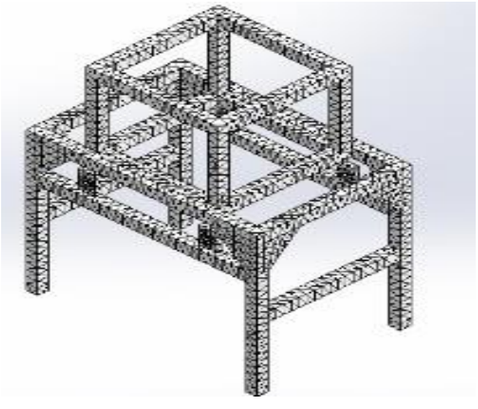


Figure 6 Numerical analysis by the finite element method of the structure
Source: Own elaboration

ISSN 2523-6865

Resultant forces

As can be seen in table 2, the forces are practically negligible in the X and Z axis due to the way in which the design is made in the software, contrary to the y axis, which practically receives all the force applied to the structure.

Selection	Units	Sum X	Sum Y	Sum Z	Resulting
All model	N	0.00976896	5275.17	-0.0487652	5275.17

Table 2 Resulting forces applied on the structure
Source: Own elaboration

Axis

Simulation

The following clamping axis (Figure 7) will be subjected to a numerical analysis using the finite element method and a static stress-strain analysis using the Von Mises criterion.

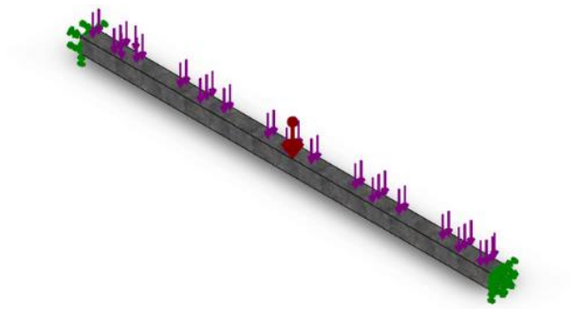


Figure 7 Clamping axis
Source: Own elaboration

Gravity

The reference point is the floor (the clamping axis), which is subjected to a gravity force of 9.81 m / s^2.

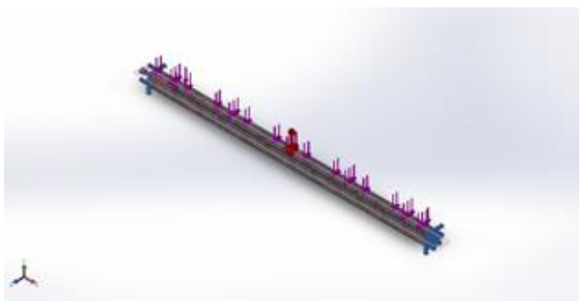


Figure 8 The red arrow in the image indicates the gravity applied to the axis
Source: Own elaboration

To apply the load to the shaft, an area was chosen where the greatest amount of force is applied due to the turning movement.

Load 1

It can be seen in blue on the first face of the structure subjected to a normal force of 750 N, (about 75 kg); these loads (represented by blue arrows) are distributed along the clamping axis. The maximum weight to support will be 50 kg, so the blades have a safety factor of 1.5.

Figure 9 Distribution of forces on one face of the shaft
Source: Own elaboration

Numerical analysis

Figure 10 represents the resulting mesh after applying the numerical analysis by the finite element method with the computer software. The method can be applied in the resolution and diagnosis of structural analysis problems to obtain displacements, deformations and stresses.

In this analysis, the entities can be in contact or at a small distance from each other, they are of various types, the one used is of the rigid union type and compatible meshing.

Thus, we have a standard solid mesh type, with an element size of 11.4398 mm and a tolerance of 0.571988 mm, as well as a total number of nodes of 3244 and a total number of elements of 1551.

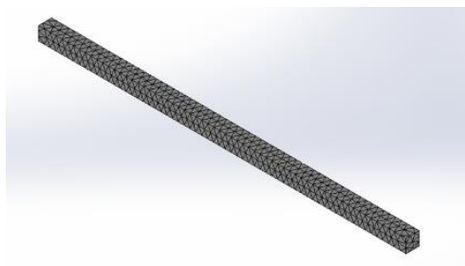


Figure 10 Numerical analysis by the finite element method of the clamping axis
Source: Own elaboration

ISSN 2523-6865

Resulting forces

As can be seen in table 3, the forces are practically negligible in the X and Z axis due to the way in which the design is made in the software, contrary to the y axis, which practically receives all the force applied to the structure.

Selection	Units	Sum X	Sum Y	Sum Z	Resulting
All models	N	-0.0956726	785.401	-0.0582352	785.401

Table 3 Resulting forces applied on the axis
Source: Own elaboration

Blades

Simulation

The next axis will be subjected to a numerical analysis using the finite element method and a static stress-strain analysis using the Von Mises criterion.

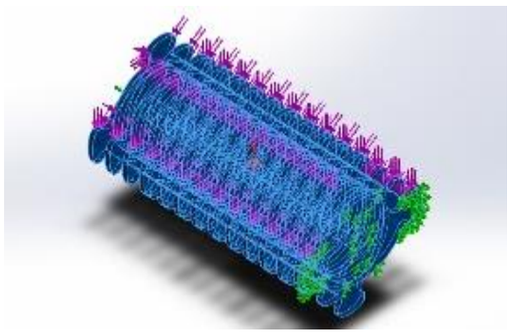


Figure 11 Holding shaft
Source: Own elaboration

Gravity

In this part, the reference point is the plant (the blades), which is subjected to a gravity force of 9.81 m / s^2.

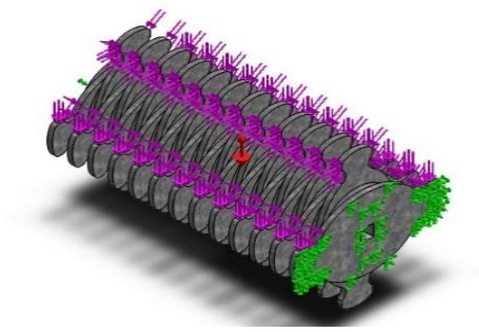


Figure 12 The red arrow in the image indicates the gravity applied to the blades
Source: Own elaboration

To apply the load to the blades, an area was chosen where the greatest amount of force is applied due to the turning movement.

Load 1

In figure 13 it can be seen in blue the first face of the structure subjected to a normal force of 750 N, (around 75 kg); these charges (represented by blue arrows) are distributed along the blades. Actually, the maximum weight to be supported will be 50 kg, so the blades have a safety factor of 1.5.

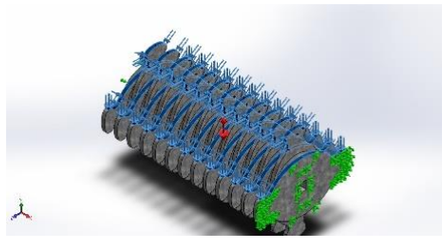


Figure 13 Distribution of forces to the faces of the blades
Source: Own elaboration

Numerical analysis

Figure 14 represents the resulting mesh after applying the numerical analysis by the finite element method with the computer software. The method can be applied in the resolution and diagnosis of structural analysis problems to obtain displacements, deformations and stresses. In this analysis, the entities can be in contact or at a small distance from each other, they are of various types, the one used is of the rigid union type and compatible meshing.

Thus, we have a standard solid mesh type, with an element size of 27.3413 mm and a tolerance of 1.36706 mm, as well as a total number of nodes of 23214 and a total number of elements of 11668.

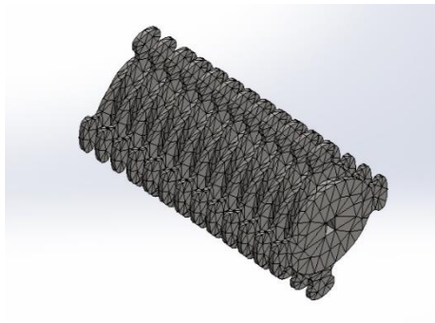


Figure 14 The red arrow in the image indicates the gravity applied to the blades
Source: Own elaboration

ISSN 2523-6865

Resultant forces

As can be seen in table 4, the forces are practically negligible in the X and Z axis due to the way in which the design is made in the software, contrary to the y axis, which practically receives all the force applied to the structure.

Selection	Units	Sum X	Sum Y	Sum Z	Resulting
All models	N	-4.73118	1485.07	61.3836	1486.34

Table 4 Resulting forces applied on the blades
Source: Own elaboration

Results

For the presentation of the results we will delve into a topic of great importance which is the Von Mises criterion, it will be of great importance to us to understand part of the results of the final structural analyses.

The Von Mises criterion, also called the maximum distortion energy criterion, is a static resistance criterion, applied to ductile materials depending on the material, it will not flow at the analyzed point as long as the distortion energy per unit volume at the point does not exceed the distortion energy per unit volume that occurs at the moment of creep in the tensile test. (Hibbeler, 2011).

Structure

Stress

As can be seen in Figure 15, in the Von Mises criterion presented by our structure, the minimum stress coefficient is $4.056e*10^2\frac{N}{m^2}$ and the maximum stress coefficient is $3.299e*10^6\frac{N}{m^2}$.

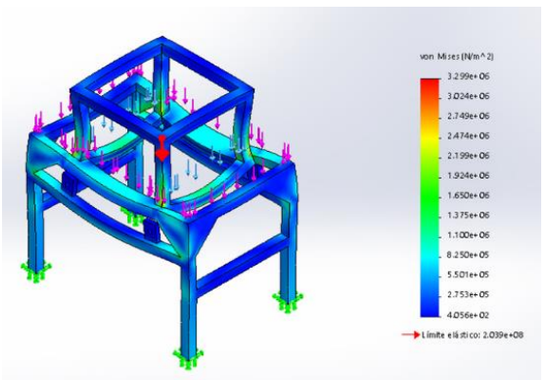


Figure 15 Von Mises stresses in the structure
Source: Own elaboration

Displacement

In Figure 16 we can observe the Von Mises criterion that our structure presents, the minimum displacement coefficient is 0 mm which makes it negligible and the maximum tension coefficient is $1.598e*10^2\ mm$. Which in turn we can visualize due to the resulting displacement (URES). (Norton, 2011).

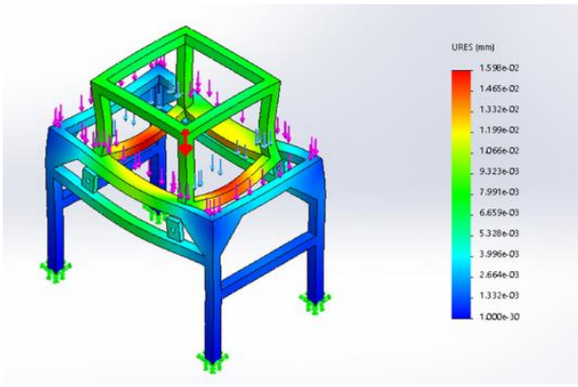


Figure 16 Displacements of the structure
Source: Own elaboration

Unitary deformations

Finally we can observe the equivalent unit strain of the structure whose minimum strain coefficient is $1.950e*-10^9$ which makes it negligible and the maximum stress coefficient is $1.063e*-10^5$.

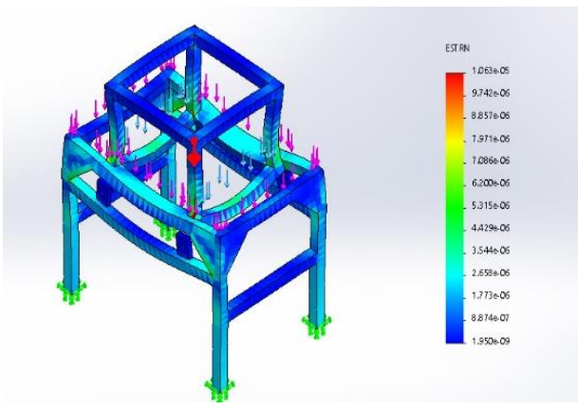


Figure 17 Unitary deformations of the structure
Source: Own elaboration

ISSN 2523-6865

Clamping axis

Stress

As can be seen in Figure 18, in the Von Mises criterion presented by our structure, the minimum stress coefficient is $1.847e*10^{4}\frac{N}{m^{2}}$ and the maximum stress coefficient is $1.623e*10^{7}\frac{N}{m^{2}}$.

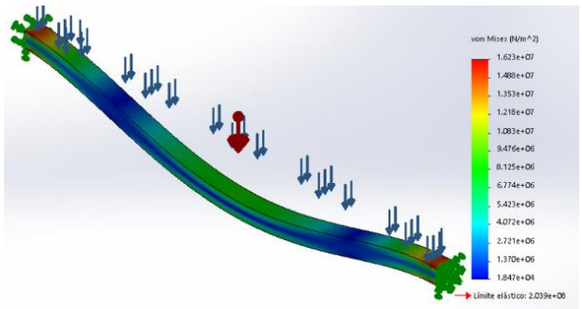


Figure 18 Von Mises stresses on the axis
Source: Own elaboration

Displacement

In Figure 19 we can see, in the Von Mises criterion that our structure presents, the minimum displacement coefficient is 0 mm which makes it negligible and the maximum tension coefficient is $1.063e*10^{-1}\,mm$. Which in turn we can visualize due to the URES.

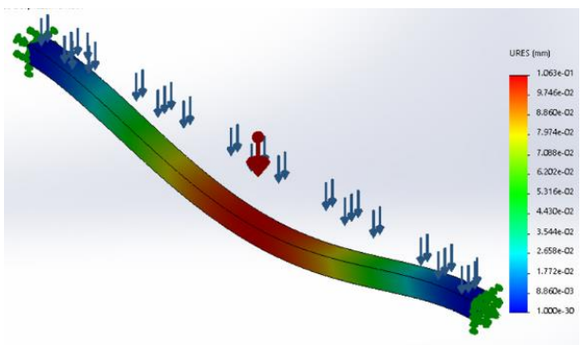


Figure 19 Axis displacements
Source: Own elaboration

Unitary deformations

Finally, we can observe the equivalent unit strain of the structure whose minimum strain coefficient is$1.861e*10^{-6}$ which makes it negligible and the maximum stress coefficient is $5.808e*-10^{-5}$.

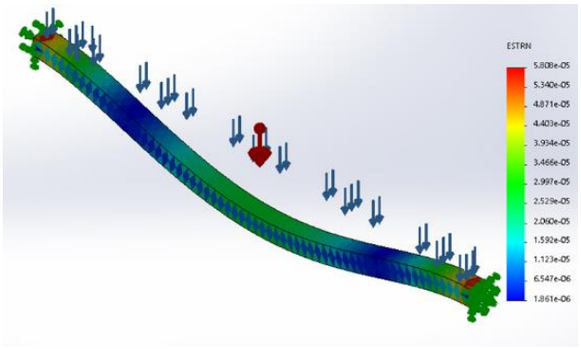


Figure 20 Shaft unit strains
Source: Own elaboration

Blades

Stress

As can be seen in the following table, in the Von Mises criterion presented by our structure, the minimum stress coefficient is $6.103e*10^{1}\frac{N}{m^{2}}$ and the maximum stress coefficient is $2.507e*10^{5}\frac{N}{m^{2}}$.

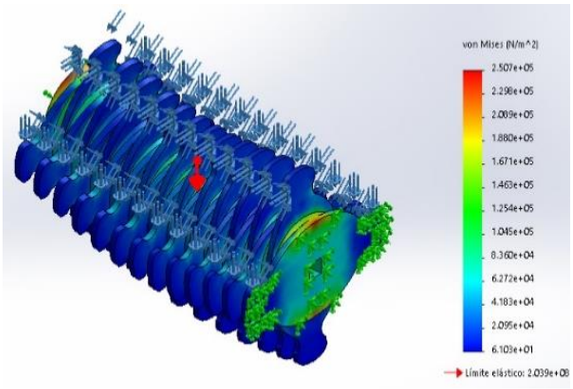


Figure 21 Von Mises stresses in the blades
Source: Own elaboration

Displacement

In this second table we can observe, in the Von Mises criterion that our structure presents, the minimum displacement coefficient is 0 mm which makes it negligible and the maximum tension coefficient is $2.045e*10^{4}\,mm$. Which in turn we can visualize due to the URES.

ISSN 2523-6865

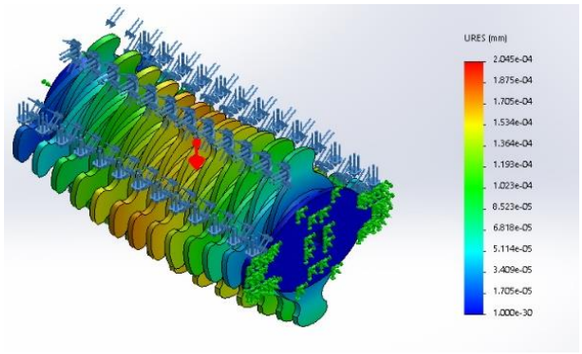


Figure 22 Displacements in the blades
Source: Own elaboration

Unitary deformations

Finally, we can observe the equivalent unit strain of the structure whose minimum strain coefficient is$6.989e*10^{-10}$ which makes it negligible and the maximum stress coefficient is $9.142e*-10^{-7}$.

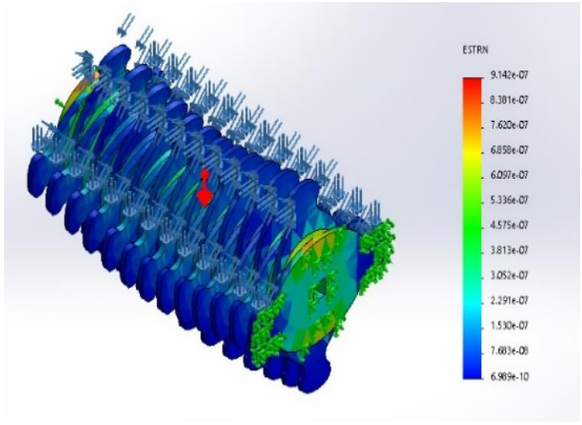


Figure 23 Deformations in the blades
Source: Own elaboration

Acknowledgement

The authors appreciate the support granted by PRODEP, for the realization of this work.

Financing

This project is financed by PRODEP through the Support Program for the Strengthening of CA with assignment document: M00/2250/2021.

Conclusions

The design of a joint system of two machines (lumps and sifters) was proposed, which, by working together, is expected to reduce work times and delivery of pottery products. Thanks to the proposal of this machinery, the artisans will have a decrease in the physical fatigue that comes with the manual work of breaking up and sifting the raw material.

References

I. Gómez, S. (2018). *El Gran libro de SolidWorks* (5th ed.). Marcombo.

II. Hibbeler, R. (2011). *Mecánica de materiales (6th ed., p. 96)*. Pearson Educación de México S.A. de C.V.

III. Faires, V. (2003). *Diseño de elementos de máquinas* (4th ed.). Limusa.

IV. Calderón, A. (2020). *Diseño de una máquina cernidora de arena verde para el proceso de fabricación artesanal de utensilios de aluminio en el caserío de chacupe – Lambayeque*. [Tesis de licenciatura]. Universidad Católica Santo Toribio de Mogrovejo.http://hdl.handle.net/20.500.12423/3102

V. Armas, I. Herrera, R. Et al. (2020). *Los costos de producción artesanal para la actividad de alfarería en la Parroquia La Victoria cantón Pujilí*. RECIMUNDO, 360-369. DOI:10.26820/recimundo/4.(1).esp.marzo.2020.360-369

VI. Cáceres, S. (2013). *Actividades económicas, industriales y artesanales.* Universidad del Norte de Nicaragua.

VII. Brito, G. Sánchez, L. (2017). *Alfarería, Producción Artesanal.* Universidad Autónoma del Estado de México.

VIII. Norton, R. L. (2011). *Diseño de Máquinas Un enfoque integrado*. (5ta ed.). Pearson.

ISSN 2523-6865

Article **Journal Computational Simulation**
December 2022, Vol.6 No.16 10-17

Tool design with augmented reality for the reactivation of regional museums

Diseño de herramienta con realidad aumentada para reactivación de museos regionales

TOVAR-ROSAS, Claudia Rocio†*, SERRANO-MACHADO, Ana Cristina, AGUILAR-ARELLANO, Felisa Josefina and RODRÍGUEZ-ALANIS, Francisco de Borja

Universidad Politécnica de Gómez Palacio, Investigadora del INAH y presidenta del Consejo de Paleontología. México.

ID 1st Author: *Claudia Rocio, Tovar-Rosas* / **ORC ID:** 0000-0002-8238-7493, **CVU CONACYT ID:** 745074

ID 1st Co-author: *Ana Cristina, Serrano-Machado* / **ORC ID:** 0000-0003-3222-0254, **CVU CONACYT ID:** 835121

ID 2nd Co-author: *Felisa Josefina, Aguilar-Arellano* / **ORC ID:** 0000-0003-24060772, **CVU CONACYT ID:** 100174

ID 3rd Co-author: *Francisco de Borja, Rodríguez-Alanis* / **ORC ID:** 0000-0002-29491785, **CVU CONACYT ID:** 719064

DOI: 10.35429/JCS.2022.16.6.10.17 Received: July 15, 2022; Accepted December 30, 2022

Abstract

Museums always motivate users to observe and analyze past situations with which circumstances that gave way to current or future events are evoked, from them future scenarios are analyzed in addition to offering a service to society that currently knows the heritage that is protected in them. Currently, with the pandemic caused by COVID-19, daily activities were restricted, and people stayed inside their homes, this brought with it the impossibility of carrying out activities such as attending events, and visiting places far from the local area, among others. All this caused some activities such as visits to museums to be restricted and therefore some had to close their doors permanently or suffered from budget cuts for their maintenance, which is why the design of a tool that promotes remote assistance is sought. towards some regional museums, to be profitable and not disappear due to lack of resources, in addition to trying to maintain the current facilities and improve the quality of service, to achieve greater dissemination of its exhibitions, conservation, and future works.

Augmented reality, Innovation, Legacy

Resumen

Los museos siempre motivan a los usuarios a observar y analizar situaciones del pasado con las cuales se evocan circunstancias que dieron paso a los eventos actuales o futuros, a partir de ellos se analizan panoramas futuros además de ofrecer un servicio a la sociedad con el fin de conocer el patrimonio que en ellos se resguarda. Actualmente con la pandemia provocada por el COVID-19, se restringieron las actividades diarias y se permanece dentro de los hogares, esto trajo consigo la imposibilidad de realizar actividades como asistir a eventos, realizar visitas a lugares lejos del ámbito local, entre otros. Todo ello causó que algunas actividades como visitas a los museos fueran restringidas y por ende algunos tuvieron que cerrar las puertas de forma definitiva o sufrieron de recortes presupuestales para su mantenimiento, por ello es que se busca el diseño de una herramienta que promueva la asistencia remota hacia algunos museos regionales, con el fin de ser rentables y estos no desaparezcan por falta de recursos, además de tratar de mantener las instalaciones actuales y mejorar la calidad del servicio, para así lograr una mayor difusión de sus exhibiciones, conservación y trabajos futuros.

Realidad aumentada, innovación, patrimonio

Citation: ARROYO-ALMAGUER, Marisol, GONZÁLEZ-MARTÍNEZ, Mary Carmen, CHÁVEZ-VIDAL, Eduardo Jesús and RODRÍGUEZ-VARGAS, María de Jesús. Tool design with augmented reality for the reactivation of regional museums. Journal Computational Simulation. 2022. 6-16:10-17.

* Correspondence to the author (E-mail: ctovar@upgop.edu.mx)
† Researcher contributing as first author.

Introduction

The world has undergone significant changes in recent years, from the way we live together, the educational model, the way we work, among others. That is why some activities that were carried out on a daily basis have been modified, as indicated by Pacheco (2020), "we could not imagine the transformation in living, thinking, acting, taking care of ourselves, distancing ourselves, that we would have since the beginning of the year 2020. All this as a result of the appearance of a compound of proteins and nucleic acids that requires living cells to reproduce, a coronavirus related to other known coronaviruses that have caused health problems and deaths in the world." In order to continue to coexist with the new normal brought about by the SARS-CoV-2 virus, daily activities had to be modified, such as how to work remotely with access to computer units from home, attend local and even global events virtually, among others. These changes brought about transformations in the economy of the entire world, in addition to redirecting economic resources towards elements related to health, leaving aside the distribution of capital that was allocated to the areas of recreation and leisure, in order to ensure available resources for doctors, medicines, hospitals, among others.

According to Román (2020) "the economic dimension of culture in Mexico has been relegated, basically, to the number of cultural infrastructure available, the source of financing and the consumption of goods and services. Factors such as the income it generates and the contribution it makes to the country's economy, and even more, the level of contribution to people's productivity, when developing their activities or the creation of others, have been left aside, although there are indicators that attest to this. Therefore, it is important to emphasize that the culture sector has a potential for the economic growth and development of the country. In recent years, the social and cultural dynamics have changed, so it is important to know in detail the cultural sector in Mexico", it is not enough, only to know what and how much is spent, but also how and for what, in addition to the economic and cultural flows that are favoring, so it is necessary to investigate the various activities that generate economic resources and are used in the cultural sector.

As part of the cultural heritage are museums, in which historical elements are stored on their walls, are preserved with the greatest amount of care to be visited by people of different ages, in order to inform and show both recent and past events, also these have had internal and external modifications to attract the attention of the public, as indicated by Colman (2022), "museums throughout history have undergone changes, they have gone from being a place of deposits of objects to a more educational place. In this sense, the link between museums and education is still in the process of being linked to the different levels of the educational system. Even in this XXI century it is in constant change to respond to the specific needs of students, teachers and the educational community", that is why part of the history, recognitions and events are stored in them and serve to give a basis to modernity, however, it is necessary to identify their economic bases and the way in which these sanctuaries full of history can be protected, in which traces of the past can be found and allow reflection on the future.

According to Unesco (1980) "the museums in Mexico depend mostly on the federal government, since by law the cultural, archeological and historical heritage, and in some cases artistic, is property of the State", since 1980 the economic resources administered by the museums come from the federal and state governments, on both depends the survival, opening and management of the museums in Mexico.

From the above, questions arise: Where do recreational activities such as museums get their economic resources if nobody visits them?, Is it necessary to have a certain activity to receive economic resources?, Are scientists still in charge of making discoveries if nobody can visit them?, How did the pandemic affect this type of places in terms of visits?, Have museums carried out some activities to raise funds or have they closed their doors permanently?

ISSN 2523-6865

ARROYO-ALMAGUER, Marisol, GONZÁLEZ-MARTÍNEZ, Mary Carmen, CHÁVEZ-VIDAL, Eduardo Jesús and RODRÍGUEZ-VARGAS, María de Jesús. Tool design with augmented reality for the reactivation of regional museums. Journal Computational Simulation. 2022

According to Inegi (2021), 70.8 % of the museums had public resources for their operation (37.3 % with resources of municipal origin; 34.7 %, state, and 28.0 %, federal); 12.6 % operated with private resources; 5.3 %, with mixed resources and 11.3 %, with self-generated resources. In 2020, the percentages were similar, which is why the resources granted by the government are fundamental for the implementation of these museums, in addition to taking into account the self-generated resources from new research.

Based on the above data, Inegi (2021) mentions: "the health contingency due to the COVID-19 pandemic caused the closure of most of the museums for some months in 2021. Of the 1248 museums considered in the directory of informant sources for the 2021 edition, information was only collected from 1046 museums that year. Considering the above, in August of that year only 650 (52%) were open. By February 2022, a total of 849 museums were open (68%). In 2020, 1003 museums provided information on the overall number of visitors. In 2021 the figure rose to 1,046 museums, i.e., 43 more museums. By geographic location, 13 states registered less than 20 museums, six registered between 20 and 29, another six states are home to 30 to 44 museums and the remaining seven states have more than 45 museums.

It should be noted that according to Longhi, Quezada, & Cappello (2021) indicate that, "between 90% and 95% of the 60,000 museums in the world remained closed as a result of the pandemic by COVID-19, given this problem, they appealed to different ways to maintain contact with their audiences, being digital technologies the ones that have reported the best achievements".

All the above gave rise to further research on what were the main reasons why visits increased in some sites, while in others the influx of users was lower, since by imitating the actions of museums that had a substantial increase in visits, could be replicated in regional museums and thus increase the number of visits, Based on this, the data provided by Ingei was analyzed and we sought to analyze the reason why visitors were interested in attending certain museums when the restrictions caused by the pandemic ended, from which it was found that the most frequent means by which visitors learned of the existence of the museum were: through friends, relatives or acquaintances (28. 5 %) and through the Internet (14.2 %). Having learned about it through teachers, fellow students or textbooks occupied the fifth position, with 10.4 % (in 2020, this option occupied the sixth position, with 7.7 % of the responses. In 2019 it occupied the second position, with 17.5 %).

For all the above, it was verified that one of the tools by which the visit to the sites increased is through the diffusion that the museum has on the internet, in addition to the talks between families, which are carried out by electronic means such as smartphones, which is why we analyzed a way to merge both elements and that could provide a considerable increase in visits to regional museums and make known the elements that they contain for their dissemination in all fields, not only in the scientific field, but also for the general public, as Celorrio (2015) indicates, "society has evolved and cultural institutions in general, and museums in particular, need to adapt to new media and communicative supports to remain integrated and, in the long run, avoid oblivion or disappearance. Nowadays it is common for museum institutions to have their own website or manage different profiles on social networks, but it is not so common for them to comply with the dialogic dimension of the Web.

Therefore, part of the hypothesis is based on the assumption that museums need to assume to a greater extent the participatory dimension of the Web and consider their target audience not as a mere passive consumer, but as an active part of the social and cultural environment of the institution, which is why some applications implemented by museums were verified, from resources such as virtual tours, to 360° views of the place.

ISSN 2523-6865

Based on the above, we proceeded to indicate which regional museums are most affected by the pandemic, in addition to analyzing the various options that could be offered to increase the number of visits, for which the museum on the Rincón Colorado paleontological zone was selected to implement new technological tools and thereby increase the number of visits, Both in person and virtually, since this area presents a particular problem, since in addition to showing the elements inside the museum, they are exposed outdoors and this has caused some of the elements to be affected by the weather and especially by the people who frequently come to view the footprints, bones and elements of the dinosaurs that existed in this region.

The Rincón Colorado Paleontological Zone is the first paleontological site in the country adapted for public visitation: Rincón Colorado, located in the municipality of General Cepeda, in the southeast of the state. Rincón Colorado, where traces of the Cretaceous period beaches are preserved and a large concentration of herbivorous dinosaur remains, called hadrosaurids, have been discovered, offers a trip to the past of the Earth 72 million years ago, along the shores of the ancient inland sea of North America, whose signs remain in the desert, in the rocks and quarries rich in marine, plant and insect fossils, in addition to the vestiges of hadrosaurids.

In this paleontological site there are only faithful reproductions of the bone remains of the original hadrosaurs for conservation reasons, as well as their reservation for research of most of them, the site offers the opportunity to enter a natural space of 72 million years where you can see geological elements of the Cretaceous, the last period of the Mesozoic era, visible with the help of informative and didactic brochures.

With this, we sought a way in which technologies could help preserve these elements or at least minimize damage from users, since these elements, being outdoors (Figure 1), could suffer unintentional damage from visitors. In addition, it is not possible to avoid visits by the various users, since, as previously indicated, it is necessary for the survival of this museum, since, although admission to it is free, it obtains its income from the government, which, from the visits, provides the resources for its conservation.

Therefore, when analyzing the options, it was indicated that the tool that could support the increase of visits could be an augmented reality application, which would expose the dinosaurs, environments and elements that could be found in the time in which they existed according to the discoveries made and the footprints left, in addition to locating the context of the types of fur or plumage that some animals had at that time.

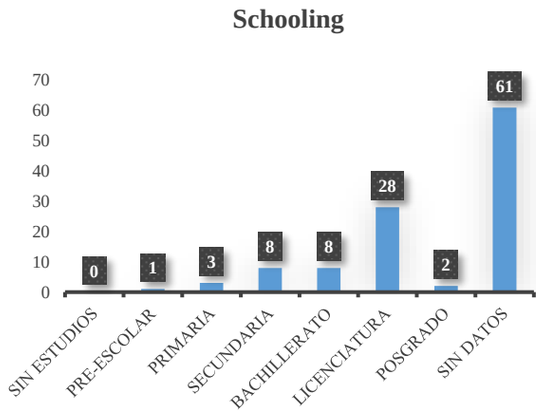
Figure 1 Exterior exposure of dinosaur remains
Source: Mexican cultural information system (2022)

Methodology to be developed

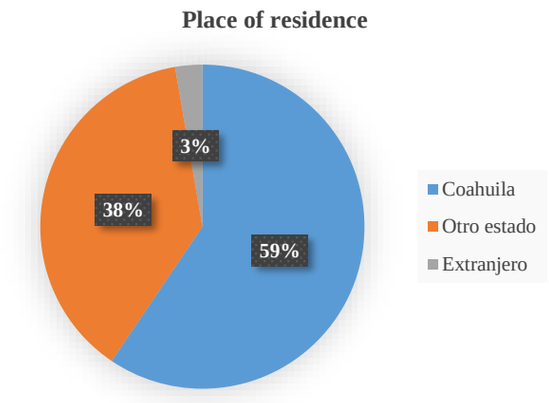
In the first instance, guided visits were made to the area, to delimit the actions that could be carried out, in addition to locating the site and analyzing the current situation, all this in order to execute an action plan according to the needs, this was done by a group of 5 project participants, of which 2 people are project administrators and 3 elements that will execute the relevant actions in the development of the activities.

Based on the visit, a situational analysis was made, in which it was verified who were the people who mostly attended this place, taking as a reference the month of January, since in this month the activities in the museum were reactivated, with the proper sanitary measures; The analysis was developed in order to know their schooling (Graph 1), their ages (Graph 2), as well as their place of residence (Graph 3), all of this in order to know the type of population to which the project will be directed, as well as to identify the characteristics of the population, since this will be the basis for promotional campaigns and the detection of needs.

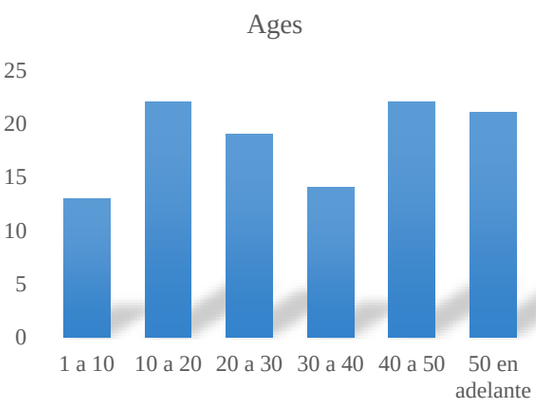
ISSN 2523-6865



Graphic 1 Schooling of visitors
Source: Rincón Colorado Paleontological Zone



Graphic 2 Place of residence
Source: Rincón Colorado Paleontological Zone



Graphic 3 Age range
Source: Rincón Colorado Paleontological Zone

Based on the above data, a comparison was made of the information obtained in general visits to museums in the year 2021 in the area of Coahuila, where the museum is located, which was 6,338 visitors to museums throughout the region, in comparison, the museum received 111 visitors at the beginning of the year in the facilities.

After carrying out the situational analysis, a team meeting was held, through which a pertinent option was sought for the development of the proposal, in addition to identifying the profiles of the creators of the project, the scopes were indicated and the limitations that they could have when elaborating the project proposal were recognized, in this meeting there were personnel in charge of the paleontological zone, as well as elements of the Polytechnic University of Gomez Palacio (UPGOP), which will be in charge of carrying out the project in its entirety and Lic. Rosario Pedroza García, representative of the civil association Morelear, which will carry out promotion and liaison activities between the museum and the UPGOP.

Once the previous meeting was held, we proceeded to create a chronogram, in which the activities to be carried out were detailed, the type of knowledge necessary for the realization, in addition to identifying the necessary characteristics for its development, promoting time management using agile development methodologies.

The development of the project was selected to be carried out in augmented reality taking into account the fact that most people have a mobile device for different daily activities, as indicated by the National Survey on Availability and Use of Information Technologies in Households (ENDUTIH) 2020, in Mexico there are 84.1 million internet users and 88.2 million cell phone users.

In Mexico, in 2020, an estimated population of 84.1 million Internet users, representing 72.0% of the population aged six years or older. The survey estimates that 78.3% of the population located in urban areas are users, while in rural areas the proportion is 50.4%.

In 2019 users in urban areas were estimated at 76.6 percent and in rural areas the estimate was 47.7 percent, which is why by identifying these characteristics there is a relevant motive in employing augmented reality as a tool to exhibit the pieces inside and outside the museum, in addition to preserving the pieces in an integrated way by drawing users away from the archaeological zone and showing the dinosaurs in a didactic way for all ages.

ISSN 2523-6865

The development team is made up of 13 students from the Animation and Visual Effects Engineering (IAEV) major, one student from the Information Technology Engineering (ITI) major, as well as 3 project managers managed by the institution and participants in the university's majors.

After creating the work team, the activities to be carried out were assigned, which consisted of the creation of sketches, modeling, dinosaur design, application of effects and textures, and implementation of QR code visualization.

All the design and modeling activities of the dinosaurs are carried out by different students of the IAEV career, since the specialty they are studying allows them to know in depth the tools for the realization of the different designs.

As part of the design of the tool, paper models of the three dinosaurs that are known to have inhabited the region, Velafrons coahuilensis or duckbill (Figure 2), ornithomimidae (Figure 3) and another dinosaur similar to tyrannosaurus rex (Figure 4), were made in the first instance, These were presented for subsequent modeling using tools such as Maya and Unity software, for the realization of the figures were used models provided by the museum, in addition to an exhaustive research on the internet about the types of dinosaurs and characteristic features.

Figure 2 Duck-billed dinosaur
Source: Mariana Escamilla IAEV student

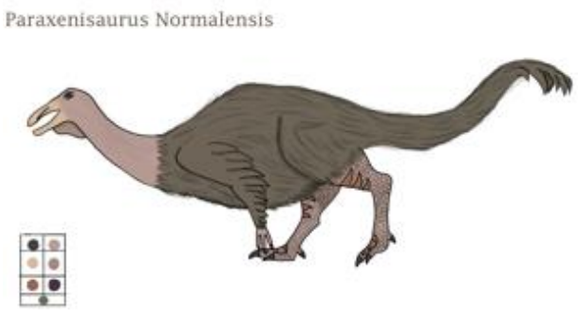


Figure 3 Dinosaur ornithomimidae
Source: Rosa Avalos, IAEV student

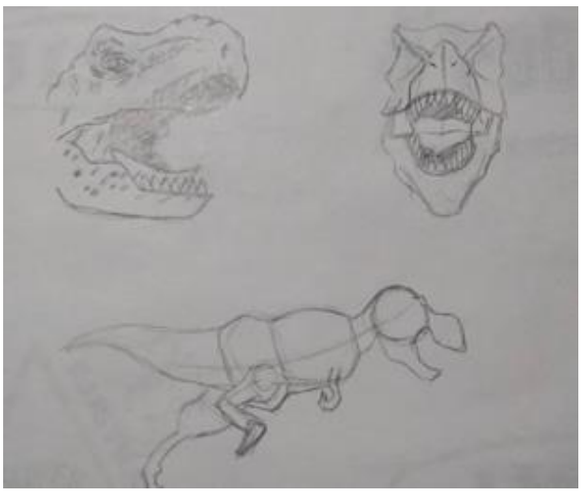


Figure 4 Dinosaur of the tyrannosaurus rex family
Source: IAEV students

Once the sketches were finished, we proceeded to verify the models from some images available on the Internet and in the museum, in order to give an approximation to what we wanted to create, in addition to including another hadrosaur, the latirhinus to the list of figures to be made (Figure 5).

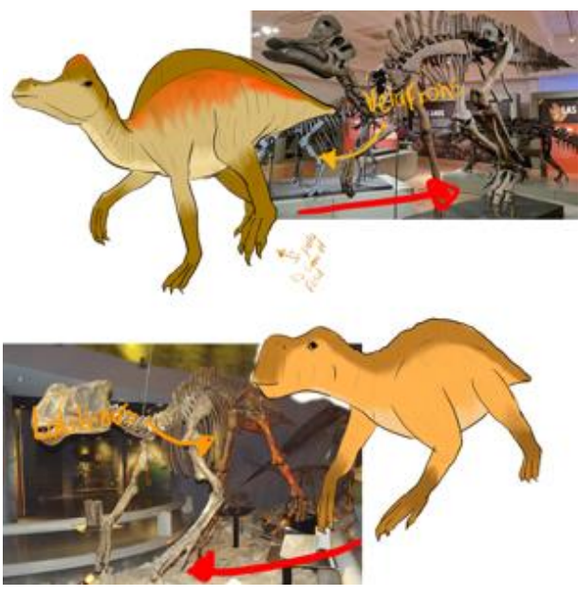


Figure 5 Dinosaurs based on real skeleton.
Source: IAEV students

ISSN 2523-6865

ARROYO-ALMAGUER, Marisol, GONZÁLEZ-MARTÍNEZ, Mary Carmen, CHÁVEZ-VIDAL, Eduardo Jesús and RODRÍGUEZ-VARGAS, María de Jesús. Tool design with augmented reality for the reactivation of regional museums. Journal Computational Simulation. 2022

Once they were drawn in order to validate the characteristics and types of skin or feathers that each species had (Figure 6), a meeting was held with the work team and the museum manager to validate the objects and identify findings of different characteristics to those drawn, in order to find relevant modifications and proceed to use the Maya software tool (Figure 7).

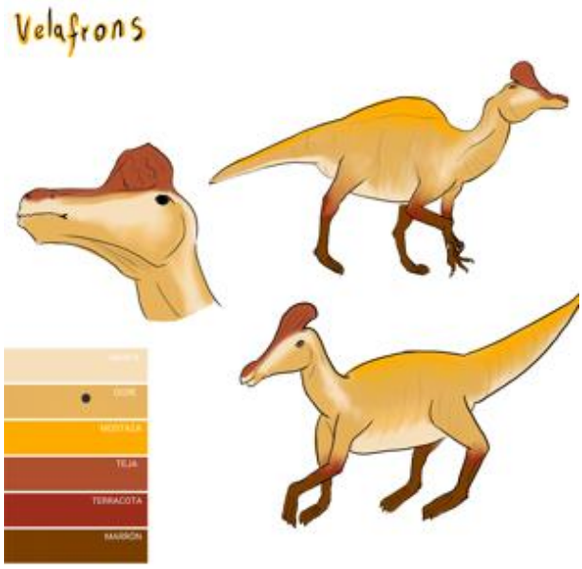


Figure 6 Image of dinosaur using colors approximating the real one
Source: IAEV students

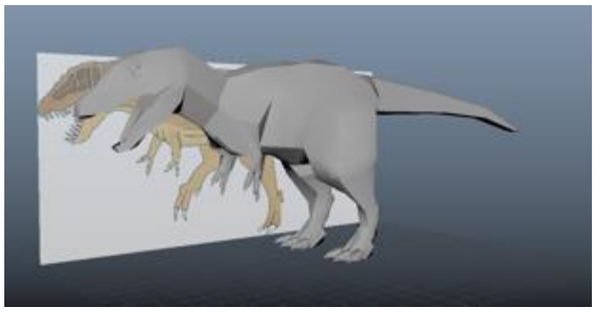


Figure 7 Element created in Maya Software based on sketch
Source: IAEV students

Results

As a result, four dinosaur sketches were obtained in the process of applying textures, movement and environment with the creation of vegetation and type of place, with this it is expected to maximize the interaction of people with the types of dinosaurs that existed in the region, in addition to promoting the visit to the site, since being in a not very busy area the museum has little attendance.

Another of the expected actions is to complete the mobile application and to be able to upload as a developer to the Play Store platform the application in downloadable format, in order to bring information about dinosaurs, types, food, among others to the largest possible population, since there are several visits from foreigners to the area of Coahuila, as well as foreigners who visit the museum in search of observing and learning about the characteristics of that time.

Currently the museum has visits throughout the year, but mainly on school dates due to the excursions made by educational institutions, besides having scheduled excursions by the tourism area of the area, that is why it is expected that at the end of the application it can be disseminated and installed on the users' devices and take a part of the museum, which can be appreciated anywhere in the world.

As future work is expected to fully realize the application and from this analyze the possibility of making a virtual tour throughout the museum, to provide a better view of the site, apart from seeking federal support to promote the project and to be made for multiple platforms and in order to reach any corner of the world, all with the support of cellular technology and internet, two powerful tools in today's age.

Thanks to

Special thanks go to the Rincón Colorado Paleontological Zone, because thanks to them, their guidance and knowledge we were able to carry out this application, in addition to recognizing the work done by Ms. Rosario Pedraza, representative of Morelear A.C., thanks to her we were able to make the research trip, apart from the necessary contact with the people in charge of the museum was fast and in the detection of needs she had a positive contribution by getting involved in the development of the project and in the dissemination of the new application to various institutions in order to promote the scientific collection.

Another special thanks goes to the IAEV career, because of them the design of the application is being carried out smoothly and efficiently.

ISSN 2523-6865

Funding

The present work was financially supported by the Asociación Civil Morelear, which helped with transportation and project management, in addition to contacting both the museum and the university for the development of the project.

As for the resources granted by the UPGOP are the project coordinators and students of the specialties of animation and visual effects and information technology, which as part of their education must perform internships in an institution or in companies in the field of their specialty, so they worked on the project without any economic perception and using the material within the institution.

Conclusions

From the development of the application is expected an increase in the number of people who currently attend the museum, in addition to seeking the increase of visits is proposed to upload the application to the Play Store platform, in order to share knowledge, in addition to proposing to make some promotional events by Morelear A.C. in the Paseo Colón, which will be inviting the community in general to meet the dinosaurs that at some point in the life of the planet were traveling around and can be seen from the augmented reality application, in addition to requesting various supports for the museum in order to expand the search for more specimens and thus can diversify the activities that currently have.

References

Celorrio Moreno, I. (2015). *La difusión del museo en el entorno digital: nuevos recursos tecnológicos y online.* Trabajo de fin de grado, universidad de valladolid, facultad de ciencias sociales jurídicas y de la comunicación, Yucatán.

Colman Ramírez, F. J. (2022). *Museos y educación: Una revisión bibliográfica*. VECTORES. Educativos, 1(1), 15–29. https://doi.org/10.56375/ve1.1-8

Instituto Nacional de Estadística, Geografía e Informática, (2021) *Comunicado De Prensa Núm. 352/21*. México: INEGI

Instituto Nacional de Estadística, Geografía e Informática, (2021) *Estadística de museos 2021*. México: INEGI

Instituto Nacional de Estadística, Geografía e Informática, (2020) *Usuarios con dispositivos móviles.* México: INEGI

Longhi-Heredia, Sebastián-Alberto, Quezada-Tello, Laddy Liset, & Cappello, Giancarlo. (2021). *Estrategias digitales de difusión museística en tiempos del COVID-19. Estudio comparativo entre Ecuador, España y Perú.* Contratexto, (36), 229-260. Epub 30 de noviembre de 2021.https://dx.doi.org/10.26439/contratexto2021.n036.5243

Pacheco-Romero, José. (2020). *La pandemia por COVID-19 y cambios en el vivir sobre la tierra.* Revista Peruana de Ginecología y Obstetricia, 66(2), 00002. https://dx.doi.org/10.31403/rpgo.v66i2244

Román Nieto, A. M. (2020). *Análisis del subsector museos y su contribución económica en México.* UVserva, (9), 20–34. https://doi.org/10.25009/uvs.v0i9.2686

SIC México. (01 de 01 de 2022). *Sistema de Información Cultural SIC México*. Recuperado el 15 de 03 de 2022, de SIC México: https://sic.gob.mx/ficha.php?table=zona_arqueologica&table_id=220

Unesco. (1980). Museos de México, Museos y patrimonio histórico. *Unesdoc*, págs. 87 - 164.

.

ISSN 2523-6865

Article **Journal Computational Simulation**
December 2022, Vol.6 No.6 18-27

Enclosure maximum capacity control in pandemic time, using artificial vision

Control de aforo máximo de recintos en tiempos de pandemia, utilizando visión artificial

HERNÁNDEZ-VILLANUEVA, Mario Alejandro†*´, MORALES-HERNÁNDEZ, Maricela´´, CASTELLANOS-BALTAZAR, Roberto Tamar´´ and RAFAEL-PÉREZ, Eva´´

´Universidad Tecnológica de los Valles Centrales de Oaxaca. Avenida Universidad S/N, 71270 Zimatlán, Oax.
´´Tecnológico Nacional de México/Instituto Tecnológico de Oaxaca. Avenida Ing. Víctor Bravo Ahuja No. 125 Esquina Calzada Tecnológico, C.P. 68030; Oaxaca de Juárez, Oaxaca.

ID 1st Author: *Mario Alejandro, Hernández-Villanueva* / **ORC ID:** 0000-0002-0097-3756, **CVU CONACYT ID:** 1230408

ID 1st Co-author: *Maricela, Morales-Hernández* / **ORC ID:** 0000-0002-3521-2041, **CVU CONACYT ID:** 731036

ID 2nd Co-author: *Roberto Tamar, Castellanos-Baltazar* / **ORC ID:** 0000-0002-3733-0711

ID 3rd Co-author: *Eva, Rafael-Pérez* / **ORC ID:** 0000-0003-2793-1254, **CVU CONACYT ID:** 905268

DOI: 10.35429/JCS.2022.16.6.18.27 Received: July 20, 2022; Accepted December 30, 2022

Abstract

The article's objective is to show the results of the development of a prototype capable of counting people, using artificial vision tools, in order to maintain a maximum capacity allowed in any closed space and thus be able to maintain a healthy distance, taking into account to the health protocols established in our country by the competent health authorities. It is used an own methodology, taking aspects and combining the cascade and prototype model. The new normality requires maintaining a health protocol. According to the Undersecretary of Health, Dr. Hugo López Gatell declared in a virtual meeting with governors on June 17, 2021, that the capacity restriction in the tourist infrastructure, restaurant, bars, recreational centers and different public spaces would allow a rapid economic reactivation and a reduction in the risk of contagion (Health Secretary, 2021). By obtaining a functional prototype, it is helping to face the problems that have occurred with the current global COVID pandemic. The prototype was programmed in Python 3, using a Raspberry board with the *Raspberry Pi* operating system.

COVID, Venue Capacity, Artificial vision

Resumen

El presente artículo tiene como objetivo mostrar los resultados del desarrollo de un prototipo capaz de realizar un conteo de personas, utilizando herramientas de visión artificial, con la finalidad de mantener un aforo máximo permitido en cualquier espacio cerrado y así, poder mantener sana distancia, atendiendo a los protocolos de salud establecidos en nuestro país por las autoridades sanitarias competentes. La metodología utilizada es propia, tomando aspectos y combinando el modelo en cascada y de prototipo. La nueva normalidad requiere mantener un protocolo de sanidad, que, de acuerdo con el Subsecretario de Salud, Dr. Hugo López Gatell quien declaró en reunión virtual con gobernadores el 17 de junio de 2021, que la restricción de aforo en la infraestructura turística, restaurantera, bares, centros recreativos y distintos espacios públicos permitirá la rápida reactivación económica y la disminución del riesgo de contagios (Secretaria de Salud, 2021). Con la obtención de un prototipo funcional, se está contribuyendo a afrontar uno de los problemas que se han generado con la actual pandemia mundial de COVID. El prototipo se programó en Python 3 usando una placa Raspberry con sistema operativo *Raspberry Pi.*

COVID, Aforo en recintos, Visión artificial

Citation: HERNÁNDEZ-VILLANUEVA, Mario Alejandro, MORALES-HERNÁNDEZ, Maricela, CASTELLANOS-BALTAZAR, Roberto Tamar and RAFAEL-PÉREZ, Eva. Enclosure maximum capacity control in pandemic time, using artificial vision. Journal Computational Simulation. 2022. 6-16:18-27.

* Correspondence to the author (E-mail: maricela.morales@itoaxaca.edu.mx)
† Researcher contributing as first author.

Introduction

All know the existence of a global pandemic due to the coronavirus COVID-19. In this context, the Government of Mexico points that the capacity restriction in the tourist infrastructure, restaurants, bars, centers recreational areas and different public spaces will allow for a rapid economic reactivation and a reduction in the contagion risk (Health Secretary, 2021).

From this approach at the federal level in Mexico, the idea arises of proposing a prototype that, based on an artificial vision technique, performs the counting of people who enter an enclosure or closed space in order to count such people and be able to know when the maximum capacity has been reached in real time.

To develop this research project, two types of software and hardware components have been required.

First, the hardware components are made up of a *Raspberry Pi* 3 B+ card, whose general characteristics are enunciated in Table 1. According to Clément (2018), the necessary connections for using Raspberry Pi are the following:

- An HDMI cable attached to an HD display.
- A USB keyboard.
- A USB mouse.
- A micro-USB power.

The of the Raspberry Pi card programming is made with the Python language since, according to Donat (2018), it is one of the easiest languages to learn, it is free to use, it is an interpreted language, which makes it easy to write the programs in any plane text editor.

The second important component is the camera that captures the images and video to be analyzed to perform the people count; its characteristics are shown in table 2.

Processor	Broadcom BCM2837BO, Cortex-A53 (ARMv8) 64-bit SoC
Clock frequency	1.4 GHz
Memory	1 GB LPDDR2 SDRAM
Wireless connectivity	2.4 GHz/5GHz IEEE 802.11.b/g/n/ac Bluetooth 4.2, BLE
Network connectivity	Gigabit Ethernet over USB 2.0 (300 Mbps de theoretical maximum)
Ports	GPIO 40 pin HDMI 4 x USB 2.0 CSI (Raspberry Pi Camera) DSI (Touch screen) Headphone jack / composite video Micro SD Micro USB (power) Power-over-Ethernet (PoE)

Table 1. Raspberry Pi B+ technical specifications
Source: Pastor, (2018)

Maximum resolution	720p/30 fps
Camera mega pixel	1.2
Focus type	Permanent
Lenses type	Plastic
Integrated microphone	Mono
Microphone radio	Until 2.74 m
Diagonal field of view (dFoV)	60°
Universal mounting clip ready for laptops, LCD or display	

Table 2 Logitech C505 camera technical specifications
Source: Logitech, (2022)

On the other hand, the software components that it was necessary to install in the Raspberry Pi, are briefly described in table 3, in which it can be seen the function of each program in the proposed prototype.

ISSN 2523-6865

Software	Description
Raspberry PI Imager	Operating system to install on the Raspberry card, it was configured with the SSH protocol to be able to manage the Raspberry card (Raspberry Pi, 2022).
VNC Server	It is a free software program based on a client-server structure to access the Raspberry desktop remotely. (RealVNC, 2022).
OpenCV	It is an open source library that it includes computer vision algorithms. (OpenCV, 2022).
Numpy	It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more. (Numpy, 2022)

Table 3 The software used description
Source: Various sources cited in each case.

The prototype is based on an artificial vision technique, in this area there are already previous works as cited by Flores & Sandoval (2021). In 2014, a study was carried out that focused on the design and implementation of a low-cost smart security camera with night vision capabilities using Raspberry Pi and OpenCV. The system was designed to be used inside a warehouse, having human and smoke detection capabilities that can provide prevention against potential crime and fire. Flores and Sandoval, also describe that in 2019, a Raspberry Pi and related camera modules were used for image acquisition. Here, special attention is paid to the recording of stereoscopic images and post-processing software that OpenCV applies. (Flores & Sandoval, 2021).

According to Pajankar (2020), the field of computer vision is a combination of different fields, including (but not limited to) computer science, mathematics, and electrical engineering. This field includes ways of capturing, processing, and analyzing real-world images and video to aid in decision-making.

Once a functional prototype was obtained, several tests and training sessions were carried out, for which a proprietary methodology was followed, based on a combination of waterfall and prototype development models. This development is presented later in this document.

Once the development of the research work has been explained, the results obtained are presented, which were the expected ones, but in addition to these, a series of observations were also obtained that allow proposing some improvements to the prototype in order to carry out the count in a correct way, more effective and reliable.

The institutional support and support of the authors of the work and in the writing of this article is also acknowledged, thanking all of them for their valuable contributions. As well as the financing of the Tenological Institute of Oaxaca.

Finally, the conclusions reached after carrying out this project are presented, as well as the sources consulted for the writing of the article. This article will allow the dissemination of the experiences that are being developed in higher education institutions as part of the human capital training, that is incorporated into the our country economic development and particularly of the state of Oaxaca.

Methodology

For the development of this capacity control prototype in an enclosure using artificial vision, a proprietary methodology was used based on the traditional cascade and prototype models. Well, as Somerville (2005) states, the waterfall model consists of five main stages, as illustrated in figure 1.

ISSN 2523-6865

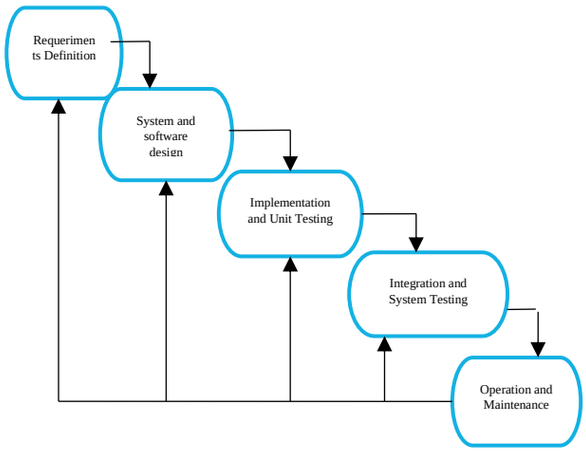


Figure 1 The waterfall model
Source: Somerville, (2005)

Alonso, Martínez & Segovia (2005), identify the following stages in the prototyping methodology:

1) Requirements gathering

2) Quick design

3) Prototype construction

4) Prototype evaluation

5) Prototype refinement

6) Product

Considering the above, six development phases are proposed for this project, which are:

Phase 1: Features definition of the used equipment.

Phase 2: Preliminary design of the prototype.

Phase 3: Identification of operating environments.

Phase 4: Color and contour recognition tests with the prototype.

Phase 5: People recognition tests.

Phase 6: Prototype tests.

Phase 7: Prototype improvement proposal.

Developing

Phase 1. Features definition of the used equipment

In this phase, the characteristics of the components are defined. First, as mentioned in previous paragraphs, Table 1 shows the characteristics of the processor used, which is *Raspberry Pi*.

Likewise, table 2 lists Logitech C505 camera features, which is used to capture the images and video. They are processed to first identify people, then image processing is performed based on techniques of artificial vision. Finally, carry out a count when people have been identified entering an enclosure, in which it is required to keep a control to know when it has reached the maximum number of people allowed.

The hardware requires the software to be able to operate together, for this, the necessary programs, libraries and tools are installed to achieve the coupling between the hardware and the software, the list is presented in table 3, as well as a brief description of the role that each of them plays in the proposal.

Phase 2. Preliminary design of the prototype.

The proposed design is a simple design, in which there is a Raspberry Pi card, a Logitech C505 camera, a display, which allow observing what the camera captures, and, a VGA to HDMI converter to be able to process the images in the Raspberry. Figure 2 shows the block diagram of the design, and figures 3 and 4 are images of the real components.

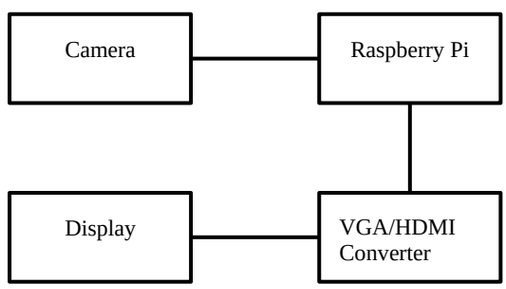


Figure 2 Block diagram of the proposed design
Source: Own elaboration

ISSN 2523-6865

Figure 3 *Raspberry Pi* and converter VGA/HDMI
Source: Own elaboration

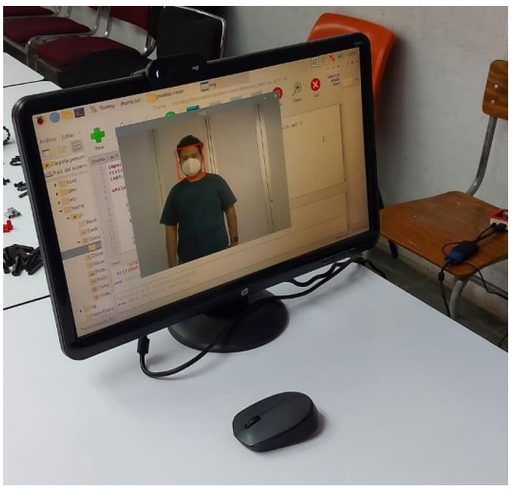


Figure 4 Display and camera of prototype proposed
Source: Own elaboration

Phase 3: Identification of operating environments

In this phase of the investigation, we worked on the identification of the possible scenarios in which the prototype could be used, identifying two possible scenarios:

1. On the outside of the enclosures where people counting is necessary to determine the capacity in real time.
2. In the interior part of the enclosures where the people count must be carried out.

In the first case, making an analysis of the proposed prototype, security aspects of the devices should be considered, since, being electronic parts, they can suffer deterioration when found outdoors, so some casing would have to be developed to its protection, in this research project this option is not considered as a scope of it. In the second case, the prototype may be protected by being installed inside the enclosure, but in a strategic way that allows people to be counted without obstacles. An important aspect to consider is that the camera must remain fixed, since if it has any movement or vibrations, its operation will not be adequate and it causes failures when capturing images and counting people.

Phase 4: Color and contour recognition tests with the prototype

In this phase, color detection tests were carried out in order to identify the image recognition functions, as well as extract only the images of interest through the background subtraction function. With these tests the recognition of people is finally achieved. As an example of these tests, Figure 5 shows an image in which the red object is detected. To achieve the detection of the red object, it is necessary to import the Numpy and CV2 libraries, the RGB (Red, Green, Blue) image is also converted to HSV (Hue, Saturation, Value), thus obtaining the binary image shown in Fig. figure 6. With the binary image of the object, it is converted back to RGB and activating the background subtraction, the result is the recognition of the red object, which can be seen in figure 7.

Figure 5 Original image of the red object
Source: Own elaboration

ISSN 2523-6865

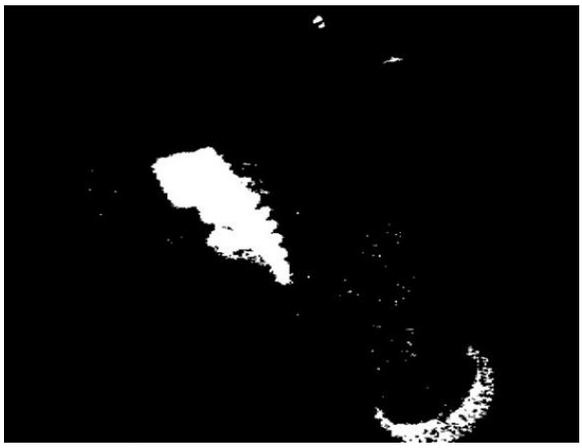


Figure 6 Binary image of the red object
Source: Own elaboration

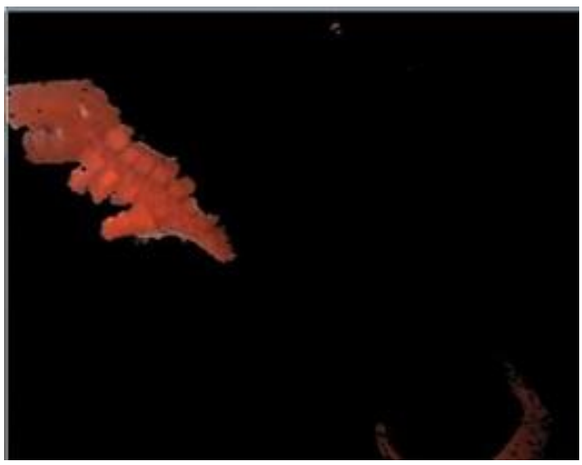


Figure 7 Isolated image of red object
Source: Own elaboration

This process was repeated with blue and yellow objects, changing the adjustment parameters to be able to detect the binary image and the color in question (blue or yellow).

For contour detection it is a similar process, but in this case the original RGB image is converted to grayscale, once this is done, edge detection is applied with the cv2.canny function which detects that the lines pass by an established threshold, providing a maximum and minimum value, with these values the contours can be identified.

Figure 8 shows the original RGB image, figure 9 shows the grayscale image, and figure 10 shows the detection of the contours from the binary image.

Figure 8 Original RGB image
Source: UTVCO, (2022)

Figure 9 Grayscale image
Source: Own elaboration

Figure 10 The image on the left is the binary and the one on the right is with the detected edges
Source: Own elaboration

Phase 5: People recognition tests

For the recognition of people in real time, the first thing that must be taken into account is that the camera must be totally static, otherwise the algorithm will have failures by not being able to adjust the detection. Next, the cv2 and imutils libraries (phyton tool for image processing such as rotation, size, etc.) are imported, the background subtractor mog tool (also known as Foreground detection) is also used to subtract the background of the video. It is important to note that this tool is a computer vision algorithm that attempts to distinguish foreground objects from background objects.

To avoid performance problems, the video is resized with imutils. Subsequently, the binary image of the regions with white points is obtained, since these white points imply that there is movement.

ISSN 2523-6865

The cv2.findcontours function is used to mark the person within a box, likewise, the detection threshold is configured, this particular step is of vital importance for the operation of the prototype because if this value is not correctly configured, there will be false positives or some people are not counted. The value is adjusted according to the needs of the environment in which it is to be used, since it mainly has to do with the distance from the camera to the ground. Figure 11 illustrates the detection of a person moving through the counting area.

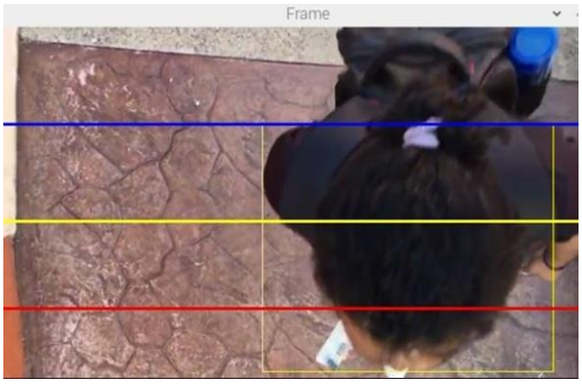


Figure 11 Detection of a person moving through the counting area
Source: Own elaboration

For counting people, the coordinates of the box generated with the binary image are taken into account and a line is drawn in the middle of the screen as a reference. When people pass through that line, the counter is increased by one.

Phase 6: Prototype tests.

The prototype tests start with the detection of the binary images, and then they are passed through filters. In these tests, it is important to obtain the correct detection of people, since the count would not be reliable.

In the Python programming, the count is made as soon as the people pass through the auxiliary line drawn in the middle of the image, and to show when a person is added, the centerline becomes thicker, indicating with this, that one person passed through the counting area. Figure 12 shows when the prototype detects a person and counts it as a person entering the room or space to be controlled.

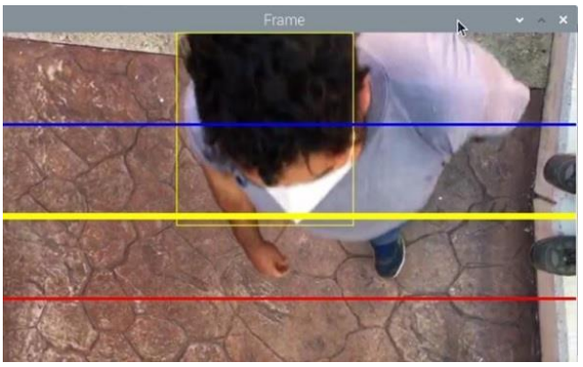


Figure 12 Moment when the prototype detects a person and counts her/him
Source: Own elaboration

The prototype only counts people because the reading threshold is configured so as not to detect smaller objects, that is to say that, for example, if a dog were to move through the detection threshold, it would not recognize it because it is smaller than the established size.

Phase 7: Prototype improvement proposal.

The improvements proposed for the prototype are based on the results obtained from the tests applied to it, a possible improvement is the expansion of the RAM memory of the Raspberry to at least 4 Gb. The foregoing, in order to make code execution more efficient, since the memory used in the analyzed prototype was limited to 1 Gb of RAM, due to the fact that there was no more budget to expand the memory.

Another important aspect is the processing speed, which has to do directly with the Raspberry model, this parameter can slow down the execution process of the artificial vision algorithm, causing some counting failures, among which it is identified that for some cases does not count people or double counts for the same person.

On the other hand, in order to optimize the code and consume fewer resources, a cascade detector can be implemented, in this way the heads or bodies of people would be specifically identified, without having to consider the rest of the objects in the input image. , and thus, optimize the reading process.

ISSN 2523-6865

Finally, the prototype can be improved by adding a second camera to be able to detect when people leave the premises. Since, the current prototype makes the count for the entrance to an enclosure or closed space. However, there would be a lack of a counterpart to do the output counting, and with this the prototype would be more complete and would perform better for the purpose for which it was intended.

Results

The results obtained were satisfactory, the algorithm can successfully count the people who enter a room and store the data. However, if there were some limitations when programming the code, because the Raspberry card with which the project was developed, it is limited since it only has 1 gigabyte of RAM, which complicates fluid work in real time. Several versions of the code had to be made, until a version was found in which the execution was efficient and thus, avoiding reading errors that led to obtaining false positives or omitting to count people. In this last scenario, by omitting the counting of a considerable number of people, the capacity may be exceeded and generate a potential risk of contagion within the closed space in which the entry control is being carried out.

The camera can be used vertically or horizontally as if it were a security camera, although as mentioned above it is essential that the camera is static so as not to contribute to counting errors. Although the camera has some versatility to be positioned, the ideal position would be vertically with a sufficiently wide angle of vision to be able to observe people from full length.

Figures 13 and 14 show the detection of people with two different positions of the camera used, figure 13 shows the detection of a person when the camera is placed facing the entrance area of the enclosure. Figure 14 shows the detection of the person in front of the entrance with a slight forward tilt.

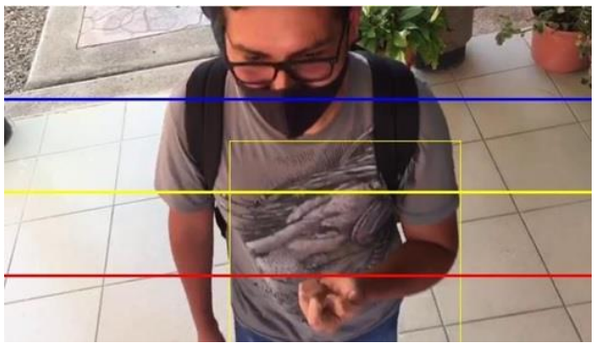


Figure 13 Detection of person with the camera placed in front of the entrance area of the enclosure
Source: Own elaboration

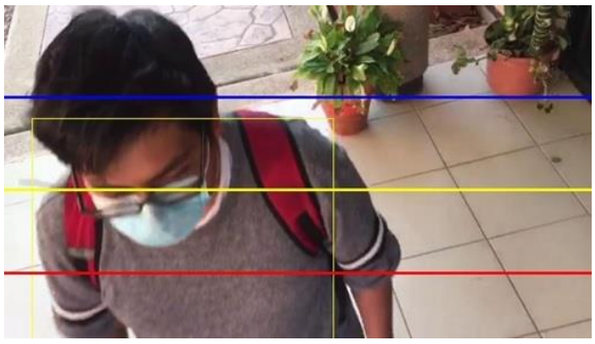


Figure 14 Person detection with the camera placed in front of the entrance area of the enclosure with a slight inclination
Source: Own elaboration

Originally, it was proposed that the prototype be installed at the entrance of classrooms; however, the option is not viable, since the entrance to the classrooms is a very limited area to count people, the suggestion that is issued is to install the prototype in an area with a greater influx of people where support is required to control capacity. It is worth noting that the current prototype has hardware limitations such as heat dissipation, it requires being in an area where air circulates so that it does not overheat and it is not recommended to use it with a capacity greater than 100 people to not compromise the integrity of the Raspberry Pi card. This problem could be improved in the future by using a cooling system in the prototype that includes a fan and heat sink, which allows maintaining the temperature of the components in a range no greater than 65° so that they do not suffer damage or alterations in its operation, mainly the Raspberry Pi.

ISSN 2523-6865

Acknowledgments

Thanks to the National Technological Institute of Mexico that through the Technological Institute of Oaxaca gave the facilities for the realization of this research work. Likewise, the Technological University of the Central Valleys of Oaxaca is thanked for having facilitated the collaboration of its student in this work.

Likewise, thanks to the student and teachers who participated with the contribution of ideas, operational work, research and academic advice for this article, hoping that it will be useful in their professional development.

Financing

This work has been funded partially by TecNM/Instituto Tecnológico de Oaxaca.

Conclusions

Currently, because of the pandemic, it is essential to protect yourself from contagion; face-to-face activities cannot be suspended indefinitely since it strongly affects the economy of societies. However, the return to face-to-face activities has had to be carried out under protocols that have been established globally by the World Health Organization and in each country by their own governments. A relevant point in this new world normality is to maintain a healthy distance where the gathering of people is necessary, mainly in closed rooms.

The objective of this project is to provide a tool that helps to control the capacity of people in those closed spaces that require housing people, controlling the maximum capacity allowed. Which is achieved by establishing a count that is done automatically using a Machine Learning technique, using artificial vision techniques.

During the testing process of the proposed device, several opportunities for improvement were found, and within them, it is considered to keep most of the components in order not to raise the price of the prototype.

In this first stage, the cost of the prototype is $4,000.00 Mexican pesos, which is a high cost for certain sectors. Therefore, in the future, components that can reduce the production cost by some percentage would be analyzed. But, despite the limitations, during the tests the prototype performed adequately for the established purposes, concluding that it was functional.

Once the prototype is more stable and affordable, the application can be transferred to different types of closed spaces such as offices, restaurants, stadiums, among others.

References

Alonso, F., Martínez, L., & Segovia, F.,J. (2005). Introduction to software engineering. España: Delta Publicaciones.

Clément, P., (2018). Python and Raspberry Pi: learn to develop on your nano-computer. Spain: ENI Edition.

Donat, W. (2018). Learn Raspberry Pi Programming with Python: Learn to Program on the World's Most Popular Tiny Computer. USA: Apress.

Flores, L., A. & Sandoval, J. (May 1st, 2021). Image processing using OpenCV and Raspberry pi 4. *Bulletin No. 84 UPIITA*. Mexico: National Polytechnic Institute.

Logitech (2022). Logitech. Web camera HD C505. https://www.logitech.com/es-mx/products/webcams/c505-hd-webcam.960-001367.html

NumPy. (2022). NumPy. NumPy documentation. https://numpy.org/doc/stable/

OpenCV. (June 5th, 2022). *OpenCV*. Open Source Computer Vision. https://docs.opencv.org/4.6.0/d1/dfb/intro.html

Pajankar, A. (2020). Raspberry Pi Computer Vision Programming - Second Edition. USA: Packt Publishing Limited

Pastor, J. (16 de abril de 2018). *Xacata*. Raspberry Pi 3 Model B+, review: more power and better WiFi for a miniPC that continues to amaze.

ISSN 2523-6865

https://www.xataka.com/ordenadores/raspberry-pi-3-model-b-analisis-mas-potencia-y-mejor-wifi-para-un-minipc-que-sigue-asombrando

Raspberry Pi (2022). *Raspberry Pi*. Raspberry Pi OS. https://www.raspberrypi.com/software/

RealVN. (2022). *REALVNC*. Frequently asked questions. https://www.realvnc.com/en/connect/download/vnc/windows/

Health Secretary. (June 17th, 2021). *Health Secretary*. Health calls to control capacity in public spaces to reduce risk of contagion of COVID-19. https://www.gob.mx/salud/prensa/253-llama-salud-a-controlar-aforo-en-espacios-publicos-para-reducir-riesgo-de-contagio-de-covid-19

Sommerville, I. (2005). Software engineering. Spain: Pearson Educaction.

ISSN 2523-6865

Article **Journal Computational Simulation**
December 2022, Vol.6 No.16 28-35

Web application with smart interface

Aplicación web con interfaz inteligente

QUIÑONES-GARCÍA, Pedro Eduardo†, GONZÁLEZ-RAMÍREZ, Claudia Teresa*, VIÑAS-ÁLVAREZ, Samuel Efrén and GARNICA-PATRICIO, Mariana

Instituto Tecnológico de México campus Zitácuaro, México.

ID 1st Author: *Pedro Eduardo, Quiñones-García* / **ORC ID:** 0000-0003-3812-8838

ID 1st Co-author: *Claudia Teresa, González-Ramírez* / **ORC ID:** 0000-0002-4106-4583, **Researcher ID Thomson**: G-6313-2019

ID 2nd Co-author: *Samuel Efrén, Viñas-Álvarez* / **ORC ID:** 0000-0001-5891-2801

ID 3rd Co-author: *Mariana, Garnica-Patricia* / **ORC ID:** 0000-0002-2692-6093

DOI: 10.35429/JCS.2022.16.6.28.35 Received: July 30, 2022; Accepted December 30, 2022

Abstract

In order to compete in the business world, it is necessary to implement a strategy that involves different channels: Web, social media, digital communities and, recently, mobile phones. People currently in their daily work are already implicitly using an intelligent cell phone, since they already have their agendas, email accounts, bank accounts and much more. There-fore, it is more than convenient that your brand has a presence on these devices. Technology such as FLUTTER, MYSQL, NODE JS. and ANDROID, support the creation and implementation of web applications. Using web ap-plications saves money, optimizes time, thus not having to deal with learning to handle new programs, and you can carry out activities from anywhere, Zitácuaro, Michoacán is no excep-tion in being immersed in the use of technologies, as in the large cities, is not exclusive, giving all businesses the opportunity to enhance their daily activities, such as the sale of food through a web application.

Web application, Empower, Technology

Resumen

Para poder competir en el mundo empresarial, es necesario implementar una estrategia que involucre diferentes canales: Web, social media, comunidades digitales y en el último tiempo, móviles. Las personas actualmente en su quehacer diario están ya forma implícita el uso de celular inteligente, como agendas, cuentas de correo, cuentas de banco y mucho más. Por ello, es más que conveniente que tu marca tenga presencia en estos dispositivos. La tecnología como FLUTTER, MYSQL, NODE JS.y ANDROID, dan una soporte a la creación e implementación de aplicaciones web. Usar aplicaciones web ahorra dinero, optimiza tiempo, así no tener que ocuparse de aprender a manejar nuevos programas, y se puede desde cualquier sitio realizar actividades, Zitácuaro, Michoacán no es la excepción en estar una inmersión del uso de tecnologías, como en las grandes ciudades, no es exclusivo, dando la oportunidad a todos los negocios de potencializar sus actividades diarias, como lo es la venta de alimentos a través de una aplicación web.

Aplicación web, Potencializar, Tecnología

Citation: QUIÑONES-GARCÍA, Pedro Eduardo, GONZÁLEZ-RAMÍREZ, Claudia Teresa, VIÑAS-ÁLVAREZ, Samuel Efrén and GARNICA-PATRICIO, Mariana. Web application with smart interface. Journal Computational Simulation. 2022. 6-16:28-35.

* Author's Correspondence (E-mail: claudia.lic@egmail.com)
† Researcher contributing as first author.

Introduction

This document shows some techniques and results on the development of a web application to place orders for various food businesses in the Zitácuaro region, as well as a general description of the tools used for its development. Two sections were developed within the application where the part of a normal user is contemplated, who is the person who orders the food and the section of a vendor where he can register, modify, edit or delete the products that the client will see. This application is developed with the purpose of facilitating daily food purchases, as well as the development or technological update in mobile devices of businesses in the eastern region of Michoacán. In Zitácuaro, according to the 2020 DataMéxico population census, the population in Zitácuaro was 157,056 inhabitants (48% men and 52% women), one of the reasons for the growth in food sales is locally or by request, coupled with COVID-19 technological alternatives gave rise to its emerging application. Talk about web systems, understanding that they are those software applications that can be used by accessing a web server through the internet, or an intranet through a browser. Among the tools used in development are: FLUTTERMYSQL, NODE JS. Application is created for use on the ANDROID platform and limited to the eastern zone of Michoacán.

According to a pilot survey on a scale of Likert applied to fast food businesses (20), considering the most representative in sales and services, 35% was obtained, coinciding with the following:

Prioritized problems to solve

- Growth and updating of the forms of purchase of food businesses in the region.
- Practicality and facility to place orders in a more comfortable way for people.
- Safety of people in terms of health in these times of COVID and personal safety since currently one is in great danger by being away from home.

Hypothesis

A web application gives food businesses the opportunity to facilitate their sales in the area of Zitácuaro

General objective

Develop a mobile application in which orders can be placed to different food businesses in Zitácuaro from the same and this notifies the owners of the restaurants or businesses of the orders.

Specific goal

- Design an optimized application that loads and respond quickly.
- Place orders through the application.
- Provide practicality to owners of food businesses such as restaurants or places where home deliveries are made, also providing users who order food with the ease of having at their fingertips different all businesses in the Zitácuaro area in a single application.
- Notify business owners when users place an order and they ship it to the user. security goals.
- Some points to be discussed are shown below: Personal security since users do not need to leave their homes. Provide secure protection of user data and prevent your information from being misused.

Justification

The purpose of carrying out the project is that through the mobile application, users can be making orders to various places or food businesses since in the Zitácuaro area there is no mobile application or method that allows us to access different types of food quickly and efficiently and in a single application, so the creation of this application is considered feasible.

Said application would make it easier for users to make their purchases in a very practical and efficient way, on the other hand, it will allow sellers to have new sales methods in which can update their businesses since today technology is at the hand of all people. It is important that small, medium and large businesses generate actions to achieve their competitiveness, and that better be using technology that is embedded in our daily lives.

ISSN: 2523-6865

Theoretical foundation

Mobile application. A mobile application is a program that you can download and access directly from your phone or other mobile device. Android Apple, Microsoft, Android, and BlackBerry all have app stores that operate online where apps are downloaded and installed.

Firebase. It is a platform for the development of web applications and mobile applications launched in 2011 and acquired by Google in 2014.1. It is a platform located in the cloud, integrated with Google Cloud Platform, which uses a set of tools for the creation and synchronization of projects that will be endowed with high quality, making it possible to grow the number of users and also resulting in obtaining of increased monetization.

It is a container-based cloud platform as a service (PAAS).

Developers use **Heroku** to deploy, manage and scale modern applications, it is an elegant, flexible and reliable platform. Easy to use, it offers developers the simplest path to bring their applications to market.

React Native. It is an open source framework developed by Facebook and released in 2015.It is written in different languages including JavaScript, Objective-C, Swift programming, and Python. React's native cross-platform framework supports Android, iOS, and Windows apps with the ability to provide native-like performance.

Ionic. It is a software development kit of open source used by developers around the world to develop various mobile applications.

Conceived as an asynchronous event-driven Java Script runtime environment, **Node.js** is designed to build scalable network applications.

Flutter. It is an open-source framework developed by Google to create native applications easily, quickly and simply.It is used to develop applications for Android and iOS platforms. Flutter offers mobile app developers a full range of widgets, APIs, and many other tools, it was first built to support AngularJS, but over time it supports all front-end frameworks.

Data and information.It’s not always easy to know what data will be accessible through an app, or how the data will be used. Before you download an app, consider what you know about who developed it and the app's usefulness. App stores can include information about the company that developed the app, as long as the creator provides it to them. If the app creator doesn't provide your contact information – such as a website or email address – the app may be less trustworthy.

Methodology

An infallible tool, as a model in the development of software products is the Sequential Model of software engineering:

- Analysis.
- Design.
- Developing.
- Implementation.

Analysis

In the requirements gathering process, the focus is on the software. Within the analysis process, it is essential that through a collection of functional and non-functional requirements, the software developer fully understands the nature of the program that must be built to develop the application, the required function, the behavior, performance and interconnect .Identification of priority modules of the pro cease

- Customers.
- Sale and registration.
- Tracking vs delivery.

Design

Software design is really a process of many steps but it is classified within itself. Design activity refers to setting up the data structures general software architecture, interface representation and algorithms. It is the design process where requirements are translated into a software representation [9].

ISSN: 2523-6865

Defining the application modules:

- Customer module: orders and order confirmation, add dishes, edit dishes, show dishes, category, add and edit business fields.

- User module: orders, purchases, user settings.

Developing

This activity consists of translating the design of a machine-readable form. In the software application for this project, code generation refers to both the part of generating virtual environments, and the part in which behaviors are added to these environments. In short, this activity involves generating code

Implementation

There will undoubtedly be changes in the software, as well as some modifications to its functionality. It is generated that the software can adapt to changes in the external environment, once the code is generated, software or application tests are carried out.

An application release is built to be able to be fully tested (Not yet uploaded to the Google Play Store) but in an official way in its first beta version, which will be tested on different devices (Android) for later in a stable and 100% complete version to launch and put it into full operation.

The developed API was mounted on the server heroku which allows us to access the routes and make HTTP requests anywhere we are, this is a free hosting. The database was mounted in the cloud in the service of alway data which is also a free service that through the characteristics it offers us will allow us to carry out functionality tests giving real use to the application

Results

In the data obtained through the survey of people and owners of food businesses, it was obtained that 90% of approval was obtained both as users and customers, since it is provided quickly to customers since it is provided provide a quick way that they can contact you in a simple way.

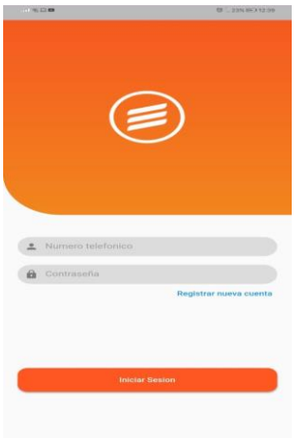


Figure 1 Login Screen

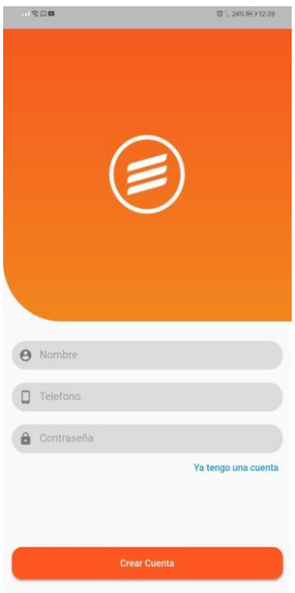


Figure 2 Link that sends us to the login screen

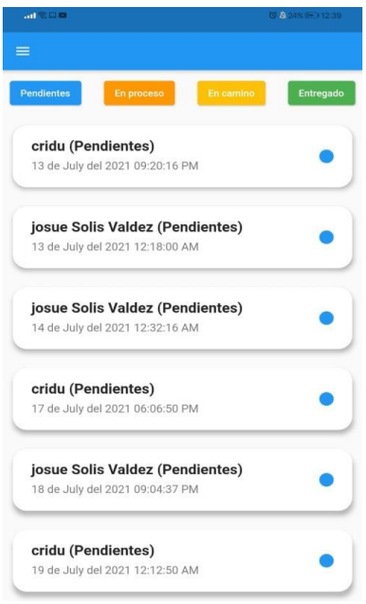


Figure 3 Link that sends us to the login screen

ISSN: 2523-6865

Below these was placed a list of elements which contains 4 sections in each element in this case is the username date Location and a point with the color of the process in which it is located. The colors were selected in this way since they make a very good reference to the period in which they find each other

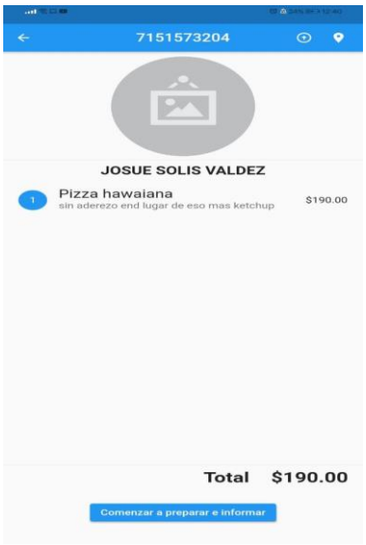


Figure 4 Current order process

In this section we can see 2 markers, one of them is the position in which we cannot find and the other the destination to which we must arrive, we can see that in the lower left part they show us 2 buttons which have the function of making a zoom or return us to the position where we are and the other zooms and positions the camera at the destination point.

Figure 5 Location on map

In this section we have at the top the default image that the product will have, in this case we have 2 options:

1.-Place a gallery image.

2.-Place a camera image.

Any option the user wants will be accepted.

Next, we have a form with the data required for the creation of the dish, the fields are the following:

- Product name.
- Description of the product (ingredients, types of preparation, etc.).
- Product category (with option to enter a new category).
- Type of sale or unit of measure this contemplates many possibilities in this case leaves the field free to the user since it could be in kilos, grams, pieces, among others.
- Product price.
- At the end we have the save button to complete the action.

As seen in figure 6.

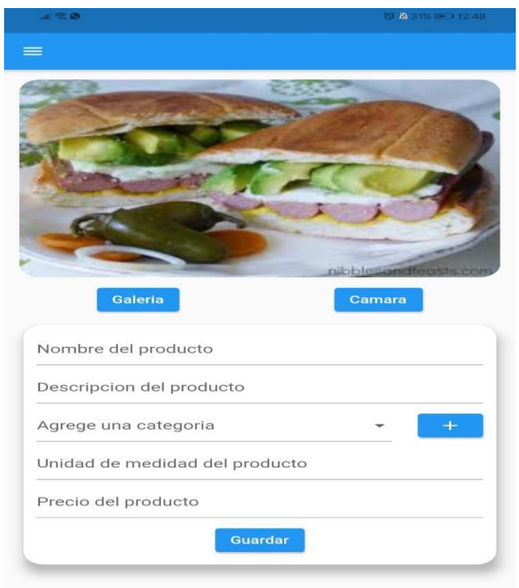


Figure 6 Add product or dish

List where all the existing dishes are shown or in case of selecting a category it shows the elements of said category, each element has general data of the dish which are:

- Plate image.
- Plate price.
- Name of the dish.
- Type of sale of the dish.

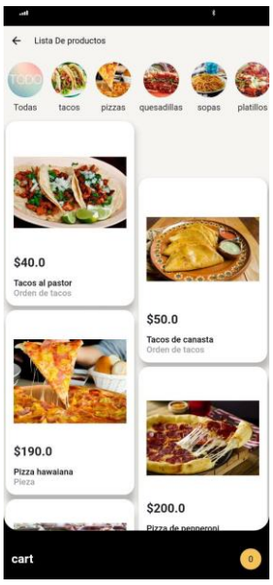


Figure 7 List of all existing dishes

In the same way, a list is obtained where we can appreciate, moving the finger from the cart list (marked in red in the previous image) upwards, which will show the list of cart elements with the following data:

Quantity of products on the plate.

Name of the dish.

Total cost of quantity

Next to the list of elements, we mark the total to pay for the order, as seen in figure 8.

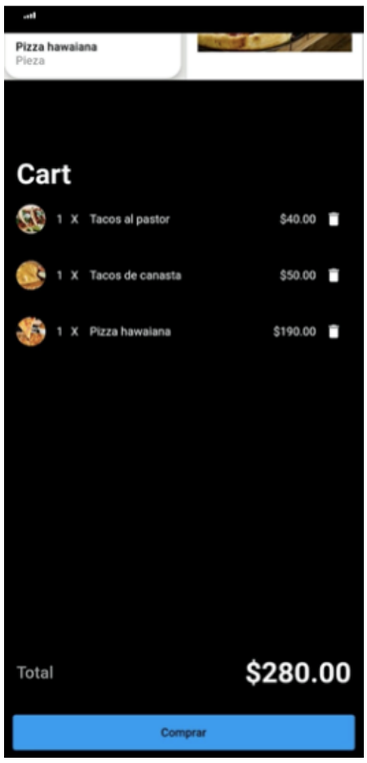


Figure 8 Cart list

To finalize the order, you must press the confirm shipment button, which will redirect us to the order screen showing the current order at the top.

In the section to select address we have 2, the first (with the GPS or location icon) button located in the lower left part is in charge of selecting a marker on the map in the exact place where the user is providing thus the search for the current location.

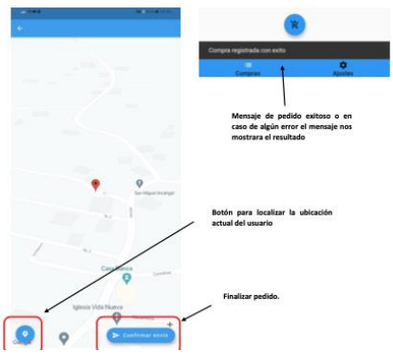


Figure 9 Customer Location

The application is in testing, before uploading to google play during 2022.

The validity and reliability of the survey in the satisfaction of the application of part of the administrative management, was carried out with Cronbach's alpha obtaining 0.86, then it can be determined that the instrument used has an acceptable degree of reliability.

Conclusions

Obtaining a real-time application and likewise a strengthened structure, using current technology, but also with new business approaches, it can be said that the hypothesis is fulfilled with a good level of significance, supported by Cronbach's alpha model. Technology in the last two years has been an emergency tool to a support tool, web applications are that tool that no organization should stop using.

References

[1] Cuello, J y Vittone, J. (2013). Designing mobile apps. Argentina: José Vittone - Javier Cuello Consulted 2021 https://books.google.com.pe/books?id=ATiqsjH1rvwC&printsec=frontcover#v=onepage&q&f=false

[2] Fossati, M. (2014). All about MySQL. Department of Computer Science and Automation University of Salamanca Natsys Consulted 2021. https://downloads.mysql.com/docs/refman-5.0-es.pdf

[3] Hoang, H. G. (2020). Determinants of the adoption of mobile phones for fruit marketing by Vietnamese farmers. World Development Perspectives, 17, 100178 Consultado enero de 2021. https://www.sciencedirect.com/science/article/abs/pii/S2452292920300023?via%3Dihub

[4] Holden, S., Tilahun, M. (2021). Mobile phones, leadership and gender in rural business groups.World Development Perspectives Consult January 2022. https://www.sciencedirect.com/science/article/pii/S2452292921000862

[5] León, C., (2021). The adoption of a mobile payment system: the user perspective.Latin American Journal of Central Banking..Consulted December 2021 Journals homepage: www.elsevier.com/locate/latcb https://reader.elsevier.com/reader/sd/pii/S2666143821000223?token=CC1C770C9C12182CCB7EAA6F6833C29FCD3FD780B9E5C1F1872BAB1C40FC4B6272E0957D1F9CF0D5AC858276AE2B9796&originRegion=us-east-1&originCreation=20221012182244L

[6] Orjuela, A .(MAY 27, 2008). Agile Development Methodologies as an O pportunity. Medellin Colombia. https://www.redalyc.org/pdf/1331/133115027022.pdf

[7] Palos,P., Saura,J., Velicia, F., Cepeda, G. (2021).A business model adoption based on tourism innovation: Applying a gratification theory to mobile applications,European Research on Management and Business Economics,Volume 27, Issue 2,100149,ISSN 2444-8834, Consulted January 2021. https://doi.org/10.1016/j.iedeen.2021.100149 https://www.sciencedirect.com/science/article/pii/S2444883421000085

[8] Peñalvo, F. J. (2019). UNIVERSIDAD DE SALAMANCA. https://repositorio.grial.eu/bitstream/grial/2468/1/Metodolog%C3%ADas%20ágiles.pdf

[9] Pressman, R. (2010). Engineering software a practical approach. New York: MCGRAW HILL. Conslted enero august https://repository.dinus.ac.id/docs/ajar/Software_Engineering_-_Pressman.pdf

[10] Sandip Rakshit, S.,Islam,N., Mondal, M.,Tripti, P.(2021). Mobile apps for SME business sustainability during COVID-19 and onwards. Journal of Business Research journal homepage: www.elsevier.com/locate/jbusreshttps://doi.org/10.1016/j.jbusres.2021.06.005. Consulted december 2021. https://reader.elsevier.com/reader/sd/pii/S0148296321004100?token=DC86700BD425F0C645FB597D83103C3B867EB7267B439212F18E8328BF4FD21CEC4F0D14732C6FB76AFACE446C63E573&originRegion=us-east-1&originCreation=20221012174524

[11] Santiago, R. (2019). Mobile learning. In S. Raul,Mobile learning: new realities in the classroom(pp. 8-26-27). Oceano Group. https://www.redalyc.org/journal/6078/607863449008/html/

[12] Schmuck,R. (2021).The use of online business modelsUniversity of Pécs Faculty of Business and Economics, Rákóczi út 80., Pécs 7622, Hungar . ScienceDirect. Procedia Manufacturing 54 (2021) 45–51. Consulted february 2022. https://reader.elsevier.com/reader/sd/pii/S2351978921001414?token=929BFF193BBF27525FF88113BCD64DFFE149516D613AB3C39742E5349467C84ABE364A40712570D260083BF769BF6FE3&originRegion=us-east-1&originCreation=20221012175133

[13] Support, G. (2020). Google Support.Retrieved on May 13, 2022, from GoogleSupport: https://support.google.com/store answer / 2462844 visit_id = 637250162936210138-2506494644 & l = is & rd = 1

[14] Svennerberg, G. (2010). Beginning Google Maps API 3. Apress. Obtenido de ISBN 978-1- 4302-2802-8 http://yuliana.lecturer.pens.ac.id/Google%20Maps%20API/Buku/Apress.Beginning.Google.Maps.API.3.Jul.2010.pdf

[15] World Health Organization. (2020). World Health Organization. Obtained from https://www.who.int/es.

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

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

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

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

ID 3rd Co-author: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 3rd co-author: (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

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In English)

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

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 Co-author, Surname (IN UPPERCASE), Name 2nd Co-author and Surname (IN UPPERCASE), Name 3rd Co-author. Paper Title. Journal Computational Simulation. 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

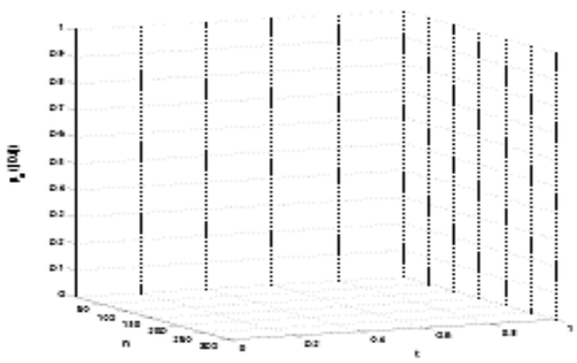
[Title No.12 in Times New Roman, single spaced and bold]

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.

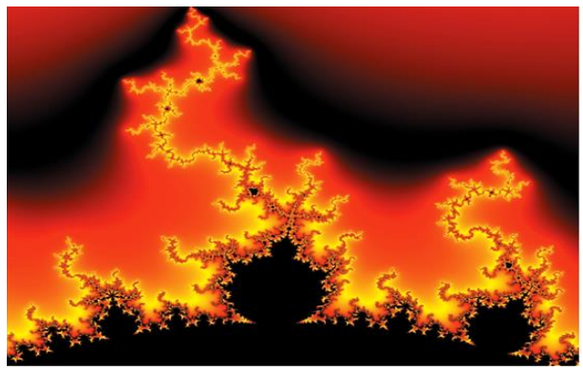


Figure 1 Title and *Source (in italics)*

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.

ISSN 2523-6865

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.

- Authentic Signature in blue colour of the Conflict of Interest Format of Author and Co-authors.

ISSN 2523-6865

Reservation to Editorial Policy

Journal Computational Simulation 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 Computational Simulation 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, S.C. in its Holding Taiwan for its Journal Computational Simulation, 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 Co-authors	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 Computational Simulation

2523 6865
ISSN 2523-6865
www.ecorfan.org