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Presentation of the Content

In the first article we present, *Access control using RFID cards and Raspberry Pi*, by HERRERA-SERRANO, Jorge Eduardo, LOERA-RODRÍGUEZ, Jesús Isaí and LOPEZ-ALVAREZ, Yadira Fabiola, with adscription in the Universidad Tecnológica del Norte de Aguascalientes, as the next article we present, *Application of Artificial Intelligence in the prediction of breast cancer survival in Mexican women*, by MELO-MORIN, Julia Patricia, AHUMADA-CERVANTES, María de los Ángeles and SANTANA-ESPARZA, Gil, with adscription in the Instituto Tecnológico Superior de Pánuco, as the next article we present, *A modified p-median model to optimize the location of facilities considering the source plant*, by SOLÍS-JIMÉNEZ, Miguel Ángel, CALDERÓN-PALOMARES, Luis Antonio, PIÑA-MARTINEZ, Ana Laura and GONZÁLEZ-SOBAL, Martín, with adscription in the Instituto Tecnológico Superior de Huatusco, Tecnológico de Monterrey, as the last article we present, *Web platform for aeroponic culture systematization*, by PAREDES-XOCHIHUA, Maria Petra, MORALES-ZAMORA, Vianney, CUAMATZI-MUÑOZ, Martín and LEAL-CASIQUE, José de la Luz, with adscription in the Instituto Tecnológico Superior de San Martín Texmelucan.

Content

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Access control using RFID cards and Raspberry Pi

Control de acceso mediante tarjetas RFID y Raspberry Pi

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Abstract

This project seeks to strengthen the Information Center of the Universidad Tecnológica del Norte de Aguascalientes through an access control system for all those who use the facilities. These types of systems usually rely on biometric sensors such as fingerprints or face identifiers, however, RFID cards will be used for our case, because the University already has them. Embedded computation was used for the development of the prototype based on the development board known as Raspberry Pi and also the sensors to read card information. This project allows a better control within the Information Center and generates data that will be transformed into useful information for various areas of the University. While the main objective is to keep a check, the system will allow in the future to generate certain types of reports that will be very useful in the different certifications.

Access control, RFID technology, Embedded computing

Resumen

Este proyecto busca fortalecer al Centro de Información de la Universidad Tecnológica del Norte de Aguascalientes mediante un sistema de control de acceso para todas aquellas personas que utilizan las instalaciones. Este tipo de sistemas por lo regular se apoya en sensores biométricos como huellas dactilares o identificador de rostro, sin embargo, para nuestro caso se utilizarán tarjetas RFID, debido a que la Universidad ya cuenta con ellas. Para el desarrollo del prototipo se utilizó cómputo embebido tomando como base la placa de desarrollo conocida como Raspberry Pi, además de los sensores para leer la información de las tarjetas. Con este proyecto se espera llevar un mejor control dentro del Centro de Información y generar datos que posteriormente se transformen en información útil para las diversas áreas de la Universidad. Si bien el objetivo principal es llevar un control, el sistema permitirá en un futuro generar cierto tipo de reportes que serán de gran utilidad en las diferentes certificaciones.

Control de acceso, Tecnología RFID, Cómputo embebido

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Introduction

An access control system can be seen as an identification system, which has had a huge impact in recent years in almost any field. These systems usually rely on biometric sensors to complement the registration, the most common being the fingerprint, although there is also the face detector. According to the author Alvarado, RFID technology can be seen as a wireless self-identification system, which consists of devices that can store information (Alvarado Sánchez, 2008). RFID technology is being adopted more and more by more industries due to its relatively lower cost than biometric sensors. These types of systems have been expanded to such a degree that they not only serve for access controls, they have also been implemented in transport systems, security, inventories, etc. This is due to its notable advantages in terms of productivity, administration and cost.

This project was born from the need to have accurate information about the people who use the Information Center, in addition to the fact that it is automated. The importance of this information lies in its use in audits in the study plans (PE) of the University, since the making of certain decisions depends on this. This project was planned to work in modules, so more functionalities will be added to it. In this first stage, only access control will work.

As mentioned above, it was decided to use RFID technology, because all students, teachers and administrations have an identification with this technology, due to the fact that there is a main access system. One of the main requirements of the project was to avoid islands of information, that is, not to generate a decoupled system from the one that originally exists at the entrance. This was a great challenge, because it was necessary to know in depth how the main system worked and especially the data storage. To solve this problem, a specific algorithm had to be developed to couple both systems.

Implementation

For the development and implementation of this project, a development methodology known as RAD (Rapid Application Development) was used, which will be discussed in its respective section.

Each of the functional requirements of the project was identified, since, from the point of view of any system, identifying the requirements is vital, since once the development begins there is no going back (Chaves, 2005). The first important requirement is that the identification cards have to be used and the second use the same database as the main access system to avoid redundant information. However, it is important to note that this system was a product of a third party and has been in operation for some time. In this system we already have all the data of both students and teachers, hence the importance of making them work as one.

RFID cards store information known as an identifier or TAG and this serves to differentiate one from another. For the implementation of the system, it was decided to use embedded computing. It is currently widely used in specific-purpose systems, in addition to having a particular characteristic that makes it the appropriate candidate, that is, reliability, which is essential in any system and is part of the pillars of software engineering. (Vega, 2010).

Although at first it was thought of using Arduino to make use of embedded computing, it was declined and it was decided to use Raspberry Pi boards, this due to the same project requirements and that there is more experience on this development board.

Figure 1 shows the first prototype, for this a basic access control architecture would be followed as a basis.

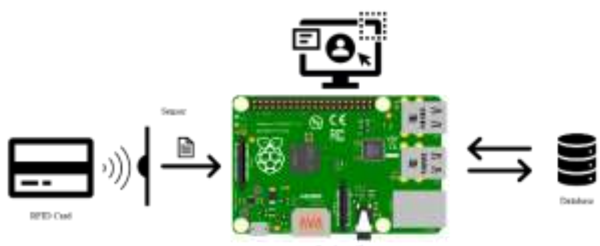

Figure 1 Access control system architecture
Source: Self Made

The sensor used is an RDM6300 since it allows the reading of 125 KHz RFID cards and the Python programming language was used for the development of the application. All the processing falls on the plate.

In the encoding, it was necessary to make adjustments regarding the readings of the cards, an algorithm was carried out to synchronize the information stored by the reader and that saved. This algorithm was based on the conversion of numbering systems.

Methodology

Two proposals were analyzed. First, the cascading approach that requires each stage to be completed before starting a new one. This methodology requires extensive development time as well as very little interaction with the end user during the software coding stage. Because of this, he was rejected for this particular project. The second methodology considered is an agile approach. This approach requires extensive and intense interaction with end users and generally requires less time for overall project development.

Therefore, this is the best methodology for the type of project developed. Agile methods are universally based on an incremental approach to software specification, development, and delivery. They are best suited for application development where overall system requirements change rapidly during the development process. Sommerville's book (Sommerville, 2016) expresses a philosophy according to this type of methodologies; “We are discovering better ways to develop software by doing it and helping others to do it. Through this work we have come to value:

1. Individuals and interactions on processes and tools
2. Working software on complete documentation
3. Collaboration with the client on contract negotiation
4. Responding to change over following a plan

Due to the requirements and characteristics of the application required for this project, it was decided to use the agile methodology known as RAD (Rapid Application Development). This methodology was enunciated for the first time in the document of J. Martin (Martin, 1991). RAD processes are designed to produce useful software quickly.

The software is not developed as a single unit, but as a series of increments, and each increment includes new system functionality. In Figure 2, you can see the process followed for the development of applications based on this methodology.

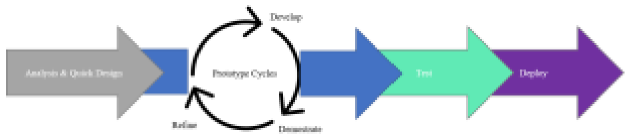

Figure 2 Basic access control
Source Based on the original by J.Martin (Martin, 1991)

During development and following the aforementioned methodology, some prototypes were generated that were changing and improving until the final prototype version was reached, which was already stable and met the previously defined requirements. The results of these tests can be displayed in the last results section.

Results

For the assembly of the prototype, the Raspberry Pi board was used, where the program is executed and in turn communicates with the sensor to obtain the labels of the cards. As a reader, an RDM6300 sensor was used, since the cards work at a frequency of 125Khz. Components are displayed in Figure 3.

Figure 3 Raspberry Pi and RDM6300 sensor
Source: Self Made

Then the system coding part was continued, where it was necessary to use Python due to its advantages in terms of the use of sensors (Torres et al., 2011)

The code was simple to implement, since the reader returns the tag of the cards, however, the difficult thing was to link this system with the previous one, since the information given by the reader did not coincide with that stored in the databases data from students and teachers, that is why it was necessary to implement the algorithm described above to perform tag conversions.

This algorithm was implemented in a function within the same code, for this it was necessary to implement number systems, specifically the hexadecimal to carry out conversions and thus make both labels coincide. A snippet of the code can be seen in Figure 4.

Figure 4 Source code snippet
Source: Self Made

A light graphical interface was implemented, which guides both the user and the administrator (Acosta & Zambrano, 2006). However, since the interface should not consume many resources and that access controls are of recurrent use, it was decided to show the basic and necessary elements to the user. The interface is shown in Figure 5.

Figure 5 Main graphical interface
Source: Self Made

By joining all the elements, there is then a complete system, which is expected to implement and carry out further tests, since it is necessary to measure efficiency and speed, in addition to the user experience.

Conclusions

This project is used to control access using RFID cards. The use of new technologies such as embedded and ubiquitous computing makes it possible to implement these types of projects with greater ease and lower cost, which were almost impossible to afford a few years ago (Durango et al., 2012). This prototype has the most basic functions, however, it is possible to add more functionalities and thus be a more complete system. Some of the tasks that you will be able to carry out in the future are already being considered, in addition to the fact that you also want to study the efficiency and benefits that it can bring compared to a conventional system.

It is also important to note that it is not the only way to implement the project, since as is known, this type of technology is on the rise and more and more are implemented, such is the case of the Arduino. As future work, it is intended to test the operation of this project using Arduino and make a comparison between the two (Casco, 2014).

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Application of Artificial Intelligence in the prediction of breast cancer survival in Mexican women

Aplicación de la Inteligencia artificial en la predicción de la supervivencia de cáncer de mama en mujeres mexicanas

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Abstract

In Mexico, the leading cause of death caused by malignant tumors in women is breast cancer and the general survival of five years treated in facilities of the Public Health System is between 75 and 80%. There are applications that determine the survival of patients with breast cancer, based on the use of drugs that are not prescribed in Mexico, so cancer specialists cannot consider the information offered by these programs for decision-making with patients Mexican. This article describes the development of an expert system that, by applying artificial intelligence techniques, allows the evaluation and prediction of patient survival, based on a model generated with data mining techniques. Rules were obtained from the patterns obtained with data collected from patients with breast cancer since 2006. The development of the system is governed by the Knowledge Discovery from Databases (KDD) methodology, supported by the WEKA tool for modeling data mining techniques. There is a data warehouse of 4,773 women with breast cancer provided by two tertiary hospitals in Mexico City: an INCan cohort of 4,300 patients diagnosed from 2006 to 2013 with a median follow-up of 40.5 months of survival and an INCMSZ-provided cohort of 473 patients from 2011 to 2018 with a median of 39 months.

Survival, Breast cancer, Data mining

Resumen

En México la primera causa de muerte causada por tumores malignos en las mujeres, es el cáncer de mama y la supervivencia general de cinco años tratadas en instalaciones del Sistema de Salud Pública es entre el 75 y 80%. Hay aplicaciones que determinan la supervivencia a las pacientes con cáncer de mama, basándose en el uso de fármacos que en México no son recetados, por lo que los especialistas en cancerología no pueden considerar la información ofrecida por dichos programas para la toma de decisiones con pacientes mexicanas. Este artículo describe el desarrollo de un sistema experto que aplicando técnicas de inteligencia artificial permita la evaluación y realice la predicción de la supervivencia de las pacientes, basadas en un modelo generado con técnicas de minería de datos. Se obtuvieron reglas de los patrones obtenidos con los datos recopilados de pacientes con cáncer de mama desde el año 2006. El desarrollo del sistema se rige por la metodología de Descubrimiento de Conocimiento a partir de Bases de Datos (KDD), apoyado en la herramienta WEKA para el modelado de las técnicas de minería de datos. Se cuenta con un almacén de datos de 4773 mujeres con cáncer de mama proporcionada por dos hospitales terciarios de la Ciudad de México: un cohorte del INCan de 4300 pacientes diagnosticadas desde el 2006 a 2013 con una mediana de seguimiento de 40.5 meses de supervivencia y un cohorte proporcionado por INCMSZ de 473 pacientes de 2011 a 2018 con una mediana de 39 meses.

Supervivencia, Cáncer de mama, Minería de datos

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Introduction

The World Health Organization indicates that 16% of cancers in women in the world correspond to breast cancer, with 1,671,149 new cases diagnosed annually, with 521,907 deaths annually (World Health Organization (WHO), 2017). In Mexico, 22.56 inhabitants per 100,000 have breast cancer, being the leading cause of death in women over 25 years of age, and the 2020 prognosis indicates that 16,500 new cases were presented. Lozano R, et al (2008), indicates that almost all cases of breast cancer are identified, but only 10% in stage 1 of the same, so, if the cancer is identified in a timely manner and adequate treatment is offered , it is curable.

In order for a doctor to formulate an adequate treatment scheme, it is necessary to know the stage of the cancer. For cancer staging, the AJCC TNM system is used in which 3 criteria are used to define the stage of the cancer: tumor size (T), affected lymph nodes (N) and the presence or absence of metastases (M), together with the stage of the cancer there are other factors that affect the prognosis such as the type of cancer, presence of estrogen and progesterone receptors, biological subtype, presence of the HER2 receptor, how fast the tumor grows, general conditions of the patient, among others. These clinical and pathological variables help the physician to define the patient's prognosis more precisely and to make more prudent decisions about treatment.

The application of data mining in the medical area has supported decision-making; transforming volumes of data, experience, knowledge and wisdom improving the health service offered. It is important for a medical specialist to have tools that help make decisions about the disease, to strengthen effective communication between the doctor and the patient, since it is essential in any treatment (OMS), the medical personnel being key in the treatment and communication in the patient so that they commit to treatment and thus control the disease (Montero JE, 2020).

This article describes some research that applies data mining techniques to cancer data warehouses. Some applications developed in other countries that predict cancer survival are also mentioned.

The methodology used in the research carried out is explained, as well as the results obtained.

State of the art

There are many studies related to the identification of patterns that affect breast cancer by applying different artificial intelligence techniques.

Piñeros et al (2008), characterized the sociodemographic factors of Colombian women with breast cancer, using a database of the District Health Department. A significant association was found with educational level, with a higher proportion of cancers in early stages in women with higher educational levels. A descriptive statistical analysis was applied with ANOVA tests; Associations between variables of a categorical type by means of the chi-square test or Fisher's exact test.

Timaran R. & Yépez M. (2016), used the database of the population cancer registry of the municipality of Pasto in Colombia and extracted survival patterns applying decision tree techniques in women diagnosed with cervical cancer since 1998 to 2007. The result obtained is that the patient is a survivor if the life span is greater than 37 months from the date of diagnosis and using association techniques, they determined the factors that affect survival.

An article by Reparaz et al (2008) used the data mining cluster task to 206 records treated with prostate branchytherapy, to characterize and classify the population of patients with prostate cancer and obtained as a result that 83% of the patients, had a successful treatment.

Hernández & Lorente (2009), applied Weka's software to the Wisconsin Breast Cancer Database data warehouse, with 699 instances and 11 attributes, to classify a tumor as benign or malignant, and determined that all attributes affect to some extent the classification, that is, the lower the attribute value, the greater the probability that the tumor is benign.

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Martínez et al (2008), applied Bayesian Networks for the classification of medical data in the processing of databases related to medical conditions such as bed cancer, cancer tumors, diabetes and hepatitis, in order to determine if Bayesian Networks are a effective and reliable tool in decision-making in the medical field and become an assistant in medical diagnosis and treatment. The databases that were used were taken from the repository of data of the University of California of 286 patients for breast cancer. The classification algorithms used were Naive Bayes, Tan, Hill-Climber and K2, resulting in that for all algorithms the classification percentages of the variables are above 70% accuracy.

Camacho C. (2014), used digital image processing and their analysis; using a Heuristic method based on Data Mining to extract essential information from mammographic images and transform them into patterns, to later classify them into subgroups of patterns for the formation of families through homogeneity and maximization of coincidence indexes, in order to facilitate the timely diagnosis of breast cancer.

Molero-Castillo et al (2012) with the database of the Surveillance, Epidemiology and Final Results Program of the National Cancer Institute (NCI) in the United States, characterized patients of Hispanic origin with breast cancer, applying data series.

Existing applications

Adjuvant Online (AO) is a tool that helps physicians in making adjuvant treatment decisions for patients with stage 1 and 2 breast cancer. The program assesses the risk of relapse and death within a 10-year period to individual patients, as well as the benefit that a specific adjuvant treatment provides.

The risk estimates calculated by AO are based on observations of the 10-year overall survival of women between the ages of 20 and 79 years diagnosed with breast cancer between the years 1988 and 1992 in the United States and are part of the SEER database (Surveillance, Epidemiology, End-results), which covers 14% of the US population.

The treatment estimate is obtained by calculating the risk of negative outcomes (death or relapse) of a patient and multiplied by the proportion of negative events that an adjuvant treatment is known to prevent.

The url of the official site of the application is www.adjuvantonline.com (Adjuvant, Inc., 2016).

Predict is an online application that uses a mathematical model to support patients and doctors in deciding the ideal chemotherapy or hormone therapy treatment after breast cancer surgery. This site does not store patient information, it only requests characteristics of certain cancer factors.

Version 2.0 of Predict was developed using 5694 breast cancer registries for women in England from 1999-2003 and has been tested with women with breast cancer worldwide.

The project was developed by the Cambridge Cancer Unit, the Cambridge University Department of Oncology and the Eastern Cancer Registry and Information Center.

The url of the official site of the application is www.predictnhs.uk (Public Health Engleand and Cambridge University, sn).

Methodology

Artificial intelligence in the medical area has been very useful in the detection of different types of diseases. The application of data mining is essential in the detection and diagnosis of cancer to obtain patterns in large volumes of data (Timaran R. & Yépez M., 2016).

The methodology used to obtain knowledge in a database is the KDD (Knowledge Discovery in Databases), which transforms information from a lower level to greater knowledge at the higher level Hernández et al, 2005, Mitra, 2003). Figure 1 indicates each of the stages.

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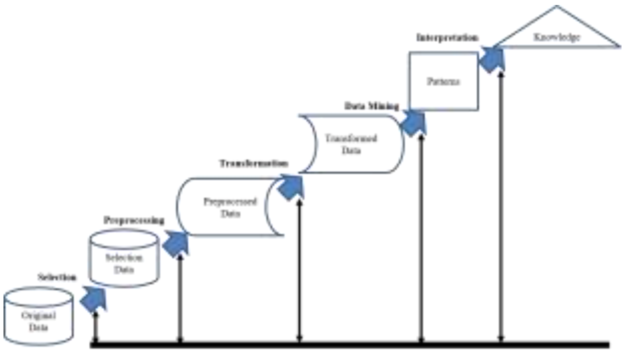

Figure 1 Stages for the knowledge extraction process. *Source: Based on Fayyad et al, (1996) and Gómez, (1998)*

To obtain the survival analysis of a patient, it is necessary to study the time variable and the relationship that exists with other variables (Abraira, 1996). To calculate the survival time, the start date and the end date of the follow-up are defined, and it is the time elapsed between both. The termination date may be because the patient died or contact with her was lost, which is why it is considered censored (Aguayo C. & Lora M., 2007). To determine survival curves, the Kaplan-Meier method is applied, which is the accumulated probability of survival over time. Formula 1 describes the survival formula that describes whether an individual or event occurs in a time equal to or greater than t.

$$S(t) = \prod_{j|ti \leq ti}(1 - \frac{deceasedj}{survivorsj}) \quad (1)$$

The risk function h (t), also called the instantaneous mortality rate, is the probability density function of the event at t, it indicates the probability that an individual dies in that unit of time. Formula 2 indicates the risk function.

$$h(t) = \frac{\text{number of deaths in t / time unit}}{\text{number of survivors in t}} \quad (2)$$

To determine the factors that affect breast cancer survival in Mexican women, the KDD methodology was followed for the extraction of knowledge, as shown in Figure 2.

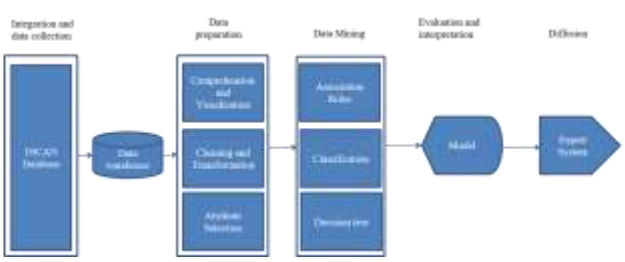

Figure 2 Stages for the knowledge extraction process. *Source: Self Made*

The data warehouse is composed of 18 different attributes, which are described in Table 1.

#	Attribute name	Description	Values	Meaning
1	Nominal_Age	Patient age	1	Age <40
			2	Age> = 40 and Age <= 69
			3	Age> = 70
2	t_clinica	Primary tumor	-1	"Null or empty"
			0	"T0"
			1	"T1"
			2	"T2"
			3	"T3"
			4	"T4a"
			5	"T4b"
			6	"T4c"
			7	"T4d"
			8	"Tx"
			99	"Unknown"
3	n_clinica	Regional lymph nodes	-1	"Null or empty"
			0	"N0"
			1	"N1"
			2	"N2"
			3	"N3"
			4	"Nx"
			99	"Unknown"
4	Hormonal_state	Hormonal Status	1	Pre menopause
			2	(Age <50)
5	M_clinica	Distant metastasis	-1	Postmenopause
			0	(Age> = 50)
			1	"Null or empty"
			2	"Mx"
			99	"Unknown"
6	clinical_stage	Clinical stage	0	"0"
			1	"I"
			2	"IIa"
			3	"IIb"
			4	"IIIa"
			5	"IIIb"
			6	"IIIc"
			7	"IV"
7	estrogen_receptors	estrogen_receptors	0	"Null or empty"
			1	Negative
			2	Weakly positive
			3	Moderately positive
			4	Intensely positive
8	progesterone_receptors	H_score progesterone receptors	0	"Null or empty"
			1	Negative
			2	Weakly positive
			3	Moderately positive
			4	Intensely positive
9	her2	HER2	-1	"Null or empty"
			0	"0"
			1	"1+"
			2	"2+"
			3	"3+"
			99	"Unknown"
10	Years_Viv	Years lived after diagnosis	(Death_date-diagnostic_date) / 365	
11	nuclear_degree	Nuclear grade	0	"Low"
			1	"Intermediate"
			2	"High"
			99	"Unknown"
12	death_related	Death / alive	0	Another cause
			1	For cancer
			99	Unknown.
			2	Death not established
			3	Still alive
13	Vital_state	Actual state	3	"Live"
			1	"Dead"
			2	"Losses"

Table 1 Attributes of the mineable view
Source: Self Made

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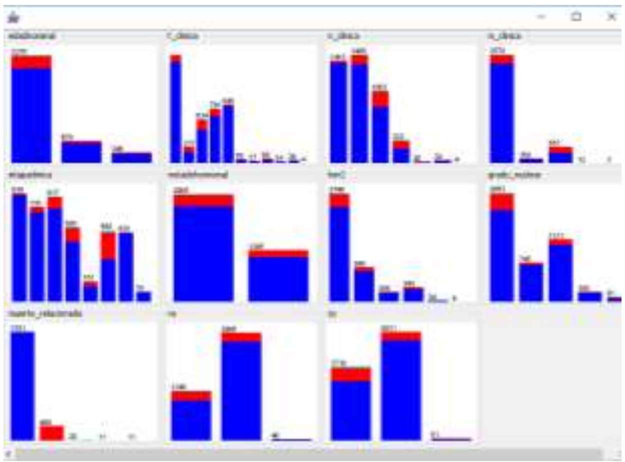
Different data mining techniques were applied, using Weka software, considering the data warehouse. Graph 1 shows the relationship of each of the attributes with the class to be analyzed (alive / dead). The blue color represents living patients and the red color represents dead patients.



Graphic 1 Attribute relationship with the dead / alive main class
Source: Weka Software, Own Execution

Table 2 shows a comparison between the different classification algorithms used, indicating the instances correctly and incorrectly classified, as well as the Kappa statistic that measures the coincidence of the prediction with the real class. The last column of the Table indicates the result of the level of error generated by the model after applying the algorithm.

Algorithm	Well-classified instances (%)	Misclassified Instances (%)	Kappa statistic	Absolut mistake
One R	87%	13%	0.0069	0.0516
Decision Table	87%	13%	0.0806	0.0873
Part	86%	14%	0.1356	0.0779
Prism	97%	2%	0.9208	0.0067
Ridor	87%	12%	0	0.0905
J48	87%	13%	0.1087	0.0803
BFTree	87%	13%	0.0113	0.0863
Naive Bayes	83%	17%	0.3336	0.0829

Table 2 Results of the classification algorithms
Source: Self Made

When applying the classification algorithms, a model was generated with different rules that determine the survival of Mexican women, describing characteristics in each of the attributes, as well as the percentage of certainty of each one of them, determining the average life span of the group of patients that was classified in each of the generated rules.

Figures 3 and 4 show the generation of the rules by some data mining algorithms, indicating the values in the different attributes and drawing conclusions from them.

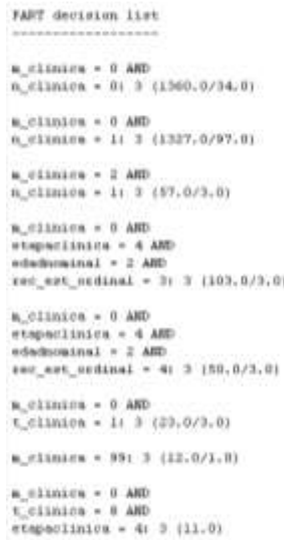


Figure 3 Rules generated by the Part algorithm
Source: Weka Software, Own Execution

The rules have the form "If ... (conditions to be met) then ... (class to which it belongs), for example:

- Rule 1. If the patient has distant M0 metastases and N1 regional lymph nodes, then she is classified as class 3 (alive). This rule is verified by 1,327 patients, with 97 errors.
- Rule 2. If the patient has distant M0 metastases and N0 regional lymph nodes, then she is classified as class 3 (alive). Verifying the rule 1360 patients, with 34 errors.

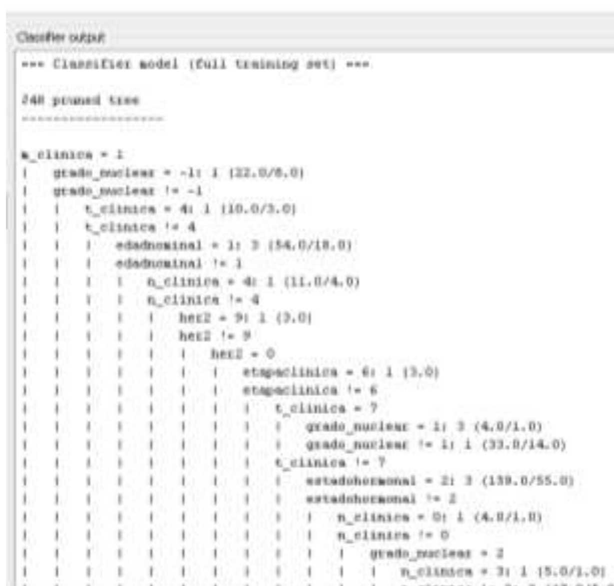


Figure 4 Rules generated by the J48 algorithm
Source: Weka Software, own execution

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Of the rules with the greatest force in the live / dead class, the main attributes for the patient to remain alive according to the model are considered to be: distant metastases N0 and regional lymph nodes N0 or N1. Similarly for the dead patient, the attributes are primary tumor T4b or T4d, and high nuclear grade.

Results

A computer system was implemented that applies the rules obtained in the data mining model, with the attributes identified as significant in Mexican patients, and the survival time. By providing new data, the computer system determines the survival time so that medical specialists can determine the appropriate treatment for the patient. The results of applying the algorithms to identify significant attributes are shown in Table 3.

Attribute priority (highest to lowest)	Ranking-ReliefAttributeEval	GreedySteepwise - Distribution in folds (Indicates the percentage of impact).
1	Years_lived	Nominal_Age -100%
2	Vital_state	Clinical stage - 80%
3	Nuclear_grade	Hormonal status - 80%
4	T_clinica	t_clinica - 70%
5	Progesterone_receptors	her2 - 70%
6	N_clinica	years_lived - 70%
7	M_clinica	
8	Estrogen_receptors	nuclear_degree - 50%
9	Hormonal state	n_clinica - 40%
10	Nominal age	estrogen_receptors - 10%
11	Her2	m_clinica - 0%
12	Clinical stage	progestereone_receptors - 0%

Table 3 Attributes selected by the different algorithms. *Source: Self Made*

The most significant algorithms were considered in the system carried out, as shown in Figure 5.

Figure 5 Capture form
Source: Application execution.

After accepting the data in the system, pressing the Predict button and taking the knowledge base, conclusions are obtained and the survival time of the patient is determined, supported by the established rules, as indicated in Figure 6.

Figure 6 Survival results of the patient. Source: Application execution.

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Conclusions

According to medical experts, this is the first expert system that allows calculating the prognosis according to the clinical-pathological variables of Mexican patients and it is of great relevance to know the survival of a Mexican patient with breast cancer in the public health system with access to essential treatments. The applications of the system can be multiple in routine clinical practice, education, and in the adoption of public policies for breast cancer in Mexico. Currently, work is being done on a predictive model for the benefit of cancer treatment, also based on a system that applies artificial intelligence techniques.

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A modified p-median model to optimize the location of facilities considering the source plant

Un modelo p-mediana modificado para optimizar la ubicación de instalaciones considerando la planta matriz

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Abstract

The present general model of the distribution of the logistics value chain considers the production processes, as well as the economic factors and logistics costs operating in the different stages of a purified water company. The model has a general application for companies that distribute goods and services, and serves as support in the choice of policies and operating scenarios. Operating conditions typical of the industry in Mexico are contemplated, specifically of bottled water purification companies. It is intended to evaluate the different operating conditions that optimize delivery points, distribution centers and production plants, considering a holistic vision to meet the objectives of a distribution system, considering their random variations and their impact on the global system to take the preventive and corrective actions to improve the logistics of operation. The above is exemplified with some adjustments that are made on the P-median model where it is shown how this variation would be applied, not considering the source or parent plant as a distribution center option. The improved model offers fundamental advantages over the rest of the techniques reviewed in the literature, such as introducing the information obtained into the model by making the distribution network more optimal, thus collecting not only objective data but also the preferences and forecasts of the decision maker himself.

P-median model, Facilities location, Optimization

Resumen

El presente modelo considera los procesos de producción, así como también los factores económicos y costos logísticos operando en las diferentes etapas de una compañía de agua purificada. Tiene una aplicación general para empresas repartidoras de bienes y servicios, y sirve como apoyo en la elección de políticas y escenarios de operación. Se contemplan condiciones operativas propias de la industria en México, específicamente de las empresas purificadoras de agua embotellada. Se pretende evaluar las diferentes condiciones operativas que optimicen los puntos de entrega, centros de distribución y plantas de producción considerando una visión holística para cumplir con los objetivos de un sistema de distribución, considerando sus variaciones aleatorias y su impacto en el sistema global para tomar las acciones preventivas y correctivas que permitan mejorar la logística de operación. Lo anterior se ejemplifica con unas adecuaciones que se realizan sobre el modelo de la P-mediana donde se muestra cómo se aplicaría esta variación no considerando la fuente o planta matriz como una opción centro de distribución. El modelo ofrece ventajas fundamentales respecto al resto de técnicas revisadas en la literatura, como introducir la información obtenida haciendo más óptima la red de distribución, recogiendo de este modo no sólo los datos objetivos sino también las preferencias y previsiones del propio tomador de decisiones.

Modelo de la p-mediana, Ubicación de instalaciones, Optimización

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Introduction

The logistical problems of location consist of locating one or several services to meet the demand of a series of known points, usually called demand points, seeking to optimize some measure of effectiveness, however, the theory of location of facilities is relatively recent, to Despite the fact that problems related to the location of different types of facilities have accompanied man throughout history (Torres, 2006), since he has had to face deciding where to locate his facilities, taking into account the relationship that they will have with other facilities or with the clients they intend to serve. In general terms, location problems try to find out the location of the facilities of an entity say, company, warehouse, facility or customer, so that costs are minimized or benefits are maximized.

The formulation of these problems may include geographical considerations, social, economic, and personal policies, among which can be mentioned: proximity of raw material sources, availability of resources, existence of competitors or proximity between facilities, among others, however, The design, development and solution of models that adequately represent reality and that serve as a tool to make the best location decision is related to the work carried out by Hakimi (Chaudhuri, 1998) (1964-1965) for the location problem of facilities, factories, warehouses, branches, stations, etc., in which the p-median problem and its extensions have been used to optimally locate these entities.

Two of these most used models in network localization are the p-median problem and the p-center problem. The first consists of minimizing the total sum of the weighted distances by calculating the location of p-service centers in a way that minimizes the total (or average) weighted distance traveled to meet all demand (efficiency), while the second tries to minimize the maximum weighted distance from a service center to its assigned users when trying to find the location of p-service centers in a way that minimizes the maximum distance between a demand point and its closest service center (fairness).

The objective of the p-median makes it efficient but not equitable, while the bound implicit in the problem of the p-center makes it equitable, but not efficient (Toro, 2011).

Most of the aforementioned applications start from deterministic models, in which all the data of the problem are perfectly known. However, the uncertainty in the weights of the vertices or edges is inherent in most of the problems, either because these data are an estimate of future behavior for which historical data are not available, or because the economic environment is not predictable through the statistical techniques in use or because other external factors not controllable by the decision maker influence them (Darós, 1998).

The median p and extents of it often model real-world situations, such as the location of industrial plants, warehouses, and public facilities (Hansen, 1997).

The p-median problem with deterministic data has been extensively studied. The median p problem is one of the basic models in discrete location theory. As with most location problems, it is classified as NP-hard (Kariv, 1979) and therefore heuristic methods are generally used to solve it (Mladenovic, 2005). A compilation of these studies can be consulted in the works of Krarup and Pruzan (Krarup, 1983) where the approaches and methods for solving both the p-median and other related problems appear. However, in many real problems the data, that is, the demands associated with the vertices and / or the distances associated with the edges, are not exactly known.

For example, if a company wants to access new markets, the demands will be estimated from some market research. If the edges represent roads and the associated weights, the time it takes to travel them, it is impossible to know them exactly, since the time will depend on the traffic circumstances, the state of the road, etc. (Darós, 1997). The work on vehicle routing for messaging problems and sending small packages is aimed at improving mainly two indicators: time of arrival, service-oriented; and operating costs, oriented towards efficiency (Arboleda, 2018).

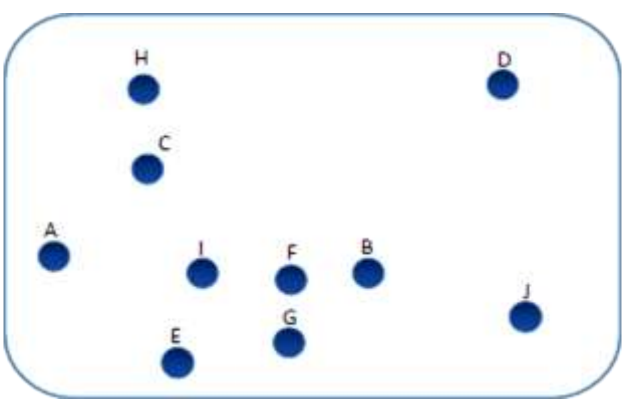
Considering the above, it should be noted that the problem of the p-median is fundamental to a large part of the discrete location theory.

It is motivated by a series of real situations, such as having to install several plants in some points of a transport system to minimize production and shipping costs or having to install different hospitals in a city so that most of its population be covered in case you need one. In short, the p-median problem tries to locate p facilities within a network in such a way as to minimize the weighted distance between the demand points and the closest open facility (Jiménez, 2018).

In markets that demand great competitiveness, business management faces decisions and problems that must be solved strategically for the successful maintenance of companies. Among those decisions, it is of great relevance to satisfy the needs of external customers in terms of product quality and service, with delivery compliance being an element of great impact (Davis-Sramek, Mentzer and Stank, 2008), cited in (Pantoja, 2017).

Derived from the information that precedes a feasibility study for the installation of a water purification company, the following scenario arises where only the distances between the parent plant and its possible distribution centers are considered as main data. The company seeks to determine which of its customers can serve as distribution centers. For this, the logistics and delivery manager determined the distances in kilometers that exist between the different clients and the parent plant.

The distances and the plan of the customer locations are presented below in figure 1 and table 1, respectively:



Location of different clients to the parent plant.

Distances from the main plant to different clients (km).

De/ A	A	B	C	D	E	F	G	H	I	J
A	0.0	63.2	35.5	107.6	43.8	47.5	54.7	59.8	30.4	97.1
B	63.2	0.0	56.2	69.5	49.0	16.1	28.0	76.6	33.0	35.3
C	35.5	56.2	0.0	76.7	66.3	46.4	64.4	27.0	36.7	91.0
D	107.6	69.5	76.7	0.0	115.1	78.8	97.0	72.0	87.7	79.2
E	43.8	49.0	66.3	115.1	0.0	36.4	23.4	93.3	31.4	71.8
F	47.5	16.1	46.4	78.8	36.4	0.0	21.0	70.3	17.1	49.7
G	54.7	28.0	64.4	97.0	23.4	21.0	0.0	89.8	28.6	48.7
H	59.8	76.6	27.0	72.0	93.3	70.3	89.8	0.0	63.2	108.9
I	30.4	33.0	36.7	87.7	31.4	17.1	28.6	63.2	0.0	66.7
J	97.1	35.3	91.0	79.2	71.8	49.7	48.7	108.9	66.7	0.0

The parent plant will be considered by the variable X1 (A). Suppose that the company can condition up to 3 distribution centers, and it may turn out that the parent plant is also selected as the distribution center, this implies that in case the variable X1 is selected as CEDI, then it will have its own clients that attend, in addition to the other centers that are selected.

Methodology

The p-Median model originally formulated in Revelle and Swain (ReVelle, 1970), in its most general form, is defined in a network of nodes and areas where it is assumed that each node represents a local area of demand or can also represent a potential location for a plant installation. The objective is to locate exactly “p-plants”, to minimize the total transport distance to meet all the demand. It is assumed that the plants are not limited in service by maximum capacity (they have infinite capacity) so that each demand can be served by the nearest plant. We can formulate this model with the following notations.

i, j = indices used to refer to a node or point numbered as 1,2,3, 4,… n.

dij = minimum distance from node i to node j.

ai = demand at node i.

Xij = 1, if the demand at i is assigned to plant j; 0, otherwise.

Xjj = 1, if a plant is located at site j and week j, it is also assigned; 0, otherwise.

p = number of plants to be placed.

Considering the above, the logistic distribution model for the water distribution company can be formulated as follows.

This model aims, in addition to minimizing travel distances, both from the plant to the distribution centers and from the distribution centers to customers.

The model is formulated with the following notations:

i, j = Indices used to refer to a node or point numbered as 1,2,3,4, …… n.

dij = Minimum distance from node i to node j.

Xij = 1, if demand at i is assigned to distribution center j; 0, otherwise.

Xjj = 1, if a distribution center is located at site j and demand is assigned to j, it is also assigned; 0, otherwise.

p = Maximum number of distribution centers that can be assigned.

X0101 = Total distance from the distribution centers to the plant

Formulation of the model using the p-median

The next step is to formulate using the P-median method. For this purpose the following considerations will be used:

1. The objective function must minimize the distances from each of the possible distribution centers to the rest of them, including the parent plant.
2. The first set of restrictions ensures that each customer is assigned to a distribution center, provided it is activated as such.
3. The second set of restrictions indicates how many customers can be served by a CEDI, for the example it is considered that each distribution center will serve three customers, including itself.
4. The last restriction determines the maximum number of CEDIS that can be enabled.
5. All the decision variables must be binary, that is, they indicate if the location is selected as CEDI and if the location is served by CEDI.

Taking the previous information, the model is as follows:

$$Min\ Z = X_{0101} + \sum_{j=1}^{10} \sum_{i=1}^{10} d_{ij} X_{ij} \quad (1)$$

$$\sum_{1}^{10} Xij = 1 \ \ for\ each\ \ i = 1,2,3, \dots n \quad (2)$$

$$\sum_{1}^{10} X_{ij} = 1\ for\ each\ \ j = 1,2,3, \dots n \quad (3)$$

$$X_{0101} = \sum_{j=1}^{10} d_{ij} X_{jj}\ for\ each\ j = 2,3,4, \dots n \quad (4)$$

$$Xij \leq Xjj\ for\ each\ \ i = 1,\ 2,\ 3, \dots \dots . n\ ;\ j = 1,\ 2,\ 3, \dots \dots \dots n,\ where\ i \neq j \quad (5)$$

$$Xij \in \{0,1\}\ for\ each\ \ i = 1,\ 2, \dots \dots n\ ;\ j = 1,\ 2, \dots \dots n \quad (6)$$

Results

Solution and interpretation of the model

Once the situation has been modeled, the next point is to solve the model, for this purpose, the Excel® Solver is used. It can be mentioned that the locations corresponding to variable (B), as well as locations (C) and (G) are those selected as distribution centers. The distribution center (B) must serve the markets of (D), (F) and (J), on the other hand, the distribution center (C) must serve the markets of (A) and (H); finally, the distribution center (G) must serve the markets of (I) and (E). The above can be seen in the following Table 2:

Selected Distribution Center	customers
B	D F J
C	A H
G	E I

Table 1 Selected distribution center with their respective customers

The distances from each Distribution Center to their respective customers are:

Center of distribution	Customer	Distance to the distribution center (Km)
B	D	69.5
	F	16.1
	J	35.3
Total		120.9

Table 2 Distance from CEDI (B) to its clients

Center of distribution	Customer	Distance to the distribution center (Km)
C	A	35.5
	H	27.0
Total		62.5

Table 3 distance from CEDI (C) to its clients

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Center of distribution	Customer	Distance to the distribution center (Km)
G	E	23.4
	I	28.6
Total		52

Table 4 Distance from CEDI (G) to its clients

The total distance traveled to cover these markets is 235.47 km, not counting the distance to take the products from the source to the distribution centers, so that including these distances, which are 153.42 km, there is a total of 388.88 km.

Center of distribution	Customer	Distance to the distribution center (Km)
A	B	63.2
	C	35.5
	G	54.7
Total		153.4

Table 5 Distance from the matrix to the CEDIS

The following image shows how the nodes of the distribution system are related.

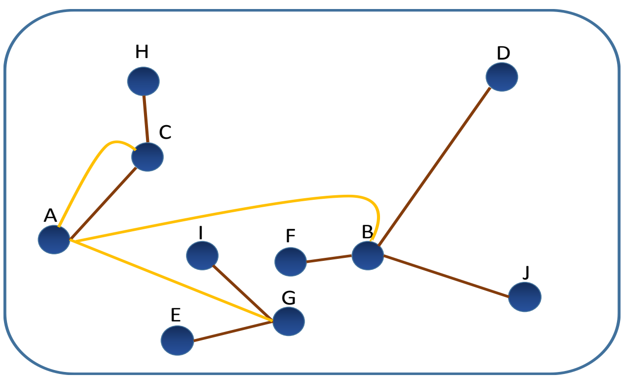

Figure 1 Structure resulting from the nodes of the distribution system

Unused approach to the plant as CEDIS

In relation to the results of the previous model, it is important to comment that in said model node A is included as a possible distribution center, and according to the solution, for the proposed situation, this variable could have been selected as a distribution center. If the company does not want to leave, it is considered as a possible distribution center, then the variable (A), would have to leave the model, and recalculate the situation considering only the other 9 variables, since, if this variable is left , there is always the risk of being selected as a distribution center.

Now, once the model is restructured, without considering (A), and it is solved, the distance from the plant to the distribution centers that have been selected by the algorithm must be added, since they must necessarily be provide product distribution centers from the production plant. According to the results obtained, the variables (B), (C) and (G) are those selected as distribution centers. The clients that will serve each of these are: (B) will serve (D), (F) and (J), while (C) will only serve (H); finally (G) attends to (I) and (E). The total route of these distribution centers is 199.96 km. To this quantity, the distance from the matrix (A) to the nodes selected as distribution centers must be added, which is 153.42 km, leaving a total of 353.37 km. The following image shows how the distribution centers and their respective customers are distributed:

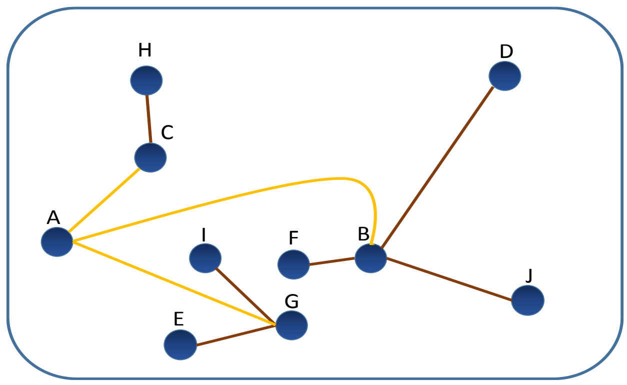

Figure 2 Resulting structure of the distribution system

Improved model

Starting from the idea presented in point 3.E, the behavior of the improved model is now shown, which, unlike the previous model, does include node (A) as part of the model, but now, (A) only considers the possibility of delivering to the possible distribution centers, for this purpose, a restriction is constructed with (A) so that it is equal to the sum of all the points where a distribution center can be placed multiplied by the distance from the plant to the possible centers. Subsequently, this variable is taken to the objective function, thereby seeking for the model to reduce the distance from the plant to the possible distribution centers and at the same time select the best distribution centers and their possible customers. The way in which the model is structured is as follows:

$$Min\ Z = X_{0101} + \sum_{j=1}^{10} \sum_{i=1}^{10} d_{ij} X_{ij} \qquad (7)$$

$\sum_{2}^{10} Xij \leq 3 \;\; for\ each\ \ i = 2, \ldots 10, j = 2, \ldots, 10\ where\ i = j$ (8)

$X_{0101=} \sum_{j=2}^{10} \sum_{i=2}^{10} d_{ij} X_{ij} \;\; for\ each\ \ i = 2,3, \ldots 10; \;\; j = 1,\ 2, \ldots 10\ where\ i \neq j$ (9)

$Xij \leq Xjj\ for\ each\ \ i = 2,\ 3, \ldots 10\ ;\ j = 2,\ 3, \ldots 10\ where\ i \neq j$ (10)

$\sum_{2}^{10} X_{ij} = 1\ for\ each\ \ j = 2,3, \ldots 10$ (11)

$Xij \in \{0,1\}\ for\ each\ \ i = 1,\ 2, \ldots \ldots n\ ;\ j = 1,\ 2, \ldots \ldots n$ (12)

The result of the improved algorithm indicates that the nodes that will act as distribution centers are (C), (I) and (F) and the clients that will serve each of these can be seen in the following figure:

Selected Distribution Center	customers
C	D H
F	B G J
I	E

Table 6 Selected distribution centers with their respective customers

Graphically the distribution can be seen in Fig. 3.

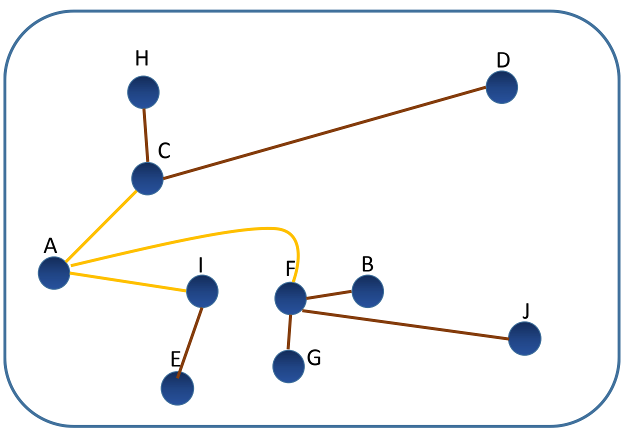

Figure 3 Result of the improved algorithm

As can be seen, node (C) will serve nodes (H) and (D), node (F) will serve nodes (B), (G) and (J) and finally node (I) will serve to node (E). The distances of each CEDI to its clients are observed in Tables 8, 9 and 10.

Center of distribution	Customer	Distance to the distribution center (Km)
C	D	76.7
	H	27
Total		103.7

Table 7 distance from CEDI (C) to its clients

Center of distribution	Customer	Distance to the distribution center (Km)
F	B	16.1
	G	21
	J	49.7
Total		86.8

Table 8 Distance from CEDI (F) to its clients

Center of distribution	Customer	Distance to the distribution center (Km)
I	E	31.4
Total		31.4

Table 9 distance from the CEDI (I) to its client

Note that the total distance traveled from the CEDIS to their clients adds up to 221.9 km, without considering the distance from the parent plant to them, which is reflected in table 10.

Center of distribution	Customer	Distance to the distribution center (Km)
A	C	35.5
	F	47.5
	I	30.4
Total		113.4

Table 10 Distance from the matrix to the CEDIS

Adding the 221.9 km from the CEDIS to the clients plus the 113.4 from the parent plant to the CEDIS, there is a total of 335.3 km. This distance is less than that presented in the two previous cases. In this particular case, an improvement can be seen in terms of the distance traveled in relation to the first model of 13.75% and in relation to the second model of 5.1%.

Conclusions

The p-median problem is central to much of discrete location theory. It is motivated by a number of real-world situations, such as having to install multiple plants at some points in a transportation system to minimize production and shipping costs or having to install different hospitals in a city so that most of the your population is covered in case you need one.

Ultimately, the p-median problem tries to locate p facilities within a network in a way that minimizes the weighted distance between demand points and the closest open facility.

In the formulation of the model, the total distance traveled to cover these markets is 235.47 km, not counting the distance to take the products from the source to the distribution centers, so that including these distances that are 153.42 km, we have a total of 388.88 km. In the model without using the plant as CEDIS, the total route of these distribution centers is 199.96 km.

To this quantity, the distance from the matrix (A) to the nodes selected as distribution centers must be added, which is 153.42 km, leaving a total of 353.37 km. And finally, in the improved model, the total distance in this case will be 335.41 km. This distance is less than the one presented in the two previous cases. In this particular case, an improvement can be seen in terms of the distance traveled in relation to the first model of 13.75% and in relation to the second model of 5.1%.

The improved model offers two fundamental advantages over the rest of the techniques discussed above. The first of these is that it allows us to focus on the information obtained by making the distribution network more optimal, thus establishing an adequate policy for the conformation of the distribution network. The second is that it allows the decision-maker to intervene in the resolution of the model, thus collecting not only the objective data but also the preferences and forecasts of the decision-maker himself.

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Web platform for aeroponic culture systematization

Plataforma web para la sistematización de cultivo aeropónico

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Abstract

Today there is a tendency to automate almost everything around us because of the circumstances that arise in the world. So, the growing boom in online platform creation, they are allowing from managing until controlling the automation of information or processes of the different sectors: productive, agricultural, economic, productive, etc. The agricultural sector relies more on the implementation of such digital platforms. Therefore, this work presents a web platform that allows to systematize an aeroponic greenhouse to improve the quality of the processes in the production of them. It aims to record planting dates, monitor environmental variables, establish spray cycles depending on the type of crop, register crops and users, among other functionalities. Thus allowing the producer to have information whereever and whenever he wants or needs to consult for decision making.

Aeroponics, Web platform, Crop monitoring

Resumen

Actualmente se tiene la tendencia de automatizar casi todo lo que nos rodea por las circunstancias que se presentan en el mundo. Por lo que, el creciente auge en la creación de plataformas en línea, están permitiendo desde la administración hasta el control de la automatización de información o procesos de los diferentes sectores: productivos, agrícolas, económicos, productivos, etc. El sector agrícola día a día confía más en la implementación de este tipo de plataformas digitales. Por lo que, en este trabajo se presenta una plataforma web que permite sistematizar un invernadero aeropónico para mejorar la calidad de los procesos en la producción de los mismos. Está tiene como objetivo registrar fechas de siembra, monitorizar variables ambientales, establecer ciclos de aspersión dependiendo del tipo de cultivo, registrar cultivos y usuarios, entre otras funcionalidades. Permitiendo así al productor tener información en cualquier lugar y hora en que desee o necesite consultar para la toma de decisiones.

Aeropónico, Plataforma web, Monitoreo de cultivos

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Introduction

Currently, the conviction for the use of digital platforms or web information systems has increased in all productive sectors: primary (agriculture, livestock, fishing), secondary (industry and construction) and tertiary (commerce, transport and tourism), among others.

According to the FAO (Food and Agriculture Organization of the United Nations, 2017) there is a strong growth in the automation of agricultural work taking into account technological evolution and the population expansion of the planet.

HSBC (2019), mentions that Agriculture 4.0 is the result of the evolution of e-agriculture in which data analysis, mobile communication and cloud services were introduced. It is about the fusion of the needs of the farmer with the most sophisticated advances in technology, in this way the potential of the information thrown by the field is used to change the way of production of food systems with the aim of solving three problems fundamental:

1. Global changes in production conditions
2. Population increase
3. Loss and waste. (HSBC, 2019)

FAO recognizes e-agriculture as a facilitator by improving information and communication processes. Hence, the importance of understanding and applying Information and Communication Technologies (ICT) in the agricultural field. The adoption of digital technologies in the agricultural sector has increased at a rapid rate, especially in the category of “precision agriculture”. This methodology is developed based on programs and data to manage and optimize crop production. The application of this technology in agriculture aims to promote the development of capacities to renew the tasks of the field and its profitability (HSBC, 2019).

The aforementioned, allows setting the objective of developing a digital platform that systematizes some of the processes that are carried out in aeroponic crops in a greenhouse. The web platform allows for various functionalities, including the monitoring of variables that directly affect the evolution of the crop, optimizing care, among others that will be described in the development phase.

Methodology

For the development of any computer solution it is necessary to follow a software development methodology, as well as to know terms that are necessary to understand regarding aeroponic crops. So some of the employees are described below.

Aeroponics is the process of growing plants in an aerial or foggy environment without the use of soil. The word "aeroponics" comes from the Greek terms aero and ponos which mean air and work respectively. Aeroponic cultures differ from conventional hydroponic cultures and in vitro growth. (Agroislas, 2019)

Therefore, an aeroponic cycle harvesting system focuses on growing plants in a closed or semi-closed environment where nutrient sprays lift the nutrient solution and spray on the aerial roots that hang in the air. The supporting roots are constantly immersed in an oxygen-rich nutrient. (Agroislas, 2019)

Some authors use the word hydroponics to also refer to aeroponics. Due to the increase in the area destined for hydroponics, it has increased in recent years due to the importance it is taking due to the overpopulation that is occurring in the world and, consequently, the increase in the demand for agricultural products. This is why several countries around the world are adopting this method. Currently, the area of hydroponic greenhouses around the world covers an area of approximately 25,000 ha. (Gualotuña Simbaña, 2018).

Next, some basic concepts characteristic of an aeroponic greenhouse process will be mentioned:

– Sprinkler systems: Applying water to crops requires the use of sprinklers, sprayers, foggers, or other devices to create a fine mist of solution necessary to deliver nutrients to roots. (Garcia, 2020)

– Solenoid Valve / Electrovalve: It is a valve designed to control the passage of a fluid through a conduit or pipe, they are made up of two different but complementary actuating parts: the valve body and a solenoid located inside the electric coil. When the coil is energized, a strong magnetic force is created in it that attracts a magnetic steel plunger that is located in the center of the coil, (Microbyte Ltda. 2019).

– REST API: It is a set of functions or procedures used by computer programs to access the services of the operating system, software libraries, or other systems. Objects in REST are always manipulated from the URL. The URL is the unique identifier for each resource in that REST system. The URL makes it easy to access the information for modification or deletion, or to share with third parties. (Anonymous, 2016)

For the development of the platform, different software tools were used, some of these are mentioned: JSON (JavaScript Object Notation), Django Rest Framework, Rest Framework Token, Raspberry PI, among others.

SCRUM software development methodology

In order to structure, plan and control the development process in information systems. Several iterations were performed, some of these are described below:

Iteration 1- Database: Everything involved with the design of the Database was carried out (Analysis of information, realization of data dictionaries and class diagram).

The following requirements were defined: User registration, User update, Login, Logout, show user, crop registration, Activate crop / Start of harvest process, Spray cycle record, List of existing crops, List of process dates of cultivation, Monitoring record, Show monitoring by day, Generate averages for weeks and month of the process, Show detail of harvest process (monitoring - report), Activity history and Show information of the crop in harvest process, deactivate crop / conclude Harvest process, Database backup and Restore database.

The structure is designed for an easy integration of information, it was with the entities defined for this project are:

– CustomUser. The main function of this entity will be to store information such as username, password, role.
– InfoUser. Entity where personal information of users will be stored to better identify and personalize them within the software.
– History. Entity built in order to store activity (log) to identify the user responsible for each movement.
– RegisterCrop. Entity that will save initial information on the fruits that are harvested in the greenhouse.
– RegisterDate. Entity where the harvest start dates of the existing fruits will be registered within the software
– Sprinkling. Entity that will store the execution and waiting times of the irrigation cycle of the existing fruits
– MonitoringDay. Entity where the readings obtained in the environment circuit and the fruit in the harvest process will be saved.
– Token. Entity in charge of storing password information for user authentication.

Iteration 2 - Platform design: developed in Balsamiq Mockups. In figure 1, the sprinkling process is presented, in which the crop is placed, the sprinkling cycle and the waiting time are established. Figure 2 shows the monitoring design of some of the variables per day.

Figure 1 Sprinkling process
Source: Self Made

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Figure 2 Variable monitoring
Source: Self Made

Iteration 3 Users Module

In this iteration the requirements to be completed will be based on functions where the customuser and infouser models are involved, as well as the management and control of backups in the database. An example of the endpoint (see Figure 3) of the information that is required is shown. Taken from the documentation created for the API.

Figure 4 presents the function that was considered to show the information related to a user, that is, a display of the user micro profile. It will only work with the infouser entity.

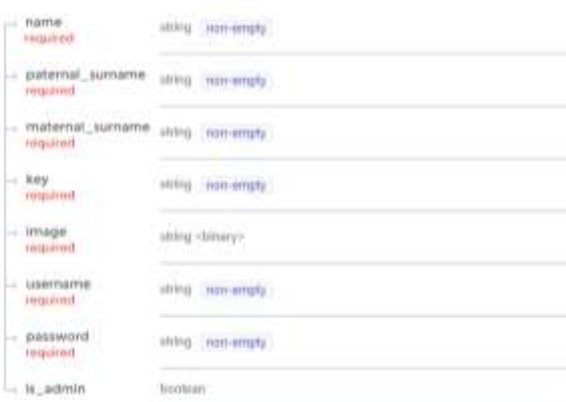

Figure 3 User register
Source: Self Made

Figure 4 User information
Source: Self Made

This article only shows some of the parts of the process that were automated on the platform. One of the advantages of the platform is the fact that the relevant variables of the crop are monitored during the production time, as requested. Generating graphs that allow observing how the behavior of these variables varies in the crop and activating the sprinkling times.

Results

The results obtained with the web platform have been relevant given that in the face of the current problem where most of the activities that were done manually, it has been necessary to migrate in almost everything to the use of ICTs, for what this allows to give the appropriate follow-up to the crops in time and form, and thus avoid that people move to the site to carry out said activities, to do it in a regular way, so it allows to save economically, there is still the limiting given that it is available for certain crops, and the knowledge of different types of experts is needed, however, since each greenhouse has its dimensions and capacities.

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Conclusions

It is concluded that the web platform allows to automate the care of crops, improving the activity and the way to optimize the time invested in this activity by people.

Some variables were identified that are not considered in the monitoring and which could improve the quality of the crop. Likewise, some functionalities that the platform does not yet have are identified, for example, that it is possible to add as many variables as necessary, add crops, although for this, the experience of qualified personnel is needed.

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Abstract (In English, 150-200 words)

Objectives
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Abstract (In Spanish, 150-200 words)

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* 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

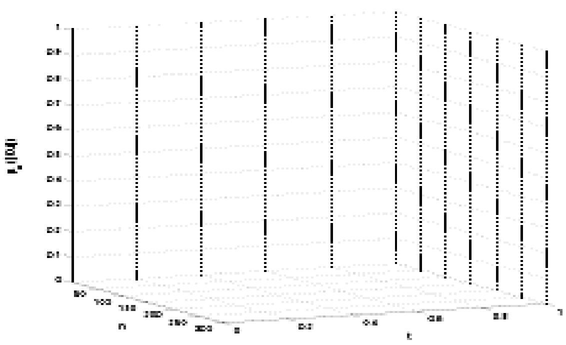
[Title No.12 in Times New Roman, single spaced and bold]

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]



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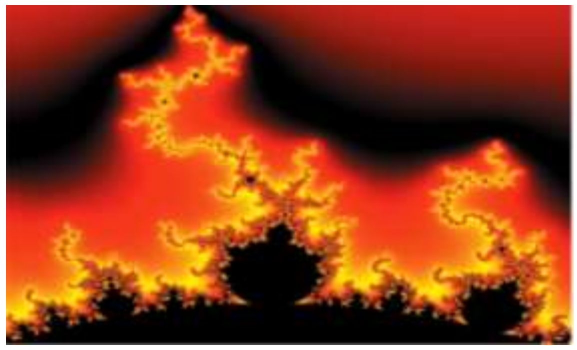

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For the use of equations, noted as follows:

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

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Methodology

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

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources

Thanks

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

Conclusions

Explain clearly the results and possibilities of improvement.

ISSN 2414-4924

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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.

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

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Abstract
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Article sections, for example:

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

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