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Journal of Technology and Innovation

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Presentation of Content

In the first article we present, *Web application for the management of the request and commission formats*, by BARRÓN-ADAME, J. Miguel, RICO-MORENO, J. Luis, GUZMÁN-CABRERA, Rafael, GARCÍA, Ernesto and QUINTANILLA-DOMÍNGUEZ, Joel, with ascription in the Universidad Tecnológica del Suroeste de Guanajuato, Universidad de Guanajuato and Instituto Tecnológico Superior de Guanajuato, as next article we present, *Interface design for water, vegetation and city segmentation in multispectral images using SVM (TOLTECA)*, by GONZÁLEZ-RAMÍREZ, Andrea, YAÑEZ-VARGAS, Israel, SANTIAGO-PAZ, Jayro, TORRES-ROMÁN, Deni and PARRA-MICHEL, Ramón, with ascription in the Universidad Politécnica de Juventino Rosas and CINVESTAV del IPN, as next article we present, *Interface development for depth level compute in water zones through bathymetry (TOLTECA)*, by ASTUDILLO-MONTENEGRO, Felipe, YAÑEZ-VARGAS, Israel, LÓPEZ-RUÍZ, Josué, PARRA-MICHEL, Ramón and TORRES-ROMÁN, Deni, with ascription in the Universidad Politécnica de Juventino Rosas and CINVESTAV del IPN, as next article we present, *PSeInt Technological tool to develop logical-mathematical intelligence in structured computer programming*, by CRUZ-BARRAGÁN, Aidee, SOBERANES-MARTÍN, Anabelem and LULE PERALTA, Armando, with ascription in the Universidad de la Sierra Sur.

Content

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Web application for the management of the request and commission formats

Aplicación web para la administración de formatos y solicitud de comisión

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Abstract

This paper describes the design and development of a web application for the management of the information obtained from the Request and Commission formats. The formats sited are "Commission Notice", "Permit request form" and "Car request form". The application was developed using HTML and PHP programming languages and MySQL as the database management system. The results obtained with the application implementation were satisfactory, being that the different forms are not just generated in a faster manner, but also the obtained information was managed in an efficient way. As an innovation, the system includes the option to back up the information forms in a digital format. The web application was developed for the Department of Information and Communication Technology in the Technological University of the South West of Guanajuato (UTSOE). Due to the obtained benfits with the application web, it is expected to implement it in all the UTSOE departments.

Web application, Information System, Digital formats

Resumen

El presente artículo describe el diseño y desarrollo de un sistema web para la administración de información generada en la elaboración y administración de formatos de solicitud y comisión. Los formatos corresponden a los eventos de "Aviso de Comisión", "Solicitud de Permiso" y "Solicitud de Automóvil". Para el desarrollo de la aplicación, se utilizaron los lenguajes de programación de HTML, PHP y MySQL. Los resultados obtenidos fueron satisfactorios ya que con la implementación del sistema no solo se elaboran de manera rápida los diferentes formatos de solicitud, sino que también se administra de manera eficiente la información generada por los mismos. Como una innovación, el sistema incluye la opción de respaldar la información de las solicitudes en formato digital. El sistema web se desarrolla para la carrera de Tecnologías de la Información y Comunicación (TIC) de la Universidad Tecnológica del Suroeste (UTSOE). Dadas las facilidades del sistema en la administración de información, se pretende extender su uso a las carreras restantes de la UTSOE.

Aplicación web, Sistema de Información, Formatos digitales

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Introduction

Information and Communication Technologies (ICT) are a set of techniques, application developments and advanced devices that integrate storage, processing and data transmission functionalities (Pérez-Foguet, 2006). Within the area of application development, two options stand out: desktop and web. Desktop applications have the disadvantage that in order to be used/accessed, it is necessary to install them on the client's computers; while web applications can be accessed or updated at any time and place via intranet or internet with the use of multiple platforms/browsers/web servers (Dressler, 2007), and (Mao Shan-jun, 2009).

Currently, there is a wide range of possibilities when facing web development. All of them are intended to provide advanced features to web pages in order to meet the broad needs of users, based on the client-server scheme. In (Tiago H. Moreira de Oliveira, 2014), the implementation of an innovative system for the administration of agricultural properties that allows the administration of more agile and efficient crops is described, with the purpose of improving productivity and competitiveness. The system records and generates reports of resource consumption in addition to the resulting products for a given period of time. In addition, the Agrifootprint system includes graphic representations so that the user obtains an immediate view of the crop information. In (Bai J, 1998) a medical teleconsultation system is presented to demonstrate the usefulness of the World Wide Web (WWW) in the exchange of medical information and telemedicine. The system is developed in Java, which provides several basic java tools to meet the requirements of medical applications, including a file manager, data tools, news window and a digital audio tool. The file manager handles medical images stored on a data server, which comes from a hospital database. The ads window allows users to discuss special cases through text, send their diagnostic reports personally or in a group, and recognize different report formats for later use.

For the development of the web application, this article uses web programming tools such as: HTML5, PHP, MySQL, JLPDF and FPDF. The rest of the paper is structured as follows.

Section two describes the characteristics of the materials used and the method implemented for the development of the application. In section three the results obtained are presented. Finally, section four presents the conclusions generated by the elaboration of the project.

Materials and methods

1. Materials

Web application development has greatly evolved in recent years (Dhande, 2014) and (Khalil, 2016). The result of this evolution is the large number of tools that can be found for the development of web applications, such as CGI, JSP, PHP, ASP, etc., which provide advanced features for web pages in order to cover the broad user needs, based on the client-server scheme (Maan, 2012).

In the development of this project, the programming languages HTML, PHP, MySQL were used. A programming language is nothing more than a structured system designed primarily for machines and computers to understand each other and us, humans.

HTML: The HTML programming language (HyperText Markup Language) is basically a set of tags that serve to define the text and other elements that can be seen on web pages (Scott, 2015).

PHP: PHP (Personal Home Page Tools) is a free and platform-independent, server-side programming language, with a large library of functions. It provides a work environment in which users can develop simple dynamic web applications, in addition to interacting with databases. Like HTML, PHP allows embedding code in HTML pages (Scott, 2015).

MySQL: A Database Management System (DBMS) is a very specific type of software dedicated to serve as an interface between the database, the user and the applications that use it; it is a software which serves to define, build and manipulate a database, thus allowing access to data in a fast and structured way. Some of the most used DBMS are: Oracle, Postfix, PostgreSQL, Access, SQL, MySQL, etc. MySQL is a very fast, multi-threaded, multi-user and robust relational database management system.

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It is designed for critical production environments with a high workload (Scott, 2015). The main features of MySQL are:

- It is a relational database management system.
- It is Open Source.
- The database server is very fast, reliable and easy to use.
- Work in client/server or embedded environments.
- There is a large amount of software that uses this system.

2. Methods

For the development of web applications, with certain quality guarantees, it is convenient to follow some of the existing software development models, where programming is only one of the stages of the software development process (Pavaloaia, 2013).

Cascade: The cascade development methodology rigorously orders the stages of the software development process, so that the beginning of each stage must wait for the end of the previous stage; also, at the end of each stage, the model is designed to carry out a final review, which is responsible for determining if the process is ready to move on to the next phase (Jain, 2012).

Some of the advantages of the cascade methodology are:

- Allows departmentalization and management control.
- It is an easy linear model to implement, understand and facilitates project management.
- The process leads to delivering the project on time.
- It allows having the project under control.
- Limits the amount of interaction between equipment that occurs during development.
- The amount of resources needed to implement this model is minimal.
- Documentation is produced at each stage of the development.
- After each important stage, the tests are performed to check the correct operation.

Figure 1 shows the stages that will be carried out for the development of the project.

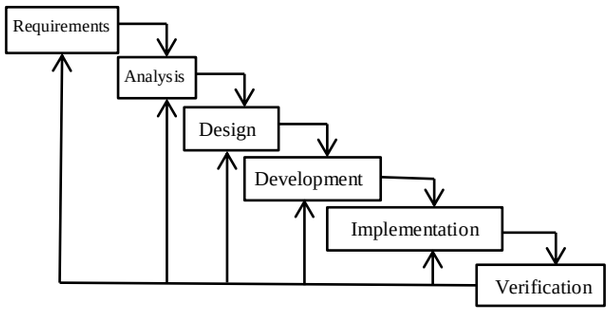

Figure 1 Methodology implemented in the development of the project

- **Requirements**: This stage consisted of investigating whether there was hardward and software for the development of the application.

- **Analysis**: Basically, at this stage the relevant information that will handle the application is analyzed. This information was obtained from the "Commission Notice", "Permit Request" and "Automobile Request" formats.

- **Design**: At this stage, the interfaces that would integrate the application were proposed; these were those of teacher and director.

- **Development**: At this stage, programming (coding) of both the interfaces and the database was carried out.

- **Implementation**: At this stage, the database connection was made with the characteristics of the user interfaces.

- **Verification**: At this stage, tests were carried out to verify the correct functioning of the data that each of the interfaces records in the database.

Results

This section presents the results obtained in the design and development of a web application for the management of information generated in the elaboration and administration of "Commission Notice", "Permit Application" and "Automobile Application".

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1. Database

For the management of the information and the generation of digital documents, a database called "applications" was created, which included the following tables: cars, commission notice, categories, cities, day, department address, chiefs, immediate chiefs, month, number, teachers, application_auto, application_permission, transport and users. Figure 2 shows the list of tables generated in the database.

Figure 2 List of tables in the database

The ***Automobiles*** table stores the various means of transportation that the institution has for the exclusive use of its workers. In the case of the ***Comission_Report*** table, it contains the fields that are specified in the commission format, in this table each generated request will be accommodated. In the case of the ***Categories*** table, it shows the administrative positions (director, ptc, among others.). The ***Cities*** table contains the name of the cities, to which they are commissioned. The ***Day*** table stores the day on which the request is solicited. The ***Department_Address*** table specifies the areas of the users involved in the various request formats. The ***Chief_Finance*** table shows the name of the Head of the finance department that signs the authorization in the application. The ***Immediate_Header*** table contains the name of immediate bosses that authorize the workers to leave. The ***Month*** table stores the users request month. The ***Number*** table stores the years of the requests. The ***Teachers*** table contains the list of potential applicants. The ***Auto_Request*** table stores the auto request format data.

The ***Permission_Request*** table stores the permission request format information. The ***Transport*** table contains the means of transportation that users may require/request for commissions. Finally, the ***Users*** table stores the list of personnel that can access the web system. The information in the tables is necessary both for the design of the website interfaces and for the generation of digital documents.

2. Interface Programming

For the storage and management of the information stored in the database, it was required to implement an access interface for both types of users. Figure 3 shows the home page of the web application; the home page, in addition to welcoming the user, requests the username and password.

Figure 3 Welcome page and start to the web administration system

If any of the data (username or password) is incorrect, a window will be displayed indicating the error. Otherwise, the system will give access to the user or administrative or management personnel. Figure 4 shows the interfaces for administrators and managers.

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a)

b)

Figure 4 Interfaces for a) administrative and b) managers

2.1. Interface for administrators

The manager interface allows each user to fill in the "Commission Notice", "Permit Request" and "Automobile Request" formats. Figure 5 shows the allowed formats and the users registered in the system.

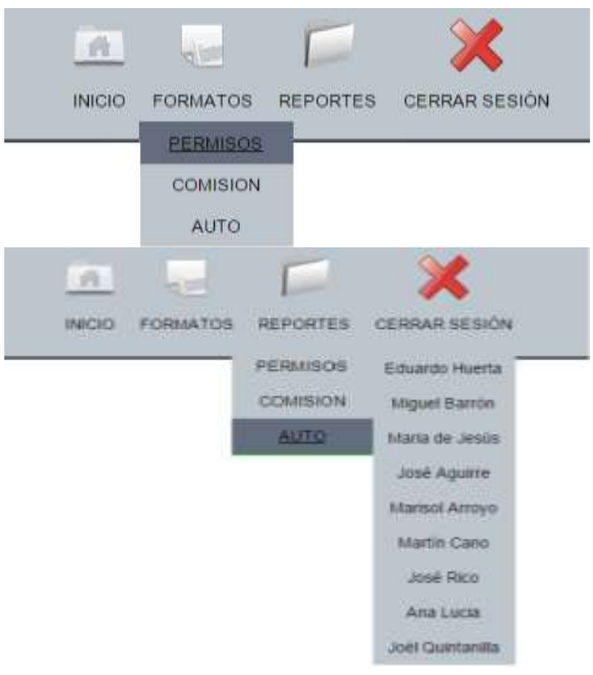

Figure 5 Drop-down menus for formats and reports

Depending on the type of format that the user requires, the system will display its filling interface. When the format is filled in correctly, the system displays a pop-up window indicating that the data has been recorded correctly. As an innovation, the system displays a pop-up window to give the user the option to save and print the document. With this option, information is stored not only in the database, but also in the different formats of digital documents. Figure 6 shows the format that is generated for *commission notice*.

2.2. Interface for managers

Unlike the administrative interface, the manager interface allows you to visualize the information generated by all administrators in the different complemented formats.

Figura 6 Format for "Commission notice"

Table 1 shows the information to be displayed in the case of the *car request* format.

ID	Day	Month	Year	Applicant	City	Days	Reason	Transportation
9	1	January	2015	Dr. José Miguel Barrón Adame	Abasolo	0		CAMIONETA
11	1	January	2015	Dr. José Miguel Barrón Adame	Abasolo	0		CAMIONETA

Table 1 Information of the generated requests

The information of the different formats which are complemented by the administrative ones in the case of *car application* is: *Day, Month, Year, Applicant, City, Days, Reason and Transportation.*

Conclusions

The management of corporate information by a company is an arduous and complex task which is normally facilitated through desktop applications.

This article described the design and development of a web application for the management of information generated in the preparation and administration of application formats: "Commission Notice", "Permit Application" and "Automobile Application". The web application was developed for the Information and Communication Technologies (ICT) of the Technological University of the Southwest (UTSOE) of Guanajuato.

The results obtained were satisfactory since, with the development of the web application, not only the different types of application formats are quickly developed, but also the information generated by them is efficiently managed.

Therefore, the use of HTML, PHP and MySQL programming tools were a good choice for the development of the application. As an innovation, the application has the option of supporting information in digital documents. Given the advantages and facilities offered by the application, it is intended to extend its use to the remaining majors at UTSOE.

Acknowledgments

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Interface design for water, vegetation and city segmentation in multispectral images using SVM (TOLTECA)

Diseño de una interfaz para la segmentación de agua, vegetación y ciudad en imágenes multiespectrales utilizando SVM (TOLTECA)

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Abstract

Floodings in Mexico generated economic and human losses in recent years, so it is necessary to use all possible tools that can help the government to reduce all these disasters, especially human losses. Therefore, a Graphical User Interface (GUI) was developed in Matlab for the segmentation and classification of vegetation, water and city in multispectral images obtained from the Landsat 8 satellite with the intention of detecting floods and vulnerable zones of flooding. The interface performs a feature extraction, segmentation, classification, validation and visualization of the final results obtained through basic segmentation algorithms such as the Normalized Difference Water Index (NDWI), Normalized Difference Vegetation Index (NDVI), in addition to performing the segmentation with one of the artificial intelligence methodologies most used in the state of the art: support vector machine (SVM) and the proposal of SVM with the k-nearest neighbors as an improvement to the algorithm.

Support Vector Machine, Flooding, Multispectral Image

Resumen

Las inundaciones en México han generado perdidas económicas y humanas en los últimos años, por eso es necesario utilizar todas las herramientas posibles que puedan ayudar al gobierno a reducir todos estos desastres, en especial la perdida humana. Por lo tanto se desarrolló una interfaz gráfica para el usuario, conocida también como GUI (del inglés Graphical User Interface) en Matlab para la segmentación y clasificación de vegetación, agua y ciudad en imágenes multiespectrales obtenidas del satélite Landsat 8 con la intención de detectar inundaciones y zonas vulnerables a inundaciones, el diseño de la interfaz realiza una extracción de características, segmentación, clasificación, validación y visualización de los resultados finales obtenidos a través de algoritmos de segmentación básicos como lo son Índice Diferencial de Agua Normalizado (NDWI), Índice de vegetación de Diferencia Normalizada (NDVI), además de realizar la segmentación con una de las metodologías de inteligencia artificial más utilizadas en el estado del arte: máquinas de vectores de soporte (SVM) y la propuesta de SVM con k-vecinos cercanos como una mejora al algoritmo.

Máquinas de Vectores de Soporte, Inundaciones, Imágenes Multiespectrales

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Introduction

Torrential rains have become one of the most common natural phenomena in Mexico. Practically every year, the increase in rains has caused severe flooding which exceeds the capacities of dams, especially in southern Mexico. In addition, they cause the increase of the riverbeds and consequently their overflow, together with the constant hurricanes in areas of the country already affected year after year.

The United States Geological Survey (USGS) facilitates the extraction and visualization of multispectral images acquired from different satellites, this tool is essential for obtaining reference data, elevation, land use, coverage data of the ground and data obtained from the satellite. From the data obtained it is possible to detect: droughts, earthquakes, changes in temperature, floods, fires and displacements in soils or rocks, pollution, etc. Also, the images of some areas of the country were obtained from this source.

For the monitoring of flooded areas any tool that can help analyze the state of the land, population and environment is necessary, so technology becomes a fundamental part of the study of the land. A typical example is the use of multispectral images obtained through remote sensing systems (RS), in which there is a great knowledge of vast areas of land, since it is possible to obtain characteristics and information of the observed scenes. This will help to classify, segment and analyze the images, which will be of utmost importance in trying to determine flood prone areas.

For the determination of flood prone areas, an extensive analysis is required in multispectral images where the first thing is to know the areas of water, vegetation, flat land and cities. For this, information that can help classify and separate/segment the classes mentioned above is required, so the use of spectral indices such as the normalized difference vegetation index (NDVI) and the normalized differential water index (NDWI) are used to segment classes in multispectral images and were described by Gao, B. (1996) and Butler (sf), but it is still not enough to have a better classification. Therefore, it is necessary to add elements used in artificial intelligence such as the use of support vector machines (SVM).

The concept of segmentation and classification of vegetation, floods and city in multispectral images has been approached from different perspectives, where it is possible to use spectral indexes, genetic algorithms, neural networks and even support vector machines. It is worth mentioning that morphological operators are also used to segment elements into images.

Among the most common algorithms it is possible to mention Sarp and Ozcelik (2017) who carry out a study for the extraction of characteristics and detection of changes in multispectral images through an evaluation of NDVI standardized indexes and the modified NDVI to subsequently use SVM. Likewise, (Elsahabi, Negm & Hamid MH El Tahan, 2016) perform a comparison of 8 different techniques for the extraction of water areas and their subsequent evaluation through algorithms of supervision and non-supervision.

Verpoorter (2012) proposes obtaining information for the classification and segmentation of water bodies for the extraction of characteristics thresholding, contrast improvement and transformations by principal component analysis (PCA).

However, all the previous algorithms fail to locate flooded areas with a large percentage, in addition to not having information that can allow a continuous analysis of multispectral images and that they do not possess an interface that allows the user to change images for later analysis or modify parameters to perform different classifications.

For this reason, this project has the design of an interface in Matlab for the detection, classification and visualization of flooded areas through multispectral images and the use of algorithms such as NDVI, NDWI, SVM and the fusion of SVM with k-nearest nighbors, which makes a great contribution to the state of the art.

Methodological Base

Remote Sensing (RS) can be defined as the science and art of obtaining information about an object by analyzing the data acquired through a device that is not in physical contact with that object.

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RS provides a temporary overview in large areas; this allows us to observe changes over time that could range from minutes to years. This can be used to study changes in the state of the earth's surface and atmosphere as mentioned by Curlander, J., & McDonough, R. (1991).

For years, remote sensing systems have been working under multispectral sensors, creating the so-called multispectral images, which are defined as a collection of several monochromatic images of the same scene, each taken with a different sensor and each image is known as a band as mentioned by Flores, B. (sf). A well-known multispectral (or multiband) image is an RGB color image, consisting of a red, a green and a blue image, each taken with a sensor sensitive to a different wavelength, as shown in the Figure 1.

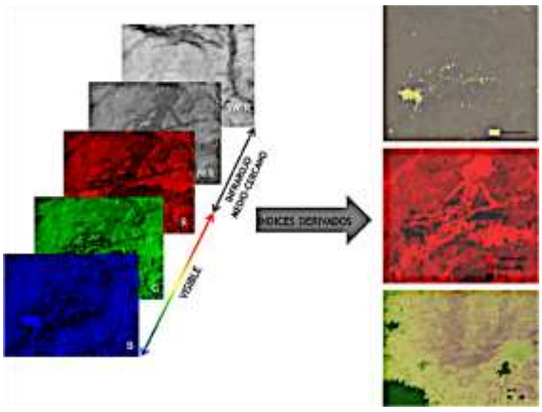

Figure 1 Example of multispectral image

It is known that multispectral images from RS systems can have linear and non-linear combinations of *m* bands that form physically significant spectral indices in the spectral space, so that during the project, 3 combinations of bands were made as Lira, J. (2010) also did.

1. Normalized Vegetation Difference Index (NDVI)

The NDVI allows identifying the presence of green vegetation on the surface and characterizing its spatial distribution. It is known from the normalized difference between the red R band and the near infrared NIR band and is calculated through NDVI equation 1, Das, K. (2017):

$$NDVI = \frac{NIR-R}{NIR+R} \quad (1)$$

2. Normalized Water Difference Index (NDWI)

The water body has a high absorption capacity and low radiation in the range of visible wavelengths to infrared, equation 2 performs the calculation of the NDWI Gao, B. (1996) and Das, K. (2017):

$$NDWI = \frac{G-NIR}{G+NIR} \quad (2)$$

Where G is the green band and NIR is the infrared band

3. Population

Butler, K. proposes that the best bands to find population segmentation are 2 and 4 of the images used, since they contain the characteristics to be able to highlight it by applying equation 3, where A is the blue band and R is the red band

$$Population = \frac{A-R}{A+R} \quad (3)$$

4. Support Vector Machines

Support Vector Machines (SVM) were developed by Vapnik in the year of 1979, together with some co-workers. SVM is considered as a supervised classification technique, which allows separating only two classes at a time, this way of classifying it is called binary type as mentioned by Zylshal et al. (2016).

The objective of SVM is to make a classification looking for the best separation hyperplane that can exist between two classes. The hyperplane is obtained from maximizing the distance that exists between one class and another; in this way, SVM finds the largest margin that exists between two classes without intermediate points within this margin and thus, is considered as the maximum distance of the points that run parallel to the hyperplane; these points are called support vectors. Figure 2 shows a small explanation of SVM, for a more detailed explanation see Santiago, J. (2016).

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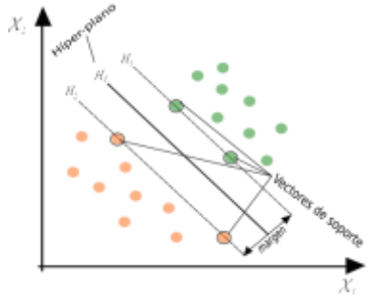

Figure 2 Explanation of SVM

5. k-Nearby Neighbors

In (Gonzalez, 2007), nearby neighbors is defined as a simple algorithm that stores all available cases and classifies new ones based on a measure of similarity. A case is classified by the majority vote of its neighbors, the case being assigned to the most common class among its neighbors. Figure 3 shows an example.

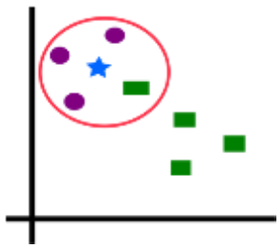

Figure 3 Example of nearby neighbors

Methodology and Development

Figure 4 shows the general block diagram to obtain the classification through SVM, where we will make a description of each of the blocks:

- Step 1: The original image is loaded with the extension .jpg, this in order to display the RGB image, as well as the bands of each image.
- Step 2: The multispectral image is pre-processed so that it has the appropriate properties for further processing.
- Step 3: The acquisition of the characteristics for its SVM training is carried out.
- Step 4: The multispectral image classification is performed.
- Step 5: The final result is projected on the RGB image.

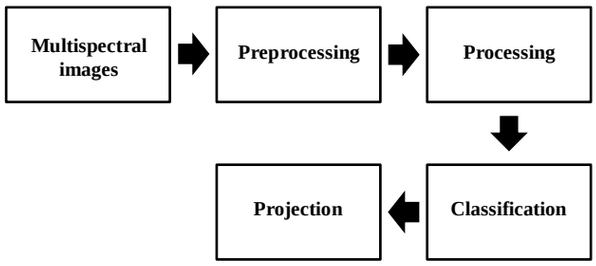

Figure 4 General block diagram

Each of the processes described above were used to perform a GUI interface in MATLAB, which will be described in the next section.

Interface

Figure 5 shows the main screen, which shows the title of the project, and at the top there is a menu bar that contains the options: Menu and Exit. In the menu option two options will be displayed: Classifier by indexes and Classifier by SVM.

Figure 5 Main interface of the TOLTECA project

Figure 6 shows the classifier screen by spectral indexes, its function is to be able to classify: water, vegetation and city. The classification by spectral indexes was made after applying a preprocessing to the multispectral images and the use of equations (1), (2) and (3).

Figure 6 Spectral index interface

The number one shows the menu bar that has the functions:

- **File**: Open the original image and the image is displayed in box number two.

- **Metrics**: Quantitative comparisons of the classification by classes, this result will be reflected in box 6.

- **Exit**: Returns to the main screen.

The four buttons in section 3 have the function of obtaining the area of interest, the results are shown in box number 5 and described below:

- **Water**: Its function is to obtain the body of water using the NDWI spectral index, loading bands 3 and 5 of the multispectral image.

- **Vegetation**: Its function is to obtain the vegetation of the multispectral image, using the NDVI spectral index, performing the mathematical operation with bands 4 and 5.

- **City**: Obtains the population of the multispectral image, through bands 2 and 4.

The GT button loads an image classified pixel by pixel in a supervised manner and is displayed in box number 4. An example of the results obtained is shown in Figure 7.

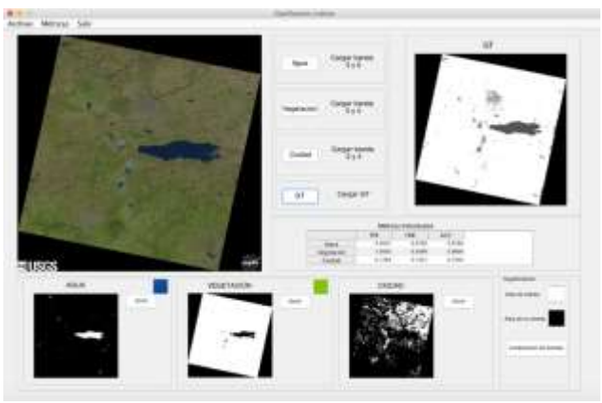

Figure 7 Example in spectral indexes

Box 7 of Figure 6 shows a button that has the function of making a projection of the final result, which will show the classification represented by colors: water-blue, vegetation-green and city-yellow as shown in Figure 8.

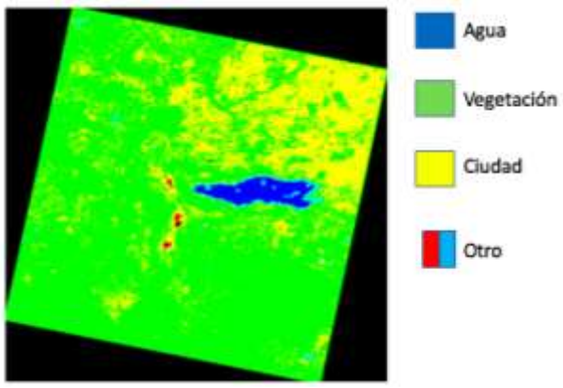

Figure 8 Result of the classification

The classification screen with SVM is shown in Figure 9, which will be described by means of numbered red boxes.

Figure 9 SVM interface

Number one contains the menu bar, which shows the following options:

- **File**: Open the original image which will be shown in box number two.

- **Metrics**: Quantitative comparison of class classification, this result will be reflected in box 6.

- **Prediction**: Makes an estimate of areas vulnerable to flooding.

- **Exit**: Returns to the main screen.

In number three, the classes defined as: water, vegetation and city, described below are shown:

- **Water**: This section contains two buttons, its function is to select in the image shown in table 2 the area that is water and the one that is not water.

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The next step is to select the best parameters to evaluate them, so the model was created and obtained the metrics True Positive Rate (TPR) and True Negative Rate (TNR); if the numbers approach 1 is a good model, otherwise the parameters will have to be moved.

- **Vegetation**: This section contains two buttons, its function is to select in the image shown in table 2 the area that is vegetation and the one that is not vegetation, the same steps described in the water section are performed.

- **City**: This section contains two buttons, its function is to select in the image shown in table 2 the area that is city and the one that is not city, as in the water section.

By having the characteristic matrices, we click on the button called Testing, located in box 4, its function is to perform the training of the matrices and thus perform their subsequent classification, which will reflect the results in box number 8.

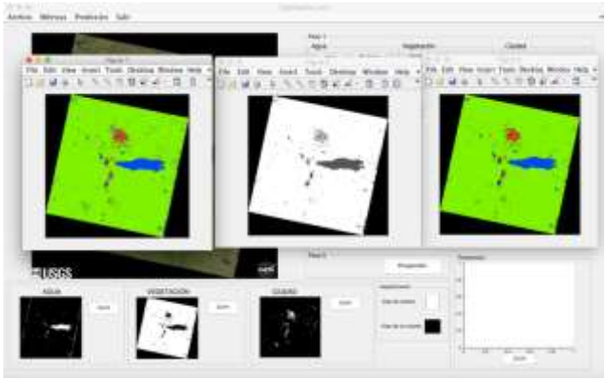

Figure 10 Example with SVM and k-nearby neighbors

Table 7 shows a button called projection, which has the function of opening a new window by displaying the first SVM result, and also opens a new window displaying the SVM result with nearby neighbors, as shown in Figure 10.

The prediction option located in the menu bar, estimates the areas vulnerable to flooding, this by means of two options: synthetic images and temporary images, in addition to the help of morphological operators, displaying the result in box 9 of Figure 11.

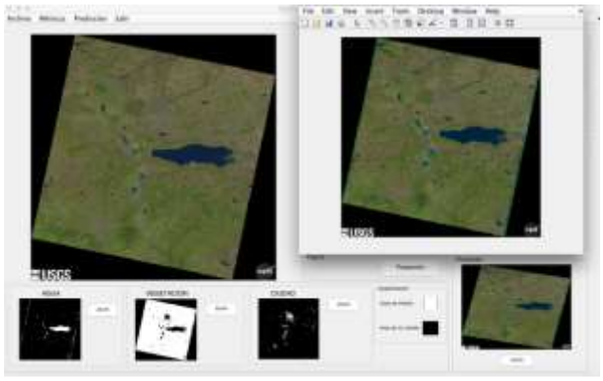

Figure 11 Areas likely to be flooded

Conclusions

This work shows that the spectral indexes perform a simple unsupervised classification of pixels, taking into account that in order to achieve it, it is necessary to have prior knowledge of each of the spectra for the election of the appropriate bands that highlight some areas of interest.

Likewise, the classification with SVM and k- nearby neighbors was proposed since by being a supervised classification better results can be obtained. As it was visually demonstrated, training is required to be able to classify in the best way, for this matrices are generated with the characteristics of the classes, in this case: water, vegetation and city.

By having two methods for processing multispectral images, it is important to incorporate an interface, as it allows for user-computer communication through a set of instructions (algorithms) of images, buttons and texts. The interfaces simplify the operation of a computer, allowing the user who is not familiar with programming to be able to use it. Likewise, they are designed to be intuitive when used, as they allow the user to gain experience and knowledge.

Thus, it helps to have a tool for manipulating these multispectral images, in order to observe the classification in a friendly way, so that the user can graphically observe each of the results and have the ability to choose freely either one of them. Also, with the use of these algorithms, better results are obtained, which will be better described in another paper, including comparative metrics between the methods and the ground trouth image, in addition to having the matrices of confusion of classification.

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Interface development for depth level compute in water zones through bathymetry (TOLTECA)

Desarrollo de una interfaz para el cálculo de los niveles de profundidad en cuerpos de agua a través de batimetría (TOLTECA)

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Abstract

Bathymetry is a method of quantifying depths to study the topography of water bodies, including oceans, seas, rivers and lakes. The measurement of bathymetry by means of satellite images is one of the fundamental investigations in the field of remote sensing (RS) of marine environment, which has a lot of applications for the coastal environment and its monitoring. The precise determination of depth water is essential for various purposes, such as the monitoring of underwater topography, the movement of deposited sediments and the production of maritime maps for navigation. Remote sensing allows the bathymetry modeling at spatial scales that are impossible to achieve with traditional methods. Bathymetry can be estimated using RS with several techniques, each with its own capacity for depth detection, accuracy, error, strengths, advantages, disadvantages and the best application environment. Before that, a GUI interface is developed in Matlab that contains enough data to be able to compute the bathymetry in multispectral images from the satellite LANDSAT 8, with the intention of being able to analyze how flooded an area will be.

Bathymetry, Multispectral image and flooding

Resumen

Batimetría es un método de cuantificación de profundidades para estudiar la topografía de masas de agua, incluidos océanos, mares, ríos y lagos. La medición de la batimetría mediante imágenes de satélite es una de las investigaciones fundamentales en el campo de la percepción remota (RS) del entorno marino, que tiene numerosas aplicaciones prácticas para el medio ambiente costero y su seguimiento. La determinación precisa de la profundidad del agua es esencial para diversos fines, como el monitoreo de la topografía submarina, el movimiento de los sedimentos depositados y la producción de mapas marítimos para la navegación. La percepción remota permite el modelado de batimetría a escalas espaciales que son imposibles de lograr con métodos tradicionales. La batimetría se puede estimar utilizando percepción remota utilizando varias técnicas, cada una con su propia capacidad de detección de profundidad, precisión, error, fortalezas, ventajas, inconvenientes y el mejor entorno de aplicación. Ante eso se desarrolla una interfaz en Matlab que contenga los datos suficientes para poder realizar el cálculo de la batimetría en imágenes multiespectrales provenientes del satélite LANDSAT 8, con la intención de poder analizar el grado de inundación de una zona.

Batimetría, Imágenes multiespectrales e inundaciones

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Introduction

The use of technology today is the most valuable tool to deal with different environmental problems. For instance, national, state and municipal organizations, which are water resource managers, need to obtain information on the volumetric behavior of water. Likewise, it is useful for the study or prevention of floods, so as to ensure making the best decision as soon as a problem occurs with rains or floods, without affecting the ecological and social environment. Due to the visible changes in the volumes of water in the country that has caused several effects, such as the increase in the area of lagoons and in some cases the rise on the creation of lagoons and wetlands, it is estimated that the monitoring of these changes is carried out only 10% by government institutions, especially for knowledge of water depths or levels. Given this, it is very important to carry out studies of multispectral images obtained from remote sensing (RS) systems, this with the idea of processing, improving and classifying them for future disaster prevention. The use of image processing techniques will help conduct better research and have the possibility of preventing disasters at some time due to increases in water levels.

There are multiple projects, investigations or works in which they mix image processing, image segmentation and even spectral indexes. A first work corresponds to Szabó (2016) who in this paper studies three spectral indices: Normalized Different Vegetation Index (NDVI), Normalized Different Water Index (NDWI), Modified Normalized Different Water Index (MNDWI), where they were investigated from the aspect of the types of land, bodies of water, forests, land plows, grasslands and urbanized areas using Landsat 8 system data.

A second work by Stumpf (2003) develops a solution for the standard bathymetry algorithm to determine the depths in clean water. The previous algorithm obtains water depths of less than 10-15 m, while the transformation algorithm can obtain depths in 25 m of clean water.

Said (2017), explains in his article the development of the acquisition of bathymetric data through the satellite-derived bathymetry technique (SDB).

It is a spatial acquisition technique that extracts bathymetric data from high-resolution multispectral satellite images for various purposes and recently it has been considered as a promising new technology in the hydrographic surveying industry.

However, all the previous investigations still have room for improvement, since they have not yet been able to completely measure the depths in bodies of water and for now only measurements are made in bodies of water of greater depths. For this reason, the present work has the design of an interface in Matlab for the measurement of depths in water bodies and the use of algorithms such as NDVI, NDWI, NDSI and satellite-derived bathymetry mentioned by McFEETERS (1996), which makes a great contribution to the state of the art.

Methodology

Satellite images of the LandSat 8 satellite platform available from the United States Geological Survey (USGS) were acquired, between 2015 and 2018, the downloaded images correspond to the different bands shown in Table 1 for the Landsat 8 satellite system, downloaded images from (USGS-US Geological Survey).

LANSAT 8		
Bands	Bandwidth (μ*m*)	Resolution
Band 1 Coastal	0.43 a 0.45	30
Band 2 Blue	0.45 a 0.51	30
Band 3 Green	0.53 a 0.59	30
Band 4 Red	0.64 a 0.67	30
Band 5 NIR	0.85 a 0.88	30
Band 6 SWIR1	1.57 a 1.65	30
Band 7 SWIR2	2.11 a 2.29	30
Band 8 Pan	0.50 a 0.68	15
Band 9 Cirrus	1.36 a 1.38	30
Band 10 TIRS 1	10.6 a 11.19	100
Band 11 TIR 2	11.5 a 12.51	100

Table 1 Bands of LANDSAT 8 Markham

The files downloaded from the USGS consist of a total of 11 bands, each with a different bandwidth and spatial resolution. They also have a metadata file, which contains information necessary for the systematic and practical search of data files, and also explains the essential characteristics of the data to be processed as radiance and reflectance, as well as the position of the sun during capture of the images.

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The block diagram of Figure 1 describes the methodology used in this investigation.

1. Multispectral images

As a first step, we have the acquisition of multispectral images; this is where we get all the bands necessary to develop the established algorithm.

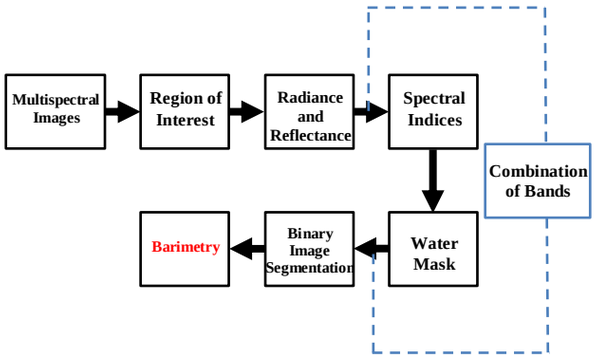

Figure 1 General block diagram

2. Region of interest

The second step is to choose or select the region of interest in which the bathymetry will be used as mentioned in Gonzalez (2007).

3. Radiance and Reflectance

The third step is to apply the radiance and reflectance equations to each of the bands. This is with the intention of calibrating the digital levels of the pixels from the metadata information, which represent the data of the multispectral images, as I investigated (Chavez, 2010).

4. Spectral Indices

The fourth step is to generate the spectral indices (NDWI, NDVI and NDSI) from the calibration of the reflectance of each of the bands.

The NDWI index (Normalized Difference Water Index) has been widely used for the remote detection of bodies of water as the study by (Gao, 1996). The NDWI can improve water information effectively in most cases. It is sensitive to built-up land and often results in overestimated bodies of water, Szabó (2016).

The NDWI is expressed as follows according to McFEETERS (1996).

$$NDWI = \frac{G-NIR}{G+NIR} \quad (1)$$

In equation 1, G is the reflectance in the visible green channel, which is Landsat band 3, and NIR is the near infrared channel spectral reflectance is Landsat band 5.

Probably the most used index to assess the state of the vegetation is NDVI (Normalized Difference Vegetation Index) which is defined as shown below:

$$NDVI = \frac{NIR-R}{NIR+R} \quad (2)$$

In equation 2, R is the reflectance in the visible red channel, which is Landsat band 4, and NIR is the near infrared channel spectral reflectance and is Landsat band 5.

The Normalized Difference Snow Index (NDSI) is a normalized proportion of the reflectance difference in these bands that takes advantage of the exclusive signature and spectral differences to identify snow from surrounding features including clouds. The equation for the NDSI is:

$$NDSI = \frac{G-SWIR}{G+SWIR} \quad (3)$$

In equation 3, G is the reflectance in the green channel of the visible one, which is Landsat band 3, and SWIR is the spectral reflectance of the middle infrared channel and is Landsat band 6.

5. Water Mask

The spectral indexes are not good water discriminators, for that reason a water mask is created due to the need to extract the bodies of water from the scene, as in Edrosa (2014).

To improve their discrimination of coverings with different reflective behaviors, such as those of vegetation, soil and water, an auxiliary RGB image called “NDXI” or “Image of indexes” was constructed. The generation and application of a permanent water mask is due to the need to extract with it the bodies of water that have a spatially stable distribution over time, and thus we are able to observe the data set only with water.

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The methodology of Figure 2 reduced the volume of information, and discriminated the coverage mentioned.

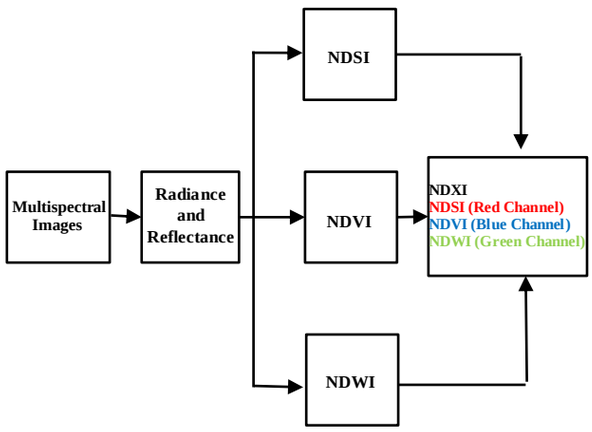

Figure 2 Generation of water masks through spectral indexes

The use of the NDXI image helped to identify the coverage of interest (in this case "water" and "no water") by means of a composite analysis of optical interpretation plus an analysis of the spectral responses of the indices.

6. Binary Image Segmentation

The next step is, from the water mask, to generate a grayscale image as to create a binary image of it, this in order to have only two values: one will represent the areas with water (white, value of one) and the other will be areas that are not water (black, value of zero).

7. Bathymetry

Finally, the next step is to obtain the water depth of any scene through bathymetry. The model developed by Stumpf (2003) applies the fundamental principle that each band has a different level of water body absorption. The different level of absorption conceptually will generate the relationship between bands and this relationship will change simultaneously when the depth is modified. Theoretically, when the ratio increases the depth will also increase. The band with a higher level of absorption will decrease continuously when the depth increases.

According to Stumpf (2003), this logarithmic ratio model is more robust and has demonstrated a more accurate depth estimate especially for shallow habitats with low reflectance.

$$z = m_1 \left(\frac{ln(L_{obs}(Band_{blue}))}{ln(L_{obs}(Band_{green}))} \right) - m_0 \quad (4)$$

Equation 4, helps to obtain the absolute bathymetry for the whole image as mentioned both in (El-Sayed, 2018) and in (Said, Mahmud & Hasan, 2017). Where L_{obs} are the radiance bands, m_1 and m_0 are tunable constants to transform linearly (i.e. scale and displacement). The algorithm results in a plotted depth.

Since with the logarithm the maximum and minimum values of the function become distant, it was decided to maintain the function in a linear manner, so that the depth range is wide to detect areas of low and high depth in the same scenario.

Figure 3 represents the first of three interfaces, which executes the Satellite Derived Bathymetry algorithm in such a way that it shows the levels of water bodies within the scene.

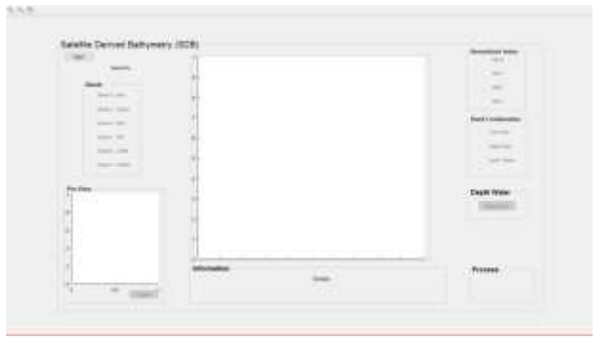

Figure 3 Main bathymetry interface

The interface has a single screen in which the user will choose the path where the images downloaded from USGS with their metadata file are saved. When selecting the file, the program will generate an RGB image so that the user can have a better interaction and choose the ROI (region of interest). In the interface the user can choose to observe each band individually from 2 to 7, visualize the spectral indexes, a combination of bands or see the result of the Satellite Derivative Bathymetry algorithm.

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Figure 4 Comparative interface of depth levels

The interface of Figure 4 has a screen divided into two sections, each calculating the Satellite Derivative Bathymetry algorithm. It is divided into two sections to make a comparison between images of the same region, but with different temporal resolution, this to see the changes that were in the depth of the bodies of water.

Figure 5 Flood estimation interface

The interface of Figure 5 has a screen divided into two sections. The reason for the division is to estimate the behavior of a flood.

The interface can work with two scenarios of different temporal resolution or with the same image, since in the process a message will appear to create synthetic images. Similarly, a message will appear saying that there is no flood or a message that says the percentage of flooding within the scene.

Results and Interface

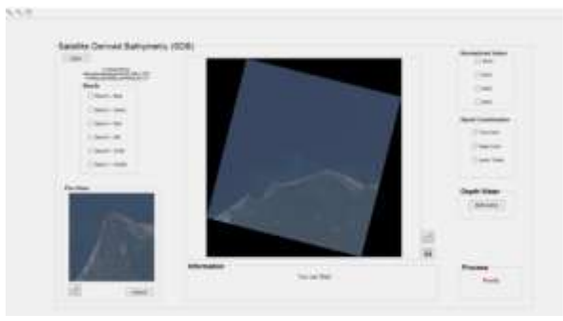

Figure 6 Result of the flood estimation interface

Figure 6 refers to the display of the first interface when the user has selected multispectral images. The RGB image of the original area is displayed in the main window. The region of interest that the user selected is shown in the left side of the lower corner of the window.

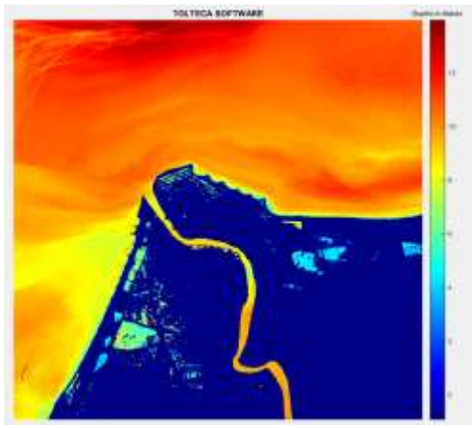

Figure 7 First bathymetry result

Figure 7 shows the final result of the SDB algorithm for the first interface where the ROI image is displayed after preprocessing, processing and having completed the bathymetry equation. The colors within the image show the depth value of each pixel of water and these can be compared in the bar on the right side, which will show the values that those colors will have reflected in meters.

Figure 8 Result of the interface, comparison of depth levels

Figure 8 shows the second interface when the user selected the ROI. In the interface the user will select two multispectral image files, which should have the same spatial resolution but different temporal resolution.

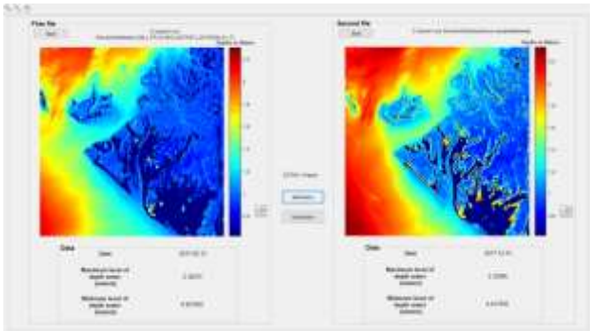

Figure 9 First bathymetry result

Figure 9 shows the images after applying the SDB algorithm in each scene. In each section we have a bar that says the depth value of each color within each file. In the lower part, the maximum and minimum water depth values in each scene appear, in addition to the date they were acquired.

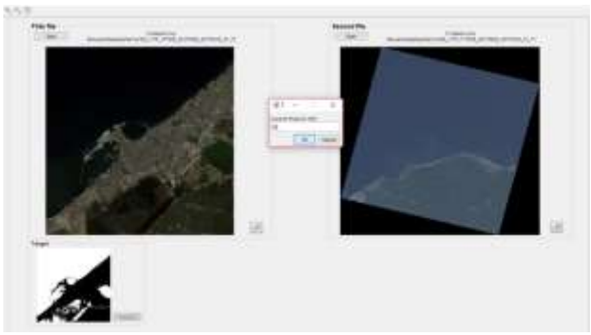

Figure 10 Result of the flood estimation interface

Figure 10 shows how the flood estimation interface is presented from multispectral images. The interface will serve to show a possible behavior of the propagation of water in a flood, we can work with images of different temporal resolution or with the same package of multispectral image files since it is possible to create a synthetic image for its operation.

Figure 11 First result of a flood simulation

Figure 11 shows the process of developing a synthetic image for the visualization of a possible flood behavior. The user has the possibility to make a real comparison between two images with different resolution in which there is one with flood or to be able to create a synthetic image and simulate a flood.

In both ways, the two images will be compared and in order to have a better visualization of the flooded areas they will be painted with a color to highlight the areas vulnerable to flooding.

Conclusions

The use of the standardized spectral indices that were described in the paper provides information for the segmentation of areas of water and vegetation with greater ease. From the segmentation it is easier to perform the calculations of depth levels only in areas of interest, without the need of mapping the entire image. It should be noted that there are multiple variants of the indexes, so each one can provide different benefits over certain images.

The bathymetry algorithm produces visible results very similar to those shown by the different articles reviewed and added as references in the document. For this, relevant adjustments of the parameters for the proposed equations must be made, since in the absence of suitable adjustments they will show results that are not appropriate to what we are looking for. One of the simplest ways to determine the parameters is the use of the linear regression method, in order to determine more precisely if the modifications are the best, a comparison with a gold model (multispectral image with data measured in situ) is required, having the depths of certain bodies of water.

With the designs of the interfaces for bathymetry, it became more user-friendly, since it will be easier to modify variables to the user's liking and visualize the results in a better way.

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PSeInt Technological tool to develop logical-mathematical intelligence in structured computer programming

PSeInt herramienta tecnológica para desarrollar la inteligencia lógica-matemática en programación estructurada de computadoras

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Abstract

Information and Communication Technologies (ICT) have an increasing influence on the way of communicating, learning and life; and that the challenge is to use these technologies effectively so that they serve the interests of the students as a whole and of the entire educational community as didactic strategies to support the students, in their arduous task of learning topics related to the development of the logic of computer programming, since for them it is a factor that makes it difficult to solve problems in algorithmic form, independently of any programming language. In the search to improve the teaching-learning process in the fundamentals of the logic of computer programming, the present work aims to describe the experience where the first semester students of the Computer Systems Engineering of the Technological of Advanced Studies of the East of the State of Mexico (TESOEM) learned to develop their skills to understand such logic, necessary to solve problems in algorithmic form using a psedolanguage as a pseudocode, where the PseInt program was used as an educational support tool significantly influencing the understanding of this logic.

PseInt, Programming, Logic-Mathematics

Resumen

Las Tecnologías de la Información y la Comunicación (ICT) tienen una influencia cada vez mayor en la forma de comunicarse, el aprendizaje y la vida; y que el desafío consiste en utilizar eficazmente estas tecnologías para que estén al servicio de los intereses del conjunto de los estudiantes y de toda la comunidad educativa como estrategias didácticas de apoyo a los estudiantes, en su ardua tarea de aprender temas relacionados con el desarrollo de la lógica de programación de computadoras, ya que para ellos es un factor que dificulta para solucionar problemas en forma algorítmica, independientemente de algún lenguaje de programación. En la búsqueda de mejorar el proceso de enseñanza-aprendizaje en los fundamentos de la lógica programación de computadoras, el presente trabajo tiene por objetivo describir la experiencia donde los estudiantes de primer semestre de Ingeniería de Sistemas Computacionales del Tecnológico de Estudios Superiores del Oriente del Estado de México (TESOEM) aprendieron a desarrollar sus habilidades para entender dicha lógica, necesaria para solucionar problemas en forma algorítmica usando un psedolenguaje como pseudocódigo, donde el programa PseInt se utilizó como herramienta de apoyo educativo influyendo significativamente en el mejoramiento del entendimiento de esta lógica.

PseInt, Programación, Lógica-Matemática

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Introduction

The incorporation of Information and Communication Technologies (ICT) in society and, especially, in the field of education, has become increasingly important and evolving in recent years. However, what gives a true potential within the classroom is the pedagogical sense of the teacher, so that incorporation must be the product of a constant reflection of the teacher on several aspects, including the didactic strategy to be used, the skills to be developed, the theme and the problem that must be solved. ICTs in the classroom provide both the educator and the student with useful tools and position the student as the protagonist of their own learning (Cruz and Barragán, 2014).

At present there are various educational technological tools, such as didactic strategies to support students, in their arduous task of learning topics related to computer science, such as the logic of computer programming, the latter as mentioned by Novara (2014) that learning to program algorithms is very difficult for most students, since programming logic is required, fortunately the tendency of the last ten years is more frequent to use technological tools at university level to facilitate teaching learning based on representations of pseudocode or flow charts, among these stand out Pseint and FreeDfd.

Recalling that programming algorithms is very difficult, López (2006) points out that one of the problems found in computer programming students is to understand the logic and how a program really works, because most of the time they simply memorize the code syntax, taught in a specific programming language and that causes a lot of confusion, because at the moment that the student advances in the different semesters how to implement Object Oriented Programming, it is where the teacher realizes that “something” is needed. So that "something" that lacks is the basic logic of programming.

Similarly, López (2006) mentions that students are not being taught to think; that is, they are not developing the logic of programming and that is a factor that makes it difficult for most students and for the teacher it is a challenge that must be faced, because programming is an intellectual activity that requires a lot of creativity, ability to abstraction, analysis and synthesis and that these skills can be developed in an appropriate way.

Howard Gardner has proposed his theory of Multiple Intelligences since 1983. Through it, Gadner concluded that intelligence is not something innate and fixed that dominates all the skills and problem-solving skills that the human being possesses as often thought, but that education can develop it. Within their theory of intelligences is Logical-Mathematical Intelligence, people with this intelligence have among their abilities logical thinking, high numerical reasoning, the ability to resolve, understand and approach arithmetic elements, in general in resolution of problems.

Gardner (1983) recognizes that every human being is born with potentialities that are the product of genetics, however, he considers that they are developing in one way or another, in what influences the environment, experiences, education received, culture, among other aspects not less important.

The experience obtained through the subject of Computer Programming Fundamentals is presented during the 2018/2 school year (September-January) in which the first semester students of Computer Systems Engineering of the Technological of Higher Studies of the East of The State of Mexico (TESOEM), learned to understand the logic needed to solve problems in an algorithmic way, regardless of some programming language, that is, to learn algorithms using a psedolanguage as a pseudo-code and not directly with a programming language.

The foregoing, in order for the student to understand how a computer program really works through the PSeInt tool as support for constructive, collaborative learning and discovery through ICT, in the sense that pseudocode exercises are not understood for some of the students in an abstract way, which led to simulate the execution of the process with true data in that tool.

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Commonly the verification of the exercises is by the blackboard and paper, so it is tedious in simple basic exercises.

ICT in educational processes

UNESCO (2013) indicates that Information and Communication Technologies (ICT) have an increasing influence on the way of communicating, learning and life; and that the challenge is to use these technologies effectively so that they are at the service of the interests of all students and the entire educational community. Likewise, it considers that ICTs help to achieve universal access to education and improve the equality and quality of education; they also contribute to the professional development of teachers and to the improvement of the management, governance and administration of education, provided that appropriate policies, technologies and capacities are applied.

Tobón et al. (2010) refers that the incorporation of ICT in educational processes offers ample possibilities to offer alternative educational models in which technologies can become support or complement of face-to-face education.

Delgado and Venesio (2013) mention that Salvador Llopis, in his article «The innovative and creative teacher. Typology of the ICT teacher », invites us to think about the creative teaching figure, who has the capacity to transform and generate new ideas / concepts or new associations; uses ICT as a useful means to achieve an end, adapting old and new methods to create a new teaching.

The same author mentions that David Sánchez Barbudo Miranda, says “The creative teacher knows the student, is not individualistic, never leads the closed class, promotes participation, is collaborative and is generous with his materials because he does not consider them his own, but an evolution than others created for him”. Referring to the innovation processes regarding the use of ICT in university teaching Salinas (2009) mentions that they usually start, most of the time, of the available technological solutions and availability and consider innovation as a creative way of selection, organization and use of human and material resources by the teacher.

According to Fullan and Stiegelbauer (2000), with the innovation processes in terms of improvements in the teaching-learning processes is the incorporation of new materials, new teaching behaviors and practices and new beliefs, as well as new conceptions to achieve significant learning.

From the perspective of Ausubel et al. (1997: 42): “The conceptualization of meaningful learning is achieved when the student can relate new knowledge to their individual experience (with what they already know), with everyday situations, with real situations, etc. so, Leon (s / f): makes mention that the human being has the willingness to really learn only what he finds meaning or logic. Tends to reject that which does not make sense. The only real learning is meaningful learning, meaningful learning. Any other learning will be purely mechanical, memorial, conjunctural: learning to pass an exam, to pass the subject, etc.

Pelayo (2007) states that the teacher becomes only the mediator between knowledge and students, it is no longer he who simply imparts them, but that students participate in what they learn, but to achieve student participation they must create strategies that allow the student to be willing and motivated to learn. Thanks to the motivation that the teacher can achieve, the student will store the knowledge imparted and find it meaningful or important and relevant in his daily life.

Mathematical Logic Intelligence

In 1983, Dr. Howard Gardner, Project Zero director and professor of psychology and educational sciences at Harvard University proposed his theory that there are seven intelligences. These are: linguistic-verbal, logical-mathematical, physical-kinesthetic, spatial, musical, interpersonal and intrapersonal. Then, based on the most recent studies, it establishes that there are more intelligences: the naturalist, the spiritualist, the existential, the digital and others.

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Through this theory Gardner (1983) concluded that intelligence is not something innate and fixed that dominates all the skills and problem solving skills that human beings possess, has established that intelligence is located in different areas of the brain, interconnected with each other and that can also work individually, having the property of developing widely if they find an environment that offers the necessary conditions for it.

Logical-Mathematical Intelligence reaches the way to identify models, make calculations, formulate and verify hypotheses or assumptions, using the scientific method and inductive and deductive reasoning. It uses the sensitization of the schemes and the logical relations, the affirmations and the proportions, cause and effect, makes connections, uses the numerical thinking to classify, categorize, sequence and plan, in general in problem solving.

Gardner also mentions that this intelligence has a very important function, but above all it is considered and recognized as social science, because it is considered complete and influential as science in general, with all its applications, it goes from the theoretical to the practical.

Gonzales (1987) "Considers that if the student learns mathematical logic, he will not have problems to learn exact sciences and will be able to program computers, since a computer program is nothing more than a sequence of logical steps that the person establishes to solve a determined problem".

How to stimulate mathematical logical thinking according to Gardner:

1. Use various interrogation strategies.
2. Pose problems with an open end for students to solve.
3. Build models for key concepts.
4. Encourage students to construct meanings from their object of study.
5. Link mathematical concepts or processes with other content areas and aspects of everyday life.

Technological Tools for Algorithms

In general, it is a fact accepted by the academic community that learning to program algorithms is very difficult for most students Bennedsen and Caspersen (2007). Fortunately, the ten-year trend to date is to use software tools as didactic support to facilitate teaching algorithm learning. For this, there are different tools, among which are Alice (Cooper et al, 2003) and JKarelRobot (Buck and Stucki, 2001) used mainly in basic and upper secondary education. At the university level, the use of tools based on representations of pseudocode or flowcharts is more frequent, among them is PSEINT (Novara, 2012), Raptor (Wilson, Carlisle, Humphries, & Moore, 2004) and DFD (Cárdenas, 1998). Next, each one of them is briefly described:

RAPTOR

RAPTOR (acronym for English Rapid Algorithmic Prototyping Tool for Ordered Reasoning) is defined as: "a programming environment based on flowcharts, specifically designed to help students visualize their algorithms and avoid syntactic baggage," is software for the Microsoft, Windows platform, very efficient and easy to handle (Wilson, Carlisle, Humphries, & Moore, 2004).

DFD

DFD, which stands for Data Flow Diagram "is a useful flowchart editor. It helps us to graphically numerous algorithms. It is redefined as "an editor, interpreter and debugger of algorithms represented in flowcharts." During the execution of a diagram, syntax and subprogramming errors are detected (Nieva and Arellano, 2009).

PSeInt

Novara (2014) the creator of this software mentions that PSeInt comes from PSEudoINTérprete, where PSE refers to PSEudocode and INT Interpreter. Therefore, the PSeInt is a program that interprets an algorithm written in pseudocode, N-S chart or flowchart. This program is free and free, distributed under the GPL (General Public License).

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PSeInt is designed to assist the student who begins in the development of computer programs or algorithms. The pseudocode is usually used as the first contact to introduce basic concepts such as the use of control structures, expressions, variables, etc., without having to deal with the particularities of the syntax of a real programming language, which will undoubtedly facilitate learning. This software aims to make it easier for the beginner to write algorithms in pseudolanguage by presenting a set of aids and assists, and some additional tools that help him find errors and understand the logic of the algorithms.

Main functionalities

Compared to other programs, PSeInt offers various tools for creating algorithms with pseudocode in Spanish. It has auto completed, command sheets, syntax coloring, etc. It also allows the simultaneous creation of multiple algorithms. It determines and marks errors and has numerous attributes, among which its free and free use should be noted. whose use is intuitive and nothing complex. It also provides a work environment with numerous aids and teaching resources and is approved tested on Microsoft Windows, GNU / Linux and Mac OS X. (Novara 2014).

Also, Pseudocode, PSeInt Algorithms is a mobile application for learning algorithms with pseudocode, this app uses the same pseudolanguage as the PSeInt tool.

PSeInt implementation

With the previous analysis, the reasons why the implementation of the PSEINT tool is preferred, beyond the existence of other tools, is because the interpreter is designed to assist the student who begins in the development of programs or computational algorithms, since which is a friendly and visual application as didactic support for the better understanding of the programming logic in students and for students to more easily understand the fundamentals of programming logic through pseudo codes, since the capabilities of this logic were limited.

Experience

Practice lived in one of the activities that was carried out in the subject of computer programming fundamentals, during the 2018/2 school year (September-January) with two groups one of 22 students and the other of 15. Sampling is not probabilistic; The selected sample is intentional, that is, all students from both groups were considered for this experience. The techniques were observation, explanation, application, and verification.

First, the theoretical classes were developed with exposition and foundation of theoretical contents as an algorithm: characteristics and foundation, forms of representation of an algorithm; control structures: concept and types; program: concept, types and basic elements of the same and practical activities through the analysis and solution of problems under the focus of the structured paradigm that were developed entirely in the classroom.

Subsequently, the practical classes were developed using the following sequence: Problem analysis, algorithm design, algorithm specification using one of the representation tools that is pseudocode, pseudocode verification, display of the proposed pseudocode, verification and debug operation.
Another technique applied was that of observation as mentioned by Schmuck, 1997, quoted in Kawulich (2005: 4) that observation methods are useful to researchers in a variety of ways. They provide researchers with methods to review nonverbal expressions of feelings, determine who interacts with who, allow them to understand how participants communicate with each other, and verify how much time is being spent on certain activities.

Likewise, (Cuevas, 2009, cited in Hernández Sampieri, Fernández Collado et al. (2010): 418) mentions that observation is very useful: to collect data about phenomena, issues or delicate situations or that are difficult to discuss or describe ; also when the participants are not very eloquent, articulate or descriptive; when working with a phenomenon or in a group with which the researcher is not very familiar; and when it is necessary to confirm what was collected in the interviews with first order data.

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One of the issues that could be observed at the beginning of the teaching of the subject, were the most common mistakes made by students at the start of computer programming, such as: syntactic errors, misuse of input-output, errors in control structures, errors in troubleshooting. Another question was that the student could not understand or imagine what he was programming for, that is, he did not find meaning or logic at the exit of the program, as well as the importance of the syntax of the variables, the order, etc.). Consequently, these errors affected the first-grade failing grades of most students.

Even clarifying the students' doubts and making corrections to paper, the tendency will be to reject what they did not find meaning, since as mentioned above the only real learning is meaningful learning, meaningful learning. Any other learning will be purely mechanical, memorial, conjunctural: learning to pass an exam, to pass the subject, etc.

There are several questions that may arise trying to find the answers to the difficulties that most students present in the teaching-learning process at the beginning of computer programming, so this work provides a didactic strategy to exercise the logic-mathematical intelligence through a technological tool like PSeInt where the student began to understand more easily and to experience the fundamentals of programming logic through pseudocodes.

As Gutiérrez and Vargas (2000) mentioned, one of the main problems faced by people who want to learn to program is to create logical sequences of instructions that allow solving a given problem. Next, in order to implement this didactic strategy, students were asked to download the PSeInt program from http://pseint.sourceforge.net/index.php?page=portada.php in a computer room assigned to the subject, a Once the application was downloaded, the installation proceeded, which takes no more than a few minutes. The next step was for each student to enter the first pseudocode elaborated on paper, explained and reviewed in class. Then it was passed to the verification tests where the instructions of the pseudocode were the correct ones to be able to visualize the proposed pseudocode, by means of the flow chart and the desk test checking that the requested outputs were consistent.

If when performing such tests, the program will mark syntax errors in writing or at runtime, the student will be supported to solve these errors. One of the objectives of this activity was a first attempt for students to develop one of the skills of logical-mathematical intelligence, such as the understanding of programming logic for problem solving. Considering the most common and important needs that students with little or no programming experience had and providing them with a technological tool that would facilitate learning and be meaningful.

Below are some results of the practices that were developed in the course.

In Figure 1, the main PSeInt environment is shown.

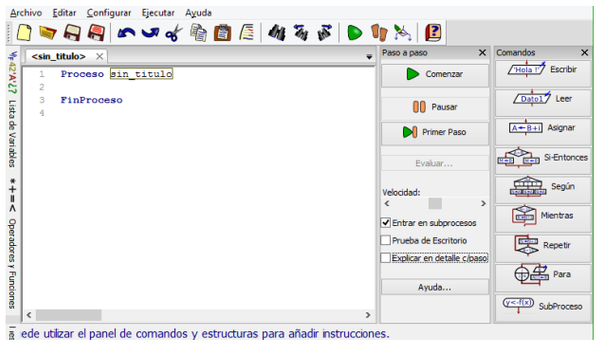

Figure 1 PSeINT Main Screen

Example of writing a pseudocode with sequential structure, see figure 2.

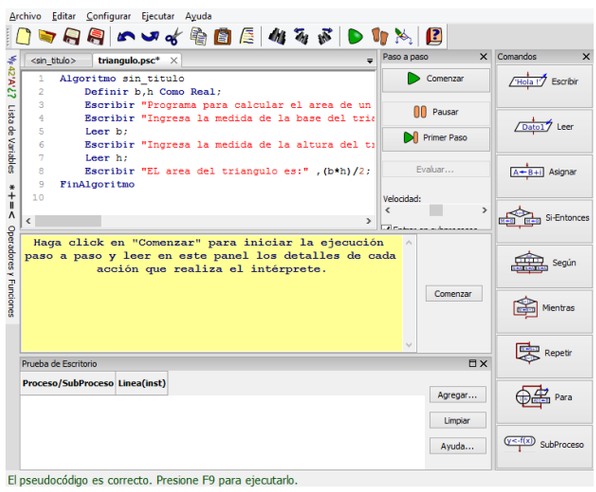

Figure 2 Correct writing of a Pseudocode

Figure 3 shows the execution of the pseudocode step by step controlling the speed and inspecting variables and expressions.

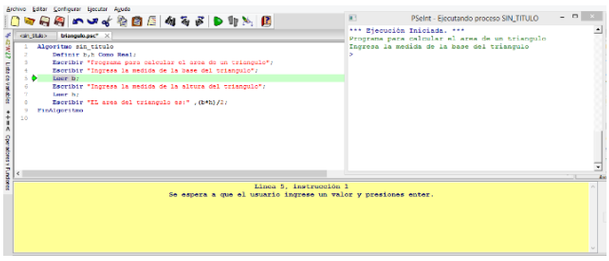

Figure 3 Pseudocode execution step by step

Figure 4 shows the complete execution of the program.

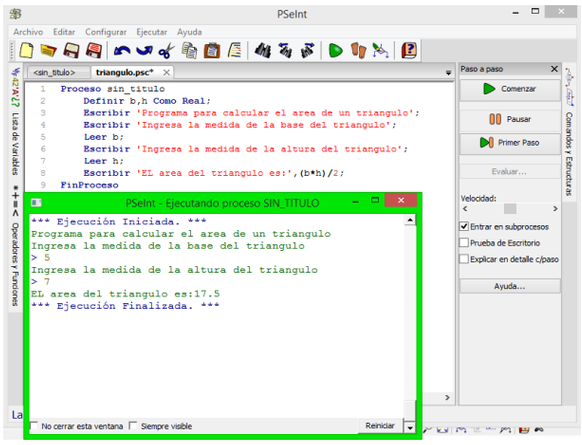

Figure 4 Complete execution of the pseudocode

Flowchart Generation from the pseudocode of figure 4, see figure 5.

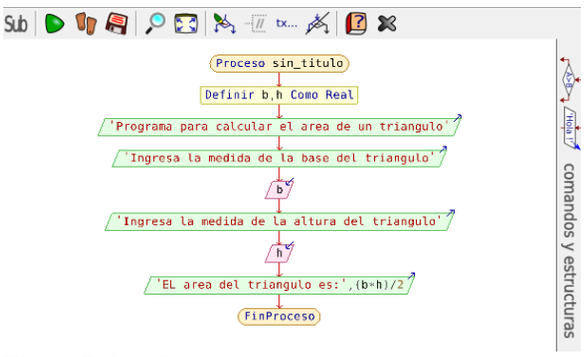

Figure 5 Flowchart

Results

Next, the results obtained from the survey applied to the first semester students of Computer Systems Engineering of the Technological of Higher Studies of the Eastern State of Mexico (TESOEM) are presented, the results are presented through figures and are accompanied by a brief analysis.

The percentage of gender that answered the survey is shown in Figure 6, where 65% are men and 35% are women, this is because the enrollment of the Computer Systems career is mostly made up of men.

Figure 6 Participation of men and women
Source: Own elaboration 2019

Another question was to know the percentage of students who had knowledge of the existence of technological tools as pseudo code interpreters, so in Figure 7 it is shown that the majority of students (represented by 86%) did not know any interpreter of pseudocodes, while 14% did know some; This allowed us to identify that the integration of PSEINT as a technological tool was a good support strategy for teaching learning.

Figure 7 Students who had knowledge of pseudocode interpreters

Likewise, it was discovered that of 14% of the students who had knowledge of a technological tool such as Pseudocode Interpreter, 8% did know PSEINT, while 92% did not know as shown in Figure 8; This allowed us to know that the integration of PSEINT as a technological tool was a good support strategy for teaching learning.

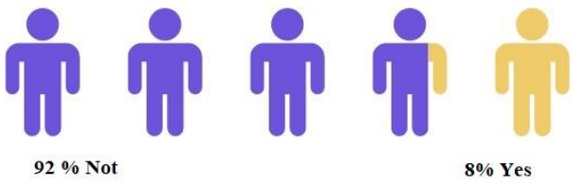

Figure 8 Students who knew PSEINT

Regarding the learning process there are several variables to consider, and among them it was when asking the students, if the learning of pseudocodes and flowcharts was facilitated with the implementation and use of a Pseudocode Interpreter.

For this the majority, 76%, declare that much, while 24% declare that enough, see figure 9.

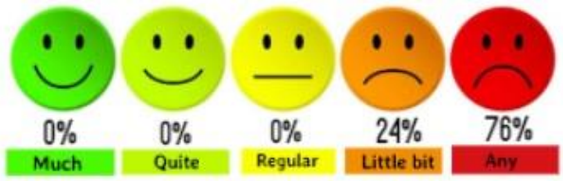

Figure 9 Students who were facilitated learning pseudocodes and flowcharts with PSEINT

In addition to knowing, if the PSEINT tool was provided in their learning, it is also useful to know the percentage of difficulty the student had with the development of pseudocodes and flowcharts, as can be seen in Figure 5. A Through this question that question could be analyzed. Of all the students, 76% did not find it difficult and only 24% the difficulty level was low. Therefore, it can be recognized that, through the response, students will be able to use this tool during their career without major problem.

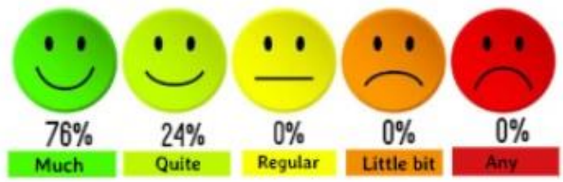

Figure 10 Difficulty percentage with PSEINT

At the same time, it was important to know if the tool is friendly, and as shown in Figure 11, it was found that the most chosen option has been "a lot" with 59%, followed by "Enough" with 41%. In no case were the other options chosen, Therefore, we see that it was a good strategy to introduce student's friendly technology and where them could generate knowledge from this tool.

Figure 11 PSEINT as a friendly tool

The technological resources offered in the classroom are considered to be very important in the education processes, which is why the students were asked, if the technological resources favor the acquisition of learning, thanks to the simulated environments, and the the most chosen was a lot, with 81%, followed by the option enough, with 11%, followed by the least voted option that was regular with 8% (see figure 12). For this, it was observed that these resources facilitate teaching and constitute an auxiliary element in the learning process by functioning as a mediator in the education of students.

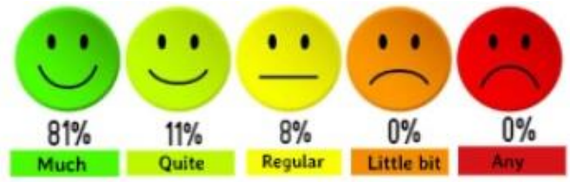

Figure 12 Perception of technological resources in the learning process

As you can see PSeInt is a friendly and visual application that as a didactic support significantly influenced the improvement of the understanding of the programming logic in the students, it was a good didactic strategy to develop the logic-mathematical intelligence and so that the students more easily understood the fundamentals of programming logic through pseudocodes, the capabilities of this logic were limited.

As López (2006) mentions, using a pseudolanguage allows to develop the mental abilities that a student must have to program a good structure, understand the logic and how a program really works by solving problems, since Problem Based Learning (PBL, for its acronym in English), it is a strategy "focused on the student, in which he learns through the experience of problem solving" (Branda, 2001).

The results were very satisfactory, since most of the practices of the subject could be carried out, so that with the use of this application the learning teaching objectives were achieved, but mainly it was observed that the student learned to understand the logic needed to solve problems algorithmically and this began to reflect in the improvement of their qualifications.

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It is important to mention that there are numerous technological tools that offer multiple advantages and possibilities to develop the capabilities of computer programming logic, where the teacher can and should take advantage, having with this a better opportunity for teaching-learning, because the Computer science is not only about programming, but a whole way of thinking (Ioannidou et al., 2011).

Finally, what is expressed by Salinas (2004) is resumed, at the university the activities related to ICT and teaching have been usually carried out by enthusiastic professors, who have managed to equip themselves with the necessary resources to experiment. Also, Rosewthar (1998) indicates in the Psychology dictionary that "The teacher's expectations are decisive for making predictions about what a student can get to learn".

Conclusions

In this experience it was interesting to observe that the students had openness, interactivity and participation in the activity. While it is true the success or failure of applications of educational innovations in the classroom depends, in large part, on the way in which the teacher implemented them. Also, as a conclusion, mathematical logical intelligence is not only intelligence with numbers, and mathematical problems, as previously reviewed, it is also problem solving through logic.

It is important to mention that this Technological tool is a didactic resource in the teaching-learning of algorithms, so it does not replace any other means of traditional learning, since these are considered an additional resource of support and enrichment of the teaching processes -learning, in which the student is the main builder of his knowledge.

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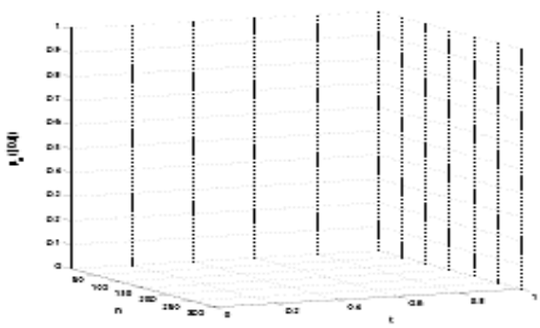

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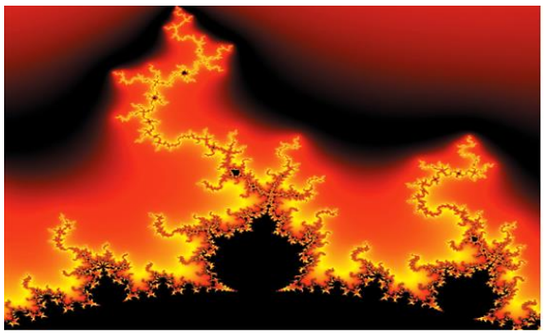

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