Simulator Training applied to the Solution of Problems in Two-Dimensional Vector Algebra.

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Abstract
Education today faces challenges that put into question the value of their purpose, content and process, consequences of complexity in the academic process, one of the concrete manifestations of what should be the teacher is teaching acting. The construction of learning products, which developed under different factors, conditions and educational practices deal with the daily work of teachers in the laboratory, classroom, workshop. Also acquire or improve skills to understand, innovate and generate knowledge. Therefore an educational software for the analysis and solution of vector algebra in two dimensions is designed to contribute to the effective acquisition of specific skills in the field of physics in career Computer Systems Engineering from the Higher Institute of Technological Irapuato provide reinforce the knowledge acquired in class and decrease the failure rate and promoting their use and school performance.

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Presentation

This project is the development of an educational software called " didactic simulator applied to solving problems of vector algebra in two dimensions " , which aims to attack the low performance in the field of General Physics Engineering in Computer Systems , providing a tool that allows them to reinforce the knowledge acquired in class, this software offers a step by step explanation of how it has to solve a problem by the method you selected. With the development of this simulator problems currently existing practice involves the solution of vector algebra in two dimensions, and thus have the ability to solve them are resolved. During the implementation of this project evaluations to a group of test were performed to verify that the developed system could really help the improvement and understanding of the methods of vector algebra in two dimensions, and found that the tool really helps students better understand the topics covered in class.

The Physics I class in the computer systems engineering career from Instituto Superior Tecnológico de Irapuato (ITESI), which is within the curriculum of the reticle 2004, and the class of General Physics reticle 2010, have been a high failure rate in regard to the issue of vector algebra, it has been presented for the last 8 semesters has taught the subject since 2006 until 2012. Table[1] low approval ratings over that time period is.

Semester	Year	Number of students	Students Reprobate	Index of Reprobation
January – June	2006	34	20	62.5%
August - December	2007	32	21	61.8%
August – December	2008	28	17	61%
August – December	2009	26	25	96%
August – December	2010	35	28	80%
August – December	2011	27	18	66.6%
August – December (Group A)	2012 – A	10	8	80%
August - December (Group B)	2012 – B	40	18	45%

Table [1] -. Disapproval Index, the first part of the matter of General Physics Computer Systems Engineering.

Disapproval rates above are due to several factors, among which are the lack of teaching materials and insufficient time spent by students and others, resulting in a low rate of utilization. Hence the idea for this project arose because the above material does not have a dedicated educational software to vector algebra, and therefore intended to give the student a tool to help you to better assimilate the issues. Although there are several tools focused on the teaching of mathematics, they tend to skip intermediate steps and throw only the final result, which prevents the student to assimilate the entire process of problem solving, and therefore self-learning its solution.

- Create an educational software that allows you to monitor the solution step by step exercises vector algebra in two dimensions, by means of the techniques, procedures and corresponding theorems.

- Provide students a tool that allows them to self- learn and reaffirm solving algebra problems, with the aim of raising the pass rate.
- Develop a software that can be used on any computer that has a "Windows" operating system that has the characteristics of functionality, usability and robustness, in order to facilitate self-learning students.

Analysis

In searching for information related to the research, some related thematic studies were found, through which it aims to achieve an orientation and a theoretical basis for sustaining the problem, among them are: In Argentina, Ruben A. Pizarro, in his thesis "Information Technology Applied to Education" refers to the development and implementation of educational software brings, in addition to improving the teaching and learning, the ability to rescue and preserve the cultural values of society where to deploy, scored a reasonable improvement where his research after the implementation of the software obtained an 83% approval rating compared to 37.50% as before using the software. Norberto Pilar Ramírez in his thesis "The use of the educational software" describe in Peru learning problems in mathematics because teachers teach according to the traditionalist model of routine and tedious way, do not apply methods, techniques and strategies appropriate learning and not trained according to technological advances.

The theoretical framework is a process of immersion in the existing and available knowledge that can be linked to our problem statement and a written compendium of articles, books and documents describing the past and current state of knowledge about the problem under study (Sampieri, Fernández , Baptista 2007).

Operating System
The author in his book William Stallings Operating Systems defines a system as organized set of parts or related items and interacting with each other to achieve a goal. Systems receive (input) and provide data (output) information.

Application Software
Application software programs that are written for users or are written by them, in order to apply the computer to a specific task is described. (Amaya , 2008).

Programming language
A programming language can be defined as a system of conventional signs adopted to express certain mathematical concepts, to write instructions or commands to the computer useful and necessary for the performance of a particular process. It is called the source language the programmer who writes orders, which are translated into machine language of the computer. Every programming language has its own grammar or language. (García Roque 2007).

Software Life Cycles
The software lifecycle as a logical approach to the acquisition, supply, development, operation and maintenance of software is defined. (Leyva, Sampalo Garzon 2006). Regardless of the model selected process, software engineers have chosen traditional means a generic framework for the process, which includes the following activities within the framework: communication, planning, modeling, construction and

development. A model is called descriptive because they prescribe a set of process elements: activities under the work of software engineering activities, tasks, work products, quality assurance and control mechanisms. All software process models conform to the generic activities of the framework, but each applies a different importance to these activities and defines a workflow activity that invokes each framework differently. (Roger Pressman 2005).

Vector algebra

Vector Algebra is the branch of mathematics that is concerned with managing operations with vector magnitudes, either addition, subtraction or multiplication A physical vector is a physical quantity characterizable by a point source or application, a module, an address and a sense, or alternatively by a number of independent components such that components are measured by different observers systematically relatable.

Vector Addition

If $a = <a\ 1.2>$ and $b = <b\ 1\ b\ 2>$ are vectors, then: $= a + b <b\ a\ 1 + 1.2 + b\ 2>$

Multiplicación de vectores por escalares

Si $A=<a1,2>$ y c es un escalar, entonces: $ca=<ca1, a2>$

Los números $a1\ y\ a2$ en $<a1,2>$ se llaman las componentes del vector. Así, para sumar dos vectores sumamos sus componentes correspondientes.

Vector multiplication by scalar

If $A = <a\ 1.2>$ and c is a scalar, then: $c\ a = <c\ a\ 1\ a\ 2>$

The numbers $a\ 1\ y\ a\ 2\ <a\ 1,2>$ are called the components of the vector. So, to add two vectors add their corresponding components.

Multiplication by a scalar

They are called scalars to real numbers, when you're working with vectors in the Cartesian plane. All vector $<a,>$ can be multiplied by a scalar c, ie by a real number c.

scalar

The dot product is also called dot product or inner product. Importantly $a * b$ is a scalar, not a vector.

If $a = <a\ 1.2>$ b $= <b\ 1\ b\ 2>$ then the scalar product $b\ a\ *$ is given by: $b\ a\ * = <1.2\ b\ b\ a\ 1\ 2>$

Angle between two vectors

The angle between two vectors u and v is given by the expression: $\cos \alpha = (u\ v\ 1 * 1) + (2 * u\ v\ 2) / \sqrt{}\ (12 + u\ u\ 22) * \sqrt{}\ (12 + v\ v\ 22)$

Projection of a vector on all

If $A\ y\ B$ two different vectors are zero vector, then the projection on $A\ \boldsymbol{B}$ scalar defined as $\| \| B \cos$, where θ is the angle between A and B.

The scalar projection of vector B on table A is: $(A * B) / A \| \|$

The vector projection of vector B on table A is: $((A * B) / A \| \| 2)$

Vector product

Unlike the dot product, which is a scalar, the product *a x b* vector two vectors *a y b* produce another vector. A determinant of order 2 is defined as: 25.

Where all the letters represent real numbers. | *a* 1 *a* 2 *b* 1 *b* 2 | = *a* 1 *b* 2 - *a* 2 *b* 1

Development

For this project two phases of which the first is the planning requirements surveys are conducted, as shown in table [2], and manipulation of data collected by the system, and finally display the results statistics, the use of software as a teaching tool.

Methodology
Requirements Analysis (software, hardware)
Feasibility study
Technical, operational, cost feasibility
Design
Coding
implementation

Table [2] -. Methodology Lifecycle Software

Table [3], one can observe the functional requirements of the system. These requirements depend on the type of software that is developed, potential users of the software and the general approach taken by the organization in drafting requirements. The training simulator shall contain the following:

Functional Requirements	
Parallelogram method	Scalar multiplication.
Vector product	A panel for plotting vectors
Scalar Product	A panel to input vectors.
Scalar and Vector Projection	Help Button
Getting the angle between two vectors	Solved exercises will set an example for the user.

Table [3]-. Functional software requirements

The home interface must the methods by which you want to work, and must be selected, as shown in Figure [1], and start working with the software.

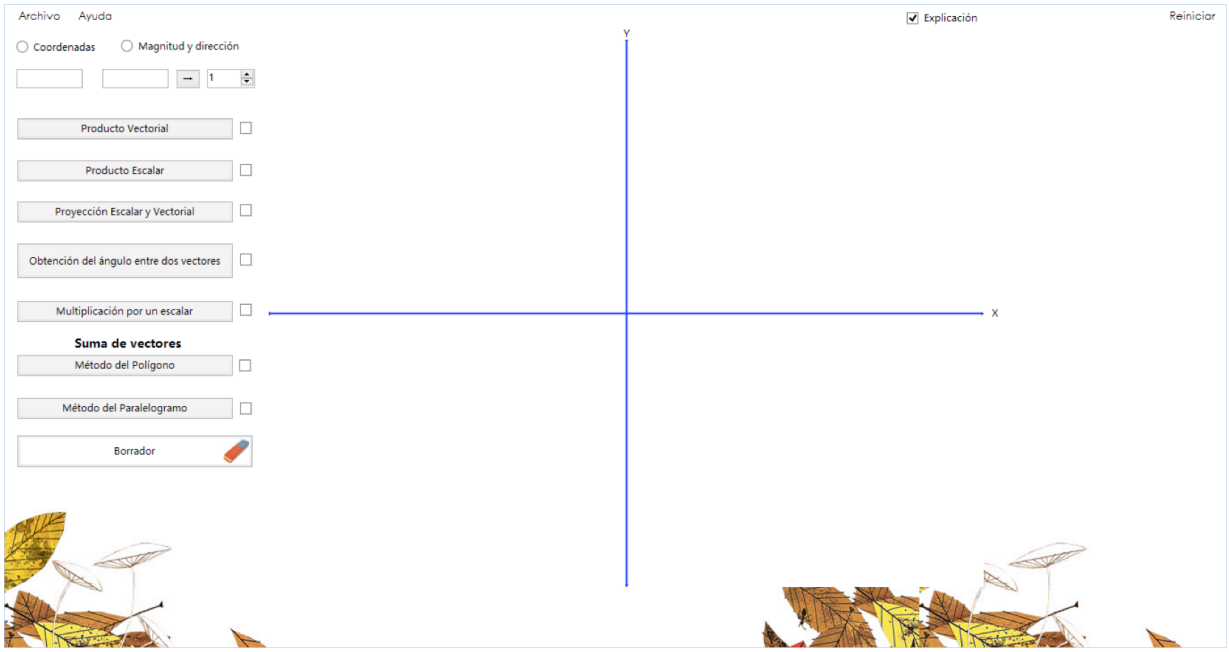

Figure [1] -. Menu options

Figure [2], the explanation of how the method of vector product is performed, showing step by step how you should solve the method.

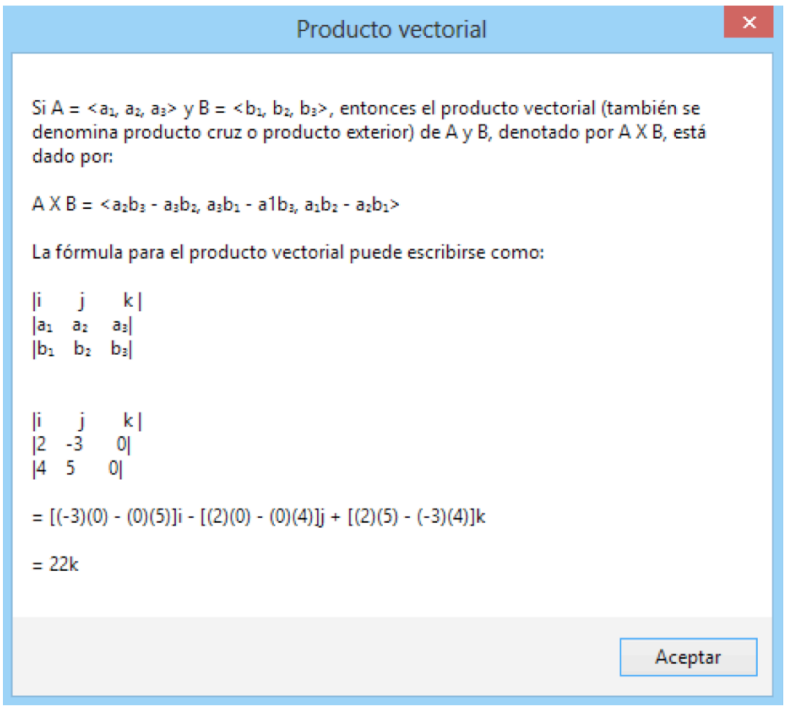

Figure [2] -. Solution stepwise method selected

Figure [3], the solution of the method of projection of a vector on another, along with its explanation is displayed, and the formula that was used.

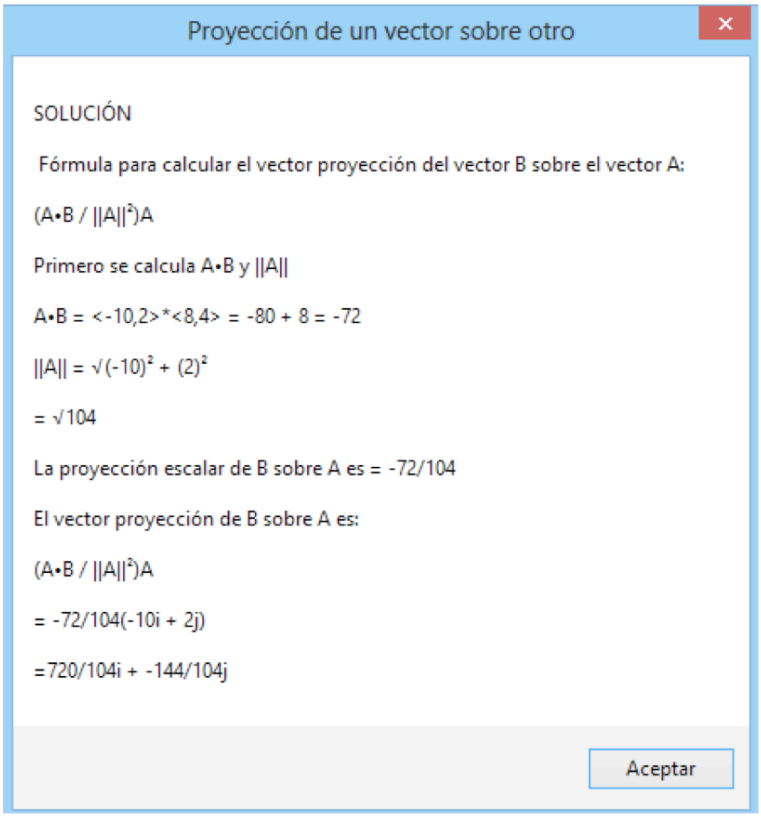

Figure [3] -. Solution step method "projection of a vector on another

Figure [4] shows graphically the resulting vector, and the right side shows the values of the vector.

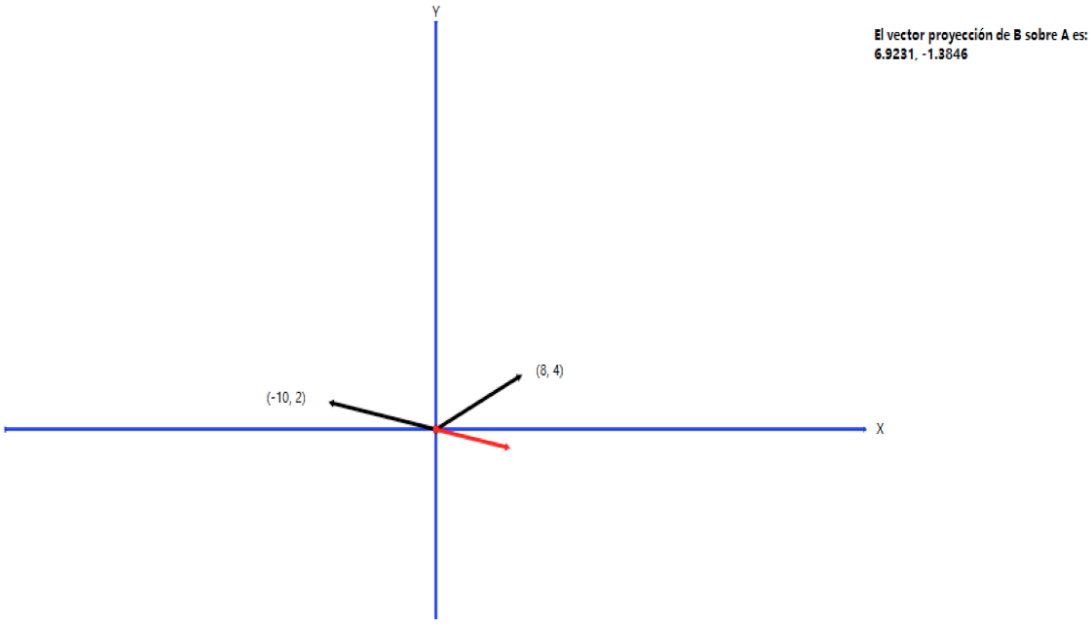

Figure [4] -. Resulting Vector

Results

A didactic software for the analysis of methods of vector algebra in two dimensions, which will serve as an educational tool that supports student learning of General Physics Engineering in Computer Systems in ITESI developed. Getting the desired results as it allows to observe step by step troubleshooting of vector algebra in two dimensions, with their respective procedures and theorems, providing a better understanding of the topics covered in class.

The developed system has good performance and is fully functional, because it meets the requirements set, usable for its architecture design , sturdy for good support system in terms of performance. The project was developed in the Department of Computer Systems belonging to ITESI applying language technology of object oriented programming in C # branch handling graphics and other aspects such as Forms interfaces.

To test the effectiveness of the software two screening tests were applied to a test group to check the efficiency of the software. The first review was previously applied to the use of software, and the second was applied to the same group after using the software, where the following results were obtained as shown in Table [4] and can appreciate the improved statistics in the use of software.

Num Students	Evaluation I (Before Software)	Evaluation II (Post-Software)
1	48	32
2	84	100
3	16	95
4	0	100
5	16	100
6	32	100
7	16	92
8	80	76
9	32	84
10	16	68
11	46	84
12	0	90
13	0	74
14	80	84
15	80	90
16	56	84
Average	**38.75**	**84.56**

Table [4] -. Results use, before and after the software

Figure [5] and [6] the rate of adoption of selected test group previously shown to obtain statistical data, which is subsequently used to compare the results before and after the use of educational software.

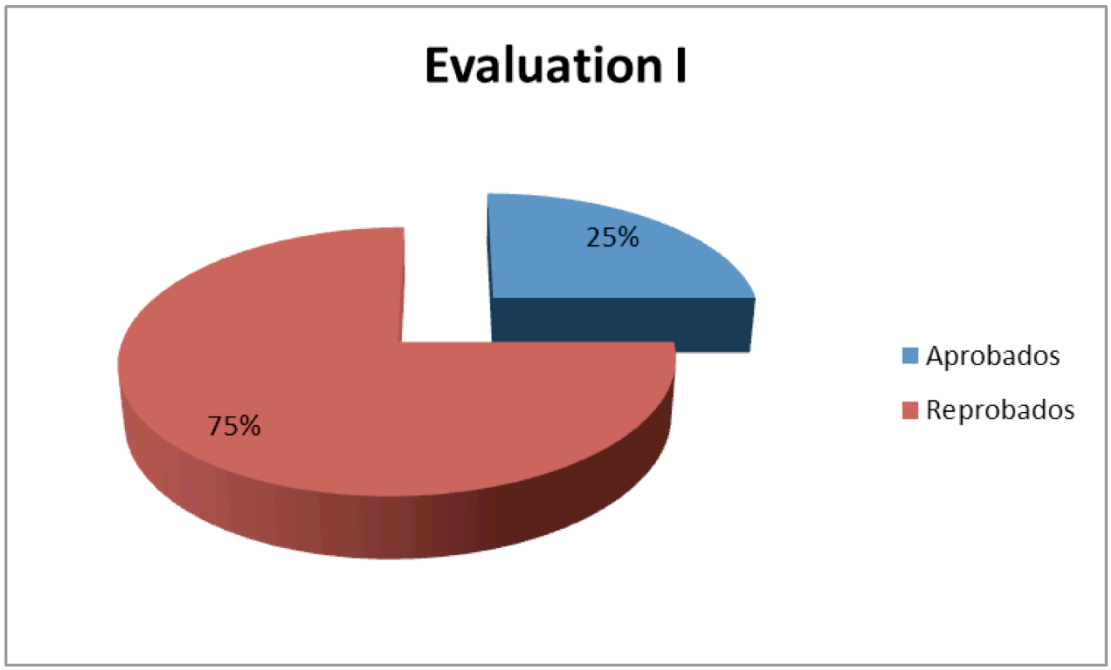

Figure [5] -. Approval index of the first examination (before using the software)

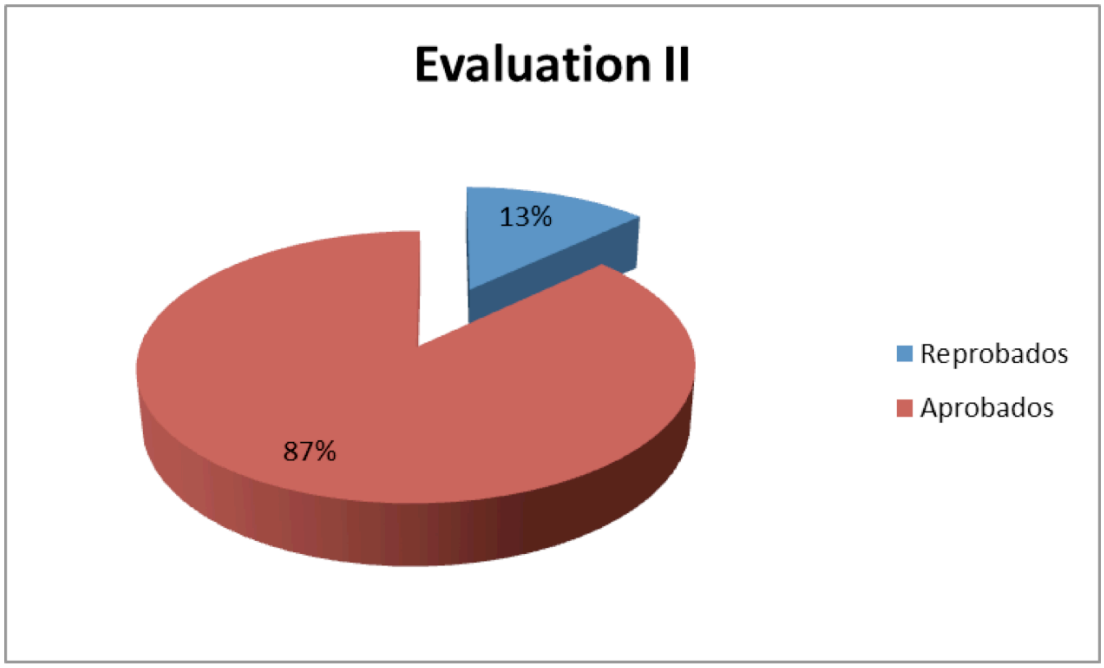

Figure [6] -. Approval index of the second review (after using the software)

With the results obtained during the assessments of a test group can be noticed that there was a marked improvement in meaningful learning and decreased failure rate of students who were a pre-test performed without the use of software, and a post-use assessment tool developed was applied. With these results it was concluded that teaching helps to assimilate and understand the two-dimensional vector algebra tool.

Conclusion

As a result of project development, the creation of a didactic software for circuit analysis of direct and alternating current, which will serve as an educational tool for achieving meaningful learning of students taking the subject of General Physics, was achieved Engineering in Computer Systems in ITESI.

The project was expected since it allows to observe step by step troubleshooting of vector algebra in two dimensions using alternate techniques, and procedures for the vector calculus theorems, and provides the student actual and immediate information that helps you have a better understanding of the topics covered in class and this results that students have acquired knowledge and firm improve its profile graduate. The system was also observed, it has a good performance and is fully functional because it meets the requirements set, usable by the architecture design for portable course because your code can be compilable on any Windows platform and robust by good support system for performance. It should be mentioned that the project was developed in the Department of Systems belonging to ITESI applying language technology of object oriented programming C # on branch handling graphics and other aspects such as are GUI interfaces, allowing a design visually appealing to users.

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