

APPLICATIONS USING VIRTUAL REALITY

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Abstract. This paper presents educational software for the discipline of formal languages. With a simple interface, easy to understand and use, it is designed to present exercises where the student will see the robots in 3D and could be developed to minimize the automaton interacting directly with the 3D object. For the design of the robots, the software uses 3D tools such as Blender and VRML and the development of education agents will be used with the programming language PHP.

Keywords. Formal languages. Regular expression. 3D. Automat. Pedagogical agents. Blender. VRML., PHP

1. Introduction

The technological evolution in the field of informatics in recent years has resulted in the rapid development of a new technology, virtual reality, that has been gaining space in several areas of study, including education and medicine. Virtual reality has been introduced to the Internet, through VRML [1] utilization that is very efficient in the construction of a virtual world where users can interact with images and visualize objects in different angles of vision.

With this technological advance it is now possible to develop educative software for theoretical disciplines, making the discipline more interesting to the student and also making learning faster and easier [5].

The software that will be presented in this paper also makes it possible for the teacher to teach without the physical presence of the student because the exercises are available on a webpage that can be accessed by any personal computer that has an Internet connection.

This work is structured in the following way: Section 2 presents material about

the formal languages discipline; Section 3 discusses some important concepts about educational software and virtual reality; Section 4 outlines the tools for the development of the software; Section 5 introduces a modeling and development system and Section 6 contains the results of our study.

2. Formal languages

Formal languages were introduced in 1950 with the aim of developing theories related to natural languages. [7] But it was soon noticed that formal languages were ideal for language studies in the area of computer studies. In the languages study two kinds of problems were found, the syntactic and the semantic

2.1 Languages and grammars

Language is fundamental in computer science and informatics. The alphabet is symbols or characters, it's an abstract entity, not formally defined, being able to be represented by letters or digits. A word is a finite group of alphabetic symbols. The empty symbol is considered a word. A Formal Language is a group of words of an alphabet. The grammar is a kind of formalism used to specify the words that will be accepted by the language.

2.2 Finite Automat

A finite automat corresponds to a system of sequential finite states that represents a computer model, much more used in formal languages and compilers, being used for studies of computer science and informatics formal languages. A finite automat can be deterministic, not-deterministic or with empty movements. The deterministic finite automat or DFA is represented by an ordering quintuple: $M(\Sigma, Q, \delta, q_0, F)$, where:

- Σ is the alphabet of entrance symbols;
- Q is the group of the existing states of the automat;
- δ is the automat transition, or the production;
- q_0 is the initial state of the automat;
- F is the group of the final states of the automat.

A deterministic finite automat is always represented by a states diagram:

- circles: are nodes that represent states;

- edges: are indicators that represent the transitions from one state to another;
- highlighted circles: represent the final states. An automat can have more than one final state;
- circles with initial indicator: represents the initial state of the automat.

2.3 Minimization of automats

The objective of an automat is to generate an equal automat with the smallest number of states or transitions. In this way two automats that accept the same language when minimized generate the same finite automat. [11]

There are some pre-requirements for the minimization of an automat:

- the automat must be deterministic;
- the automat can't have any unavailable state;
- the automat going from any state must have transitions to all the symbols of the alphabet.

In the case of not satisfying one of the cited requirements its ad equation is necessary:

- to generate an equal automat that is deterministic;
- to eliminate unavailable states;
- to include a new and not final state and include the necessary transitions.

3. Educational software and virtual reality

With the continuing fast pace of technological advance computers are becoming ever more faster and equipped with more modern tools, making it possible for virtual reality to be able to be used in any personal computer. Pushed by the industry and entertainment, virtual reality has become a versatile and efficient learning tool. Virtual reality is no longer merely an object of study at large research centers and is now spreading to several areas, including education. [9] The introduction of virtual reality to education shows a new paradigm that relates education in a more dynamic and creative way, putting the student in the position of creator of their knowledge.

3.1 Defining virtual reality

Virtual reality is an advanced method of interaction between the user and the computer and through its use it is possible to give to the user a sensation of living something that is not actually happening. It is a relatively new area of computer science.

With virtual reality, the software becomes highly interactive, the user now becomes a part of the virtual space, where it is possible to manipulate and explore data in real time, using the senses, particularly tridimensional movements of the body.

3.2 Immersive or non-immersive virtual reality

Immersive systems are what can be called traditional virtual reality. In them it is necessary to use a virtual reality helmet, glove, position scanner and headphones. With this equipment the user is “put in a virtual world” and starts visualizing, hearing and feeling only the stimuli generated by software. Non-immersive systems are those where the user sees the virtual universe on a conventional computer screen or from a position. The major part of contemporary electronic games and surfing interactive systems fit into this class. The sound for these environments is produced by speakers put in front of the user, similar to the ones we find in traditional multimedia kits. Some of these systems have already got special interactive devices such as a 3D mouse, electronic gloves and glasses for stereoscopic sight. The reading of the user’s movements is limited, in most cases, only to reading devices that give the position of some of the user’s body parts. In these environments the user has to keep looking at the screen in order to see the virtual world.

4. Tools for the development of the software.

For the development of the software that uses virtual reality, the follows tools were used:

- Poseidon for UML CE 6.0.2: UML is not a development methodology, which means that it does not tell you what to do first or how to design your system, but it helps you to visualize your design and communication between objects. Basically, the UML allows developers to view the products of their work on standardized charts. Along with a graphical notation, UML also specifies meanings, i.e. it is semantic [10].
- Blender: a free software for 3D open source modeling that is improving very quickly. [2] Blender allows the creation of images interacting with each figure point, making the image quite close to reality. It also allows exportation to VRML 2.0 language.

- VRML: an independent language platform that allows the creation of virtual worlds where it is possible to surf on the image and visualize the objects in different angles. [4] It is also through VRML (Virtual Reality Modeling Language) that we can apply virtual reality to the Internet. It is the pattern for the construction of 3D environments on the Web.
- Cortona Plug-in: Through the Cortona plug-in we can visualize and explore through the browser scenery in 3D. [4] The browser opens automatically when a file is opened in VRML. There are different plug-ins for different operational systems.
- PHP: a free interpreted computer programming language, much used to generate dynamic content on the Web.[8] PHP (Hypertext Preprocessor) is a language that runs on the server, having the advantage of not exposing the font code to the client. It is also used to interact with a data bank or to work with any confidential information, for example, passwords.
- Java Script: a script language based on objects, made basically for authors that create HTML documents in order to be visualized under compatible browsers. [6] JavaScript does not depend on the platform because its scripts are interpreted on the browser level. The written functions in JavaScript can be inputted inside its HTML document.

5. Modeling and development system

The developed educational software is based on virtual reality aimed at the formal languages discipline, targeting the automats minimization study.

For the building of this software the Blender [3] modeler (Figure 1) was used, which allows the exportation of its files to VRML 2.0 language (Figure 2).

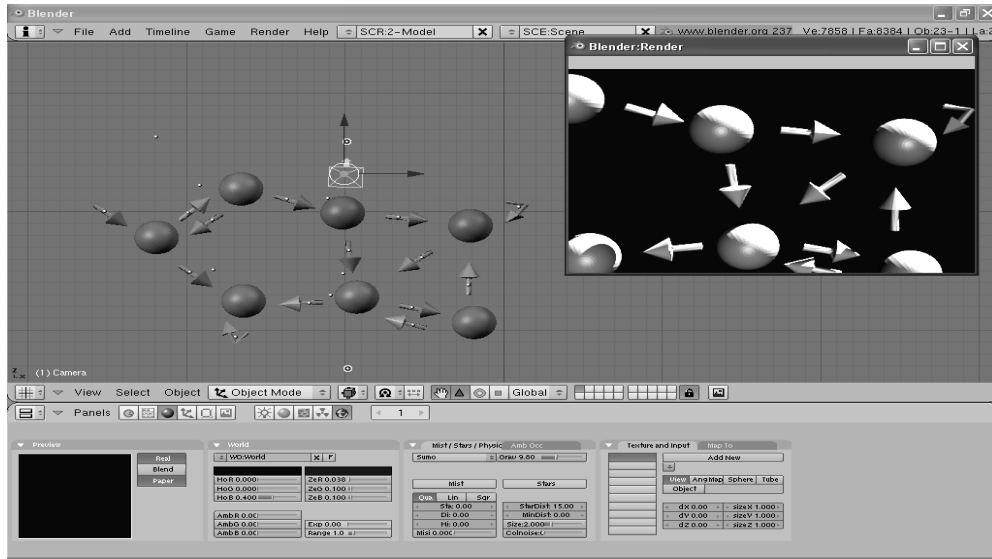


Figure 1. Blender Modeler

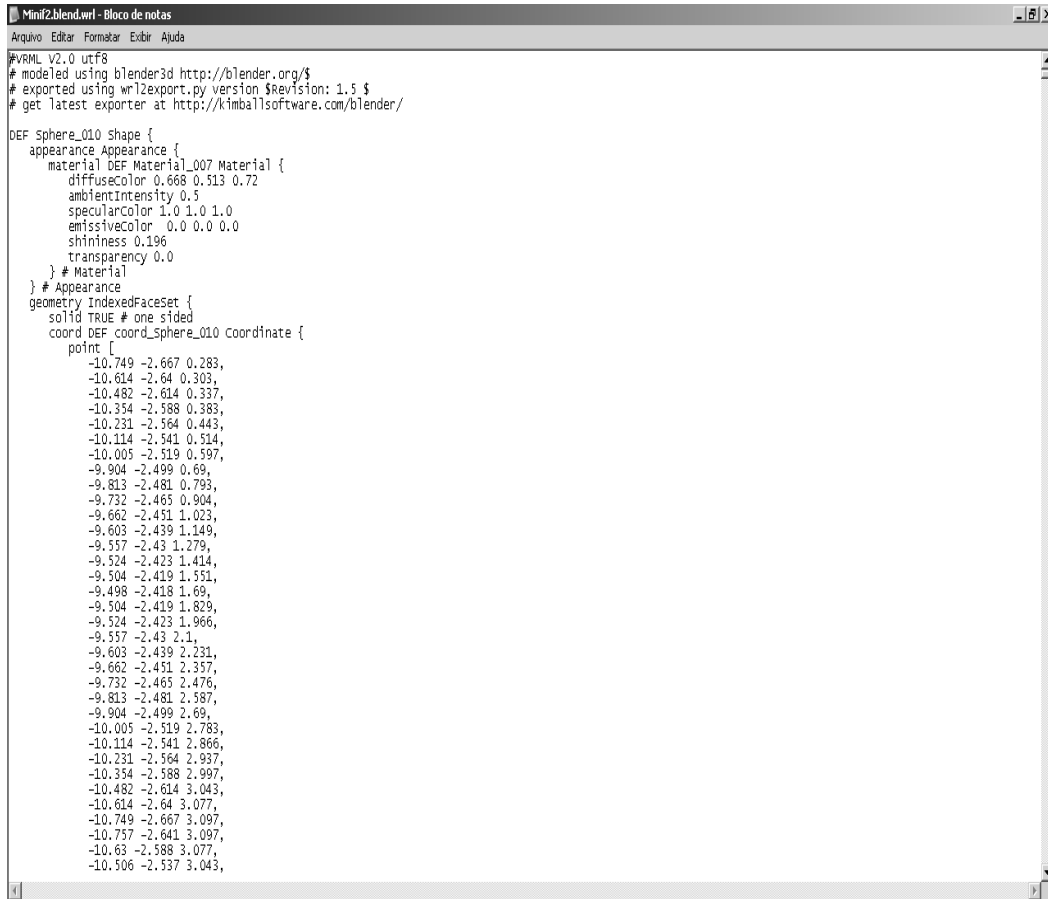


Figure 2. VRML 2.0 Language Code

It is necessary that the Cortona plug-in is installed on the computer where the software will be used (Figure 3). The plug-in opens the browser with controls that allow the user to visualize the images from different angles.

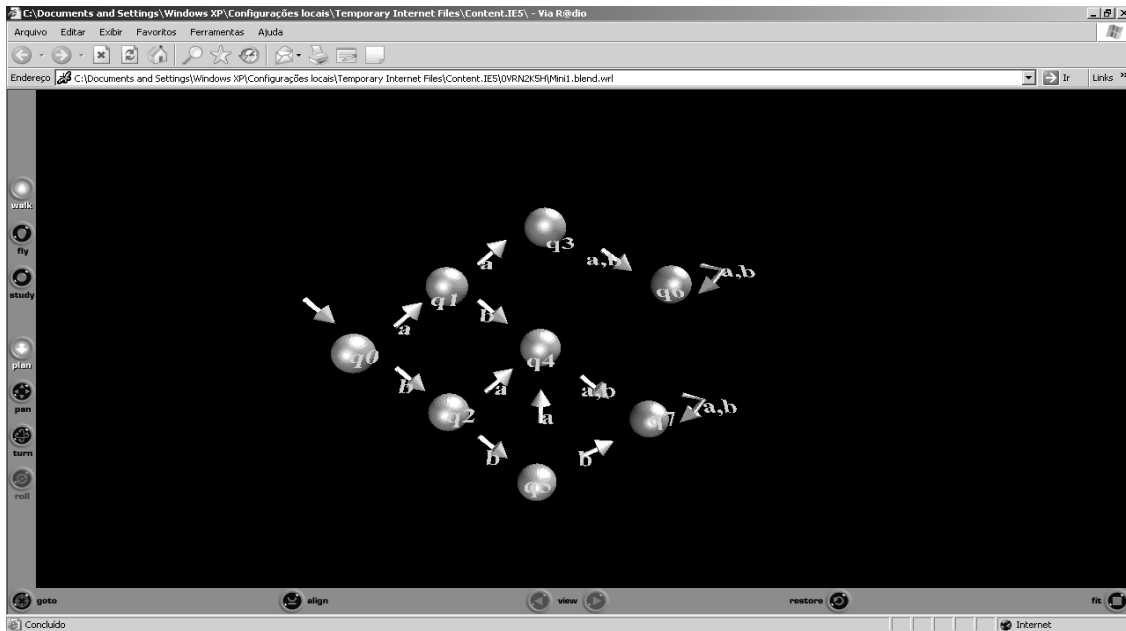


Figure 3. Cortona Plug-in

The software will be available through a built page using PHP programming language (Figure 4), also used to develop the pedagogical agent that helps in solving exercises.

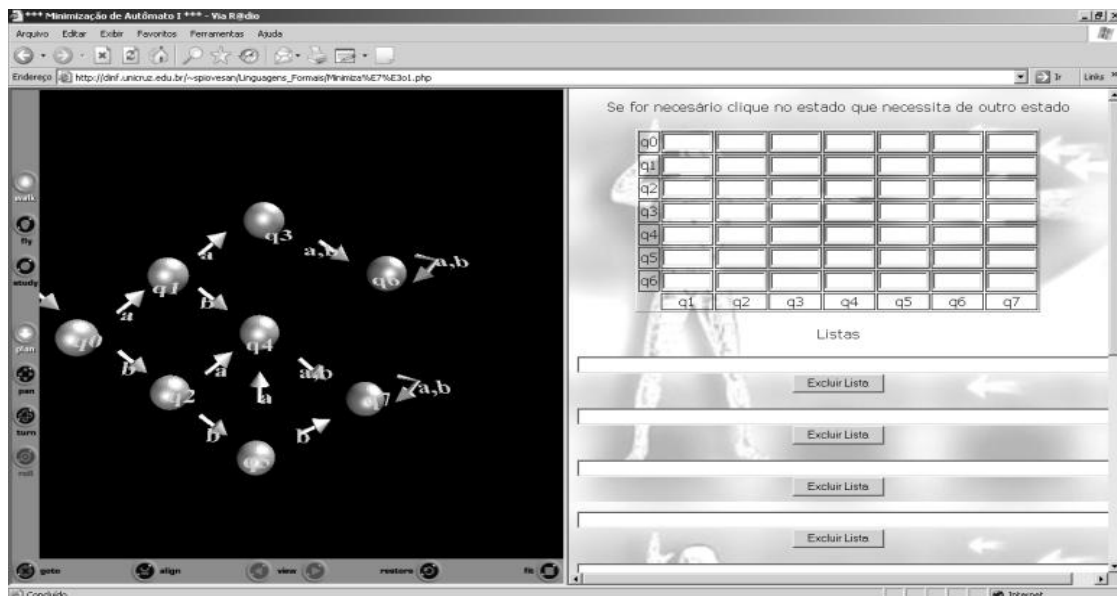


Figure 4. Page image using PHP

The minimization of automata is done on a screen where the user views drawings of the automata in 3D and must enter a state and use the table and the lists to

find the equivalent states that can be removed. When the user enters the wrong state or the lists have been misused the pedagogical agent built using the PHP language will assist the student in correction, warning them of the error. When the user finds the equivalent states they can view the minimized automaton in 3D.

The software also makes available a page with multiple choice exercises where the student will answer questions and verify if the chosen answers were the correct ones. (Figure 5) This way the student will be able to test their theoretical knowledge.

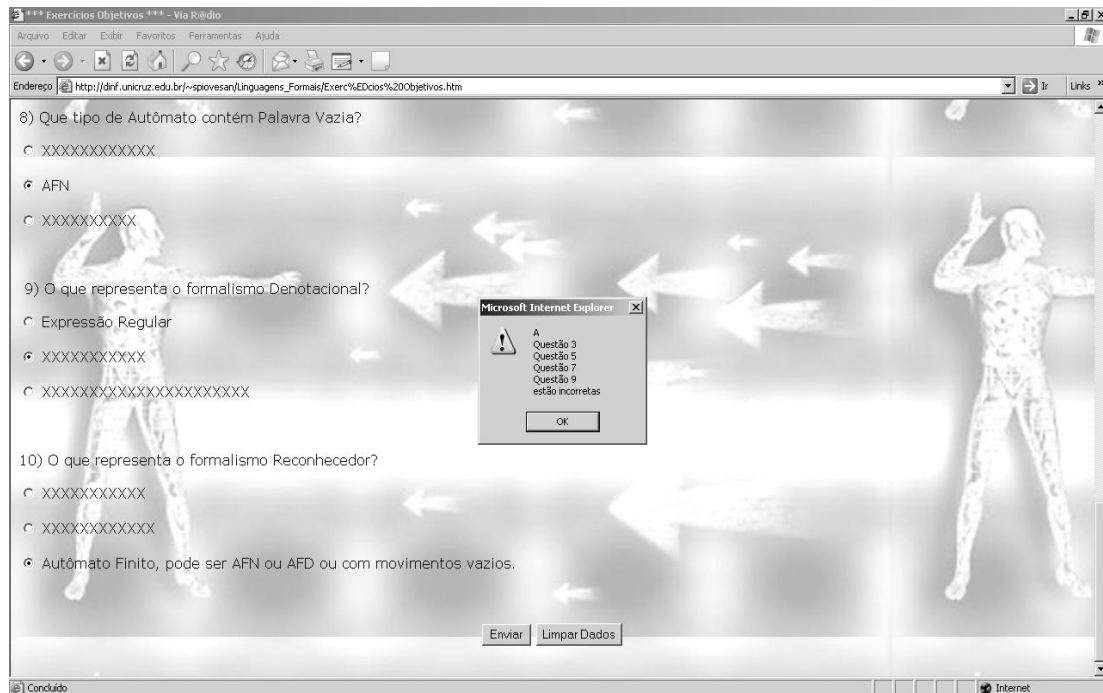


Figure 5. Multiple choice exercises

6. Results

This paper presented the design and development of a support system to study the discipline of formal languages, which can administer disciplines either in person or remotely. This software was used by the sixth semester of Information System in the discipline of formal languages at the Franciscan University, UNIFRA of Santa Maria-RS, Brazil, and the use of this software promoted greater interest and greater ease of learning. During this study some important concepts about virtual reality were examined and it was noticed that the informatics area is growing rapidly in several study fields such as education and medicine.

It was also observed that with the utilization of educational software learning is faster and more interesting than if it was taught in a theoretical way or in the classroom.

Thus we can say that virtual reality is beginning to change education because, despite the technological barriers, its use can be associated with fantasy and imagination, revolutionizing the traditional concepts of teaching and learning.

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