Virtual Reality Applied on the Formal Languages Discipline

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Abstract: This work presents an educational software for the distance or presence education, to Formal Languages discipline. With a simple interface, of easy comprehension and utilization, will present exercises where the student will visualize the automats in 3D and will have to develop the corresponding correct Regular Expression and in a second moment will be able to develop the minimization of the automat interacting directly with the 3D object. To the automats’ drawing, the software uses 3D tools, as the Blender and the VRML and for the publication of a page on the Internet with proposed exercises, applied the PHP programming Language. It’s also developed an exercises page of multiple choice in Java Script. This software intends to take the discipline in reference from the classroom to the informatics laboratories and will make it more interesting to the student, making the learning easier.

Keywords: Formal Languages, Regular Expression, 3D, Automat, Blender, VRML, PHP.

1. Introduction

The verified technological evolution on the informatics in the last years allowed the surging of a new technology, the Virtual Reality that even more starts gaining space in several study areas, among them the education and the medicine one. The Virtual Reality is being taken to the Internet, with the VRML (Realidade Virtual, 2006) utilization that’s very efficient to the virtual worlds’ construction where the users can interact with the images and visualize the objects in different angles of vision.

With this technology advance it is possible the developing of several educative softwares to disciplines that are taught in theory, taking this way the students from the classrooms to the informatics laboratory, making that way the discipline more interesting to the student and also making his learning faster and easier.
The software that’ll be presented also makes available for the teacher to teach without the students’ physical presence, because the exercises are available in a page that can be accessed in any personal computer.

This work is structured in the following way, in chapter 2 it’s presented a material about the Formal Languages discipline, in chapter 3 it’s presented some important concepts about Educational Software and Virtual Reality, in chapter 4 it’s presented the used tools, in chapter 5 it’s presented the software development and in chapter 6 it’s presented this work’s conclusions.

2. Formal Languages

The Formal Languages were developed in 1950 with the aim of developing theories related to the natural languages. (Menezes, 2005) But soon it was noticed that the formal languages were ideal to the language study in the Computer and Informatics’ area. In the languages study two kinds of problems to be treated were found, the syntactic and the semantic one. The syntax treats the programs’ grammatical verification, the language free properties, although the semantic treats the language interpretation, as a meaning of a program.

2.1 Languages and Grammars

The language is fundamental in Computer Science and in Informatics. The alphabet are 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 alphabet symbols. It’s also considered a word, a web without symbols that is the empty web or the empty word. A Formal Language is a group of words about an alphabet. The grammar is a kind of formalism used to specify the words that’ll be accepted by the language.

2.2 Regular Languages

The study of the Regular Languages is done going from three formalisms:
- Finite Automat: it’s the recognizer formalism, being a group of states of a finite system;
- Regular Expression: it’s the denotation formalism, defines how to build the words of the language, it’s a basic group of language operation;
- Regular Grammar: it’s the generator formalism, corresponds to the production rules.
2.3 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 the 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(∑, Q, δ, q₀, F), where:
- ∑ 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;
- q₀ is the initial state of the automat;
- F is the group of the final states of the automat.

2.4 Regular Expression

The Regular Expressions are designed by a regular language. It’s the detonational formalism, called also as generator, because it builds the words of the language. The regular expressions are considered as fit to the human to human and human to machine communication. Following there are some examples of these expressions: aa, bbba, (a+ b)*, a*, baa* + ba* e baa* (a + b).

2.5 Minimization of Automats

The objective of an automat is to generate an equal automat with the smallest number of states or transitions. The Finite Automat is the only, this way two automats that accept the same language when minimized generate the same finite automat. (Rangel, 2001)

3. Educational Software and Virtual Reality

The educational software is being used in several areas, the learning with the informatics help makes the classes more interesting and attractive to the student. With the fast technology advance, the computers are each passing day faster and with more modern tools, making the virtual reality able to be used in any personal computer. Pushed by the industry and entertainment, the Virtual Reality became a versatile tool and of great efficacy as a learning tool. The Virtual Reality finished being a study object of big research centers and is spreading to several areas, including the education. (Pinho, 2004)
The introduction of the Virtual Reality on education shows a new paradigm that relates an education in a more dynamic and creative way, putting the student as creator of his knowledge.

3.1 Defining Virtual Reality

Virtual Reality is an advanced way of interaction between the user and the computer, through it it’s possible to give to the user a condition of living something that there isn’t or is not happening. It’s an area relatively new of Computer Science.

With Virtual Reality the software becomes highly interactive, the user now starts being a part of the virtual space, where it’s possible to manipulate and explore data in real time, using his senses, particularly tridimensional movements of the body. The Virtual Reality is characterized by three basic ideas (Pinho, 2004):

- Immersion: The User has the real sensation of being inside the virtual world of the computer. Devices that cause this sensation: Digital helmets and digital Cave.
- Interaction: The user manipulates virtual objects. Devices that cause this sensation: Digital gloves.
- Involving: Exploration of a virtual environment, it’s like the user made part of the virtual world and can interfere directly on the application result, the user may surf on the virtual environment in a passive or active way.

3.2 Immersive or Not-Immersive Virtual Reality

The Immersive Systems are what's can be called traditional virtual reality. On them the user uses a helmet of virtual reality, glove, position scanner and headphones. With these equipments the user is “put in a virtual world” and starts visualizing, hearing and feeling only the stimulates generated by a software.

The not-immersive systems are those which the user sees the virtual universe on a computer conventional screen or from a position. On this class today the major part of the electronic games and surfing interactive systems are fit. The sound of these environments is produced by speakers put in front of the user as the ones we find in the traditional multimedia kits. Some of these systems have already got today, special devices of interaction as 3D mouse, electronic gloves and glasses to stereoscopic sight. The reading of the user’s movements is limited, in the great part of the cases, only to reading of devices that give the position of some user’s body parts. On these environments it’s supposed to keep looking at the screen in order to see the virtual world.
4. Tools for the Software’s development

To the software’s development that uses Virtual Reality, own tools were used to the creation of virtual worlds and also some programming languages for the page’s development:

- Blender: it’s a free software to 3D Open Source modeling that’s improving very quickly nowadays. (Blender, 2006) The Blender allows the creation of images interacting with each figure point, making this way the image quite near to the real. Besides, it allows that is exported to the VRML 2.0 language.

- VRML: it’s an independent language of platform that allows the virtual worlds’ creation, where it’s possible to surf on the image and visualize the objects in different angles. (Cortona, 2006) It’s also through the VRML (Virtual Reality Modeling Language) that we can apply the virtual reality on the Internet, it’s the pattern to the construction of 3D environments on the web.

- Cortona Plug-in: it’s through the Cortona Plug-in that we can visualize and explore in the browser the sceneries in 3D. (Cortona, 2006) The browser opens automatically when we open a file in VRML. There are different plug-in to different operational systems.

- PHP: it’s an interpreted computer programming language, free and much used to generate dynamic content on the Web. (PHP, 2006) PHP (Hypertext Preprocessor) is a language that runs on the server, having this way the advantage of not exposing the font code to the client, it’s also used to interact with data bank or to work with any confident information for examples passwords.

- JavaScript: It’s a script language based in objects, made basically to authors that create HTML documents in order of being visualized under compatible browsers. (Java, 2002) The JavaScript doesn’t depend of the platform because its scripts are interpreted on the browser level. The written functions in JavaScript can be inputted inside its HTML document.

5. Virtual Reality System to the Formal Languages discipline

The developed educational software is based on the Virtual Reality aiming to the Formal Languages discipline, having as target the Automats Minimization study.

For this software building it was used the Blender modeler (Figure 1) that allows to export its files to the VRML 2.0 language (Figure 2).
It’s also 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 by different angles.
The software will be available through a built Page using the PHP programming language (Figure 4).

The Automats minimization is done on a screen where the user visualizes the Automats drawings in 3D and must insert some state that is necessary and use the chart and the lists to find the equal states that can be removed. When the user finds the equal states, he’ll be able to visualize the minimized Automat in 3D. The software also makes available a page with exercises of multiple choice, where the student will answer the questions and verify if the chosen answers were the correct ones. (Figure 5) This way the student will be able to test his theory knowledge.
6. Conclusion

This work showed a support tool to the discipline study of Formal Languages, where it’s possible to develop the Regular Expressions study and also develop the Automats Minimization.

During this work it was studied some important concepts about Virtual Reality and it was noticed the accelerated growing of this Informatics area in several study fields as on the education and medicine.

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

Also in front of this work’s results we verified the necessity of indicating the realization of a future work where it is developed the own teacher’s idea of having the power to login the exercises without the developer’s help.

References