Chapter 4

Virtual Reality Applied in Distance Education

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Additional information is available at the end of the chapter

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1. Introduction

The constant evolution of technology is leading the education to new ways, which are more attractive to students, making possible to use new tools, leading to an evolution in the teaching and learning process. The Virtual Reality has an important place in this evolution.

There are many definitions about virtual reality, but in general, refers to an immersive and interactive 3D-based graphics generated in real time by computer, that is, a computer-generated a real world simulation or just imaginary.

Virtual Reality is present in many knowledge areas, allowing several benefits in its uses. Some examples:

- Entertainment: games and virtual tours.
- Health: virtual surgeries, treating patients in the ICU, rehabilitation.
- Business: virtual models, buildings, interiors.
- Training: flight simulators, motorcycles, vehicles quality test, etc.
- Education: educational software.

The virtual reality systems have three characteristics:

- Immersion: all sensorial devices are important for the immersion feeling. Regularly, they use objects such as viewing helmets and projections views rooms to help in the immersion.
- Interaction: this idea is related to the computer's ability to detect the user input and modify immediately the virtual world and the actions on it (reactive capacity).
- Involvement: is related to the motivation degree to a person engagement with a particular activity.

Education can be seen as a discovery, exploration and observation process, except the eternal knowledge construction. Thus, the Virtual Reality specific features can turn it into a

powerful instrument in the service of all who seek the evolution of education. Many things that until a short time were dreams nowadays, existing with technological advances, become a reality, a Virtual Reality.

With Virtual Reality working in education we can discover, explore and build knowledge about places and situations that we could never explore. The great potential of virtual reality is exactly these possibilities, not only through classes or physical objects, but also by manipulating virtual target to be explored, analyzed and studied.

It is understood by the Theory of Automata and Formal Languages the mathematical models study that enable the specification and recognition language (in the broad sense of the word), their classifications, structures, properties, characteristics and interrelationships [8].

The importance of this theory in computer science is twofold: it supports both other aspects of theoretical computer science, as also it underlies several computer applications such as language processing, pattern recognition and systems modeling.

The Educational Software is a technical resource teaching, with pre-established educational objectives for teaching and learning of their target. It is any software used with educational purpose integrated curricular activities with the possibility of a multidisciplinary tool available to students and teachers.

The educational software should be well structured, properly uses the technological resources, to have interaction in the curriculum and activities, has friendly interface, be easy to perform, and mostly have well-defined its target to achieve its goals.

The quality of an educational software depends on some criteria to be observed: clear and defined goals; vocabulary appropriate to the target; activities with writing correction (spelling), clarity and conciseness of the text; feedback; implementation easy and secure with the possibility of termination at any time, user-friendly interface, online help, the possibility for interactivity [10] [3].

The virtual reality has been available as a technology for learning, offering great potential for applications in many areas. RV is considered a new and advanced computer interface for 3D models, which presents a whole new world of possibilities for human-machine interaction. It provides an environment in which users are able to interact and view images from different viewing angles. Consequently, the Virtual Reality enables the user to develop a spatial relationship with the information he is interacting.

The virtual reality, when inserted into an educational context can provide many benefits to teaching and learning, promoting:

- motivation and multisensory stimulation to the learners;
- the student creativity;
- opportunities to communicate with students from other cultures;
- possibility of the learner performing an experiment at his own pace;

- active participation rather than passivity opening these opportunities for special education and distance education [6].

Nowadays, the Internet provides the possibility not only to seek information, but also to help the teacher in the distance education process, using new interaction methods with the student, such as participation in chat rooms, discussion boards, and videoconferencing.

For education, the Internet can be considered the learning tool most complete, comprehensive and complex which have been used so far. We can, through them, find sources of information that virtually enable us to study different areas of knowledge [4].

For the scientific community or researcher, we can say that the Internet is an indispensable tool. Through it, we have access to more advanced search features of the world. Thus, one can discuss research with colleagues who work with the same concerns and seeking to achieve equal results.

The educational software proposed aims to help students and teachers to have a more complete and interesting of Automata and changes in its minimization. It also aims to make the subject more interesting to students, making learning easier as well as making the students to become more participatory, so they have a more interactive learning.

2. Tools for software development using virtual reality

The application of Virtual Reality is an animated simulation that lets you define and display a 3D object, change its point of reference and field of view, manipulate and interact with objects, and make these objects affect each other. The Virtual Reality software allows to pervade objects with behaviors as well as programming them to activate some kind of visual feedback, auditory or tactile when a specific event happens, and manage the entire sequence of events.

The most systems of building virtual worlds share some basic concepts that characterize the development of Virtual Reality and allow developers to create a very realistic simulation.

According to Jacobson (1994), these basic concepts could be: the universe and its objects, presentation techniques and dynamic feedback. The Universe is the place where the experience of virtual reality that is the place to be modeled. This universe contains objects that are characterized by the geometry (shape of the object), appearance (size, color, composition, lighting and shading applied to the geometry of the object) and behavior (reactions to events ahead of the object). Any object is formed by a set of polygons and its presentation techniques involve concepts of computer graphics. Some of these concepts are: linear perspective (the object size decreases with increasing distance from the user), lighting (intensity of light striking an object), shading (shading caused by the position of another object between the light source and the object) and overlay (objects obscuring other objects or parts of them). In addition to sharing the concepts mentioned above, the software for creating Virtual Reality also usually offer resources for certain types of interaction devices, allowing programming them to activate some kind of visual feedback, auditory or tactile. In

this virtual world you can use a 3D modeling program to create virtual objects and scenarios and import them into the software that creates virtual reality. The modeling usually is based on primitives called polygons, and an object of the virtual world is composed by multiple polygons combined. Then, the 3D modeling programs will combine modeling (creation of objects), visual representation (application properties to objects, such as texture and lighting) and animation (movement of objects in the scene), making the presentation of scenes and objects as close to reality as possible.

Currently, there are several software programs for the Virtual Reality. Some allow only the creation of Virtual Reality exploratory where the participant may not modify or interact with the environment and its components, while others allow you to create sophisticated scenes with interaction capabilities across devices compatible. In this chapter we present the software used to create the system to Formal Languages.

2.1. Blender

Blender or Blender3D is a program for modeling three-dimensional (3D) that is evolving very quickly. The program is open source, and it is developed by the Blender Foundation [1].

Originally, the program was developed as an in-house application by Dutch animation studio NeoGeo (not to be confused with NeoGeo game console) and Not a Number Technologies (NaN), the lead author, Ton Roosendaal, founded in June 1998 to NaN to develop and distribute the program. Blender was initially distributed as freeware until NaN went bankrupt in 2002 [1].

The debtors agreed to release Blender as open source under the GNU terms General Public License, with a single payment of € 100,000. On July 18, 2002, a Blender funding campaign was started by Roosendaal in order to collect donations and September 7, 2002 it was announced that the fundraising was enough, and that the blender source code would be released.

The objective of the development team is able to reach the development of commercial software. There are many professionals who have already used this program as a primary or secondary in their work [1].

The Blender3D can be used in any area that is necessary for generation three-dimensional models. We can mention architecture, industrial design and engineering, among others [1].

Blender can be downloaded from the actual web page design: www.blender.org, and yet there are several pages about the program.

2.2. VRML

VRML (Virtual Reality Modeling Language) is a standard for virtual reality applications used on the Internet. Through this language, written in text mode, you can create three-

dimensional objects can set color, transparency, gloss, texture. The objects can be basic shapes such as spheres, cubes, ovoid, hexahedrons, cones, cylinders, or forms created by the programmer [12].

In addition to objects, it is possible to add interactivity to them by means of sensors, so you can move them in position, add light to produce a sound when the object is clicked or simply close it and open a file or Web page or yet another page in VRML, when the object is triggered.

It isn't necessary a specific software for VRML files creation (although there are), since all objects can be created in text mode. Figure 26 shows an example of code in VRML 2.0 using Windows Notepad (txt extension) to be opened. VRML 2.0 is the version used to create the software to Formal Languages.

2.3. Plug-in Cortona

Plug-in Cortona is an interactive 3D display ideal for viewing virtual worlds on the web. It is compatible with many 3D technologies for VRML formats developing. Plug-ins are programs that allow the virtual worlds visualization developed in VRML [2].

In the web address: www.parallelgraphics.com/products/cortona/ is available to download and install free software. Plug-in makes the images with *.wrl* extension are automatically loaded into the browser.

There are different plug-ins for different operating systems, but the Cortona plug-in was chosen for the Formal Languages development software .

2.4. HTML

The acronym HTML derives from the English expression HyperText Markup Language. It is a markup language used to produce web pages. These codes can be interpreted by browsers to display pages on the World Wide Web [5].

Unlike other structured languages, HTML uses tags, markings that are known as tags, which consist of brief instructions with a start tag and the other end, by which to determine the text formatting, images and other elements that compose a HTML page.

2.4.1. Macromedia dreamweaver

Macromedia Dreamweaver is a development tool for web created by Macromedia (now Adobe Systems), which is currently in version 8. Early application versions served as simple WYSIWYG HTML editor ("What You See Is What You Get", or "What you see is what you get"), but newer versions have incorporated notable support for many other web technologies such as XHTML, CSS, JavaScript and several server scripts [9].

Since the late '90s, Dreamweaver has had increasing success and now dominates around 80% of the market for HTML editors. There are versions for both Mac OS and Windows, but

you can also run it on Unix platforms and through the use of emulation software like Wine. As a WYSIWYG editor, Dreamweaver can hide the HTML details user, making it possible for non-experts to easily create web pages and sites.

To develop the Formal Languages pages layout software was used Macromedia Dreamweaver MX.

2.5. PHP

PHP (a recursive acronym for "PHP: Hypertext Preprocessor") is a computer programming language interpreted, free and very used to generate dynamic content on the Web Despite being an easy language to learn and use for small scripts, simple dynamic PHP is a powerful object-oriented language [11].

The language appeared around 1994 as a Perl subset scripts created by Rasmus Lerdof. With Zeev Suraski and Andi Gutmans, two Israeli developers belonging to the Technion, the Israel Institute of Technology, who additions rewrote the parser, was launched in 1997 to PHP 3, the first stable version and like the current language. By rewriting the parser was created the Zend Engine, which is officially maintained by the company together with the Zend PHP community. In May 2000, came to public version 4, and in July 2004, version 5, where the main change was a new API for object orientation provided by the Zend Engine 2.

This is a highly modularized language, which makes it ideal for installation and use on web servers. Several modules are created in PECL repository extensions (PHP Extension Community Library) and some of these modules are introduced as standard on new language versions. It is very similar, data types, syntax and even functions, with C and C + +. Maybe, depending on server configuration, embedded in HTML. Moreover, there is the extreme ease with which PHP handles database servers such as MySQL, PostgreSQL, Microsoft SQL Server and Oracle.

There are PHP versions which are available for the following operating systems: Windows, Linux, Mac OS, OS / 2, AS/400, Novell Netware, RISC OS, IRIX and Solaris.

2.6. JavaScript

JavaScript is a programming language created by Netscape - in 1995, which at first was called LiveScript to meet mainly the following requirements:

- form validation on the client side (browser software);
- interaction with the page. Thus, it was done as a scripting language [7].

Javascript has syntax similar to Java, but is totally different in its concept and use:

- provides dynamic typing - variable types aren´t defined;
- is interpreted rather than compiled;
- has great tools for standard listings (such as scripting languages in general);

- provides good support for regular expressions (a feature also common scripting languages).

3. Modeling of virtual reality system for formal languages

In this chapter we will introduce how the Educational Software building was made for the Formal Languages subject.

The educational software developed, is based on Virtual Reality facing the Formal Languages subject, targeting the automata minimization study. For this software installation was used Blender 2.37a modeler for the automata images construction (Figure 1) that allows you to export your files to VRML 2.0.

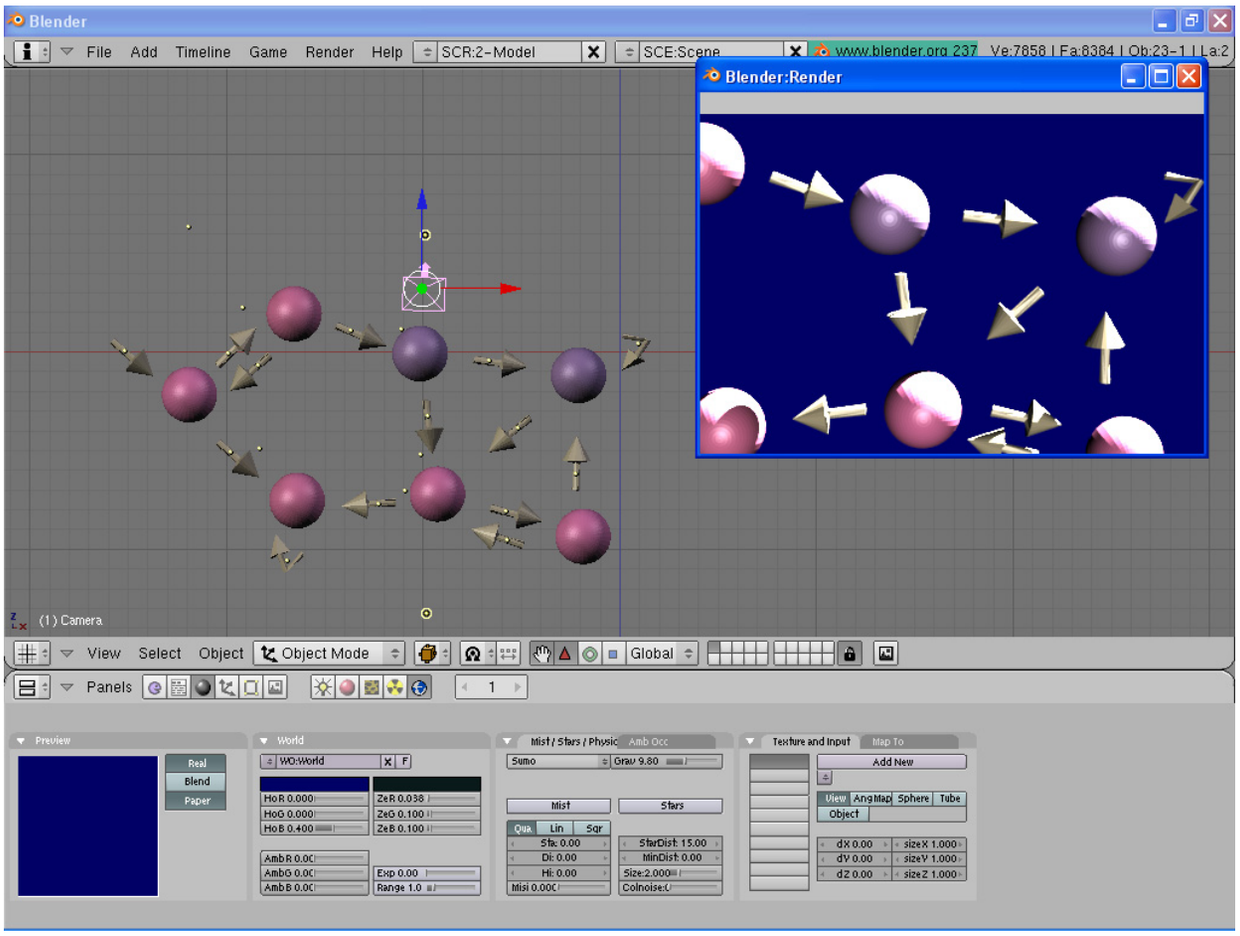

Figure 1. Construction of Automata using Modeler Blender

It is also necessary that Cortona plug-in is installed on your computer where the software will be used (Figure 2). Plug-in opens the Browser with controls that allow the user to view images from different angles.

The Maker Blender used to create images of Automata doesn´t allow that letters and numbers are exported, then it is necessary that the letters and numbers (q1, q2, a, b, 0) are placed in the images through the VRML Language.

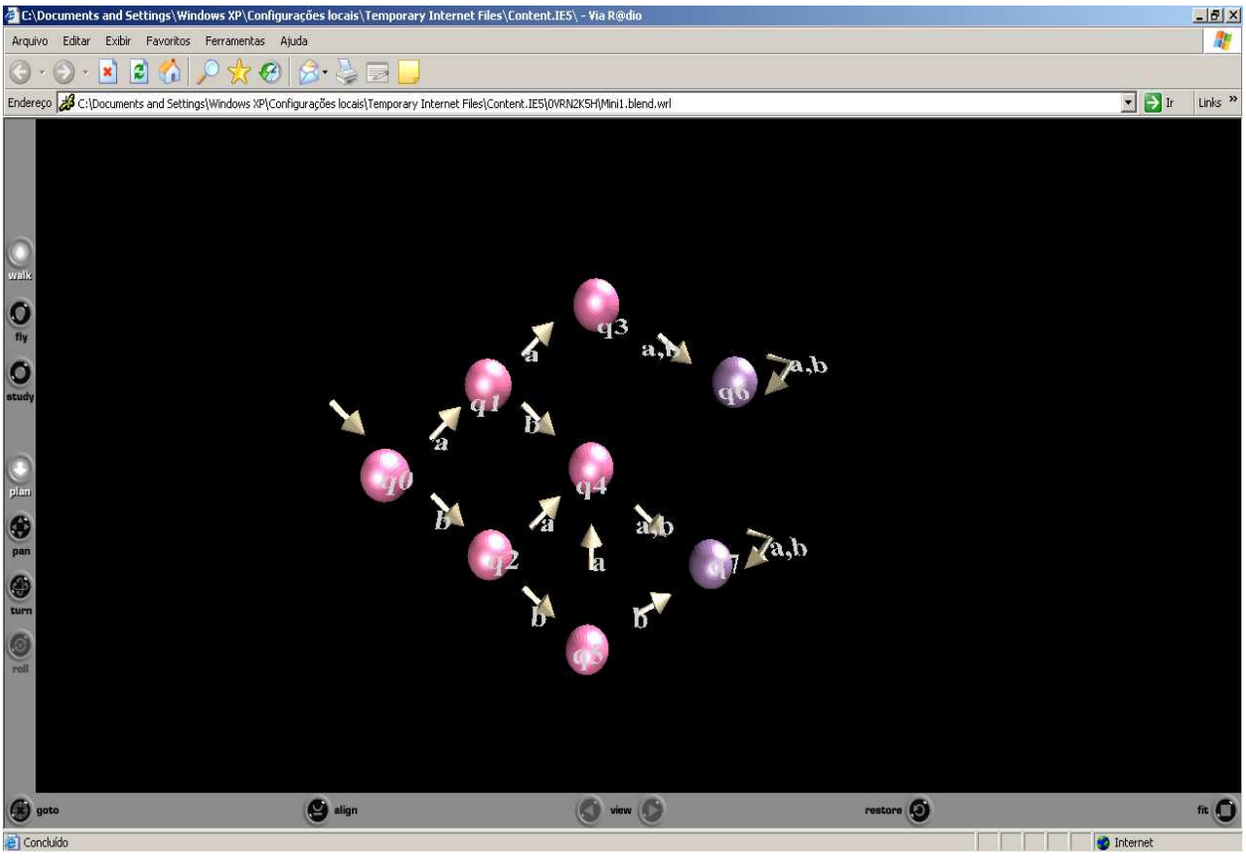

Figure 2. Cortona Plugin by opening an image generated by Blender

3.1. Use case diagram

The figure 3 shows a use case diagram that demonstrates the system use.

Initially the user will access the subject homepage. By entering the page, display the main menu that will give the student the possibility to choose the type of study he will perform. Through the menu, the user can:

- Access Plug-in Cortona;
- Access the Explanatory Material Formal Languages;
- Access Issues Objectives;
- Access the Menu Minimization;
- Access the Menu Regular Expression;
- Access Links Used.

If the user chooses to access the Plug-in Cortona, it must save and run, so he can view the Automata images.

If the user chooses to access the Explanatory Material on Formal Languages, he will have access to the reading material, with concepts and how to solve a minimization exercise.

If the user chooses to answer the objective questions, he will receive the answer if the options chosen were the right ones.

If he accesses the Minimization link, he goes in another menu that will give him the option to choose the exercise he wants to minimize doing or want before he visits the help page. If he chooses the exercise, the user will perform the exercise and should fill the spaces with equivalent states, so the user gets the correct answer or if the program will prompt re-run the exercise.

If the user accesses the regular expressions link, he can choose the exercise he wants to do. After choosing the exercise, he will answer what is the correct regular expression and gets the answer result.

The user can also access the links used in the workplace.

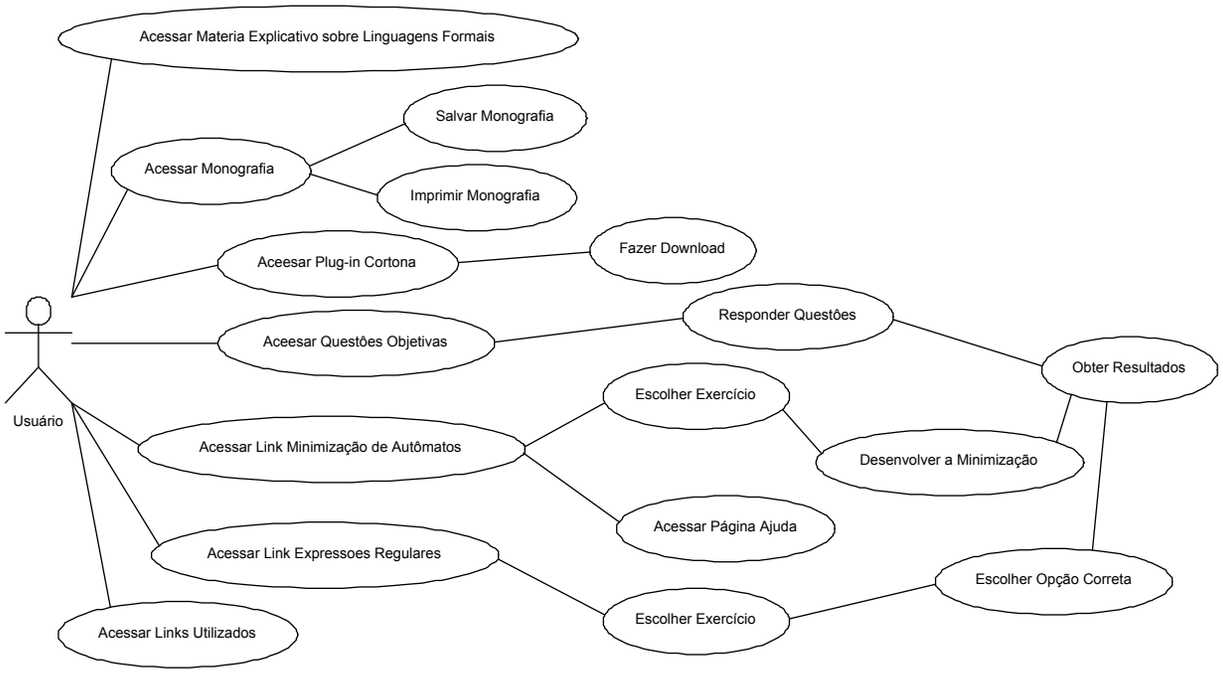

Figure 3. Use Case Diagram

3.2. Virtual reality system for formal languages with emphasis on regular expressions

The exercises will be available to students through the homepage (Figure 4). The pages layout was built using HTML through Dreamweaver MX software. From the home page users can access the page menu that shows the studying options it shows to the student the possibility to download the plug-in Cortona and also provides some links for reading (Figure 5).

The software will be available through pages built using the PHP programming language. The student can choose for answer questions about regular expressions before performing the Automata minimization. The figure 6 shows an exercise on regular expressions which is available through the Menu.

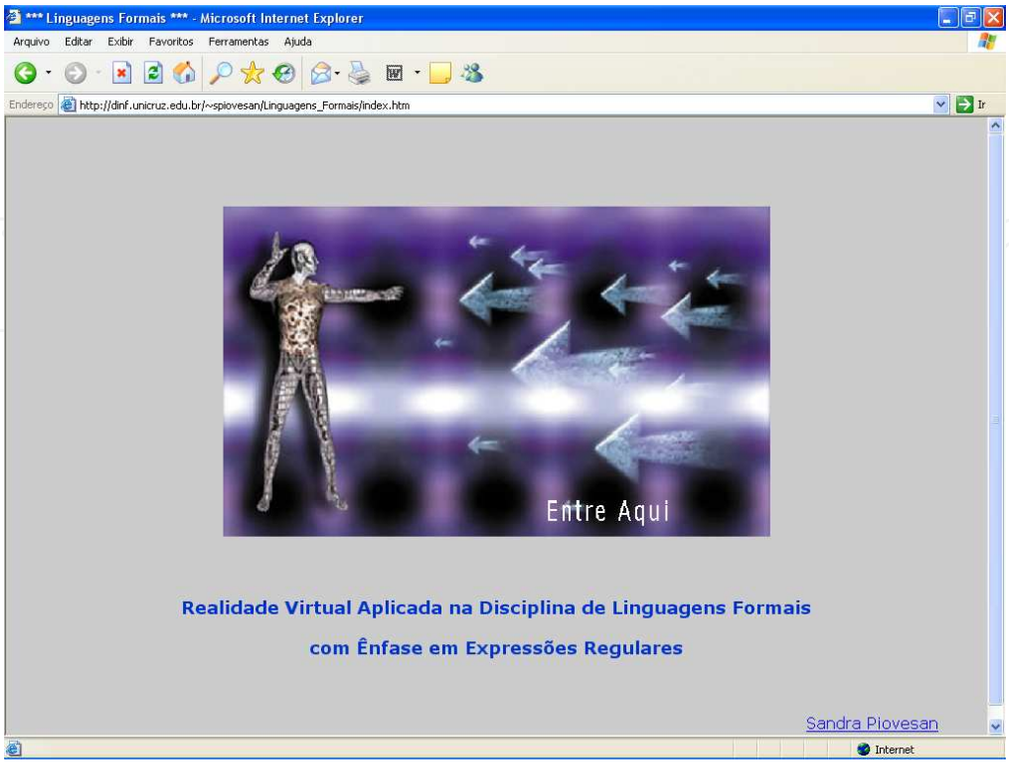

Figure 4. Home Screen

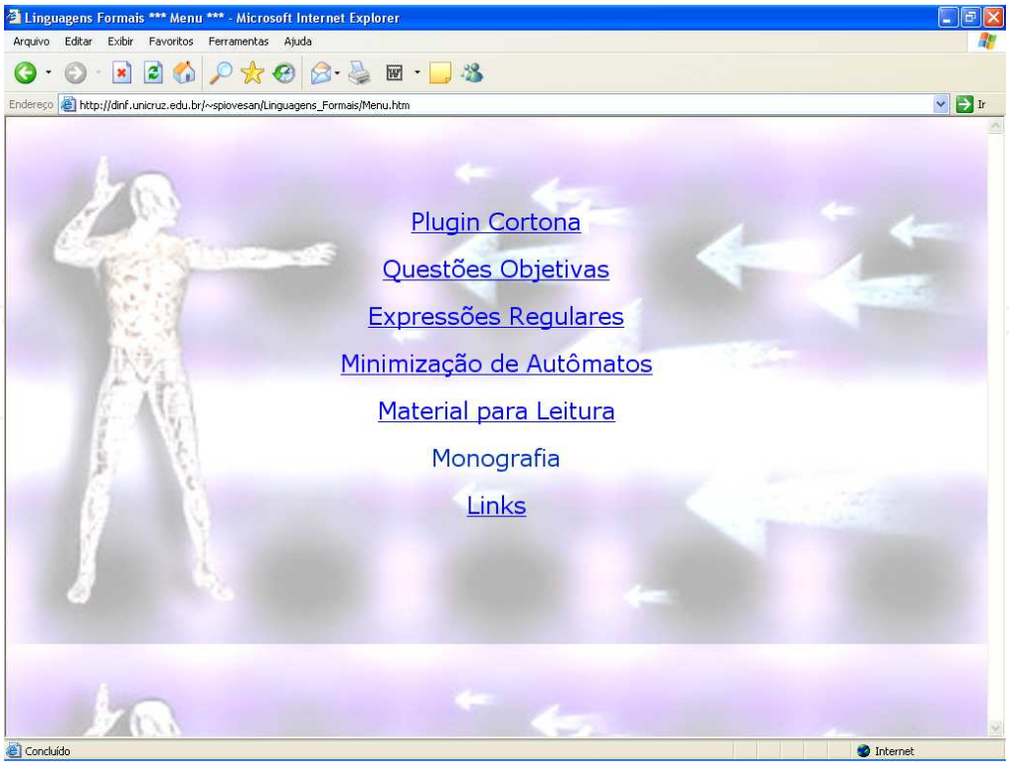

Figure 5. Menu

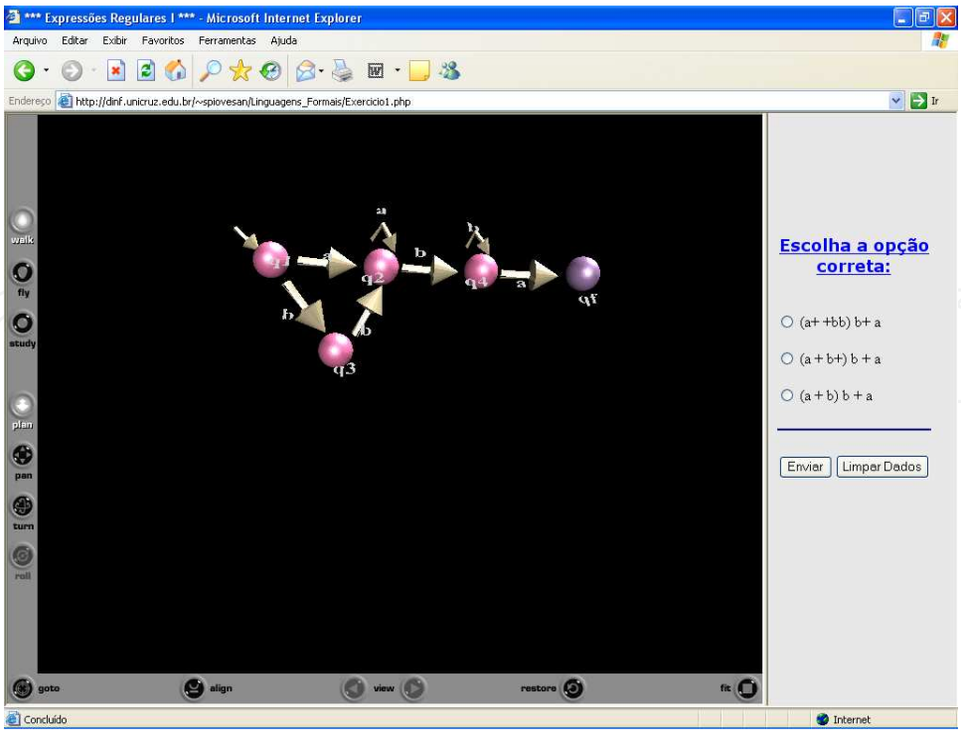

Figure 6. Exercises about Regular Expressions

The automata minimization is done on a screen where the user views the Automata drawings in 3D and must enter some state that is necessary and use the table and the lists to find the equivalent states that can be removed. When you find the equivalent states, he can view the 3D minimized automata. If the student doesn´t hit the equivalent states, the page warns him about the error and the student may retake the answers (Figure 7).

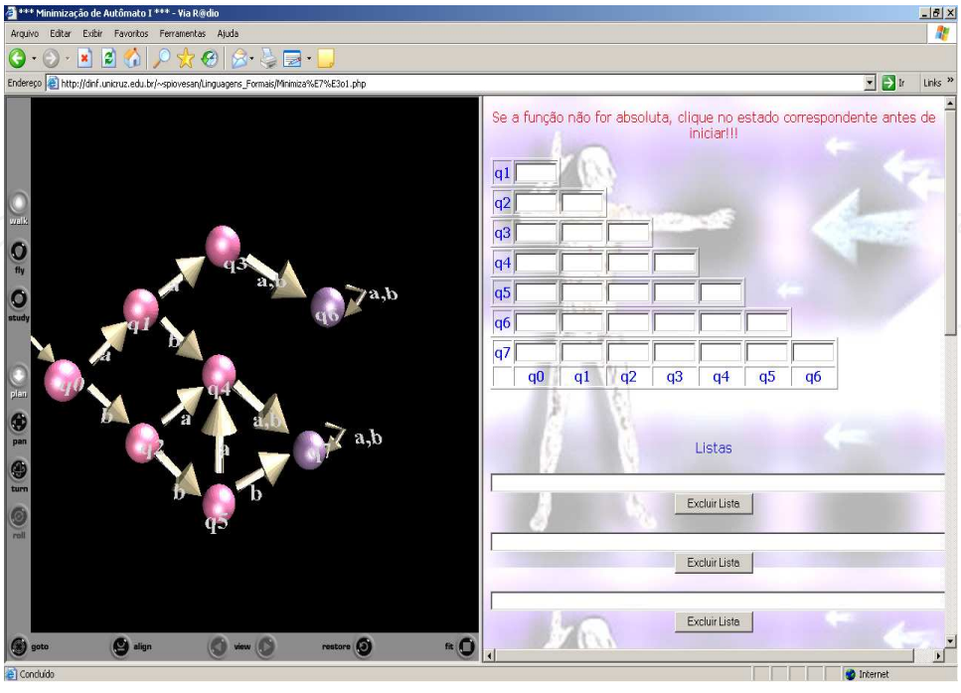

Figure 7. Home Exercise with Minimization

The page shows multiple choice exercises, where students will answer the questions and check whether the chosen answers were correct. (Figure 8) so students can test their theoretical knowledge. The page warns the student when the choices made in multiple-choice questions aren´t correct and the student will have the option to redo these wrong questions.

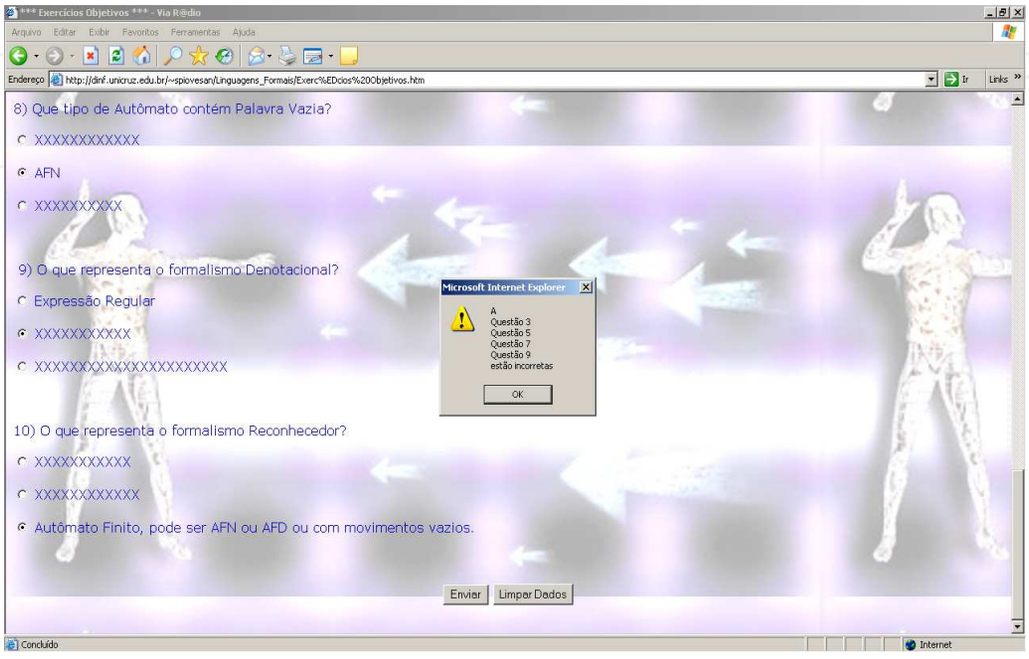

Figure 8. Exercises Multiple Choice

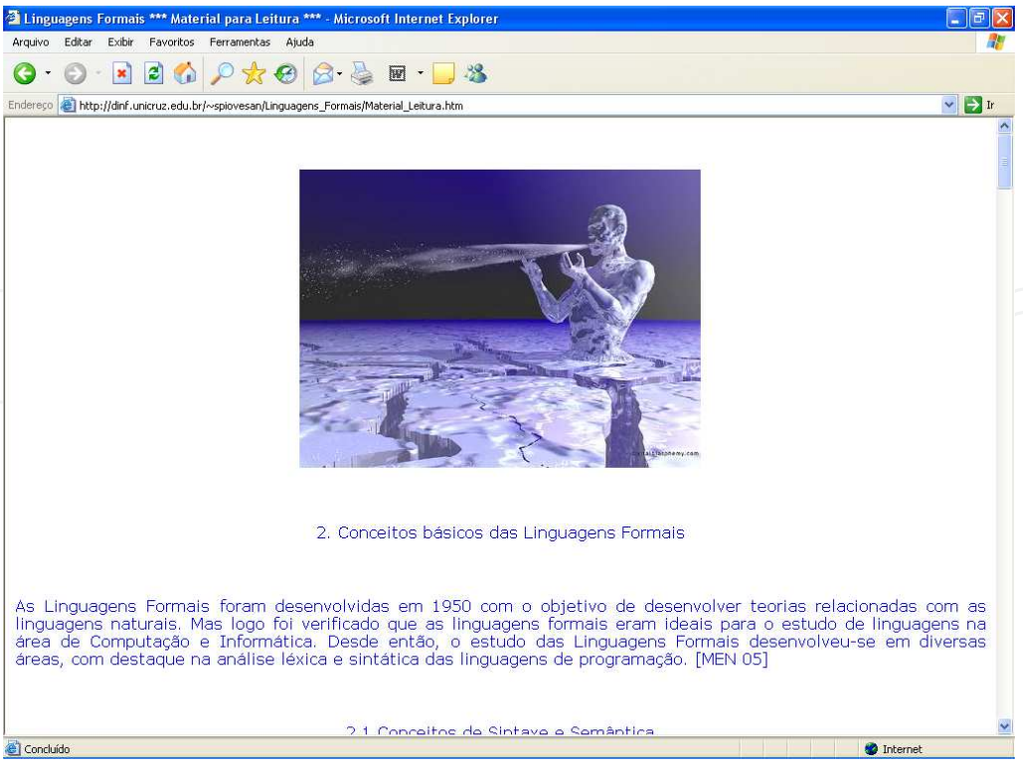

Figure 9. Materials for Reading

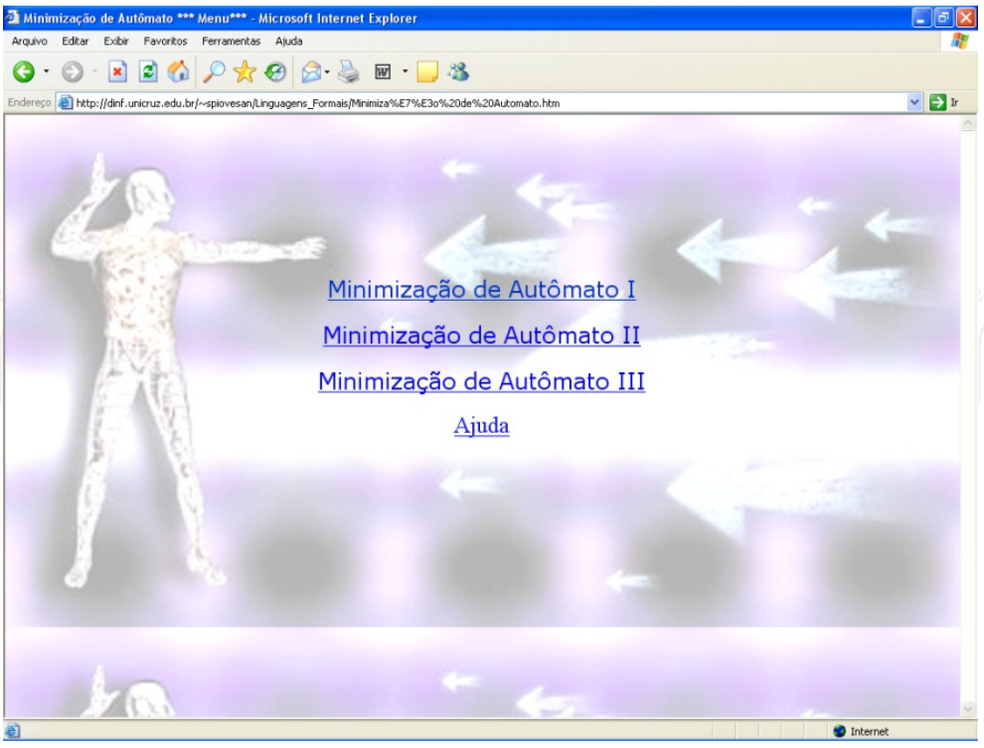

Figure 10. Menu Minimization

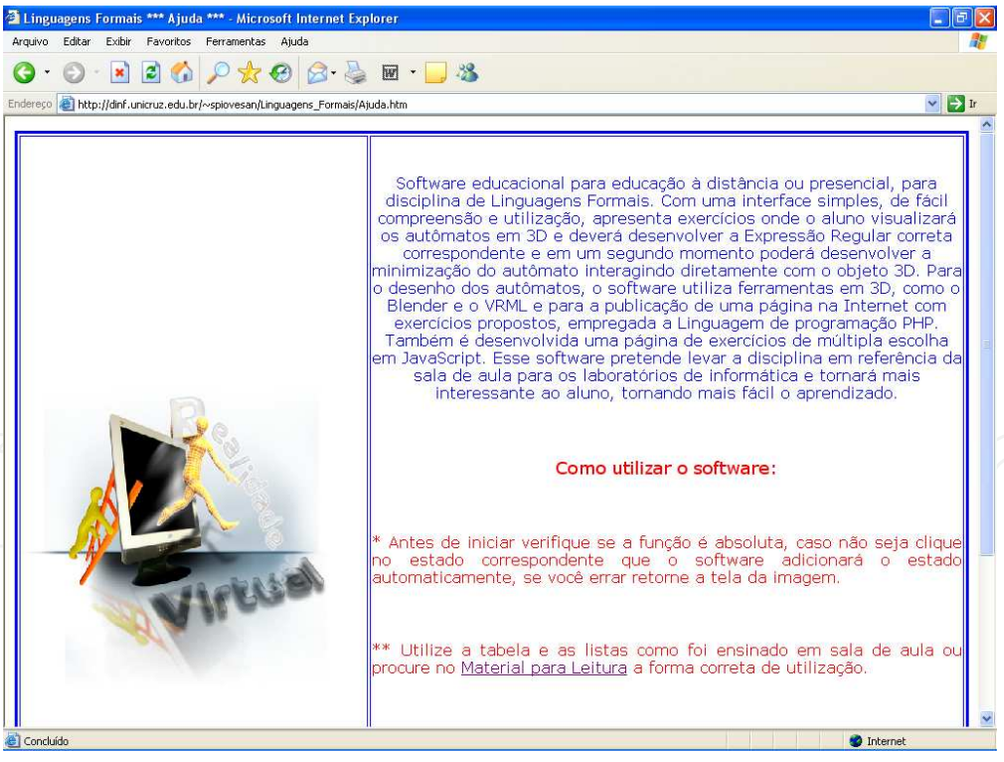

Figure 11. Material support

The page shows a Reading Material which is intended to answer doubts about Regular Expressions and Automata Minimization. This page can also be used by educators in their classroom or virtual class. The figure 9 shows the Theoretical Material page.

The page also has a help material, which explains how to use the pages with exercises Minimization. This help is available through the Menu Minimization that is shown in Figure 10.

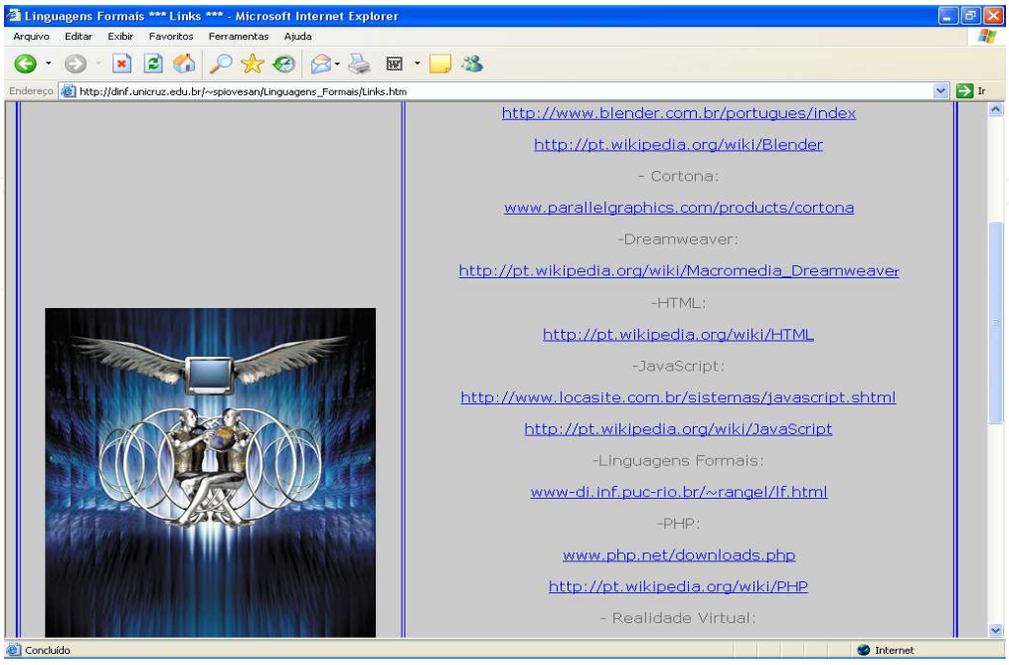

Figure 12. Links

Figure 13. Answers to Questions Minimization

The figure 11 shows the help page, where teachers and students can ask questions about the use of the Minimization exercises pages.

If the reading material doesn´t take all the doubts, is available through pages some links that were used in the workplace. The figure 12 shows the page that contains the web address links for reference.

Also are available on the discipline page, the answers for the minimization questions, which can be accessed through the help page. This page aims to help teachers and students if problems occur in these exercises solution. The figure 13 shows the page with the minimization exercises solution.

The educational software was used to take the Formal Languages subject from the classrooms to the computer labs, making the study more interesting to students.

The research made about the tools used for this research development can help in future research about Virtual Reality and Educational Software.

3.3. Assessment tool for the formal languages department

Using the system above together a distribution package apache server that has PHP phpMyAdmin tool (Figure 14) was created a database to store the students' login and

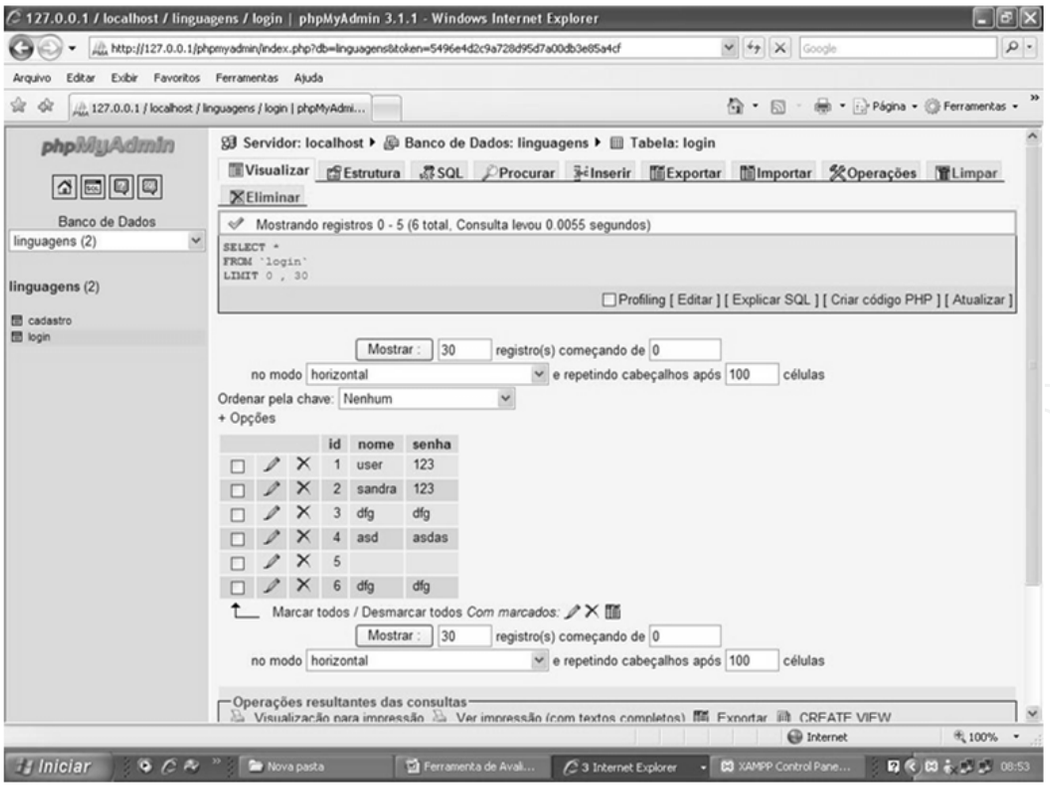

Figure 14. PhpMyAdmin tool which is created the database to store the login

password to perform the evaluation. The student´s login must be the email that he wants to receive his assessment, and the teacher will receive an email that is already defined in the program. To facilitate the database use will be exported and must be imported by the teacher who wishes to use the system.

```
$texto.='</br></br>Minimization:  </br>';
if (isset($_COOKIE['tb1']))
{$tb1 = $_COOKIE['tb1'];
$texto.="</br>M1:  $tb1";
}else{$texto.="</br> Exercise has not been resolved!";}
```

After the scan is done if the answers are correct as the code below:

```
<?php
include('conexao_mysql.php');
if (isset($_COOKIE['nota']))
{$nota = $_COOKIE['nota'];}
$q[0] = $_POST['quest1'];
$q[1] = $_POST['quest2'];
$q[2] = $_POST['quest3'];
$q[3] = $_POST['quest4'];
$q[4] = $_POST['quest5'];
$q[5] = $_POST['quest6'];
$q[6] = $_POST['quest7'];
$q[7] = $_POST['quest8'];
$q[8] = $_POST['quest9'];
$q[9] = $_POST['quest10'];

$certas_O[0] = 2;
$certas_O[1] = 1;
$certas_O[2] = 2;
$certas_O[3] = 3;
$certas_O[4] = 1;
$certas_O[5] = 2;
$certas_O[6] = 1;
$certas_O[7] = 2;
$certas_O[8] = 1;
$certas_O[9] = 3;

for($i=0;$i<10;$i++)
{if($certas_O[$i] != $q[$i])
{$valor = 'incorreta';}
else
{$valor = 'correta'; $nota = $nota + 0.2;}
```

```
setcookie("objs[$i]", $valor, time()+3600);}
$ver = true;
setcookie("objetivas", $ver, time()+3600);
setcookie("nota", $nota, time()+3600);
header("location:menu.php");
?>
```

After performing all the exercises the student will automatically send the results and note to the email address registered at the beginning as login and for the teacher´s email, so the evaluation made, according to the code below:

```
if (isset($_COOKIE['user']))

$user = $_COOKIE['user'];

}
$prof = 'sanpiovesan@hotmail.com';
$assunto = 'Resultado Avaliação';

mail($prof,$assunto,$texto);  // send email to the teacher, variable text containing all the answers

mail($user,$assunto,$texto);  // send e-mail to the student's login, variable text containing all the answers
```

4. Conclusion

In this work was shown an educational software for the Formal Languages subject, using virtual reality, with the goal carrying the subject from classroom to the computer labs, also making possible to use for distance education or as an extracurricular task.

The study was developed using the modeler Blender for the images creation, which were converted to VRML, to be used on the available Internet pages. We also used the PHP languages, to provide the proposed exercises, for the HTML layout pages and JavaScript for the multiple-choice exercises.

Virtual Reality is a relatively new area, where the student sees the possibility of exploring the environments through the objects manipulation scattered in the virtual environment, related to the content to be learned, making learning more interesting and easier for the students.

The ability to simulate real situations in a way that wouldn´t be possible, allow a breakthrough in several military and business sectors. In education, the use of Virtual Reality enables conducting experiments with the interactively knowledge, allowing the environments exploration, processes or objects, through the manipulation, interaction and virtual analysis from the own target in context.

Currently, with the increasing information spread through the Internet, the development of virtual environments that allow integration among students through the Internet can enable geographically dispersed students to learn without being present in the classroom.

Thus we can say that Virtual Reality is starting to change education. This is because, in spite of the technological barriers, the use of Virtual Reality can be associated with fantasy and imagination, revolutionizing the teaching and learning traditional concepts.

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