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COLLABORATIVE VIRTUAL LAB FOR ELECTRONIC EXPERIENCE

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ABSTRACT

This article introduces the LVCEE, a prototype that allows interaction among users in a visually and textually shared environment fostering collaboration. The LVCEE is an evolution of the single-user LVEE, in its functionality, as well as in its interface. It allows the user to create and simulate all the building steps of an electric circuit through the Web. It also allows the users to perform the same task but in a collaborative way, prompting the aggregation of new methods to the learning process.

KEY WORDS

Virtual Reality, Educational Software, Collaborative Virtual Environment.

1 Introduction

Virtual Reality (VR) has supplied novel ways of enhancing the interface and the interaction of computational systems. It has allowed the users to immerse themselves in the environment through their senses, augmenting the realism effect. So, the experiences acquired in the execution remain for the long haul [1] [2].

However, the main concern is not only to improve the human-computer interaction, but to better the human-human interaction, with the computer being the means of communication. With this and the VR power in mind, the first Multiuser Virtual Environments (MUVE) - tridimensional, computer generated environments where the users meet, share information and the space - were brought into existence. The development of MUVEs lies heavily on the high potential of this kind of application on the creation of activities for groups of users in any field, especially in teaching and training, which happens to be what this paper is focused on. Besides, the majority of the tools that permit collaborative activity present themselves in bidimensional shapes, restricting the users in many ways: the user is unaware of the presence of other users, there's lack of a better contextualized task environment or a more life-like, task-developing environment, among other things.

Thus, the Collaborative Virtual Environment (CVE) may be used. It is a MUVE that allows several people to interact through a virtual three-dimensional space to attain a common objective.

New collaborative virtual reality applications are developed every day, since they can be applied in any domain in several different ways. However, as these application are actually pieces of software, software engineering techniques may support their conception facilitating either the development of new modules or the update of existing ones.

This paper's organization involves, in a bird's eye view, CVE and aspects in the implementing of the prototype. On section 2, several concepts on Collaborative Environments are introduced. The characteristics of the LVEE project are introduced on section 3. Finally, on section 4, several issues are brought up regarding the development of the project up to this day, and regarding future papers.

2 Collaborative Virtual Environment

Multi-Users Virtual Environments [3] are environments where several users can interact among themselves in real time and share information and tridimensional environments. Collaborative Virtual Environments (CVE) is an environment in which the above-mentioned interactions and the sharing of information allow the realization of group activities. Churchill [4] gives a more general definition: "A CVE is a virtual space, or a group of spaces, spread out, and based on a computer. In that space, people may find or even interact with other people, agents or virtual objects, in order to achieve common objectives. CVEs may vary, in its representational richness, graphic spaces 3D, 2.5D and 2D, to text-based environments. The usage of CVEs does not imply that one is limited to the usage of desktop devices, but it could be perfectly used in mobile or wearable devices, public booths (kiosks), etc."

CVE's main features are [3] [4]:

1. A sense of space sharing: all participants have the feeling of being in the same place, same room, building or lot.
2. A sense of presence sharing: from the entrance in the virtual environment, each participant must have a clear ID. Generally, a "virtual identity" called avatar is chosen, which includes a graphic representation, body structure model, movement model, physique model and other characteristics.
3. A sense of time sharing: the participants must be apt to see other behaviors and what happens to them in real time.
4. A means of communication: even though the visualization is the cornerstone of multiuser virtual environments, most of them must also grant communication among participants – through gestures, text or voice, for example.
5. A way to share: the elements aforementioned effectively supply a high-quality netmeeting [video conference] system. Therefore, the true power of multiuser virtual environment lies in the ability to thoroughly interact not only with other users but also with the virtual environment itself.

3 Collaborative Virtual Lab for Electronic Experiments

The Virtual Lab for Electronic Experience (LVEE) is a virtual environment that enables the student to create tridimensional electric circuits, simulate them and achieve results related to the current and tension values of their components, for instance. The LVEE was originally conceived by Meiguins [5], in its single-user version, as well as in its multi-user version [6].

The experiments performed in an electric circuit lab are set over a special platform called protoboard. Resistors, sources, inductors and capacitors are used as components, which may be analyzed under either direct current (DC) or alternating current (AC), and under different frequencies. Its interface shows two main parts: one tridimensional part, used especially for visualization, and a second part, that allows an interaction with the user when creating the components. These two are part of a Web page (Figure1).

The applet's components for the interaction of the user are clearly shown in Figure 1. The interface's components may be gathered in three main groups. The authentication interaction components, as well as the chat components are in the first group. The components related to the configuration of objects used for insertion and removal to/from the circuit, and the components related to the generation and simulation of the circuit are found in the second group. The components of Group 3 refer to class control – to open and close a class, for instance.

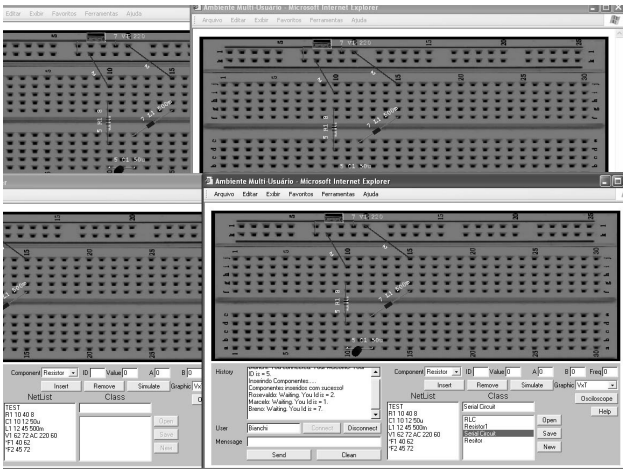

Figure 1 – Four users interacting with the LVCEE

The generic architecture of the LVCEE is shown in Figure 2.

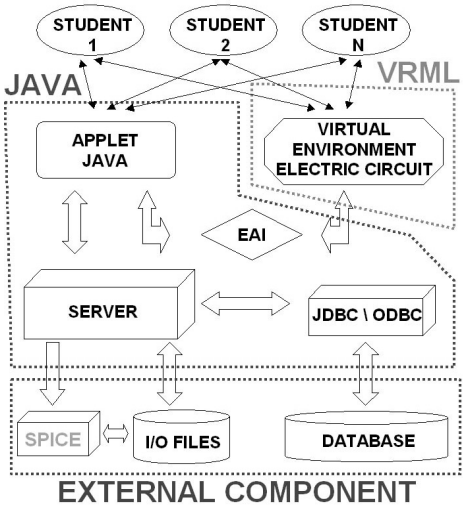

Figure 2 – Architecture of the LVCEE

Type_message	Length	Content

Figure 3 – Message format of the LVCEE

The LVCEE is based on the client-server architecture. It is implemented through concepts of threads and sockets in order to allow simultaneous and shared access into the virtual environment and chats. The sharing of messages between client and server obeys the format presented in Figure 3. Some of the types may be login, simulation, insert components, etc. In the simulation process, the LVCEE is assisted by the PSPICE [7]. A feedback result is shown in Figure 4. The generation of several graphics, in order to better analyze the circuit, becomes possible with this result (Figure 5).

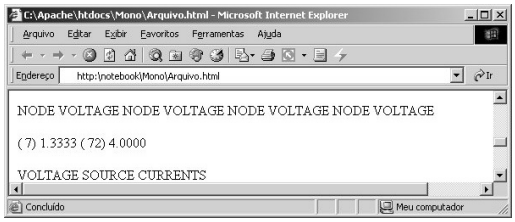

Figure 4 – PSPICE Result

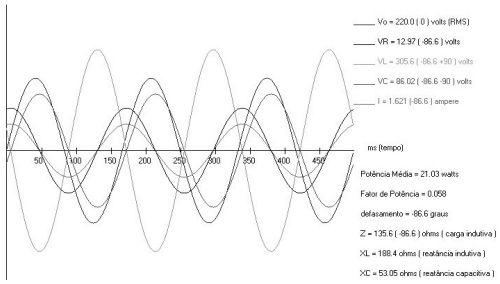

Figure 5 – PSPICE Result Graphic

Other views are also possible in the LVCEE, such as the electric-mechanical connections in the protoboard (Figure 7).

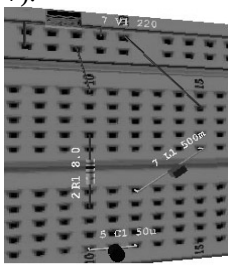

Figure 6 – Another view in the LVCEE

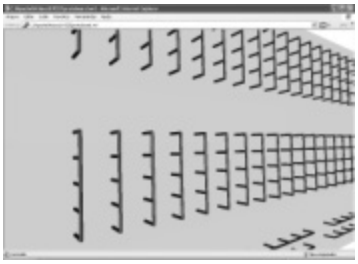

Figure 7 – Electric connections in the protoboard

4 Final Considerations

The LVCEE has shown new functionalities, as well as a new interface, compared to its first version [5], so that its usage becomes possible. It may help students in an intermediate phase between what is performed in real labs and in 2D application programs that simulate those labs. In the future, new experiments might be performed, since the LVCEE has been developed with the use of standard technologies, what facilitate its reusage and portability. The LVCEE, as a prototype, has achieved enough maturity so that it can perform classroom tests, and may be evaluated effectively in its pedagogic efficiency, functionality and interface.

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