Customizing Multimedia and Collaborative Virtual Environments

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INTRODUCTION

Virtual reality (VR) represents a modern human-computer interface consisting of a three-dimensional (3D) environment generated by computer where the user can interact in different ways. VR can be applied in several applications domains such as medicine, education, entertainment, etc. In particular, interest is drawn to the application of VR in education since a student is able to interact and to be involved with a 3D environment, which simulates situations that are difficult or even impossible to be carried out in the traditional education process.

The application of multimedia within virtual environments (VEs) represents a promising and interesting trend in the development of educational environments since interaction can be enhanced, thus, captivating interest and increasing the motivation of the student by the addition of audio and video. Besides multimedia, we should also consider the benefits of the computer supported cooperative work (CSCW) inside VEs: Cooperation motivates and increases productivity. When applied to educational environments, it can stimulate the student since he is able to communicate with geographically disperse participants of a collaborative session.

This chapter introduces some important issues when considering the integration of three different research domains: virtual reality, multimedia, and CSCW, and presents a generic architecture for the development of multimedia and collaborative virtual environments (MCVEs) for educational purposes, called CreaTiVE (creative toolkit in multimedia and collaborative virtual environments). CreaTiVE aims at exploring the potential of VR, multimedia, and CSCW in the development of educational software.

BACKGROUND FOR MULTIMEDIA AND COLLABORATIVE VIRTUAL ENVIRONMENTS

Different issues must be considered for the development of MCVEs for education, especially when considering a multidisciplinary approach that shall take into account the particularities of three different domains in computer sciences: virtual reality, CSCW, and multimedia.

Virtual Reality

The application of VR to the design and implementation of educational VEs aims at allowing the students to interact and to be involved with this environment and its objects. This experience can be advantageous to the student in a learning process according to his degree of involvement (or immersion) with the VE which depends upon his sense of presence (awareness). The sense of presence is the feeling experienced by the user as the result of how his cognitive model is built in response to the user's immersion within the VE. The sense of presence is object of discussion and definition by different researches. According to Coelho, Silvério, Da Silva, and Santos (2005), presence does not depend only on technology but also on the participant. Some

user's psychological aspects influence this feeling: (1) The man-machine *commitment* in which the man let himself be misled by the machine in order to finish a task; (2) The users' focus (*attention*) on the VE stimulus; (3) The participant's *ability and will to focus* on the task; (4) The participant's *selective attention,* which describes the tendency of selecting significant information with a particular interest to the individual; and (5) The *focus on the virtual world,* etc.

VR systems are inherently immersive, where according to his or her sense of presence, a user has the feeling to be inside the VE (generated based on head mounted displays (HMD), immersive rooms, etc.). However, the main drawback for the development of immersive VR application is related to the cost of VR devices. This limitation can be overcome by the development of non-immersive systems and by the industry advances. Non-immersive systems are described by the three-dimensional visualization of a VE using a conventional monitor (desktop VR). Although, immersive VR application has evolved and either considered typical, the desktop VR still presents some positive points as: to use all the advantages of the evolution of computers technologies industry, to prevent the technical limitations and problems of the HMDs and the intuitive use. Furthermore, multimedia presentations can also be applied in VR applications in order to increase the sense of presence, to capture the user's attention and to promote involvement within non-immersive VEs.

With the increasing development of the Internet, the VR concepts can also be applied to the implementation of distance learning courses. However, there are still some constraints related to development of distributed VR applications such as the optimization of response time, consistency and scalability upon limited and dynamic resources, leading to perceptive delays, which represent challenging, research drawbacks. One of the main purposes for using VR interfaces in distance learning is the high degree of interaction provided by these applications. In other words, it allows students and teachers, geographically dispersed, to communicate considering the educational application scope. The VR techniques applied to distance learning courses enable the student to construct his own knowledge model without time/space limit considering the teacher as an advisor.

Collaborative Work

CSCW describes the appropriate forms of cooperation among people or groups to execute a common task and evaluates the conception, the implementation, and the development of software for these forms of cooperation. The software tools that provide a computer-based support interface for the access to a shared environment for groups of people engaged in a common task are called *groupware*.

The increasing number of technologies for supporting collaborative work and CSCW has allowed the mobility of people and the execution of common synchronous tasks. However, there are still some limitations that make groupware development a difficult task. For instance, the lack of coordination support in a collaborative activity and the need of an automatic management in synchronous sessions. This management relies on providing some mechanisms so that users can initiate, enter, or leave a session, controlling the behavior of the collaborative system and applications that compose it. Some other challenges on the groupware development are: (1) the management of the data consistency (participants must have the same view of the shared data); (2) group awareness (each participant must know the activities of all the other participants of the group), and (3) the treatment of the delayed participants (groupware capacity to provide to the new participant the state of the current session).

Collaborative work is relevant within educational applications since it provides mechanisms and services to the support, formation, and control of users groups that can be remote and which can interact in real-time through a synchronous or asynchronous communication. Among the contributions in the literature that apply collaborative tools within educational systems (computer supported collaborative learning) are Azambuja and Vicari (2002), Kurhila, Miettinen, Nokelainen, and Tirri (2002), and López, Núñez, Rodríguez, and Rubio (2002). Unfortunately, these works are not based on a session model, thus constraining the creation and management of complex sessions.

The development of collaborative systems within VEs is described by the acronym *collaborative virtual environments* (CVEs). Snowdon, Churchill, and Munro (2002) define CVEs as a virtual space or a set of distributed computer-based spaces. Within these spaces (places), people can interact with other people, with