Agent and Virtual Reality-based Course Delivery System

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Abstract: - This paper reports on the development of the Agent and Virtual Reality-based (AVR) a non-traditional course delivery system. The system allows creation of lectures in a virtual world that enhances the learning experience of students by creating interactive lectures and class discussions in 3-D with multimedia contents delivered through a low-bandwidth Internet connection. We have been evaluating the effectiveness of the AVR technology through expected measurable outcomes of improved student performance, and increased student satisfaction.

Key-Words: - Virtual Reality, Agent, Course delivery, 3-D, Classroom, Multimedia

1 Introduction

The author was involved with a team of researchers in a funded NSF grant to explore perceptions of online education and how users view the effectiveness of online education systems as a function of the types of technologies used [1], [2]. We looked at the utilization of technology in online education. This study has the potential to maximize the effectiveness of online education by providing us with a clear understanding of online education environments in terms of their major differences from traditional face-to-face education, especially with regard to social and psychological dynamics, cognitive processes, and technological elements. The author and colleagues showed that student and professor become interconnected through collaboration and interaction in a virtual learning space, relationships develop and students begin to take on an individual identity, Hodge et al [3].

The common features of online education course management systems include the following: computer-mediated communications, navigational tools, course management, assessment, and authoring tools [4]. A number of studies have indicated that virtual reality environments and multimedia [5] could be used effectively to support a constructivist paradigm of instruction [6]. Winn [7] suggested that including a 3D immersive environment could help bridge the gap between experimental learning and information representation.

Several successful applications have demonstrated the potential of 3D virtual worlds in creating learning environments for traditional and distance teaching [8]. Active Worlds Educational University (AWEBU) is one of the oldest and most dynamic 3D virtual applications. These web-based 3D-model technologies are shown to be important tools for visualization in the classroom to ensure an enriching learning experience [9]. Amon & Valencic [10] also have developed 3D biological structures based on Virtual Reality Model Language (VRML).

Although virtual reality-based systems are well-developed, their educational uses have not fully developed, [11]. A research project completed by the authors [12] features effective implementation of a Web-based learning environment called “School for All”. Navigability and content organization in online learning environments have been found to be significant issues for some researchers, [13]. Moundridou and Virvou [14] reported on an empirical study they conducted in order to design and develop intelligent tutoring systems. Song et al [15] developed a human tutorial conversation system for the Web that enhances educational courseware through mixed-initiative dialog with natural language processing.

A questionnaire concerning perceptions, experiences, resources, and perceived effectiveness related to online education developed by the author’s participation has already been administered to a sample of students and faculty nationwide. This includes those who have experience with traditional online courses and those who have not. Responses were analyzed and the findings supporting virtual reality and multimedia-based online course delivery system were published [16].

Two-dimensional textbook illustrations provide a limited description of the content being discussed. The academic sciences teach mainly
process-oriented content that requires more than a static image on a page. Three-dimensional models provide students with fully interactive content. These web-based 3D-model technologies are shown to be important tools for visualization in the classroom to ensure an enriching learning experience [17].

Moreover, sending motion data with streaming data from server to client can greatly reduce the time required before playback; we also will be streaming motion data over a narrow bandwidth for a quick playback [18].

2 Project Design
The author has designed and prototyped 3D based AVR classroom environments, communication, and training systems (Figure 2).

Figure 2. Showing 3D-based virtual reality classroom

The underlying technology used to develop the AVR system comprise an emerging medium demonstrated in many areas, such as computer games and visualization. The Author's AVR system provides the instructor an environment to teach in the virtual setting similar to the face-to-face classroom. The instructor will teach using the uniquely designed whiteboard and PowerPoint slide presentation both integrated in the VR environment. The virtual classroom's message board allows student/instructor interaction and communication to take place. The students observe the online lecture in a VR class resembling a face-to-face classroom. The students can observe the lecture, and adjust the environment to suit their personality.

The AVR course delivery system is developed using different technological elements, to including:

- A 3-D virtual reality platform,
- A course management system,
- A dynamic learning assessment system,
- A multimedia-based communication environment,
- An effective client/server model with an advanced security layer,
- An electronic whiteboard and PowerPoint presentation,
- E-campus features (virtual reality labs), and
- Motion-capture and tracking with a communication architecture that optimizes the bandwidth usage.

A general architecture of AVR system designed and developed by the author is shown in Figure 1.

Figure 1. An abstract view of the AVR architecture

The AVR system is implemented for delivery of face-to-face and online courses with multimedia content to users including those areas with low bandwidth network infrastructure. Students view lectures online in a virtual reality environment setting. The instructor appears as an animated character, with real-time facial expression, body posture, position, and movements captured by the system. Students can hear the instructor, see notes written on the blackboard, observe demonstrations, ask questions, and engage in classroom discussion. An interactive lecture with a full screen multimedia content can be received in real time or archived, regardless of the type of network connection, including dial-up. The main strengths of this system are:

- Detected Cartesian coordinate (X, Y, and Z) points of the instructor’s position, facial expression, and body posture are the only data streamed, reducing the bandwidth requirement tremendously,
- The students’ interface will enable re-generation of the animated 3-dimensional objects (representing virtual instructor, students, and the classroom) tracking the real instructor’s movements while teaching,
- Increased engagement of online learners,
- The lectures can be archived for students to use in the future, and
- Students can interrupt the teacher and ask questions.

3 Current State of the AVR System
2.1 The AVR system is ready for primetime
It is quite common that there could be some glitches when downloading and installing software. Besides some minor problems related to the firewalls and network settings by the institution IT departments or service providers our clients have been able to download and use the VR system successfully. However, these problems are very often resolved with a phone call or email to the software developers.

2.2 The AVR system is logical replacement for video streaming
Unlike AVR system, video streaming
• Requires broadband service
• Is often viewed in a restricted view on computer screen
• Is not interactive
• Does not represent the physical and natural environment well.

2.3 The AVR system will not require wearing special equipment all the time
Wearing our VR equipment is not required all the time, for the first time users (instructors) we recommend wearing our equipment once (the process may take about 30 minutes) in order to collect more personalized and natural motion data.

2.4 The AVR system requires a little training
The simple instructor interface will enable smooth delivery of the lecture. Our colleagues’ first lecture was delivered without prior training.

2.5 The AVR system will require minimal installation efforts
Simple instructions as how to download and install three software components are available.

4 Conclusion
Besides anecdotal evaluation which has shown successes on the students’ motivation and learning, the effectiveness of the AVR system is being evaluated by several professors at this time. However, the effectiveness of the other multimedia based course delivery systems have already been studied and validated. Moreover, students’ positive attitudes towards gaming systems have widely been agreed upon. The application of the AVR system will provide students a platform to learn in an interactive multimedia based environment similar to gaming world.

References:


