Serious Games for Training, Rehabilitation and Workforce Development

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ABSTRACT

We present a set of demonstrations of current work in the Clemson University Virtual Environments Group involving the development and testing of interactive virtual environments for applications in training, rehabilitation and workforce development. All of these applications are designed to leverage commodity hardware such as HDTVs, game controllers, and the Kinect sensor.

Keywords: patient safety, stroke rehabilitation, 3D user interaction, workforce development, training

Index Terms: I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—virtual reality; J.3 [Computer Applications]: Life and Medical Sciences—health, H.5.2 [Information Interfaces and Presentation]: User Interfaces—input devices and strategies

1 PATIENT SAFETY TRAINING IN AN INTERACTIVE MEDICAL SIMULATION

This complex multiagent immersive virtual healthcare simulation is used to teach and train clinicians in the Center for Disease Control's five moments of hand hygiene. Participants in the simulation act as an infection control specialist and travel throughout the virtual replica of the fourth floor Roy Carver building at the University of Iowa hospital. The users observe autonomous virtual healthcare workers as they interact with virtual patients and record any infringements of proper hand hygiene they may observe. [1]

Figure 1: In the patient safety training, the user observes the hospital worker interacting with the patient and records any infringement of the hand hygiene protocol.

2 DUCK DUCK PUNCH: A STROKE REHABILITATION GAME

"Duck Duck Punch" is a 3D neurorehabilitation game for post-stroke upper extremity reaching impairment. The game is based on a carnival shooting gallery where targets pop up on-screen to present reaching tasks that stroke survivors use physical arm movements to complete. A Microsoft Kinect allows stroke survivors to interact with the game using reaching motions made with their impaired arm that control a corresponding virtual arm seen in the game environment. Therapists can configure how the virtual arm compensates for impairment, allowing survivors with moderate to moderately severe impairment to interact with the game.

Figure 2: Stroke survivor participating in a pilot study of Duck Duck Punch at a neurorehabilitation center.

3 RAPID RESPONSE TRAINING SYSTEM

The Rapid Response Training System is designed to help practicing nurses sharpen their observational skills with special attention to helping them learn to recognize patients who are in rapid deterioration. Outcomes for rapidly deteriorating hospital patients are unfavorable unless a nurse recognizes the signs and symptoms and a special "rapid response" team is called quickly. Our system simulates four hospital patients and requires the nurse to monitor their vital signs using instruments in the hospital room, to interact with patients and interpret their behaviors, and to record observations in an electronic health record system. The nurse's goal is to determine which patient is deteriorating.

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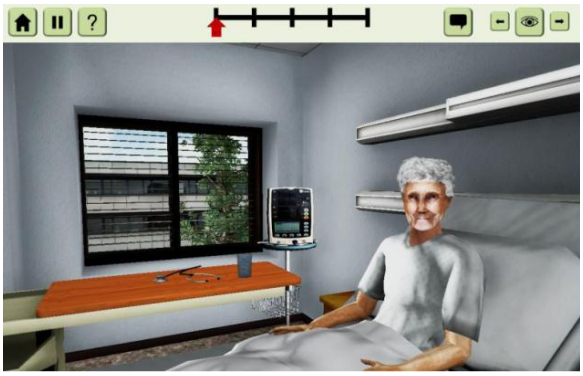

Figure 3: A patient in her hospital room in the Rapid Response Training System. The nurse may interact with the instruments in the room or ask the patient questions to gather information about her condition.

4 Virtual E-School for Aviation and Automotive Technology Education

We have developed a set of virtual reality applications for supplementing precision measurement education for technical college students that involves bimanual and unimanual interaction metaphors. The user interacts with the simulation via a 6 degree of freedom electromagnetic tracker with both hands to simulate real world interaction as opposed to using a mouse. Step-by-step instructions show the user how to manipulate calipers and micrometers, and then they are given an exercise to determine if they have learned the proper technique. We are interested in determining if bimanual psychomotor skills translate to the real world better than using a mouse for interaction.

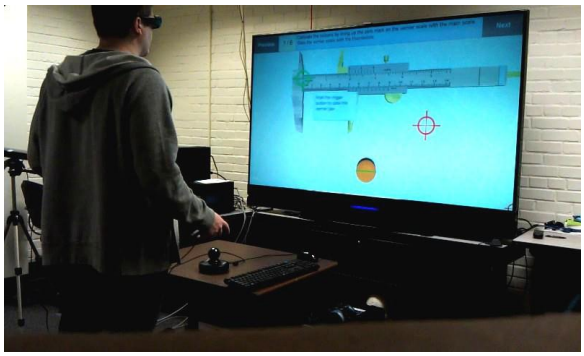

Figure 4: A user interacts with the virtual calipers using a two-handed 6 DOF controller

5 The Virtual Environments Group

The Virtual Environments (VE) Group at Clemson University (www.cs.clemson.edu/group/vegroup) imagines, designs, builds, and evaluates software and technology for all types of virtual environments. Our interests include immersive virtual reality, virtual humans, online virtual worlds, 3D user interface design, multi-modal interfaces, and applications of virtual reality systems. The group is led by Dr. Larry Hodges and Dr. Sabarish Babu.

The VE Group was initially established in 1993 as part of the GVU Center at Georgia Tech. In 2002 it moved to the University of North Carolina at Charlotte and then to Clemson University's School of Computing in 2008. Over 20 years the group has made many contributions to both basic research and applications of virtual environments, including virtual reality exposure therapy, Virtual Vietnam, early pc-based CAVE-like displays with surround audio (the NAVE), the Simple Virtual Environments Toolkit, the Virtual Reality Gorilla Exhibit at Zoo Atlanta, embodied virtual agents, and numerous published studies of 3D user interface design and interaction techniques.

The VE Group is part of the Human-Centered Computing Division within the School of Computing at Clemson University. The Group maintains active collaborations with the Departments of Psychology and Industrial Engineering, the School of Nursing, St. Francis Hospital, and the Medical University of South Carolina.

Figure 5: Students meeting in lab conference area

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