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Me and My VE, Part 4

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Virtual environments, augmented reality, serious games, simulations, and other digitally mediated experiences are revolutionizing the way that we work, learn, and interact with people and systems. The employment of these technologies is driving innovation in research, training, education, evaluation, and various business endeavors. This session will provide a brief overview of some of the diverse uses of virtual environments (VEs) in an alternate demonstration format that leaves just over half of the session time for hands on, interactive demonstrations. Unlike most demonstration sessions, where possible, we encourage session attendees to personally interact with the demonstrations. The session will begin with demonstrators providing a brief description of their VE and how they've used it to address a unique need. At the conclusion of the description portion of the session, each VE will be set up at a demonstration station in the room, and session attendees are encouraged to engage with both the demonstrations for a hands on interaction with the VE and with the demonstrators to get more information about the development and use of the VE, and stimulate discussion on how the concepts, methods, and tools can be used to solve additional problems or business needs.

INTRODUCTION

Virtual environments (VE), augmented reality, serious games and simulations are changing the way we do business in many ways. Many people think of training and research when they consider VEs, but the application of these technologies is *virtually* unlimited, and is increasing daily. For instance, simulation environments are often used to analyze future system performance, or to compare future human systems performance with different systems or processes. In maintenance and sustainment operations, augmented reality or virtual environments can be used to provide step by step illustrated work instructions for infrequent or remote repair operations, delivering just in time guidance on the steps and procedures to be followed. If the repair technician needs to reach back to an expert, this can be done virtually, as well. Mobile apps have been developed to provide guided work instruction, and some even include the ability to capture video of the work process, to allow virtual sign off by remote supervisors that the work was completed as expected. Virtual tours are increasingly popular; almost anyone who has looked at houses in the past decade has seen virtual home tours online, but these tours have expanded to many other types of tours. One website, http://www.virtualfreesites.com/museums.museums.html claims to have links to over 300 free virtual tours of museums, special exhibits, and interesting locations and locales.

So, why are VEs so popular among researchers, trainers, educators, evaluators and business people? First, VEs allow a high degree of replicability. We can deliver training and instruction to many people in many locations, and the delivered product in each location will be exactly the same. In addition, there is often a cost savings that can be captured by using VEs and simulations. Instruction can be developed just once in a VE, simulation or serious game, and administered as many times as needed with requiring any additional instructor time, in some cases. Even when instructor time is still required, it is significantly reduced. With virtual instruction or training, trainees can often take the training at their workstation, eliminating the cost of travel. In addition, VE or game-based training systems often provide the training materials in a more engaging and entertaining format than a traditional classroom lecture. Another advantage is that hazardous tasks can be practiced with no risk in a VE or game. Driver training is a familiar example, but the military is increasingly using game-based training to familiarize personnel with combat skills, both physical and cognitive (e.g., Strater & Bolstad, 2008). VEs can train or evaluate team or individual skills in a manner that is hard to recreate in a live setting, such as complex scenario-based training. While this can be done in live environments, it is very costly to set up and maintain, and often requires many personnel to support each live training event. By using avatars and video, opportunities for interpersonal interaction and complex decision-making can be provided in a VE much more easily and at a lower cost than live training. VEs and simulations have been used for both large and small-scale experimentation efforts with great success, as they allow much greater experimental control than is possible in "real world" environments. These advantages explain the increasing employment of VEs for a variety of application areas.

Other uses for VEs include education, including education in the development of VEs and serious games, ranging from developing the game objectives and storyboard, developing the graphics and art for the game, designing the flow of the game through various level designs, modeling the environment, and progresses with the final product through testing user experience. Our first demonstration describes this process, and shows how a University program can use serious games as an educational discriminator for their students. Another use of VEs is personnel evaluations, where VEs can be used to evaluate the performance of either individuals or teams. An advantage of VEs for personnel evaluation is that they provide an excellent venue for creating a structured and detailed debriefing session. Events that occur in the evaluation session can be tagged and time stamped for later video review and discussion. In fact, one of our demonstrations involves a serious game designed to adapt a popular test of executive function in an environment that is more relevant to evaluate military personnel.

Advances in technology allow VEs to be more responsive to individual participants in many ways. In scenario based training, participant decisions and choices have an effect on the outcome of the scenario through branching algorithms, but more advanced technologies can adapt the material delivered through the VE based on participant emotional response to VE activity and avatars. One of our demonstrations in this session will present a VE that uses this type of technology to deliver individually targeted material to the participant.

The objective of this unique demonstration session is to introduce session attendees to several creative and interesting ways our demonstrators use their VEs to solve the problems they face. By seeing demonstrations in the Me and My VE session, we hope that session attendees will think of novel ways that they can use VEs, games and simulations to address their real world concerns. The format for the session will include a brief introduction of each VE by the demonstrator that includes a video of the VE in action. After the demos are complete, each demonstrator will have his or her demo set up at a location in the room, and session attendees can go to each demonstration table to interact with the demonstrations. Demonstrators will describe their systems and their research in detail, and answer attendee questions. We hope that by seeing and interacting with the demonstrations in this session, attendees will be inspired to develop new and creative methods for using VEs to solve their business and research questions.

DEMONSTRATION DESCRIPTIONS

The Game-based Education and Advanced Research Simulations Lab and the Game Development Club – Game Development Process and The Hauntlet

A modern application of HF skills and knowledge occurs within the game development environment. From the development of a story that cognitively appeals to and challenges players, to testing user experience for a fully developed game, this environment is a rich one for best practices in human factors. At Embry-Riddle Aeronautical University, we have developed the GEARS Lab, which stands for Game-based Education and Advanced Research Simulations Lab. The lab’s purpose is to understand game-based and technology-enhanced learning and performance from beginning to end. The GEARs Lab is divided up into three distinct areas – a multi-player, team performance lab, a virtual environments and individual gaming lab and a design lab. The present demo will focus on showcasing the products of our virtual environment area.

The GEARS-VE Area is equipped with 4 workstations and Oculus Rift 3d Virtual Reality Headsets. This lab was created for experimental research related to virtual environments, but also serves as the University’s primary location for game development. The Game Development Club is a multi-disciplinary student group, comprised primarily of Human Factors and Engineering undergraduates, created to engage students in digital game development. The GDC is comprised of 4 teams each focused on a different area of game development: Storyboard, Art, Level Design and Modeling. Each team has a lead, who also arranges training in programming, software and hardware use for his/her team members. The GEARS VR Lab is used for training and team meetings. Each semester, the Game Development Club decides on a type of game to develop, and then the teams each work on their aspect of the game, coming together to produce a working product at the end of the semester.

This type of development activity allows students to participate on a team to produce an actual game. In addition, students learn to use advanced technologies, develop programming experience and project management skill. Our demonstration discussion will provide information about the design process used in the creation of virtual reality games, as well as provide Oculus Rift headsets that allow attendees to experience the most recently developed GDC game, The Hauntlet. This game was debuted in Fall 2015, and combines a puzzle game with the horror genre. You, as a player, are trapped in a dorm with a psychopathic student. In order to escape you must find clues left by the student that will allow you to find the dorm's exit. In creating this game, the GDC focused on contextual realism, going so far as to measure dorm rooms and replicate those dimensions, as well as integrating actual furniture, lighting and color schemes into the game design. GDC members and faculty mentors will be available to answer questions about the Virtual Reality Lab, the game development process, and how to facilitate and foster student creativity and productive outcomes.

Virtual Multiple Errands Test: Military Version

Mild Traumatic Brain Injury (mTBI) is caused by a head injury that arises merely from an abrupt blow to the head that is severe enough to cause interruption in the normal functions of the brain (Pocket Guide for Clinicians, 2010). Executive dysfunctions are common consequences of traumatic brain injuries (McDonald, Flashman, & Saykin, 2002) and may include disruptions of reasoning, planning, concept formation, and mental flexibility. These are important executive functions that help people accomplish any given task (McDonald et al., 2002).

In the past, researchers have employed a variety of subjective and objective measures to examine executive function. The Multiple Errands Test (MET) is one such measure that assesses executive function by employing a simulated shopping task. Shallice and Burgess (1991) created and executed the MET in an open pedestrian area. Since then, real world and virtual versions of the MET have been developed that focus on civilians. However, according to the Defense and Veterans Brain Injury Center (DVBIC), active duty military personnel are at a greater risk than civilians of experiencing mTBI (DVBIC, 2014).

Considering the prevalence of mTBI among military personnel, researchers at Old Dominion University collaborated with scientists from Advanced Anti-Terror Technologies (A2-T2) to develop a virtual environment within which they have simulated a military version of the MET. This environment is a first-person gaming environment that can be used to assess executive function among returning warfighters who have sustained open or closed form of mTBI. The virtual environment is designed to mimic a Middle Eastern marketplace setting.

In this environment, a virtual agent is programmed to present instructions about the MET task and explain the role that the participants will assume while completing the task. Participants play the role of an active duty warfighter tasked with purchasing a number of objects from several street vendors. Virtual agents present information to the participants and help them remain immersed in the virtual environment. They also help maintain realism. For the MET task, participants are asked to purchase specific items under a given time limit. Items can be bought by merely clicking on them. Multiple icons (i.e. orders, map, time, money, satchel, & radio) are included at the bottom of the screen. These allow participants to monitor their progress on the MET task (see Figure 1). This virtual environment is programmed to record data representing performance measures that include task completion time in seconds, items bought, and money spent.

Creation of a virtual MET in the context of a military task may contribute to the realistic assessment of warfighters who have sustained head injuries. Specific advantages of the military virtual MET include ecological validity, considerable control over independent and confounding variables, and real-time cognitive performance assessment. The utility of the military virtual MET has been demonstrated by Hanson (2015) using military experts. Further research is needed to expand the variety of tasks represented and to determine the limits of memory assessment.

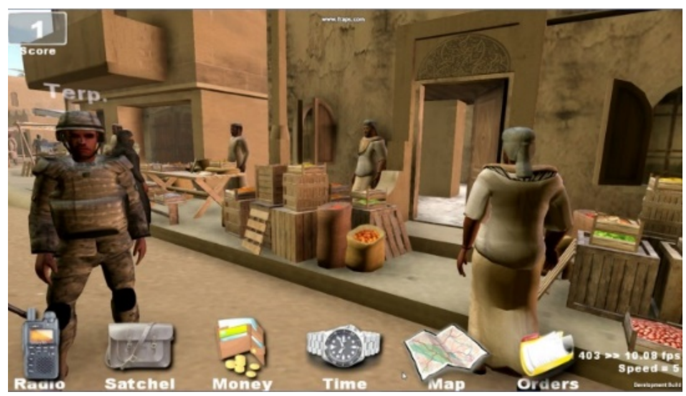

Figure 1: Screenshot from VMET-MV scenario.

Emotional Response to Avatar Narrative In a Therapeutic VR Simulation

Patients suffering from mental health and substance abuse disorders face many challenges in effectively receiving outpatient behavioral therapies (e.g., service accessibility, personalized care). Mobile health technologies integrating virtual reality (VR) platforms have become more accessible and affordable, thus providing a technological infrastructure to deploy outpatient behavioral therapy. We aim to address the aforementioned health care challenges by creating personalized VR simulation content for behavioral therapy that adapts in near real-time to a patient's emotional response. A demonstration will be shown in a group therapy setting for tobacco cessation (Figure 2), which is a critical public health area for mental illness and substance abuse. The VR simulation records the participant's emotion and brain activities through a neurophysiological measure (electroencephalography – EEG) of emotional response. The avatar script is then modified to maximize the subject's response to emotion evoking stimuli.

The participants will wear an Emotiv EPOC EEG headset and a VR headset (Oculus Rift) during the demonstration, which is intended to be passively interactive. Emotional response will be used to control the simulation and the scripted avatar content, based on previously developed smoker personas (one persona per avatar). Each avatar will be scripted to speak in a random order and alter their facial and body movements to further increase the realism and the emotion-evoking capabilities of the VR environment. Facial movements were animated from the captured video of human actors reading scripts. The virtual avatars and motions were created using Blender and MakeHuman, which are open-source software packages. Blender's motion tracking capabilities were used to optically track visual markers placed on the actor's face.

A neurophysiological calibration is required at the start of the demonstration (1 minute baseline calculation), where the participant will stare at a blank screen. Data will be stored in memory for Unity3D's real-time processing. After the baseline calculation, each avatar will share an introductory tobacco narrative. A JavaScript module will actively monitor the subject's neurophysiological response as he or she listens to each avatar's tobacco narrative. This module will utilize the Emotiv EPOC API for emotional state (e.g. excitement, engagement, meditation). For the duration of each avatar's narrative the average emotional state of the subject is recorded. After the completion of each avatar's script, the average delta values are calculated (difference between the baseline and current value) to define the subject's reaction to a specific avatar using the JavaScript module. After completing the introductory narrative of each avatar, the script will search for the maximum or minimum values of each emotional variable to determine which avatar's story evoked the most response from the subject. This avatar will then expand upon their tobacco narrative.

To allow participants wearing the headset and those watching the demonstration to visualize the simulation, a large screen will be used to display the simulation along with the audio. A simplified moving average graph of the real-time Emotiv output will be shown in a split screen image. This will allow participants to visualize how the Emotiv API emotion states change in response to emotional stimuli (tobacco narratives), whose timestamps will be textually noted and flagged on the graph.

Figure 2: Group therapy simulation for tobacco cessation

CONCLUSION

In this paper, we've presented descriptions of how several researchers, practitioners and developers are using VEs in diverse ways to advance the state simulation and game development, therapeutic evaluation of combat veterans, and therapeutic application incorporating emotional response to avatars' narrative. The objective of this paper is to encourage readers to consider ways in which VEs, games and simulations can be useful in addressing their own research, training, and business needs. As augmented reality, VEs, serious games and simulations become increasingly capable, available and cost effective, new uses and applications will be found. These technologies will be employed in increasingly diverse areas, to address increasingly complex problems. The authors hope that this paper and the demonstrations provided at HFES encourages readers and session attendees to consider their role in advancing the future employment of VE technologies.

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