Mixed Reality Game Prototypes for Upper Body Exercise and Rehabilitation

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ABSTRACT

This research demonstration consists of an integrated hardware and software platform developed for rapid prototyping of virtual reality-based games for upper body exercise and rehabilitation. The exercise protocol has been adopted from an evidence-based shoulder exercise program for individuals with spinal cord injury. The hardware consists of a custom metal rig that holds a standard wheelchair, six Gametraks attached to elastic exercise bands, a Microsoft Kinect, a laptop and a large screen. A total of 21 prototypes were built using drivers for Kinect, MaxMSP and Unity Pro 3 in order to evaluate game ideas based on deconstruction of the exercise protocol. Future directions include validation of our heuristic design and evaluation model and the development of an exercise suite of point-of-care VR games.

KEYWORDS: virtual reality, games, interaction design, rehabilitation, exercise.


1 BACKGROUND

This demonstration consists of an integrated hardware and software platform developed for rapid prototyping of VR-based games for upper body exercise and rehabilitation. The exercise protocol has been adopted from an evidence-based shoulder exercise program for individuals with spinal cord injury [1].

2 COMPONENTS

We developed a platform for rapid prototyping of concepts using off-the-shelf hardware and popular software. The hardware consists of a custom metal rig that holds a standard wheelchair, six disassembled Gametraks attached to elastic exercise bands to enable exercises that require resistance, a Microsoft Kinect for upper body tracking, a laptop and a large screen (Fig. 1). We developed 21 game concept prototypes using MaxMSP, which receives and processes real-time data from the Kinect and Gametraks and sends it to Unity Pro 3 to enable interaction, graphics rendering, animation and sound processing (Fig. 2).

3 FUTURE DIRECTIONS

Future directions include validation of our heuristic design and evaluation model and the development of an exercise suite of point-of-care VR games.

4 PROJECT ACKNOWLEDGEMENTS

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5 CREATIVE MEDIA & BEHAVIORAL HEALTH CENTER
The Creative Media & Behavioral Health Center (CM&BHC) is an organized research unit between the School of Cinematic Arts and the Keck School of Medicine. CM&BHC builds on USC’s existing academic strengths and unique reputation within the creative and technology industries to develop the preeminent center for innovation in the use of entertainment applications at the intersection of behavioral science, medicine and public health. CM&BHC’s mission is to increase public awareness of critical issues in mental health and behavioral science, to revitalize formal medical education and to improve treatments through innovative clinical, research and commercial applications using transmedia storytelling and emerging technologies.

6 INITIATIVES
The center pursues projects through the following initiatives:

6.1 Sports & Exercise for Wellness
This initiative aims to investigate novel assessment and treatment techniques using entertainment & technology for improvement of health outcomes related to obesity, nutrition and physical activity.

6.2 Healthy Brain Architecture
This initiative aims to develop and disseminate innovative storytelling products toward promotion of healthy behavior for brain development and affect regulation during the entire human lifespan.

6.3 Social & Sensorimotor Play
This initiative aims to investigate novel assessment and treatment techniques using interactive play for improving social skills, visuospatial navigation & motor coordination in physical space.

6.4 Games for Health
This initiative was established in 2007 as a pre-cursor to the Center in an effort to develop and assess innovative games with behavioral health applications [2].

7 METHODOLOGY
CM&BHC is comprised of multidisciplinary teams of artists, designers, researchers and technologists that uses an eclectic design, testing and evaluation methodology that includes: paper prototyping, physical prototyping, software prototyping, personal interviews, informal focus groups, observational studies and longitudinal playtesting.

8 THEORETICAL FRAMEWORK
CM&BHC has been developing a transtheoretical checklist for design heuristics for ideation and evaluation of prototypes. The checklist combines concepts from neuroscience, public health, psychotherapy, psychology, neurobiology/psychophysiology, game design, game rhetoric and art (Table 1).

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<tr>
<th>Table 1. Heuristic Design &amp; Evaluation Model</th>
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<td><strong>COGNITIVE CHALLENGE</strong></td>
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<td><strong>DIALECTICAL ENGAGEMENT</strong></td>
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REFERENCES