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SYMPOSIUM

Learning in a Virtual Environment Using Haptic Systems for Movement Re-Education: Can This Medium Be Used for Remodeling Other Behaviors and Actions?

Alma S. Merians, Ph.D.,[1] Gerard G. Fluet, D.P.T.,[1] Qinyin Qiu, M.S.,[2] Ian Lafond, M.S.,[2] and Sergei V. Adamovich, Ph.D.[1,2]

Abstract

Robotic systems that are interfaced with virtual reality gaming and task simulations are increasingly being developed to provide repetitive intensive practice to promote increased compliance and facilitate better outcomes in rehabilitation post-stroke. A major development in the use of virtual environments (VEs) has been to incorporate tactile information and interaction forces into what was previously an essentially visual experience. Robots of varying complexity are being interfaced with more traditional virtual presentations to provide haptic feedback that enriches the sensory experience and adds physical task parameters. This provides forces that produce biomechanical and neuromuscular interactions with the VE that approximate real-world movement more accurately than visual-only VEs, simulating the weight and force found in upper extremity tasks. The purpose of this article is to present an overview of several systems that are commercially available for ambulation training and for training movement of the upper extremity. We will also report on the system that we have developed (NJIT-RAVR system) that incorporates motivating and challenging haptic feedback effects into VE simulations to facilitate motor recovery of the upper extremity post-stroke. The NJIT-RAVR system trains both the upper arm and the hand. The robotic arm acts as an interface between the participants and the VEs, enabling multiplanar movements against gravity in a three-dimensional workspace. The ultimate question is whether this medium can provide a motivating, challenging, gaming experience with dramatically decreased physical difficulty levels, which would allow for participation by an obese person and facilitate greater adherence to exercise regimes.

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Author Affiliations: [1]Department of Rehabilitation and Movement Sciences, University of Medicine and Dentistry of New Jersey, Newark, New Jersey; [2]Department of Biomedical Engineering, New Jersey Institute of Technology, Newark, New Jersey

Abbreviations: (3D) three-dimensional, (BWSS) body-weight support system, (JTHF) Jebsen Test of Hand Function, (VE) virtual environment, (VR) virtual reality, (WMFT) Wolf Motor Function Test

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Corresponding Author: Alma S. Merians, Ph.D., Department of Rehabilitation and Movement Sciences, University of Medicine and Dentistry of New Jersey, 65 Bergen St., Newark, NJ 07107; email address merians@umdnj.edu