

Project Title: *VROOM: Development of a robotic system with an augmented reality interface for rehabilitation of brain injured individuals*

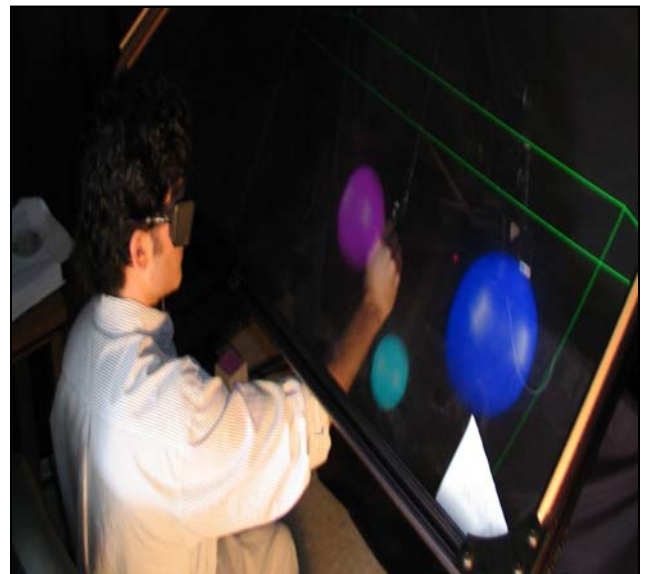
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Project Description

The goal of this project is to design, develop, and test a new robotic interface for upper-limb rehabilitation of brain-injured individuals. The novelty of our device is that it safely operates in three dimensions with a large workspace and an appropriately designed visual interface. The first year we proposed to acquire implement the components for the system, in the second year we proposed to interface the robot and develop foundational software. The third year we proposed to will develop an easy-to-use interface for therapist operators. In the fourth year we proposed to develop the various therapeutic programs. In the fifth and final year proposed to test the system and identify technical parameters for the next generation system.

Progress to Date

The resulting system is the Virtual Reality Robotic Optical Operations Machine (VRROOM). In year 1, we acquired and assembled the PARIS display system combined it with the PHANToM haptic robot, and implemented basic software that demonstrated the system's capabilities. In Year 2 we developed a foundational library for data acquisition, robot control, motion tracking, and viewer-centered display (above). This past year and a half we have broadened our connectivity so that the system can use a choice of several robotic (and other) devices (PHANToM 3.0, Wanda, CyberGlove, HapticMaster, and soon PHANToM Omni and WAM). Initial studies on healthy individuals have validated VROOM as a tool for studying training and adaptation¹ and demonstrated the differences between training in 2 and 3 dimensions². We have also published a paper on the system's development and architecture³. This year we have developed the ability to enable the various features in a user friendly interface for therapist operators. Focus-groups and a formal questionnaire process are currently being used to help determine and prioritize the many programs we develop. We have also begun preliminary reaching tests on individuals with stroke. Finally, our initial tests on machine quality (brightness, resolution, field of view) are being used to determine the minimum necessary requirements for the next generation of this system. We have partnered with SenseGraphics Inc. (Stockholm) to help us shape the next generation of easy to use software that uses an open source library for a wide variety of applications in both haptics and graphics, which also is in a commonly software used widely by others developing in this field.



Demonstration using interaction with artificial spheres. VRROOM is a large-workspace, three-dimensional system that incorporates PARIS display (developed at EVL at UIC) that allows the user to see their own limb as well as virtual objects; a Robot that renders programmed forces, and a Flock of Birds motion tracking system.

Presentations and Publications

1. Patton, J. L., Dawe, G., Scharver, C., Muss-Ivaldi, F. A. & Kenyon, R. in IEEE Engineering in Medicine and Biology Society Conference (EMBC) (San Francisco, CA, USA, 2004).
2. Scharver, C., Patton, J. L., Kenyon, R. & Kersten, E. in IEEE-International Conference on Rehabilitation Robotics (ICORR) (Chicago, IL, USA, 2005).
3. Patton, J. L., Dawe, G., Scharver, C., Muss-Ivaldi, F. A. & Kenyon, R. Robotics and virtual reality: A perfect marriage for motor control research and rehabilitation. *Assistive Technology* 18, 181-195 (2006).