

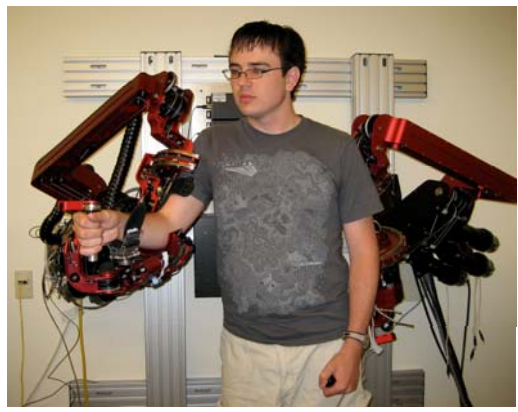
# Developing Exoskeleton Controlled Virtual Reality Games for Rehabilitation

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## Purpose

- Stroke rehabilitation often requires several hour sessions with a physical therapist three to six times a week.
- Patients have trouble keeping up with boring and redundant exercises at home.
- Virtual reality games provide entertaining ways to do the exercises with less assistance from a physical therapist.

## Hardware



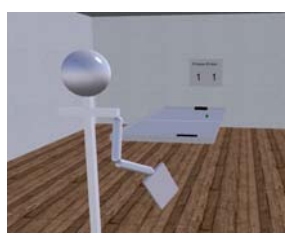
- Seven degrees of freedom (three in the shoulder, two in the elbow and two in the wrist)
- Covers 95% of a healthy human's workspace
- Capable of force feedback (haptics)

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## Games

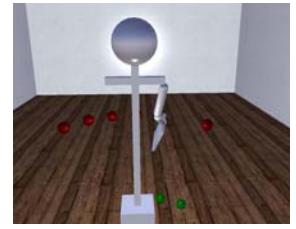
### Reach



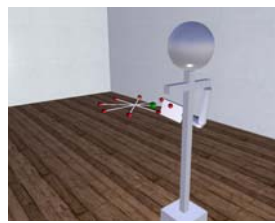
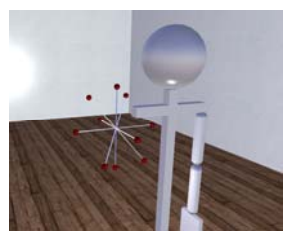
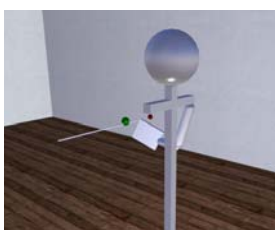
- Movement is based on position of the hand or the movement of a single joint.
- Requires both motor control and trajectory planning.

### Reach

- "Touch" each of the balls to make it fall.
- Requires hand-eye coordination.



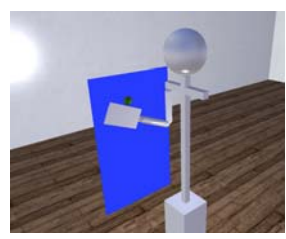
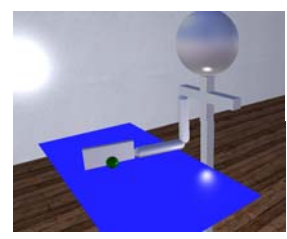
### Line Movement



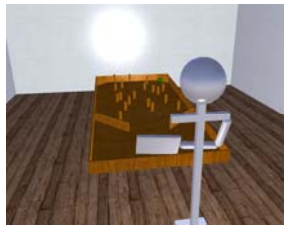
- Keep the ball on the straight lines.
- Reach both of the goal points (the ends of the lines) without moving away from the line.

• To complete the activity the brain must learn to solve the inverse kinematics for the various joint angles.

### Single Joint Movement



- Unlock one joint at a time and move along its full range of motion.
- The user's range of motion can be measured and shown visually.
- The goal is to increase the range of motion by working on muscle groups individually.



• In pinball the user moves one of his or her joints to control a flipper.