

Modified home video game shows promise for improving hand function in teens with cerebral palsy

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Engineers at Rutgers University have modified a popular home video game system to help teenagers with cerebral palsy improve hand functions. In a pilot trial with three participants, the system improved the teens' abilities to perform a range of daily personal and household activities.

The modified system combined a Sony PlayStation 3 console and a commercial gaming glove with custom-developed software and games to provide exercise routines aimed at improving hand speed and range of finger motion.

The Rutgers engineers, who are members of the university's Tele-Rehabilitation Institute (ti.rutgers.edu), worked with clinicians at the Indiana University School of Medicine to deploy systems in participants' homes for up to 10 months. A description of the modified system and its use in the pilot trial appeared this week in the journal, *IEEE Transactions on Information Technology in Biomedicine*.

"Based on early experience, the system engages the interest of teens with [cerebral palsy](#) and makes it convenient for them to perform the exercises they need to achieve results," said Grigore Burdea, professor of electrical and computer engineering and director of the Rutgers Tele-Rehabilitation Institute.

Each system communicated via the Internet to allow the Indiana and Rutgers researchers to oversee participants' exercise routines and evaluate the effectiveness of the systems. The system is an example of both virtual rehabilitation, where patients interact with computer-generated visual environments to perform exercises, and tele-rehabilitation, where patients perform exercises under remote supervision by physical or occupational therapists.

"All three teens were more than a decade out from their perinatal strokes, yet we showed that improvement was still possible," said Meredith Golomb, associate professor of neurology at the Indiana University School of Medicine and Riley Hospital for Children pediatric neurologist in this study. "The virtual reality telerehabilitation system kept them exercising by rewarding whatever movements they could make, and all three showed significant progress in hand function."

Golomb oversaw the pilot study where participants were asked to exercise their affected hand 30 minutes a day, five days a week, using games custom developed by the Rutgers engineers. The games were calibrated to the individual teen's hand functionality. An on-screen image of a hand showing normal movements guided the participants in their exercises.

After three months of therapy, two participants progressed from being unable to lift large, heavy objects to being able to do so. Participants showed varying improvement in such activities as brushing teeth, shampooing, dressing, and using a spoon. At 10 months, one participant was able to open a heavy door.

The modified PlayStation 3 is the second system based on commercial video gaming technology that Burdea and his institute have developed to investigate economical and engaging rehabilitation therapy tools. Earlier work involved modifying an older model Microsoft Xbox to help stroke

victims recover hand functions.

"Systems like this have the potential for widespread deployment in outpatient clinics or the homes of people needing rehabilitation services for any number of illnesses or injuries," said Burdea, a noted inventor of virtual rehabilitation technology. "Well-designed custom games are likely to hold patients' attention and motivate them to complete their exercises, versus conventional therapy regimens, which patients may find boring or tedious."

Burdea acknowledged the popularity of gaming platforms and many newer games that physically engage their players, but noted that they generally are not suitable off-the-shelf for rehabilitation needs. Games for rehabilitation need to focus on the specific impairment, and they require professional oversight to ensure that patients exercise within therapeutic bounds while not over-exercising and risking stress or injury.

The systems that Burdea and his colleagues built combined a [PlayStation 3](#) console with a Fifth Dimension Technologies 5 Ultra sensing glove, a flat-panel television, mouse, keyboard and digital subscriber line modem for Internet communication. They reprogrammed the game console using the open-source Linux operating system and developed games written in Java3D.

One game promoted range of finger motion by asking participants to clean up bars of "dirty" pixels on the screen to reveal an image. Another promoted finger movement speed by asking participants to flick away an on-screen butterfly. A third promoted hand opening and closing speed by asking participants to manipulate an on-screen unidentified flying object.

The developers also wrote software to manage participant scheduling and performance data and to administer subjective evaluation questionnaires.

Provided by Rutgers University

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