Engineers introduce rehab robot HARMONY

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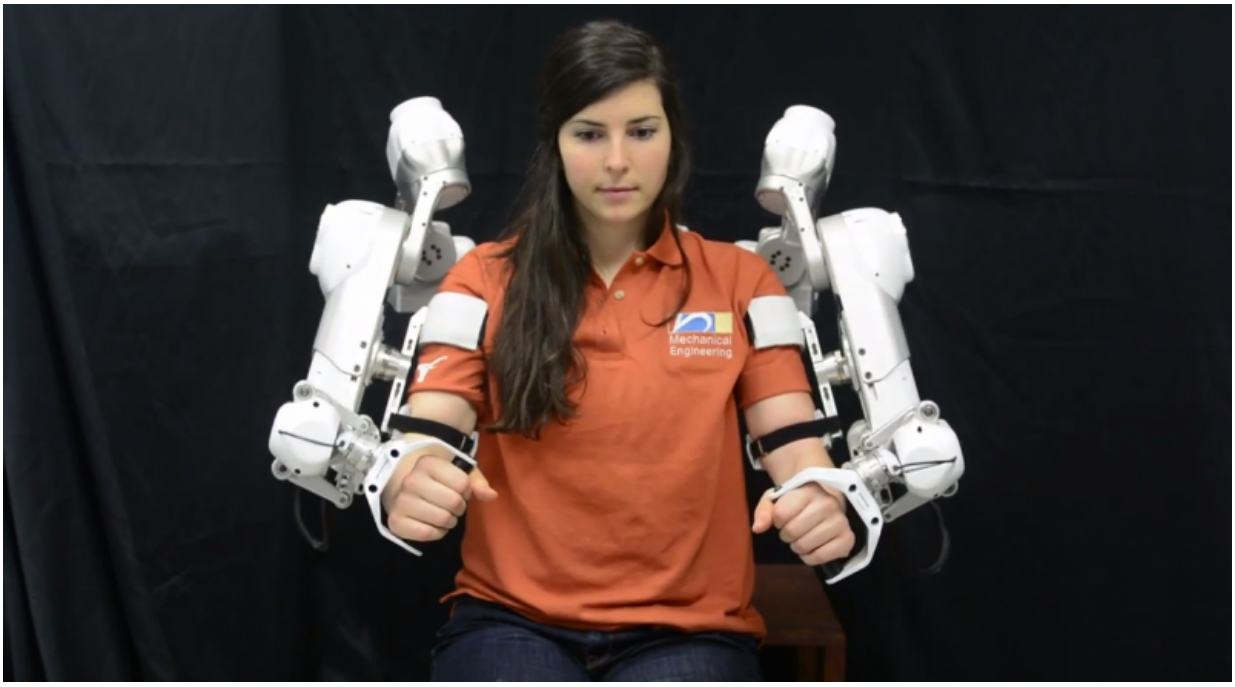

Researchers in the Cockrell School of Engineering at The University of Texas at Austin have developed a first-of-its kind, two-armed, robotic rehabilitation exoskeleton that could provide a new method of high-quality, data-driven therapy to patients suffering from spinal and neurological injuries.

Mechanical engineering researcher Ashish Deshpande and a team of

graduate students from the Rehabilitation and Neuromuscular (ReNeu) Robotics Lab designed the exoskeleton, named HARMONY, to deliver full upper-body therapy with natural motion and tunable pressure and force, enabling the robot to feel weightless to patients. HARMONY's software will give therapists and doctors the ability to deliver precise therapy while tracking and analyzing data.

The researchers believe HARMONY will be used to help patients recover strength and motor skills after injuries, and it could help patients recover coordination for daily activities such as eating and dressing.

"HARMONY is the culmination of years of research and development in the ReNeu Robotics Lab," said Deshpande, assistant professor in the Department of Mechanical Engineering. "It was specially designed to offer customized therapy for optimal efficacy. Not only does the exoskeleton adjust to patient size, it can also be programmed to be gentle or firm based on the individual's therapy needs."

HARMONY's design accommodates the entire upper body, setting the robot apart from existing technologies that focus on only one arm and limit bilateral training possibilities. It connects to patients at three places on each side of the upper body and features 14 axes for a wide range of natural motion. The UT Austin research team built and tested the first of several HARMONY prototypes in 2011. They worked with Meka Robotics in 2013 to select the hardware and construct the robot.

The robot is equipped with a suite of sensors that collect data at 2,000 times per second. These data are then fed back into the robot's program for an instantly personalized robotic interaction. With input from physical therapists and doctors, the Cockrell School researchers designed HARMONY's shoulder mechanism to facilitate natural, coordinated motions, particularly the scapulohumeral rhythm—a critical coordinated rotational motion necessary for upper-limb movements and long-term

joint stability.

The researchers believe HARMONY could reduce a patient's recovery time because it can adapt to the specific, corrective ways that humans learn. High levels of force control and torque control enable HARMONY to gently course correct a patient during an improperly performed robot-guided exercise. Additionally, HARMONY can be programmed to gradually increase exercise difficulty levels. Physical therapists can use the data that HARMONY collects during those exercises to chart patients' progress and tailor regimens to the individual.

Rehabilitative upper-body exoskeletons have been shown to aid in the recovery of strength and motor skills after injuries. However, experts debate about exoskeletons' abilities to help patients recover the coordination needed for daily activities. HARMONY's shoulder mechanism assists in a range of motions that are very close to those required for daily activities and the eventual incorporation of a screen or gaming environment to simulate such activities may lead to successful relearning.

With HARMONY now complete, the researchers will continue to develop the software and prepare for an upcoming trial period this summer. Enrollment will begin in June for this study of 20 to 30 healthy subjects, to be conducted at UT Austin. The researchers plan to follow it with a study with stroke and spinal cord injury patients that will compare HARMONY's efficacy with conventional rehabilitative therapy.

Provided by University of Texas at Austin