THE WALL STREET JOURNAL.

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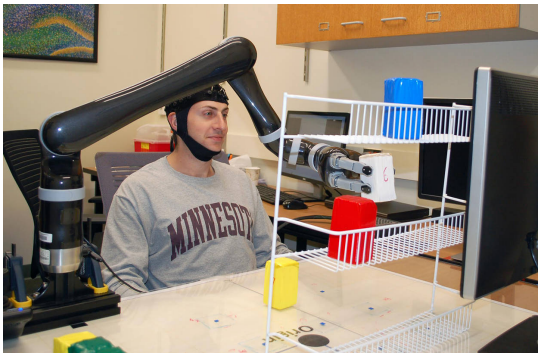
Moving Robots With Just a Thought

Technology may help the paralyzed; a head-covering with electrodes does the job



Research subjects at the University of Minnesota fitted with a specialized noninvasive brain cap were able to move the robotic arm just by imagining moving their own arms. *PHOTO: COLLEGE OF SCIENCE AND ENGINEERING*

By **DANIEL AKST**
Updated Dec. 22, 2016 11:34 a.m. ET

Children often hear that they should put on their thinking caps. Perhaps they would do so more often if they could control a robot—as volunteers at the University of Minnesota recently did.

In an experiment, participants steered a robot arm using nothing more than their thoughts, which were captured by means of a special head-covering fitted with 64 electrodes that picked up brain activity. In earlier research reported in 2013, the University of Minnesota's Bin He and colleagues used the same technology to enable users to fly a small helicopter drone using only their thoughts.

The team's latest research involves tasks more like those that a paralyzed person might want to perform in real life and was much more technologically demanding. The helicopter had simple controls for moving up, down and sideways, and even then, crashes were so frequent that Dr. He began ordering 10 of the drones at a time. Moving a robotic arm to lift and relocate objects "is a much more complex control task," he says. It involves navigating through space with greater precision, hovering in just the right place, grasping an item, lifting it and then putting it down just so. New software was required.

The robot arm, like the helicopter drone, still relies for its commands on electroencephalography—that is, detecting and measuring brain waves. But the special cap let the scientists achieve their goal without the brain implants and wires that have previously allowed paralyzed people to move objects.

Eight able-bodied adult volunteers completed the He team's experimental program. The participants first learned to move a cursor on a computer screen with their thoughts and then progressed to the robot arm. On average, each volunteer needed about 10 two-

hour sessions in all. The scientists knew from earlier research that imagining such movements involves the same parts of the brain as actually moving your arm; both moving and thinking of moving produce electrical impulses in the motor cortex. The sensor-laden cap, which resembles a balaclava, picked up the impulses from these sectors.

The cap transmitted brain signals to a computer, which relied on custom-designed algorithms to sift "move my arm" thoughts from other brain noise in the user's head. Participants were asked to command the robotic arm to pick up foam blocks from a table and raise them to a shelf. They achieved a success rate of more than 80% in picking up the objects and more than 70% in moving them from the table to the shelf above.

The scientists hope that their research can eventually help paralyzed or otherwise seriously disabled individuals to become more independent. Dr. He adds that applications with broader appeal should be possible with further research. Why not use the same technology to let people type or control other devices just with their thoughts? "In theory," he says, "you can." Disabling a bomb might become safer, and finding the Dallas Cowboys game on TV might be faster. Says Dr. He: "It's not limited to people who are disabled."

Dr. He says that he thinks this is the first time people have been able to operate a robotic arm in a complex setting without brain implants.

"Noninvasive Electroencephalogram Based Control of a Robotic Arm for Reach and Grasp Tasks," Jianjun Meng, Shuying Zhang, Angeliki Bekyo, Jaron Olsoe,Bryan Baxter and Bin He, Scientific Reports (Dec. 14)

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