Science

Connecting Mind And Machine

Andy Greenberg, 05.29.08, 6:00 PM ET

Multitouch screens are all the rage as companies such as Microsoft and Apple race to build gadgets and operating systems that respond to the simple flick of a finger. But some neuroscience researchers are already working on a computer interface that's infinitely more intuitive--one that responds directly to human thought.

At the World Science Festival on Wednesday, Brown University neuroscientist John Donoghue showed the audience a video of 25-year-old Matt Nagle playing a videogame in which he moves a cursor to a series of treasure chests while avoiding onscreen obstacles. Rather than wield a mouse or a controller, Nagle, who is paralyzed from the neck down from a stab wound, manipulates the cursor with his mind; his thoughts are transmitted by a sensor implanted in his brain.

For more on the World Science Festival, see "Digital Download," David Ewalt's blog on science and technology.

Nagle was one of several patients whom Donoghue has worked with in an ongoing study designed to create interfaces between the human mind and machines. Other patients have suffered from brain stem strokes that have left them quadriplegics. Some have been "locked in" by Lou Gehrig's disease, with almost no ability to move their bodies.

In another video from Donoghue's study shown at the festival, a woman paralyzed by a stroke was able to manipulate music software, using her mind alone to "click" on a Joni Mitchell album and play and pause the music at will.

Rather than commercialize a machine-brain interface--imagine an iPod that reads its user's mind--Donoghue is focused on the medical uses of the technology, making daily activities possible even for completely paralyzed patients.

"In the future," he said, "we can hope to see a virtual nervous system where we can repair damage by connecting the brain to muscles or assistant robots--or for amputees, connecting the brain to state of the art prosthetic limbs."

The possibility of thought-controlled prosthetics seemed even more real after a presentation by University of Pittsburgh neuroscientist Andrew Schwartz. In a paper published Wednesday in *Nature,* he describes an experiment in which monkeys with brain implants were able to move a prosthetic arm to feed themselves using only mental signals.

Schwartz showed the science festival's audience a video of the experiment, in which a monkey used the mind-machine interface to grab bits of apple and marshmallow off a moving metal platform. In one instance, food started falling from the monkey's mouth, but the animal deftly nudged it back in using the mind-controlled prosthetic.

Reading brain signals isn't simple--the brain has more than 10 billion neurons, with thousands of connections between them. But even in that complicated network, Schwartz said, it's possible to watch neuron activity and find simple patterns in electrical impulses between nerve cells that correlate to movements such as an arm motion.

"When the animal moves its arm in a certain direction, the neuron fires. When it moves in another direction, the neuron stops firing," Schwartz said. "Each neuron has a preferred direction. We just have to listen to them and intercept the intention to move."

To "listen" to those signals, Schwartz's and Donoghue's experiments used aspirin-sized semiconductors covered in hair-thin wires that pierce about halfway into the brain's cortex, a layer of tissue that's only as thick as an orange peel. Inserting those semiconductors, Donoghue warned, requires removing a small piece of skull, a procedure that wouldn't appeal to most consumers.

"For now, the only way to get this done is to have a craniotomy, and I think that should remain a barrier," he said.