Mind over body: new hope for quadriplegics

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Around 2.5 million people worldwide are wheelchair bound because of spinal injuries. Half of them are quadriplegic, paralysed from the neck down. European researchers are now offering them new hope thanks to groundbreaking technology that uses brain signals alone to control computers, artificial limbs and even wheelchairs.

People left paralysed by spinal injuries or suffering from neurodegenerative diseases could regain a degree of independence thanks to a new type of non-intrusive brain-computer interface, or BCI, developed by the MAIA project.

Using electrical signals emitted by the brain and picked up by electrodes attached to the user's scalp, the system allows people to operate devices and perform tasks that previously they could only dream of. So far, the team, led by the IDIAP Research Institute in Switzerland, has carried out a series of successful trials in which users have been able to manoeuvre a wheelchair around obstacles and people using brainpower alone.

"We have demonstrated that it is possible for someone to control a complex mechanical device with their minds, and this opens up all sorts of possibilities," says MAIA coordinator José del R. Millán.

Though BCIs, for people with impaired movement and for other uses, have been under development for many years, they have had varying degrees of success, largely because of the difficulties of turning brain signals into accurate mechanical movement. What sets the EU-funded MAIA system apart is that it does not rely on the human brain alone to

do all the work, instead incorporating artificial intelligence into the device being used.

Intelligence meets artificial intelligence

A person using the MAIA BCI to control a wheelchair, for example, only has to think about going straight ahead or turning left and the chair follows their command. However, they do not have to worry about colliding with obstacles – even moving ones such as people – because the wheelchair itself monitors and reacts to its environment.

“A user can tell the chair to go straight ahead, but it will not just randomly roll in that direction if there is a wall or a flight of stairs in the way,” Millán notes. “What we have done is combine the intelligence of the person with the artificial intelligence of the device.”

In a sense, the artificial intelligence embedded in the chair acts much like a human’s subconscious. People, for example, do not consciously send commands to every muscle in each leg in order to walk and do not think where to step to avoid an obstacle – they do it subconsciously. Similarly, a wheelchair-bound user of the MAIA BCI simply has to send the signal to go in a certain direction and the chair figures out how to get there.

But the user always stays in control!

Keeping the user in control

“We wanted to see how much of the movement was down to the user’s brain signals and how much was due to the intelligence of the chair. It turned out that the wheelchair intervened between 10 and 40 percent of the time depending on the user and the environment.

“In one demonstration in which someone was manoeuvring the chair for six hours, the computer intelligence kicked in more frequently later on as the person became increasingly tired and made more mistakes,” Millán says.

Importantly, the chair can recognise from the user’s brain signals if it has made a mistake, and, through tactile devices similar to the vibrators used in mobile phones, it can send feedback to users about the direction they are going that enhances their sense of awareness beyond the visual.

Millán notes that the same technology could be applied to artificial limbs to allow quadriplegics to pick up objects or unlock a door. By using the BCI to interact with computer systems, meanwhile, they could control the lighting in their homes, surf the internet, or change the channels on the TV. Those simpler brain-computer interactions, which have the potential to become the basis for commercial systems sooner, will be the focus of a follow-up EU project called TOBI that is due to begin in September and which will also be led by Millán.

“For a wheelchair, such as the one developed in MAIA, to reach the market would take extensive trials to prove that the technology is robust enough. We can’t have it breaking down when someone is in the middle of the street,” Millán notes.

Carrying out such validation trials remains a goal of the project partners who are actively seeking further funding and investment to continue their work.

Source: ICT Results