robotics Swiss National Centre of Competence in Research

NEWS BULLETIN

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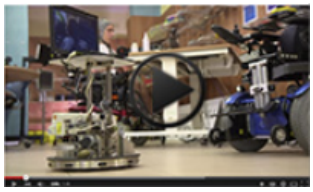
Towards Independence: A BCI telepresence robot

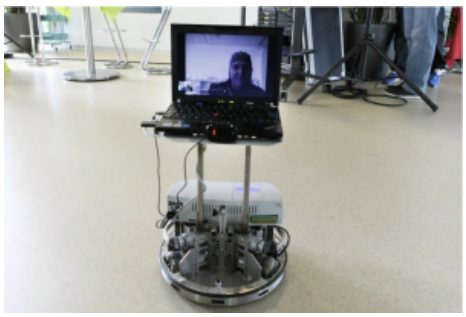
For those with extreme mobility problems, such as paralysis after spinal cord injury (SCI) or neurological disease, a large problem exists with social isolation – it is not so easy to spend time with friends and family, to leave the house or to visit attractions, restaurants or bars that may not be wheelchair accessible. A team from CNBI, EPFL and NCCR Robotics has this week published an innovative solution that uses brain-computer interfaces (BCIs) to enable patients to "telepresence" in to social events.

VIDEO



The idea behind the work is for patients to use BCIs to remotely control a mobile telepresence robot, through which the patient can move and communicate with a group of friends using a bidirectional audio/video connection. Nine end users and 10 healthy participants were tested using a BCI and telepresence robot in order to test both the BCI configuration and the shared control of the robot when used in tandem.

The system was tested using a non-invasive BCI to record brain impulses from a cap sitting over the head on the sensorismotor complex via 16 electroencephalogram (EEG) channels and transmit them to the robot via Skype. This was then tested by asking participants who were at home to remotely manoeuvre the robot in the CNBI lab along a set path with obstacles (such as doorways and tables) under four separate conditions (BCI shared control, BCI no shared control, manual shared control and manual no shared control) in healthy subjects and two separate conditions (BCI shared control and BCI no shared control) in end-users.



By using shared control (where the robot uses sensors to avoid obstacles without instruction from the driver), inaccuracies in the system are reduced. For example, if a participant instructs the robot to turn left, this can result in a hard turn or a gentle turn, the system is not able to detect which. By using shared control, if the user wishes to travel through a doorway to the left, they instruct the robot to turn left, and the robot uses its sensors to avoid the doorframe and thus travels through the doorway.

The second advantage of using shared control is that the amount of information needing to be passed from the user is reduced, thus also reducing the cognitive workload that frequently leave participants tired after sessions. When using shared control, participants were able to complete tasks in shorter time periods and with fewer commands.

Of the 19 people who participated in the study, all were able to pilot the robot after training, with no discernable difference in ability between disabled and able-bodied participants. Prof. José del R. Millán who was in charge of the study says "Each of the nine subjects with disabilities managed to remotely control the robot with ease after less than 10 days of training." What is even more remarkable is that patients, where possible, were also allowed to control the robot by using small residual movements (such as head leans that someone might perform while playing a video game, or pressing a button with their head), but these movements were shown to be no more effective in controlling the robot than just the information transmitted over the BCI.

References

R. Leeb, L. Tonin, M. Rohm, L. Desideri, T. Carlson and J. Millán, "Towards Independence: A BCI Telepresence Robot for People with Severe Motor Disabilities," *Proceedings of the IEEE, v*ol. 103, no. 6, pp. 969-982, Jun 2015. A pdf of the full article can be downloaded from IEEE Xplore.

For Further Information please refer to:

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NCCR Robotics

The Swiss National Center of Competence in Robotics (NCCR Robotics) is a federally funded programme bringing together robotics laboratories from EPFL, ETH Zurich, University of Zurich and IDSIA to work on wearable, rescue and educational robots.

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