Wearable robots usher in next generation of mobility therapies

October 17 2016

Wearable robots that can anticipate and react to users' movement in real time could dramatically improve mobility assistance and rehabilitation tools.

Wearable robots are programmable body-worn devices, or exoskeletons, that are designed to mechanically interact with the user. Their purpose is to assist or even substitute human motor function for people who have severe difficulty moving or walking.

The BIOMOT project, completed in September 2016, has helped to advance this emerging field by demonstrating that personalised computational models of the human body can effectively be used to control wearable exoskeletons. The project has identified ways of achieving improved flexibility and autonomous performance, which could assist in the use of wearable robots as mobility assistance and rehabilitation tools.

'An increasing number of researchers in the field of neurorehabilitation are interested in the potential of these robotic technologies for clinical rehabilitation following neurological diseases,' explains BIOMOT project coordinator Dr. Juan Moreno from the Spanish Council for Scientific Research (CSIC). 'One reason is that these systems can be optimised to deliver diverse therapeutic interventions at specific points of recuperation or care.'

However, a number of factors have limited the widespread market adoption of wearable robots. Moreno and his team identified a need for wearable equipment to be more compact and lightweight, and better able anticipate and detect the intended movements of the wearer. In addition, robots needed to become more versatile and adaptable in order to aid people in a variety of different situations; walking on uneven ground, for example, or approaching an obstacle.

In order to address these challenges, the project developed robots with real-time adaptability and flexibility by increasing the symbiosis between the robot and the user through dynamic sensorimotor interactions. A hierarchical approach to these interactions was taken, allowing the project team to apply different layers for different purposes. This means in effect that an exoskeleton can be personalised to an individual user.

'Thanks to this framework, the BIOMOT exoskeleton can rely on mechanical and bioelectric measurements to adapt to a changing user or task condition,' says Moreno. 'This leads to improved robotic interventions.'

Following theoretical and practical work, the project team then tested these prototype exoskeletons with volunteers. A key technical challenge was how to combine a robust and open architecture with a novel wearable robotic system that can gather signals from human activity. 'Nonetheless, we succeeded in investigating for the first time the potential of automatically controlling human-robot interactions in order to enhance user compliance to a motor task,' says Moreno. 'Our research with healthy humans showed such positive and promising results that we are keen to continue validation with both stroke and spinal cord injury patients.'

Indeed, Moreno is confident that the success of the project will open up potential new research avenues. For example, the results will help scientists to develop computational models for rehabilitation therapies, and better understand human movement in more detail.

'In the project we also defined novel techniques to evaluate and benchmark performances of wearable exoskeletons,' says Moreno. 'Further innovation projects are planned by consortium members to follow up on this research, and to exploit developments in the field of human motion capture, human-machine interaction and adaptive control.'

More information: For further information, please see the project website: www.biomotproject.eu/

Provided by CORDIS

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