Exoskeleton gets disabled people back on their feet

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Thanks to an exoskeleton developed at EPFL, people with paraplegia can stand up, walk and even climb steps. The prototype will be put to use this coming Saturday at the 2016 Cybathlon, the sports competition for disabled athletes who use assistive technologies.

Stand up. Take a few steps. Change direction. Climb some steps.

Navigate around an object on the ground. Sit back down. Most people take these everyday movements for granted, but for people with paraplegia, they're simply impossible. All that may change now thanks to an exoskeleton called TWIICE. This is a walking assist device that was developed entirely at EPFL's Robotic Systems Laboratory (LSRO). It will be used at the 2016 Cybathlon – the first competition for disabled athletes who use various assistive technologies – which will take place on 8 October in Zurich. EPFL's team, called PolyWalk EPFL, will square off against eight other teams in the Powered Exoskeleton category. Silke Pan, a handcycle athlete, will pilot the device.

One of TWIICE's main advantages is that it's light. Because the device weighs only 14 kilos – it consists mainly of composite materials – it easily becomes one with the user. The hip and knee joints are flexed and extended by two electric motors per leg, and the exoskeleton's charge lasts for three hours. The device can bear the entire weight of the user, who nevertheless needs crutches to maintain balance and a steady gait. There are buttons in the handles to actuate steps and set the pace: fast walk, slow walk, climb steps, stop, etc.

"Our goal is to make the vertical world accessible to handicapped people," said Mohamed Bouri, a group leader at the LSRO and the project supervisor. "In several years, it will undoubtedly be common to see people in exoskeletons standing up and walking around outside or in stores."

An expert at the controls

The device is not yet ready for daily use by the general public. But after a year and a half of work, the researchers have come up with a prototype that is both safe and operational enough for testing and for use in a competition. "At this point, the pilot needs a lot of strength, stability and concentration to handle it, since each step is controlled manually," said

Jemina Fasola, a PhD student in bioengineering.

That's why the team called in an expert, Silke Pan, to pilot their device at the Cybathlon. Pan is a former acrobat who was left paraplegic following a trapeze accident. She's not averse to taking up physical challenges – she's now a handcycle athlete with several victories under her belt. She trained several times per week starting this past summer, familiarizing herself with the device and getting more adept at piloting it. She also helped improve the user experience through the position of the control buttons and appropriate gait cycle times.

Adapting to all body types

In the future, the researchers will work on making the exoskeleton even lighter, more ergonomic and easier to control. It will have built-in walking programs so that users won't have to control every step and so that the motions will become more fluid and natural. "We came up with a very flexible production method," said Tristan Vouga, a PhD student in microengineering and the person behind the concept. "It makes it easy to produce exoskeletons that can fit different body types and work with different handicaps."

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