Demo of mind-controlled exoskeleton planned for World Cup

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The World Cup opening ceremony next month in Brazil in and of itself will be enough to make June 12 a standout for athletes and their fans but yet another eye-opener may make the Sao Paulo stadium opener long remembered globally. This is when a mind-controlled exoskeleton designed to enable a paralyzed person to walk is to make its debut. Wednesday's BBC report provided the latest developments in the robotic suit. "If all goes as planned," wrote Alejandra Martins, "the robotic suit will spring to life in front of almost 70,000 spectators and a global audience of billions of people."

The exoskeleton was developed by an international team of scientists, part of the Walk Again Project, and described by the BBC report as a "culmination" of over 10 years of work by Dr Miguel Nicolelis, a Brazilian neuroscientist at Duke University in North Carolina. The effort comes from an international collaboration, including the Duke University Center for Neuroengineering. The goal is to show the brain-controlled exoskeleton during the opening ceremony of the 2014 FIFA World Cup. Joining the Duke University Center for Neuroengineering are the Technical University of Munich, Swiss Federal Institute of Technology in Lausanne, Edmond and Lily Safra International Institute of Neuroscience of Natal in Brazil, University of California, Davis, University of Kentucky, and The Duke immersive Virtual Environment (DiVE).

The (DiVE) website talks about the day when "the first ceremonial kick in the World Cup game may be made "by a paralyzed teenager, who, flanked by the two contending soccer teams, will saunter onto the pitch clad in a robotic body suit." (According to the BBC, since November, Nicolelis has been training eight patients at a lab in Sao Paulo, amidst "media speculation that one of them will stand up from his or her wheelchair and deliver the first kick of this year's World Cup.")

That was the original plan, said Nicolelis, telling the BBC, "But not even I could tell you the specifics of how the demonstration will take place. This is being discussed at the moment."

Speaking to the BBC, Nicolelis said the exoskeleton is being controlled by brain activity and it is relaying feedback signals to the patient. The patient wears a cap which picks up brain signals and relays them to a computer in the backpack, decoding the signals and sending them to the legs. A battery in the backpack allows for around two hours' use. The robotic suit is powered by hydraulics.

Writing in *Scientific American* in 2012, Nicolelis authored the article "Mind in Motion," referring to the 2014 World Cup in Brazil and their hopes to mark a milestone there. "This scientific demonstration of a radically new technology, undertaken with collaborators in Europe and Brazil, will convey to a global audience of billions that brain control of machines has moved from lab demos and futuristic speculation to a new era in which tools capable of bringing mobility to patients

incapacitated by injury or disease may become a reality. We are on our way, perhaps by the next decade, to technology that links the brain with mechanical, electronic or virtual machines."

Many different companies helped to build the skeleton's components. Dr Gordon Cheng, at the Technical University of Munich, told the BBC they used a lot of 3-D printing technology for purposes of both speed and achieving strong but light materials, along with using standard aluminum parts. As for Cheng's contribution, he said his side of the collaboration was contributing a state of the art sensor for artificial skin sensing.

"When the foot of the exoskeleton touches the ground there is pressure, so the sensor senses the pressure and before the foot touches the ground we are also doing pre-contact sensing. It's a new way of doing skin sensing for robots," Cheng said.

Duke University in November announced that in a study led by Duke researchers, monkeys learned to control the movement of both arms on an avatar using just their brain activity. The findings, published in *Science Translational Medicine,* "advance efforts to develop bilateral movement in brain-controlled prosthetic devices for severely paralyzed patients." According to the release, senior author Nicolelis said future brain-machine interfaces aimed at restoring mobility in humans will have to incorporate multiple limbs to greatly benefit severely paralyzed patients.

More information:

- http://www.bbc.com/news/science-environment-27316027#sa-ns_mchannel=rss&ns_source=PublicRSS20-sa
- http://www.nicolelislab.net/wp-content/uploads/2012/11/SciAm2012_Nicolelis.pdf
- http://stm.sciencemag.org/content/5/210/210ra154.short?rss=1