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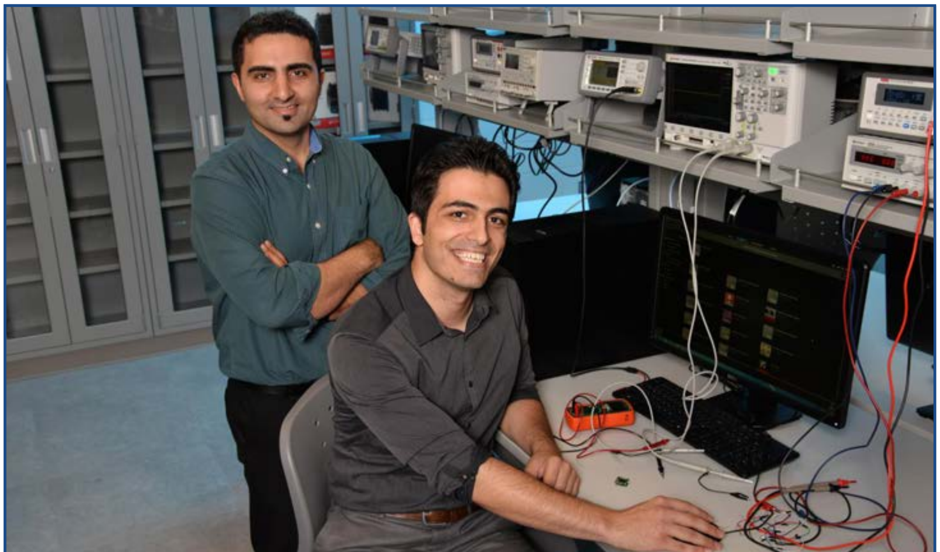
Micro-device offers potential to stop seizures before they start



Academic entrepreneur Hossein Kassiri (centre) developed an implantable device with micro-EEG capability to actively detect and prevent epileptic seizures. His technology is now being commercialized through Braincom, a startup company he created with business partner Nima Soltani (left).

Imagine being able to stop epileptic seizures before they start. A tiny, implantable device developed by Dr. Hossein Kassiri, a professor at the Lassonde School of Engineering at York University and Toronto-based entrepreneur, is showing promise of doing just that.

Slightly bigger than a quarter, his wireless, battery-less implantable technology monitors and detects the unusual electrical activity in the brain that signals a seizure is about to start. The device then stimulates the brain to change the pattern, preventing or reducing the severity of the seizure.

Dr. Kassiri's device represents an exciting new approach to monitoring, diagnosing and treating brain disorders. "Increasingly, low-power integrated sensory systems are showing potential to move patients' brain monitoring and diagnosis out of the hospital and into their lives," he says.

It's estimated that one in every 100 Canadians suffers from epilepsy, and, of those, roughly one in four has seizures that can't be controlled with anti-epileptic drugs. For many years, the only medical device on the market to prevent seizures acted much like a pacemaker, sending mild, periodic electrical pulses to the vagus nerve at the base of brain. It doesn't monitor brain activity and can miss seizures.

"The overall detection and control efficacy of commercially available technology isn't good," says Kassiri, who joined York as an assistant professor earlier this year. "We saw an opportunity to address these gaps."

The multi-channel device is attached to an electrode array that sits on top of the cortex. The key to their technology is essentially a miniaturized version of the electroencephalograph (EEG) monitoring device that doctors use to analyze the electrical activity of a patient's brain. A sophisticated algorithm makes it possible for their tiny device to actively monitor and react to brain activity – a complex function that until now could only be done by computers.

Kassiri says their device is more sensitive than its one competitor that recently became commercially available, with 64 channels rather than eight, and a more sophisticated algorithm.

"We employed various design and prototyping techniques to meet the tight energy and size constraints of a brain-implantable device," says Kassiri. "Every one of our 64 channels can do both recording and stimulation. The on-chip algorithm processes the recorded brain signals, and upon detection of an upcoming seizure, determines when and where to stimulate."

He conducted the project as a doctoral student with University of Toronto's Dr. Roman Genov, director of the Intelligent Sensory Microsystems Laboratory. From the beginning, they worked closely with neurologists at Toronto Western Hospital and neuroscientists at The Hospital for Sick Children.

They also sought the expertise of CMC Microsystems, which helped with prototyping and fabrication. "They played an important role both in terms of facilitating microchip fabrication and providing consult for wire-bonding and packaging," says Kassiri.

The potential of Kassiri's device and his promise as an up-and-coming innovator have been recognized with a spate of honors, including a fellowship from the Heffernan Foundation, which helps U of T final year students or graduates commercialize their ideas. He also won an entrepreneurship award from the Ontario Brain Institute, a University of Toronto Early Stage Technology award, and, in 2012, the CMC Brian L. Barge Award for Excellence in Microsystems Integration. And earlier this year he was named one of U of T Engineering's "16 Grads to Watch."

Kassiri and his business partner, Nima Soltani, have founded a company, Braincom Inc., to commercialize the device. Its core technology has been validated in animal studies, and next steps include attracting investors and beginning clinical trials.

"Our aim is to see our implantable device successfully reach the market, and provide a new treatment option to people around the world," he says. *cmc*