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Deep Thoughts

University of Dayton

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Deep Thoughts

University of Dayton researcher Tarek Taha hopes his third National Science Foundation award is a charm in his quest to develop a brain-inspired computer chip that can learn by itself and be more secure, efficient and compact than current chips.

"Anything small you need to be smart and powerful. The key is teaching the chip to learn and then apply it. One thing that differentiates us is we're looking at learning on the chip," said Taha, who is using a three-year, $440,000 National Science Foundation award to work toward this goal. "We want to make these systems more autonomous, or independent of outside systems."

Think of it like this, Taha explained. Modern intelligent systems such as self-driving cars typically ship data gathered throughout the day to servers at the manufacturer's facility for processing. This will likely move into smaller items as artificial intelligence further pervades our everyday lives.

"But chips like these can be more expensive in terms of energy and time, especially energy," he said. "Plus, if you cannot connect to the Internet or share data, or need enhanced security or do not want to share data, a chip like this is important."

Other applications that could benefit from a learning chip are robots.

"Big batteries in robots are heavy. Batteries and computing components take up most of the space in robots," Taha said. "This can shrink the size of robots."

Deep-learning, an artificial intelligence approach that has caught fire, is at the root of making this work, according to Taha.

"Deep-learning has created a mini-revolution in the industry by replacing decades-old approaches," he said. "Deep-learning involves

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mimicking what we think the human brain may do, teaching a system. And once you teach it, it works on its own. This latest project is to do the actual teaching."

The U.S. Postal Services has been using deep-learning to recognize handwritten digits, according to Taha. He added the multibillion deep-learning industry hopes to ramp up to large-scale networks for applications like Google voice translation and others.

Taha has been a rising researcher in the artificial intelligence field for a decade.

In 2007, the National Science Foundation awarded Taha, then at Clemson University, a $400,000 CAREER award that supports junior faculty who exemplify the role of teacher-scholar through outstanding research. A few years ago, he received another NSF award to examine ways to make computers smarter by mimicking human brains.

Taha's research uses a type of nanoscale device, known as a memristor, which retains memory without power. His group has applied for four patents for this work.

Taha's group is in the process of designing a new computer chip that can provide the equivalent performance of an entire supercomputer, while consuming nearly 1 million times less energy.

In addition to his research supported by the National Science Foundation, Taha's group is performing research on an IBM TrueNorth chip. It's believed the University of Dayton is the only Ohio university that has the chip on-loan from IBM. The chip is capable of 46 billion neural (brain-like) operations per second, literally a supercomputer in your palm, according to IBM.

For more information, contact Shawn Robinson, associate director of news and communications, at 937-229-3391 or srobinson@udayton.edu.

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