# Advancing intelligence: Universal Robotics' technology helps machines learn like humans
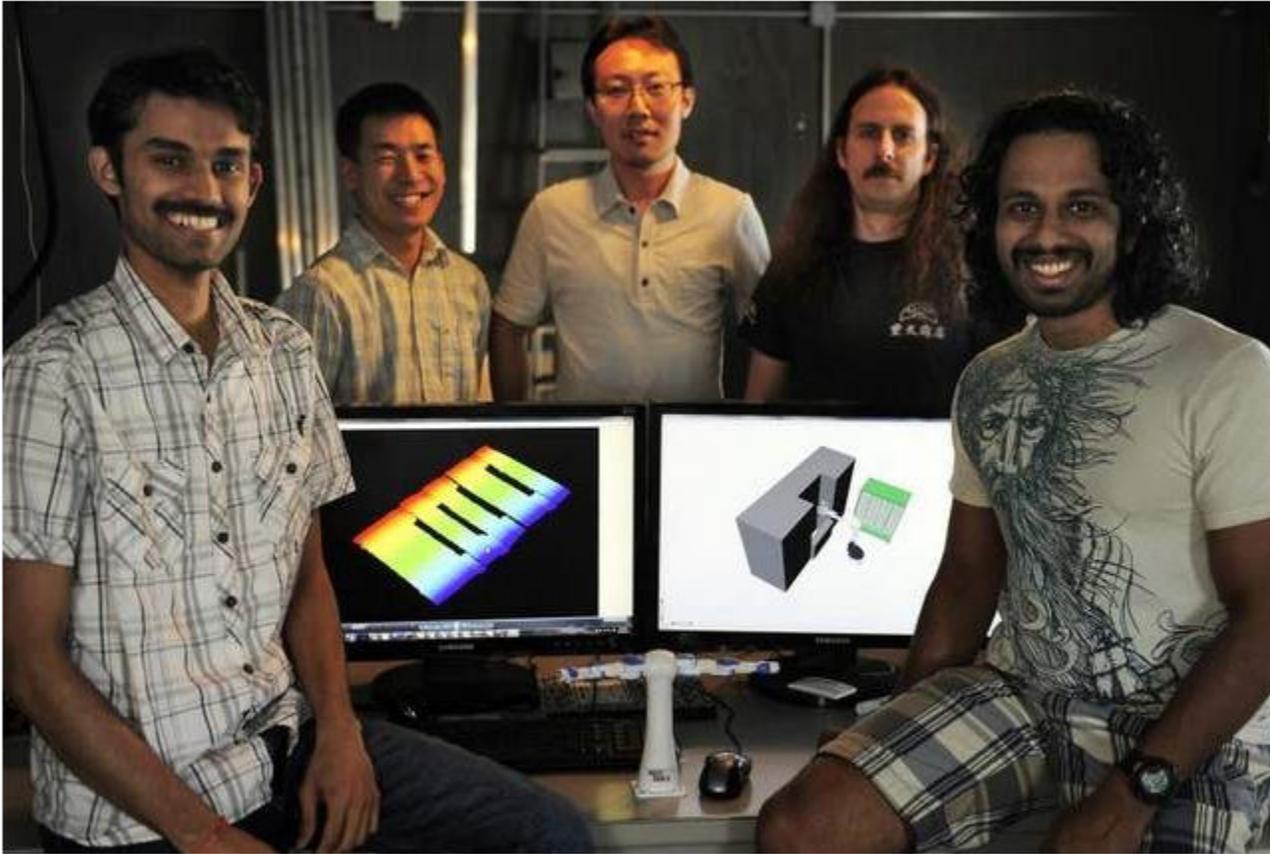
Goutham Mallapragada, left, Daejin Kim, Di Wang, Shawn Atkins and Ashwin Mudigonda are among the 12 employees at Universal Robotics, which is looking to hire more. / George Walker IV / The Tennessean

On a gated 2.5-acre property southeast of Nashville International Airport, behind a stone building that looks like a small bed and breakfast, past the basketball hoop, beyond a grill and patio table, to the left of a pool and water slide, is a small building where a team of scientists and engineers is creating highly sophisticated artificial intelligence technology.

It all began in 2001, when a group of Vanderbilt researchers collaborated with NASA to create software that would allow machines to learn how to function in unfamiliar, chaotic environments. They partnered with the school's Center for Technology Transfer and Commercialization to bring their work to market, and in 2008, Universal Robotics was born.



David Peters is CEO of Universal Robotics, which grew from a collaboration between Vanderbilt researchers and NASA. / George Walker IV / The Tennessean

The company's flagship technology, Neocortex, is a form of software that learns similar to the way humans do. It's scheduled to be deployed on the International Space Station to perform maintenance tasks difficult for astronauts to do, CEO David Peters said.

Vice President Hob Wubbena explains Neocortex through the analogy of a child trying to hit a baseball.

The first time the ball is thrown, a kid might get distracted by a bird flying by, Wubbena said, "and the ball comes in and hits him in the head." Eventually, children learn to ignore distracting information and pay attention to sensory details that are useful. They learn to concentrate on the path of the ball, how best to move their arms and how to match the motor control of swinging the bat with the speed of the ball.

## Making adjustments

Neocortex, which can be installed into just about any type of robot or automated machine, absorbs massive amounts of data in an environment and quickly learns how to react when handling a variety of objects.

Most machines, such as ones on an assembly line, are pre-programmed to handle certain tasks, and they make errors when something in their environment deviates from what they're programmed to expect (for example, if a new object comes down a conveyor belt or if an object is positioned in an unexpected way). Neocortex learns to distinguish between what works and what fails and adjusts accordingly, sometimes even if it's not at all familiar with the object a robot needs to move or manipulate.

"There's nobody in the world that has anything close to this," Wubbena said.

Down the road, the company sees its software being used for a variety of purposes — particularly in situations where activities are costly or dangerous for humans. Currently, its primary commercial use is in materials handling and logistics, which has the highest rate of worker injury of any U.S. industry, and is an area where companies are always seeking more efficiency.

One of its uses is amusing to watch, though not particularly glamorous: It can be installed on robots that remove boxes that are stacked without any perceivable pattern on a pallet.

In that small building, which feels like a cross between a miniature warehouse and a computer lab, there are robotic arms and screens filled with lines of code, as well as pallets, boxes and sandbags.

An engineer demonstrates how this works. He randomly stacks a group of cardboard boxes on a wooden pallet and uses a remote to switch on a blue mechanical robotic arm. Installed on the robot is Kinect for Windows, a motion sensor input device also used on the Xbox 360 video game console. In swift, precise movements, the arm uses a suction mechanism to remove the boxes from the pallet, one by one.

The technology, of course, can handle tasks more complex than moving boxes. For one client, Universal is working on tailoring its software to be able to differentiate between 40 different cosmetic containers and seamlessly switch between handling them, without having to reprogram the system.

## 'Dramatic growth'

Wubbena declined to disclose revenues but said the company experienced "dramatic growth" during the past 18 months. Universal has 12 employees and is looking to hire more.

The company now has 12 clients, Peters said, including Fortune 100 companies. Recently, it added CHEP, the world's largest pallet leasing company. CHEP uses a 3-D vision inspection system from Universal to improve how it identifies damaged pallets. The target for Universal's software is to give clients a return on their investments within two years.

The company has started looking at how its technology could be applied in the mining industry, and through collaboration with Vanderbilt, Universal recently tested its software's ability to detect atrial fibrillations, a type of irregular heartbeat that increases the risk of a stroke. Peters is now looking for an entrepreneur to sublicense the company's intellectual property rights to and take the idea off the ground.

David Peters' brother, Alan Peters, was one of the Vanderbilt researchers who developed Universal's software and is chief technology officer. The algorithms his brother developed create a fundamental building block, David Peters said, one that captures how learning occurs in the world and "allows for a very clear distinction of when you're doing something right and when you're doing something wrong."

From that foundation, he said, "we've gotten pretty good at predicting the unknown."

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