

# Billions of sensors power professor's vision of interconnected world

January 29 2013, by Roy Wenzl

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A professor at Wichita State University plans to create a university center with an ambitious name: The Center for the Internet of Everything.

Step one: Plant a small garden on campus where plants will message irrigation pipes telling how much water they need.

Ravi Pendse, helped by Internet companies NetApp and Cisco, hopes to create other innovations he says could put WSU in the high-tech big leagues.

The garden will model how to save water and billions of dollars in the world's crops and lawns.

In the second and subsequent steps, Pendse's students and partners would develop innovations linking computers, smartphones, social media and the billions of sensors now being attached to - everything.

Pendse as a technologist has collaborated with NetApp and Cisco for years, creating technology and many WSU graduates who went to work for those companies.

Stan Skelton, director of strategic planning and advanced development at Net-App, said his company hopes to work out plans with Pendse this semester to grow the garden and establish the center.

The center will not require tax money or buildings, Pendse said; it will operate as a mobile group of students, faculty and business partners, and be financed with private money. The only expenses necessary so far: a few hundred dollars for seeds and sensors.

WSU President John Bardo endorsed Pendse's plans after he became WSU president in July.

"What Ravi is talking about in part is that we're all seeing a massive increase in low-cost connectivity ... and this allows you to think very differently about what you can do."

NetApp and Cisco are international companies that create [data storage](#) and network underpinnings for the Internet. They've partnered with Pendse and his students for years.

"Students get firsthand experience working with an industrial partner," said NetApp's Skelton. "And they with their projects allow us to try riskier innovations, or projects that we might not do ourselves."

Pendse was so concerned about how to explain his ideas that he prepped for the interview for this story by writing out pages of notes and carefully arranged note cards. (He did all this with handwriting, using an ink pen.)

He and his business partners think an "Internet of Everything" will be inevitable, and that WSU could help create it.

Currently, he said, there are actually several "Internets."

There is the Internet that is actually an Internet of "information." With Google and other search engines and the storage of machines and the Cloud, it has been a powerful tool humans use to organize information.

Facebook, Twitter and other social media are "the Internet of people," networking on a planetary scale.

There can be an Internet of "places": for example, WSU, Cowtown, City Hall, restaurants.

Unseen by most of us, however, is the "Internet of things" - billions of sensors attached to machines or people, all with wireless capability. The OnStar driver protection system installed in many cars is a system of sensors that communicate to machines and people hundreds of miles from the car, for example.

The "Fitbit" Pendse wears records his every step, whether on the treadmill or walking across campus. On the day we saw him, by 2 p.m. he had walked more than 14,000 steps from the time he got on his treadmill.

These sensors, billions of which surround us already, will multiply and play a big role in our lives, he said. Cars will drive themselves, talk to each other and to roadways and destinations, which will reply.

There will be smart fabrics - if we have a medical problem, we can put on a shirt, and the shirt will talk to our doctors, giving information about whether we're sick. Soon, Pendse said, there will be smart pills we can swallow, which will message from our intestines about whether we took our prescription, whether we're sick, whether we have early-stage cancer.

Skelton said Pendse first came to the attention of his company more than a decade ago, when Pendse and his students startled executives and technologists pioneering a way to use handheld devices (PalmPilots) to monitor and maintain data storage remotely.

Skelton was at a conference of engineers in Europe at the time and saw their jaws drop when the WSU innovation was demonstrated. Up until then, engineers had to work on storage systems by hand, including at night after breakdowns.

Remote technology like that might seem old hat today, but it thrilled engineers then, Skelton said.

What Cisco and NetApp also noticed about the same time was that they were hiring a large number of WSU graduates trained by Pendse.

One other result of this relationship with WSU: Net-App says it now has 525 employees in Wichita, including Skelton, a 1977 graduate of WSU.

Pendse and the quality of WSU students are part of the reason [NetApp](#) is here, Skelton said.

By most estimates, Pendse said, about 15 billion to 16 billion "smart" devices - such as desk computers, laptops, smartphones and tablets - are permanently connected to the Internet. There are only 7 billion people on the planet, so that's how ubiquitous these devices are, he said.

There also are currently about 50 billion to 60 billion sensors in the world.

By the year 2020, only seven years from now, Pendse said, technologists think there will be 50 billion smart devices, and 200 billion sensor devices, talking to each other, doing tasks for us, doing some thinking for us.

What his "Internet of Everything" will do, Pendse said, is more coherently bring all these devices in line, enhancing our world.

Many people in Wichita, Pendse said, are already capable of developing many of these technologies, and creating new jobs, new industries in Wichita. It might be possible, he said, to turn the entire campus into a lab. For example, he said, parking is a huge problem, including on WSU's campus.

He wants to put sensors in every parking space, capable of communicating with every car in Wichita if necessary.

Anyone who parks at WSU regularly could obtain an app for their smartphone or car. On their way to the campus, the app could talk simultaneously to every parking space on campus. The empty spaces would talk back.

The technology to make this possible will be created soon, he said. Why not create it here, using WSU as the lab?

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