Sensor networks protect containers, navigate robots

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Aristo, the Washington University robot, uses sensor networks to avoid simulated "fire" - red cups - while navigating near "safe" areas,which are blue cups. Credit: WUSTL

Agent 007 is a mighty versatile fellow, but he would have to take backseat to agents being trained at Washington University in St. Louis.

Computer scientist engineers here are using wireless sensor networks that employ software agents that so far have been able to navigate a robot safely through a simulated fire and spot a simulated fire by seeking out heat. Once the agent locates the fire, it clones itself - try that, James Bond -- creating a ring of software around the fire. A "fireman" can then communicate with this multifaceted agent through a personal digital assistant (PDA) and learn where the fire is and how intense it is. Should the fire expand, the agents clone again and maintain the ring - an entirely different "ring of fire."

Agents in computer lingo are specialized pieces of code that are self-contained and mobile. Wireless sensor networks are made up of tiny computers that can fit in the palm of a hand. They can run on simple AA batteries, sport an antenna and a sensor with a specialized duty of sensing the environment -- temperature, magnetism, sound, humidity, for instance.

Gruia-Catalin Roman, Ph.D., the Harold B. and Adelaide G. Welge Professor of Computer Science and department chair, envisioned a new kind of software architecture to support applications targeted to the sensor network environment. Chenyang Lu, Ph.D., Washington University assistant professor of computer science and engineering and Roman's doctoral student Chien-Liang Fok, and Roman developed a middleware - a special kind of software -- called Agilla, which enables agents to move across the sensor network and between sensor networks connected via the Internet and to clone themselves, thus forming complex communities of cooperating agents.

This approach to the development of sensor network applications is novel and offers an unprecedented level of flexibility. It also permits multiple applications to co-exist over the same basic hardware in response to changing needs.

Roman believes that wireless sensor networks are poised to explode upon the world stage, similar to the way that the Internet took off after the creation of the World Wide Web.

"What researchers are banking on is that sensor networks will be so cheap to make that they can be employed on a very large scale," said Roman, who directs Washington University's Mobile Computing Laboratory. "This way you can spread hundreds and thousands of them around gathering data and communicating."

Imagine a farmer wanting to get soil data - temperature, or Ph - over hundreds of acres with slightly varying soil types. Instead of painstakingly physically taking measurements - being a farmer 'outstanding in his field' -- in theory, he could send a software agent with Ph sensing capabilities to a

particular sensor network, have the Ph agent clone itself and gather the data over hundreds of acres, then transfer itself onto another sensor network on the Internet and send its data back to the farmer's office. That's not Old MacDonald's farm.

Similarly, a manufacturer might want to safeguard containers in a warehouse. A sensor network can be put in place on the containers that communicates with each other, alerting an alarm should, say, light be sensed, or a vibration. Again, the manufacturer can remain in his office and communicate with the network with a PDA.

"This is fascinating software, and this technology is opening up, and we have no idea where it's going to go, " Roman said. "Right now, wireless sensor networks are allowing us to explore the future."

One of the key features of Agilla software is its flexibility. For instance, in the fire-simulation study, the networks allow for both simulation of fire and tracking of the fire. Agilla is considered a major breakthrough in the field of wireless sensor networks and lays the foundation for rapidly developing applications.

Source: Washington University in St. Louis, By Tony Fitzpatrick