Purdue and Olympus Corp. creating technology for sensor networks

September 7 2004

Olympus Corp. and Purdue University are collaborating on a three-year project to develop technologies that will use omnipresent cameras and sensors to monitor and enhance the well-being of people in the living environments of the future.

Engineers leading the research said these smart, ubiquitous devices will be networked with miniature sensors worn by individuals, enabling people – especially the elderly and impaired – to have fuller lives and greater peace of mind.

"We believe these technologies will improve the quality of life for people around the world in the decades to come," said Atsushi Yusa, founder and director of the Future Creation Laboratory at Olympus.

Olympus is providing $1.05 million over three years to finance the project.

The sensor networks will likely have many applications, but those uses won't be entirely known until the technologies are fully developed and tested, Yusa said.

Purdue will develop special software needed to enable numerous sensors to operate independently while also communicating with each other when necessary.

"Right now we are interested in developing the core technology of these

sensor networks," said Avinash Kak, a professor of electrical and computer engineering and director of Purdue's Robot Vision Laboratory. "Each sensor will have its own smarts, its own internal computer.

"There will be no central computer anywhere. The sensors will talk to one another through wireless networks, requesting information that they need to make sense of the local scene and sending information to other sensors as they request it."

Each sensor will be a separate "communications agent," so the network's design is referred to as an "agent-based architecture."

"The partnership between Purdue and Olympus is unusual because many universities and corporations are working on sensor networks, but nobody has focused on networks of vision sensors and imaging sensors to the extent we will be," Kak said.

Researchers at Purdue will establish an Olympus Room in the Robot Vision Lab, and Olympus will establish an identical facility in Japan so that team members can communicate and work together on the same experiments.

"We decided to collaborate with Olympus because it is the best organization when it comes to optical sensors and state-of-the-art computer vision sensors," Kak said. "Olympus also is a very progressive corporation, and Dr. Yusa is a world leader in issues that relate to the impact of technology on societies."

The networks will use various types of sensors – cameras, thermal sensors that pick up the heat signatures of people, and ultrasonic and laser sensors that pick up the presence of both moving and static objects in an environment.

Software is needed to enable sensors to extract and interpret information.

"As a particular sensor is interpreting information, it may need information from other sensors for corroboration, for augmenting what it knows," Kak said. "That's where these sensors have to work together."

Ultrasonic sensors might be used to detect intruders, and laser sensors enable computers to picture a living space in three dimensions.

For example, stereoscopic sensors – or two vision sensors operating together like human eyes – and possibly laser sensors might continually scan a particular room. The resulting data might be interpreted by computers to reconstruct the 3-D layout of everything in the room, perhaps even showing people and objects in motion. The sensors, mounted in various locations, also may communicate with sensors that people may wear, perhaps embedded in eyeglasses. Such networks will then include information that a person sees, as well as information from sensors observing that person.

"Let's say you are an elderly person and you are living in a community of elderly people," Kak said. "And let's say your eyesight is not as good as it used to be and you are trying to make your way from point A to point B.

"It is possible that you may want sensors to monitor your movements and perhaps give you some feedback on whether or not you are headed in the right direction so that you don't fall into a swimming pool or collide with stationary or moving objects and other people. Or let's say that you are an elderly person in a swimming pool. Sensors might record your pattern of swimming, your body temperature and other information and quickly determine whether there is a medical emergency."

At the opposite end of the age spectrum, such sensor networks could be

ideal for monitoring and protecting young children in daycare and classroom settings.

"But the exact uses remain to be seen, so it's hard to really chart out very specific scenarios," Kak said. "Once we develop the technology of sensor networks, how that technology will evolve will depend a great deal on what is acceptable to humans and to what extent humans may find it intrusive."

Because the sensors will likely be omnipresent, such networks represent a potential threat to personal privacy.

"It becomes a question of how to balance the privacy issues with the need for monitoring the well-being of people," Kak said. "That remains to be seen. It will depend completely on how people react to these sensor networks. Those issues will not be resolved until we develop the core technology and install it somewhere.

"The ultimate goal is to give an individual control over how much information about himself or herself is broadcast to a sensor network. That will be an important element of the whole exercise. You should be able to regulate how much about you is available to the sensor network, adjusting the flow of information according to how protected you feel, how safe you feel, depending on what your needs are at the moment."

The core technologies for the networks will likely be created over the next five years, he said.

"But how that gets deployed for the benefit of mankind will take longer to determine and will depend on the feedback we get from people during additional research," said Kak, who has been working on sensor research for 25 years and whose lab is a national leader in work dealing with vision sensors.

The research team will include Akio Kosaka, an adjunct faculty member in the School of Electrical and Computer engineering at Purdue; Johnny Park, a principal research scientist; and three graduate students.

Olympus, founded in 1919, manufactures and sells equipment for medical, health-related, imaging and information-related applications, as well as a variety of industrial uses. The Future Creation Laboratory was established in April 2003 to focus on relatively long-term research and development.

Source: Purdue University