Rochester Institute of Technology Researchers Work on Sensor Network

The goal of the multiyear project is to develop a secure RFID-based system that would enable care providers to remotely monitor patients' cardiac health and medicine consumption.

By Claire Swedberg

Oct. 1, 2007—Researchers at the Rochester Institute of Technology (RIT) are developing a sensor network that would allow medical care providers to remotely monitor patients' cardiac health and medicine consumption—and to do it with a layer of data protection. The project—which begins this fall and is expected to last three or four years—will involve developing a marketable prototype of a system that could improve medical care and reduce costs, says the team's leader, assistant professor of computer engineering Fei Hu.

RIT will collaborate with Yang Xiao, a professor of computer science at the University of Alabama, in Tuscaloosa. The Rochester Institute of Technology is designing the RFID tags and interrogators, Hu says, and integrating the readers with back-end databases, while the University of Alabama team, under Xiao's leadership, is designing algorithms for securing the data.

Although RFID technology already exists to accomplish the task of monitoring patients' vital signs, locations and prescription use, Hu says, current technology used to ensure the privacy and security of data consumes too much electrical power for the heart-monitoring system he envisions. The challenge for the team, therefore, will be to create a platform in which data can be encrypted automatically by network protocols to make sure it is secure, without making the security system so complex it becomes a power hog.

Because the research group is using small, low-cost sensors to interface with battery-powered tags, the researchers are striving for long battery life. In the case of most encryption systems available today, Hu says, "When you are going back and forth between tags and readers, the algorithm can be too complicated and overuse power. We aim to create a low-overhead, low-complexity, low-power security scheme for RFID reader-tag communications."

Telemedicine—which uses such technology as video-conferencing and robotics, together with a communications system that can be either wired or wireless—is gaining the interest of the medical industry. By monitoring the health of a patient from a remote location, doctors and nurses can reduce the expense of personal visits and perhaps improve service by tracking that patient's health 24 hours a day through real-time sensor data.

Health-care professionals and their patients, however, still have reservations about using wireless technology to transmit health-care data. "The problem with wireless technology [as opposed to wired connections] is the data is not secure," Hu explains. "If you cannot guarantee the security of a network, no one wants to use it."

Security and privacy are both concerns for patients, Hu says—patients want to be assured no one else can access their data and discover, for example, their health problems, the medications they take or any

identifying information, such as a social security number. Patients also need to be confidant no one can, for example, access a nursing home's network and tamper with their information, he adds.

Although the RFID tags would only transmit a unique ID number, which could then be linked to a patient's data in a medical database, "we need to protect the ID," Hu says, to keep unauthorized individuals from capturing that number and using it to access or change a patient's data. He adds that researchers will attempt to build a system that operates properly in the event of radio interference resulting from environmental signal distortion caused, for instance, by a metal cart. "The sensor data needs to be error-resistant since radio propagation can bring lots of interference," he says. "Error resistance means overcoming those natural radio errors through data-recovery schemes."

With the cardiac sensor system, patients at a nursing home or hospital could wear an RFID tag connected to a sensor attached to several areas of the body, such as a fingertip or the chest, to monitor the heartbeat's rate and pattern, as well as blood pressure and oxygen level. The tags—which Hu says would most likely be battery-powered—would transmit data to receivers deployed throughout the nursing home or hospital. Those receivers could then transmit the information directly to a server, or to another gateway before going to the server.

Additionally, the nursing staff could affix RFID tags to patients' prescription containers, the unique ID numbers of which could be connected with that patient in the back-end system. If a patient came within close range of the prescription bottle, either alone or with help from a nurse, the RFID number would be captured by the reader, along with the patient's own RFID tag, alerting the system that the patient had taken his or her medication. If the patient accidentally took the same prescription twice in one day, failed to take a prescription when prescribed to do so, or took the wrong medication, the system could send an alert to health-care providers.

RELATED_ARTICLES In the event of a heart attack or other health emergency, the sensor would capture the change in vital signs and the RFID chip would transmit that data to an RFID interrogator, then to the server, and an alert could be sent to medical staff. The patient could then be located, based on the location of the interrogator that captured the signal of the patient's RFID tag.

The project is being funded by a $400,000 grant from the National Science Foundation's Cyber Trust Program.