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Researchers Use RFID to Fight SIDS

A team at the University of Texas, Arlington, has designed and built a device that monitors the carbon dioxide a child exhales, and sends an alert via RFID seconds after the infant stops breathing.

By Claire Swedberg

April 17, 2007—One hour after his son was born, Hung Cao had an idea while watching the hospital nursery room filled with cribs and tiny infants. "Seeing my son from the outside," says Cao, a graduate research assistant at the University of Texas at Arlington's department of electrical engineering, "while no one was taking care of him—they were checking the other babies—I began to wonder if there was some way to always know my son was okay." His idea was a technological solution to sudden infant death syndrome (SIDS), a phenomenon that takes the lives of approximately 2,250 babies in the United States each year, according to the U.S. Centers for Disease Control and Prevention.

With his UTA colleagues at the electrical engineering department and the university's Automation & Robotics Research Institute, Cao began to develop a solution. They designed and built a device that monitors the carbon dioxide a child exhales. If the infant stops breathing, the device transmits an alert via RFID within seconds. For hospitals and nurses, the system could provide a way to monitor a baby's breathing around the clock, thereby helping to fight SIDS.

Research began in summer 2006, when Cao and two colleagues, under the direction of UTA electrical engineering professor Jung-Chih Chiao, were carrying out a project on the evaluation of gas sensors. Cao discovered he could use such a sensor to detect exhaled air from a distance of about 50 centimeters.

In the meantime, Cao also spent time at home caring for his infant son. Having a baby and a crib in his own home, he says, made it easier for him to consider design options. Most SIDS-related sensors are invasive, requiring a device that attaches in some way to the child. In the case of Cao's solution, the sensors and RFID chip would attach to the crib rather than to the child. "I thought, 'If we could apply an array of sensors to make sure that he was always facing a carbon dioxide sensor at a point of time, we could monitor his exhaled air and know he was OK or not. If we have an ID for each sensor, we can even know the direction that he was facing.'" Cao then took this one step further to address the issue of an infant sleeping face up: In such a scenario, a sensor could be attached to a crib mobile hanging about 20 centimeters above the infant's face.

The system, which is patented by Cao and Chiao, includes an array of sensors attached to both sides of the crib, serving to capture carbon dioxide exhaled by an infant regardless of the direction the child is facing. A home monitoring system could include an overhead sensor as well. Attached to the bottom of the crib, wired to the sensors, is an active 900 MHz or 433 MHz RFID tag. The tag transmits the data to a nearby RF receiver, such as a baby monitor or an RFID-enabled computer, which can be located in another area of the room or even in an adjacent room. The interrogator captures data from the RFID tag every five seconds. If none of the sensors detect the expected carbon dioxide level for a baby breathing normally, the system issues an alert. Chiao says they have not yet chosen one specific RFID tag for the application.

This system would be especially useful in hospital nurseries, Chiao says, since it could send the unique ID number of the baby's crib RFID tag, as well as the sensor results, to the hospital's management

system. If a baby's carbon dioxide levels fluctuated, it could not only send an alert but also automatically open the infant's health record on a computer screen used by hospital staff.

After working with Chiao, Cao says, "I have carried out the tests for a proof-of-concept system and got some good results." That proof of concept includes testing a prototype for the effectiveness of the sensor mechanism and wireless transmission of sensor and tag data.

Thus far, only the proof-of-concept version of the system has been tested in the UTA lab. For the test, Cao says, "I used an LED as a indicator [to show a drop in carbon dioxide level]. First, I faced the sensor at a distance of 50 centimeters and kept breathing. After that, I withheld my breath." When the device failed to detect the necessary level of carbon dioxide at its next measurement—after five to 10 seconds—the LED light illuminated.

The next step, Chiao says, is to introduce the system to the hospital setting at the UTA School of Nursing, where computer-controlled mannequins, or "robotic infants," are used to train nurses. There, the team would use these robotic infants to show the nurses how to operate the new anti-SIDS device. The mannequin babies make sounds, have heartbeats, release fluids and can even run a fever. "We envision the next step," Chiao says, "is to integrate our monitor system in a setting where the nurses can be trained to be familiar with RFID technologies." When the system will be tested there has not yet been decided, he says, adding that the engineering group is hoping for funding from a government source, and to generate interest in the device from pharmaceutical companies or other commercial parties.

"SIDS is not an epidemic like cancer," Chiao says, "but as parents who come through it will tell you, the suffering is tremendous. The economic impact is tremendous as well. We are trying to address this issue."

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