Engineers: Wireless crib monitor keeps tabs on baby's breathing

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Radar — the technology that tracks enemy bombers and hurricanes — is now being employed to detect another danger: when babies stop breathing.

In a high-tech twist on the remote devices that allow parents to listen to or watch their baby from afar, University of Florida engineering researchers have built a prototype baby monitor that focuses on a baby's breathing. If his or her chest stops moving, the crib-mounted monitor detects the problem and sends an alarm to a portable unit kept by the parents.

"It's a step beyond just watching the baby through a video link or hearing it cry," said Jenshan Lin, a UF professor of electrical and computer engineering and the principal investigator of the Doppler radar technology used in the monitor.

A paper on the system, which works by using Doppler radar to remotely scan the in-and-out movement of the baby's chest due to respiration, will appear in the February issue of *IEEE Microwave Magazine*.

Parents buy millions of baby monitors each year in the U.S., but most transmit only sounds or video images of the baby — both useful, but only if a parent is listening or watching. Some recently available monitors also monitor babies' movements and breathing, but Lin said he is not aware of any on the market that use wireless technology.

UF engineering students Changzhi Li, Julie Cummings, Jeffrey Lam, Eric Graves and Stephanie Jimenez designed the monitor.

The students did the work as part of the College of Engineering's Integrated Product and Process Design Program, which allows senior-level undergraduates to participate in yearlong design projects of new products or processes. The student team's goal: to use Lin's radar technology, first developed three years ago and under continuous refinement since, in a useful product with the potential to be licensed to a company.

The students produced a small-book-sized device that attaches to the crib just like a standard monitor. They also designed a remote station with red, blue, green and yellow lights, variously indicating the status of the baby's vital signs, the battery life of the station and confirming the station's wireless connection to the crib monitor. The station emits a loud alarm and flashes a red light when the monitor detects that the baby's breathing activity has fallen below a preset threshold, or that he or she has stopped breathing.

Future versions could also detect heartbeat, using a higher frequency signal, Lin said.

"It's the same Doppler radar that police use to catch speeders, but in our case, we don't measure constant speed, but rather back-and-forth motion — sort of like vibration," Lin said. "That's the fundamental principle of this technology."

The crib monitor's signals are very low power and not harmful to the baby or parents, Lin added. While a standard cell phone emits about one watt of power, the Doppler radar emits just one ten-thousandth of a watt of power, he said.

Tom Weller, associate dean for research at the University of South Florida College of Engineering, said the baby monitor is a good example of how research and education can come together in a useful product.

"This miniaturized monitor is an example of solid microwave engineering coupled with great innovation, and something with the potential for a very broad societal impact," Weller said in an e-mail. "It is especially noteworthy that Dr. Lin transferred his research output into the very capable hands of creative undergraduate students."

Lin is also pursuing other applications for his technology. His best-realized idea so far: a search-and-rescue robot equipped with the Doppler system to determine the presence of living people in structures damaged by earthquakes or explosions. Lin said the system, so far tested in a small working prototype robot, could complement robotic video systems because it requires less power to operate and has greater range. The robot was developed by student Gabriel Reyes as his research project in the University Scholars Program.

"Or the military could use it to find enemy soldiers," Lin said, noting that the Doppler radar easily penetrates walls or other structural components.

Lin has also reduced the size of the electronics in his system so that they fit on a fruit fly-sized microchip, potentially enabling the remote monitor to be used in cell phones. That could turn the phones into portable life-sign detectors useful, for example, for friends and family who wish to keep tabs on elderly relatives living alone, he said.

Source: University of Florida