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Hard hat alerts workers to dangerous equipment

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Submitted | Photo Courtesy of Jochen Teizer
Georgia Tech civil and environmental engineer Jochen Teizer (left) and Matt Reynolds, Duke University assistant professor in the Department of Electrical and Computer Engineering, are collaborating on a prototype of a "smart" hard hat.

By Neil Offen

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DURHAM -- The hard hat looks pretty much like any construction hard hat, even if it is colored a dark blue and sports a prominent Duke University Blue Devil sticker.

Until it starts beeping.

It's an insistent, irritating beep, higher and higher pitched. There's no ignoring it.

Which is the point.

The prototype hat, designed by Matt Reynolds, an assistant professor of electrical and computer engineering at Duke University, is designed to sound a warning beep when dangerous equipment is nearby on a construction site.

"A lot of construction equipment is dangerous and it's noisy, too," said Reynolds. "Being a construction worker is one of the world's most dangerous occupations."

Five people die each day in the U.S. in construction accidents. Reynolds believes his SmartHat could improve those numbers.

"The problem is, the operator of heavy equipment and the construction worker frequently don't have a good line of site," he explained. "The construction worker might have his back turned to the equipment and not hear it approach. Frequently they get into the path of a machine."

A hat that beeps at the approach of construction equipment is an obvious idea, Reynolds acknowledged. The problem has been that putting a battery inside a hard hat wouldn't work -- batteries are too fragile.

"Battery technology doesn't operate well in extreme temperatures," Reynolds said. "When it's very cold or very hot, when it's under a lot of stress, it fails."

But the SmartHat doesn't have any batteries at all. The wireless beeper and microprocessor work by capturing radio waves in the air.

The radio waves -- precisely, RFID, or Radio Frequency Identification tags -- come from antennas mounted on backhoes and bulldozers, put there to keep track of the vehicles' location. The antennas serve as a transmitter, sending messages to the hard hat.

The use of radio waves to power wireless electronic devices hasn't been feasible until recently, because the waves' strength dilutes quickly. But improved silicone technology now can work with even small amounts of radio wave energy.

The beeping device -- mounted on a small piece of circuit board, weighing a total of only 23 grams -- is attached by Velcro at the crown of the hat, inside the straps. It beeps faster as the danger gets closer.

"By getting rid of the batteries, we made it much less fragile," Reynolds said.

He's worked on developing the hat over the last two years with Jochen Teizer, a professor of civil and environmental engineering at Georgia Tech. While the research into how well the hat works is "in the very, very early stages," Reynolds said, he and Teizer have created a variety of different prototypes and have been conducting field tests on actual construction sites in the Atlanta area.

"It's proven reliable so far," Reynolds said. "It's a very audible beeping sound that's inside your hat. In fact, it's very disconcerting -- it's like it's inside your head. It definitely makes you take notice of the situation. You can hear it even if you're wearing ear protection."

In his lab at Duke's Fitzpatrick Center for Interdisciplinary Engineering, Medicine and Applied Sciences, Reynolds recently put on one of the prototype hats to demonstrate how it works. A transmitter mounted on a tripod sent out the radio waves.

The beeping started and Reynolds took the hat off quickly.

"It is really very loud," he said. "Frankly, I would rather not wear it."

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