Go-anywhere tracking of first responders with WIISARD radio-frequency system

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Researchers at the University of California, San Diego, are hoping that a device the size of a business card will one day reduce the toll of human lives in disaster situations.

The team, known as WIISARD (Wireless Internet Information System for Medical Response in Disasters), is engaged in a proof-of-concept experiment at the UCSD division of the California Institute for Telecommunications and Information Technology (Calit2) to demonstrate that small 2x4 inch radio frequency identification (RFID) tags can be used to track first responders inside burning buildings or other scenarios.

Normally, GPS is a more efficient way to track moving objects or people, “but GPS doesn’t work inside buildings,” explains WIISARD Project Manager Alexandra Hubenko. “If buildings had no metal in them, we wouldn’t have any problems, but metal interferes with GPS signals and prevents communication with line-of-sight satellites. Compounding that problem are a building’s multiple floors. With no line-of-sight satellites, there is no way to determine a person’s altitude, or what floor they are on.”

That can be a problem for those monitoring the whereabouts of first responders, says Javier Rodriguez Molina, a programmer analyst for Calit2.

“It’s a necessity for the command center to know the location of their

team in case of an incident, and in order to use their resources in the most efficient way possible," he adds. "In the event something happens to one of their responders, they know exactly where they are and don't have to go looking for them."

The WIISARD researchers, who are led by Calit2 Principal Development Engineers Doug Palmer and Don Kimball, hope their work-around will not only allow emergency responders to track their teams more efficiently, but also on the cheap. Their concept is to furnish buildings with strategically placed passive RFID tags -- similar to those embedded in modern library books -- and then equip responders with RFID "readers" that send a signal every time they pass by a tag. The system's accompanying user interface includes a map of each floor in the building, allowing those in the command center to accurately pinpoint the location of their roving team members at all times.

In contrast with GPS, radio-frequency signals are not impaired by the metal inside buildings and do not require line-of-sight satellites to function properly. Instead, the readers have three internal components: The reader apparatus itself, a Bluetooth interface and 802.11g interface (also known as WiFi)

"This way," says Molina, "the reader can scan for RFIDs and send everything back through WiFi straight to the server. If the WiFi network dies, the Bluetooth interface is the back-up. The Bluetooth isn't as long-range as WiFi and it's slower, but with it you don't need to worry about WiFi access points," which might be disabled in the event of a major disaster.

And the reader needn't have a big, bulky battery, Molina adds, "because firefighters only have one hour autonomy with oxygen tank."

WIISARD's approach deviates from a previous methodology used in

disaster scenarios: First responders wear RFID tags on their person and are tracked by readers scattered throughout a building. By turning that idea on its head and reducing the number of expensive readers required for tracking, the WIISARD team hopes to save public safety institutions money.

The only questions now are where in the building to place the RFID tags -- and where, amid all their heavy gear, the responders should wear the readers, which are about the size of two stacked Blackberry cell phones.

“The typical responder going into building is a firefighter wearing gloves, a respirator, a helmet, boots, breathing equipment --- and now they would have to wear this reader on top of everything else,” notes Hubenko. “We were considering placing it on their breathing apparatus, but a better idea is to place it on somewhere on their boot, because boots are close to the ground and heat rises.”

That’s the same reason the ground -- or more precisely, the area underneath a building’s carpeting -- might prove to be the ideal placement for the RFID tags.

“Now the question becomes: Is this a new design consideration as new buildings are built?” asks Hubenko. “Do you put the tags under the carpet, do you put them under the light switches?”

For now, WIISARD has placed the prototype tags in various locations throughout Calit2’s UCSD headquarters at Atkinson Hall, where they are routinely tested as part of an iterative development cycle.

“Once in a while someone will walk around with a reader and do demos,” says Molina. “We’re working on scaling the device down so it’s more wearable. We test every time they make antenna smaller, for example, and we test to see if we can still track the tags efficiently if we

put them at knee level. One thing we've found is that as soon as we stick them on doors, something in the doors themselves reduces the capacity of reflection of the tags."

In November, the team plans to test its prototype system and get usability feedback from collaborators at the San Diego Naval Training Center. In the long-term, Hubenko says she could also see the RFID tags and readers used for other applications, such as supply or asset tracking.

"When you think about it, though," she adds, "in this application the assets are the first responders."

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