INNOVATION

Seeing the Light

A prototype system developed by Mitsubishi Electric Research Labs could make losing items within a warehouse a thing of the past.

The RFIG system could enable companies to locate a specific case or pallet by combining RFID and a light projector.

It's a fact of life that almost every company misplaces items within its own warehouses and distribution centers. While an RFID system can indicate that an item is in a general area, it cannot identify its precise location. But research scientists at Mitsubishi Electric Research Labs (MERL), the North American R&D arm of Japan's Mitsubishi Electric Co., have a bright idea for pinpointing items using light.

A team at MERL has developed a system called Radio Frequency Identity and Geometry (RFIG), which provides the precise location of a specific item and a visual cue that enables an operator to find it. Although the system is a few years from commercial availability, here's how it works.

RFID tags with tiny photo sensors are placed on cases of product or individual items before they're stored in a warehouse. To find the precise location of misplaced items or specific boxes, an operator walks around with a handheld device that emits 1,024 columns and 768 rows of light. These are projected in an on-off pattern that can be captured by the photo sensors as bits of data.

The box's X-Y coordinates are stored within the RFID tag's memory. If, for instance, an item is located in row five, the device's projector would flash on, off and on to communicate 101, which is five in computer language. The same process is repeated for the vertical column.

The RFID tag transmits its unique identifier—say, a 96-bit EPC—and its X-Y coordinates. (A commercialized system would project light at perhaps 1,000 frames per second, so even if the operator's hand shook, the device would get an accurate fix on the item.) Software in the handheld device would search a database to find information associated with each RFID tag. When it finds the lost item, the projector shines a light on the box, using the X-Y coordinates.

The system currently uses 433 MHz battery-powered tags, because only active tags can be programmed to receive and transmit X-Y coordinates. But the goal is to develop an inexpensive handheld reader that works with passive RFID tags. "Passive tags are ideal for this application," says Ramesh Raskar, a research scientist at MERL. "Photo sensors can be as small as tens of microns, so they can fit on a passive RFID chip. And they require very little power, so they could be powered by energy from a reader."

There are few obstacles to deploying the technology. A handheld RFID location device could be used with high-frequency or UHF RFID tags. The sensors would add

almost no additional cost to the tag, and the projector would add only a few dollars to the cost of an RFID handheld reader.

RFIG holds great promise for picking items in warehouses to fulfill orders. A warehouse manager using the system could scan shelves of product that look identical and pick out those items that have been in inventory the longest. Or a librarian could find books that have been misplaced on shelves or that are stacked upside down.

"Our system provides not just the location but also orientation and changes in the order or position of an item," says Raskar. "These are things that can't be achieved with conventional RFID systems." ◉

CONSTRUCTION

Concrete Use for RFID in Roads

Determining the hardness of newly laid concrete is, well, hard. A variety of factors, including humidity and temperature, can
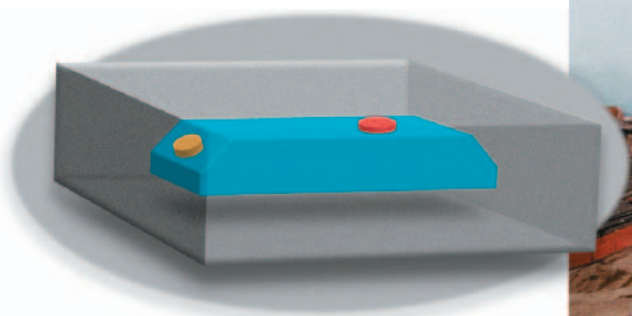
affect the curing process. Today, construction crews test sample concrete cylinders by crushing them, but that doesn't always prove accurate; the cylinders could be stored under different conditions, and the sheer mass of a slab of concrete can affect how it cures.

The Michigan Department of Transportation has solved the problem using RFID. Three years ago, it started working with

Identec Solutions, a Canadian provider of active RFID tags with temperature loggers. MDOT embeds Identec active tags, which operate at 950 MHz, in concrete to get accurate temperature readings for the concrete.

The MDOT also worked with another Canadian company, International Road Dynamics (IRD), which developed algorithms that calculate the hardness of fresh concrete based on its temperature. Identec's tags and the IRD software are sold as a package by a Michigan company called Wake, which offers a PCMCIA reader that turns an HP iPAQ or other PDA into a handheld hardness detector.

The active tags can cost from $40 to $70, according to Warren Atkins, Wake's president. But road crews need to place only four or five tags in a stretch of concrete laid in one day to get an accurate reading of its maturity. Atkins says the system can save construction crews one day of time per week because once they determine the concrete has reached the proper hardness, the next step in

Testing the maturity of concrete with RFID tags could deliver hard savings.

the construction or repair process can begin. Crews complete their work quicker, commuters get back on the road sooner, and the MDOT winds up with hard savings. ◉