Small Feats

Tiny MEMS technology set to deliver big bar code scanning benefits

By John Burnell

Photo: John Gallagher.

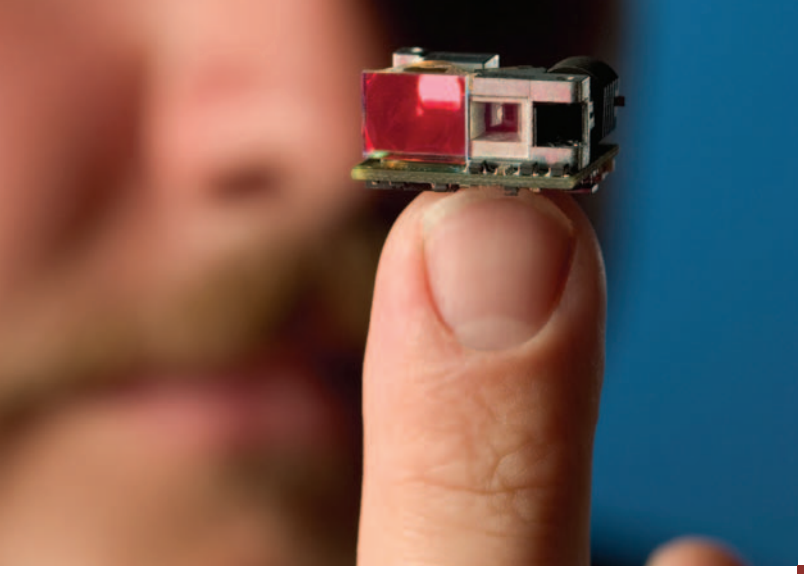
On a rainy night a deer emerges from the darkness and darts in front of an oncoming car. The driver instinctively slams on the brakes with such force that the airbag deploys, saving the driver's face from smashing into the steering wheel. But the car doesn't skid on the wet road, because a sensor instantly activates the antilock breaks, enabling the shaken but unharmed driver to safely pull over. In seconds, the deer is gone, disappearing into the night. Unseen devices that work reliably in milliseconds kept the driver from harm by detecting the rapid braking, deploying the airbag and engaging the antilock brakes.

Every time you get in a car, you trust your safety to a technology you've probably never heard of. MEMS (microelectromechanical systems) sensors monitor speed, acceleration and deceleration; automatically activate antilock breaks when necessary; and in an emergency will deploy vehicle airbags. Other MEMS devices operate tire, blood pressure and other sensors, help provide sharp, clear images from projection systems and televisions, control the spray from inkjet printers, provide switching in optical networks, and deliver real-time battlefield images and information to U.S. soldiers in Iraq. Millions of MEMS devices make life safer and more convenient around the world each day. Most of these MEMS devices are smaller than a quarter—remember, the first "M" in MEMS stands for "micro."

MEMS combine electronic circuitry with miniaturized mechanical devices—sensors, gyroscopes, actuators, motors, pumps and other components—on a silicon substrate that can be smaller than a grain of sand. MEMS production processes are well-proven, mature and similar to those used for silicon wafer manufacturing. Earlier this year one manufacturer, Analog Devices, shipped its 200 millionth MEMS device and has ramped production to a million devices per week. MEMS is a nearly $10 billion global industry. In the MEMS industry, only the devices are small.

In what could be called "a small step for MEMS technology, but a giant leap for scan-kind," Intermec is the first to offer MEMS-based bar code laser scanners. Intermec's first MEMS laser scan engine, the EL10, is about the size of a sugar cube. It includes all the optics, mechanics and processors needed to scan and decode linear and select 2D bar codes in a shock- and drop-resistant package measuring 0.44 inch (11.1mm) high, 0.68 inch (17.2mm) deep and 0.81 inch (20.6mm) wide.

A major differentiator between traditional laser scanners and MEMS devices is the construction of the



scan engine. Traditional lasers use a motor-driven mirror (or mirrors) to direct the laser light. The mechanical mirror and motor are a leading source of failure and are a limiting factor on scanner durability, speed and size. In the EL10 MEMS scanner, the mirror is etched directly on silicon and uses a unique method of oscillation that requires less power and offers increased speed, as well as 2-D matrix scanning capability. Furthermore, the very small MEMS mirror installation in the EL10 enables separate emission and collection mechanisms while maintaining a very small overall engine size. Traditional motor-based laser engine designs use the same large mirror to emit and collect the light even though a lens would be a much better optical choice for collecting light. The size of the mirror and motor is just too large to allow separate mechanisms for emission and collection to be designed into the engine package. Employing MEMS, the EL10 overcomes this limitation of large retro collection mirrors and supplies a lens for the most sensitive and efficient light collection.

"MEMS technology already is used in mission-critical applications around the world," said Dr. Harald Schenk, deputy director of the Fraunhofer Institute of Photonic Microsystems, a leading European research institution that collaborated with Intermec on MEMS scanner development. "Now, as a result of our work with Intermec, we are able to extend the benefits of MEMS to bar code applications."

It's not so much the size of the MEMS scanner that matters—it's the performance. The EL10 is already five times faster than common, traditional laser scanners and has about the same range and power requirements. But unlike traditional laser scanning technology, which has been manufactured and refined for about 30 years, MEMS scan engines are just at the beginning of their development cycle. That leaves a lot of room for technological advancement.

It also leaves a lot of room for integrating MEMS scanners into other devices and new applications. As with other technologies, the value and adoption of bar coding grow as the size of the device shrinks. MEMS scan engines will deliver value by removing size and weight from mobile devices, improving ease of use, and extending battery life. The tiny form factor also lends itself into integration of new types of devices and environments. Intermec will first begin offering MEMS scan engines in its 700 Series mobile computers and extend the technology throughout the data collection product line. Intermec customers have been using MEMS scanners for more than a year in various applications around the world, and

scanner performance and reliability have been outstanding.

"This approach to laser bar code scanning launches a new era in laser scanning capabilities," said Intermec Chief Technology Officer Arvin Danielson. "By combining the proven technical capabilities of MEMS technology with Intermec's expertise in automatic data collection, our researchers have developed a high performance and reliable option to currently available laser scanners."

Intermec will leverage advances in MEMS research and development to greatly expand its MEMS scanning capabilities. There is a vibrant MEMS development community of researchers from numerous fields. Researchers are studying how implantable MEMS devices could take over the functions of damaged optical cells to prevent blindness and restore sight. MEMS-powered bio-submarines also have been considered; the devices would be injected into the body to seek and destroy diseased cells, help the heart pump blood, or assist other organs. Intel has spoken of cell phones that have all the wireless protocols a user could want packaged in a single MEMS chip. MEMS has also been proposed for wireless mesh networks, for smart toasters that detect when the slice is perfectly browned and for environmental monitoring—beyond sparing the deer in the headlights. ▮

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