Georgia Tech

Research News

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**THE EYES OF NEW MACHINES:**
**LOW-COST MACHINE VISION SYSTEM EXPANDS**
**USES FOR AGVs, ROBOTS & AUTOMATED INSPECTION**

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Color Photo Available

Researchers at the Georgia Institute of Technology have developed a low-cost integrated machine vision system which they believe could expand applications for machine guidance and automated inspection systems.

"We have a fast vision system that for a few hundred dollars can do the job of machines costing thousands of dollars," said Dr. Steve Dickerson, professor of Mechanical Engineering at Georgia Tech. "You could use this anywhere you need a gray-scale machine vision system."

The system is relatively simple and inexpensive because it does not produce a video picture. Instead, the vision system generates digital data on the location of bright spots used as "landmarks" to direct robotic arms, automated guided vehicles or parts retrieval systems. Because the spots occupy only a small portion of each scene, the camera scans only those areas, reducing the amount of analysis the system must do -- and speeding up the process.

"We can dynamically change the part of the picture we are digitizing," Dickerson explained. "We can change the area we are recording, which gets us into a higher speed of operation."

The system was developed in Georgia Tech's Material Handling Research Center for guided vehicles and storage systems, but Dickerson believes it also may be modified for use in automated inspection systems, especially for demanding electronics applications.

The camera uses a CCD imaging chip, standard for video cameras. Instead of an optical lens, however, the camera uses a tiny pinhole to admit and focus the light.

A strobe is fired into a mirror located on the camera. The reflected light illuminates "landmark" spots made of special retroreflective material (also used in traffic markings) which return the light sent to them by the strobe. Because of their high reflectance, the spots are easily seen by the camera -- especially since the pinhole dramatically reduces the amount of light entering it.

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Instead of using all its photodetectors to create an image, however, the camera can selectively scan only the rows it needs to determine the location of the landmarks. This selectivity gives researchers highly accurate information about the location of the bright spots and dramatically reduces the amount of data generated. Data from the CCD chip is converted to digital form, amplified and loaded into a self-contained computer for analysis.

"Unlike most cameras, we have complete control over exposure time, which lines we scan and how far we scan," explained Dickerson. "Because we have loaded this information directly into memory, we can immediately do the analysis."

In addition to the selective scanning of the CCD chip, the system further reduces information demands by isolating the reflective spots, which are hundreds of times brighter than their surroundings.

The initial application for the integrated vision system was in directing automated guided vehicles through an industrial facility. By taking its bearings as needed from reflectors placed on the walls or ceilings of a building, an AGV could accurately find its way without the need for guide wires or stripes on the floor. Location information can be processed in less than 1/50th of a second.

The landmark tracking would allow AGV routes to be easily changed, and would avoid costly modifications to factory floors.

Dickerson said the system could also be used to guide the movement of robotic arms, or to help machines pick parts. Because the components needed to build it cost less than $200, he believes the vision system can open up new applications in these areas.

"Much of our work has involved keeping the cost under control," he said. "Once you get the cost of an integrated vision system down, there are many more applications."

The cost may facilitate other applications, especially in industrial inspection. One important area would be in the electronics industry, where the placement of thousands of tiny mounds of solder must be examined.

Improper placement of solder or an incorrect mixture of solder and flux could cause failure of the electronic device. Dickerson believes the camera could be modified to handle such inspection quickly and inexpensively.

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