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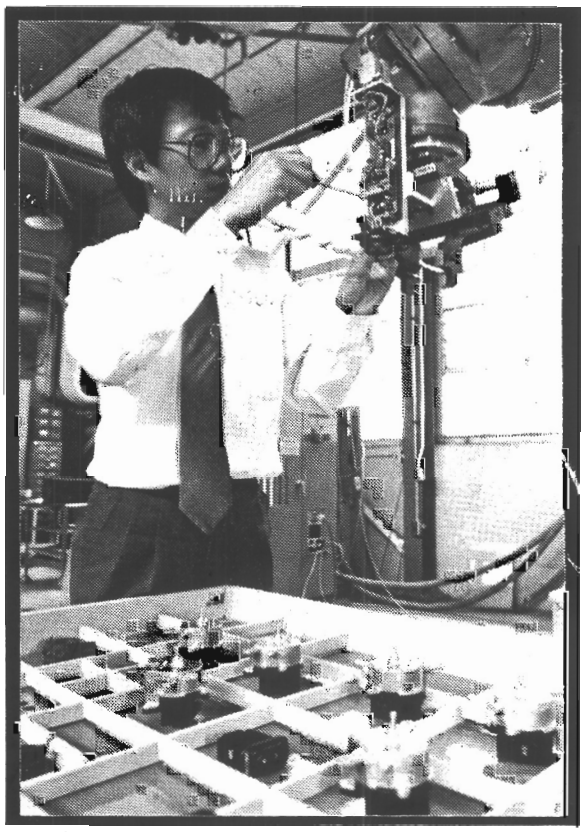
NEW VISION SYSTEM FOR ROBOTS COULD REDUCE MANUFACTURING COSTS

Feeding parts to assembly robots could become less complicated and costly, thanks to a vision system that includes components as simple as a pinhole camera and reflective paint.

Application of the system to manufacturing ultimately could reduce production expenses by eliminating the need for creating custom equipment each time a robot works with a different part, says Dr. Kok-Meng Lee, associate professor of mechanical engineering at the Georgia Institute of Technology. Lee is also a project director in the school's Material Handling Research Center (MARC).

"Right now, every time you have one product you want to make, a significant portion of the whole assembly system has to be redesigned," said Lee, who is developing the integrated vision system with Tech mechanical engineering professor Dr. Steve Dickerson. "The idea here is to make it so you can change the parts very easily."

The Generic Retroreflective Integrated Parts Pick-up System (GRIPPS) uses a digital camera mounted on the arm of the parts retrieval robot. An outline of each part is programmed into the system's memory.



Dr. Kok-Meng Lee works with a vision system that could reduce the complications and costs of feeding parts to assembly robots. (Color Slides/B&W Prints Available)

The actual parts are then put in a simple, low-cost tray coated with retroreflective paint and placed near the robot. The highly reflective paint provides the camera with a high-contrast, two-dimensional image of the parts, which it

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matches to the pre-programmed outlines in its memory. The robot then uses that image to locate and pick up a part, no matter what position the piece is in. The machine then places the part in the correct spot -- depositing a switch in a hole on a dashboard, for example.

Using the integrated vision system in manufacturing could free assembly lines from many of the strictures governing today's robotic manufacturing processes. Currently, automated guided vehicles (AGVs) deliver parts to robots in trays specifically designed to hold several copies of one particular part in the same precise position. Each AGV must place its tray a certain way on a table near a robot.

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>
> ***--Dr. Kok-Meng Lee***

"If you misorient a part, the robot will miss it," Lee said. "Any misalignment will cause a problem, especially with finished parts that only lack assembly and might be scratched."

Each time the robot has to assemble a new part, a new type of tray must be created, Lee added.

"We have eliminated human assembly, but we have to hire engineers to design the trays," he said. "That involves a cost."

The new vision system allows a flat, four-sided, compartmentalized tray to be used in assembling any part. In fact, a variety of different parts could be put in a single tray for the robot to assemble one after another -- all the parts that go into a car dashboard, for example. The parts could be placed in the tray in any position or order and the robot would still recognize them.

A big difference between the GRIPPS vision system and others is that it is designed for robots, which do not need the expensive images humans enjoy that can cost $50,000 to $80,000 per assembly machine to produce. Instead, the camera provides the robot with dull but recognizable gray-scale images. The extra light reflected by the painted tray adds definition to the pictures. This simple view is all the robot needs, Lee said.

"We want to have something costing less than $5,000," he explained. "It has to be fast, reliable and accurate. It also should be flexible -- it's got to be flexible to program easily."

The new system is also fast. A robot using it could conceivably assemble a number of items within one second, whereas current systems require four to 10 seconds to place one part.

The researchers are currently working on integrating the GRIPPS software from an external computer to one inside the vision system on the robot's arm. They are also developing guidelines for parts that are easier for machines to grip and are considering the use of stereo, or three-dimensional, vision, and how to employ the shadows that come with it.

"The silhouette becomes larger than the part," he said. "But ultimately, when we use stereo vision, the shadow may be good for telling the computer the height of the part."

Dickerson and Lee have applied for a patent on certain aspects of the vision system Lee is working with, which was developed at MARC on behalf of its member companies. GRIPPS research also was sponsored by General Motors, Ford Motor Company and the National Science Foundation.

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