Cognitive Sciences Explored in Chicago

The beauty of being a cognitive scientist is that, while trying to learn how people think, or to build computers that mimic the human brain for use in industrial robots, you get to sample a rich broth of scientific pursuits: linguistics, anthropology, and philosophy as well as psychology and, of course, computer science. Experts in—and "tasters" of—all of these pursuits mingled at the University of Chicago from 7 to 10 August during the thirteenth annual Conference of the Cognitive Science Society. Here are some of the highlights that drew 500 researchers to the meeting.

Computer Vision Moving Closer to Reality

The buzzword is "active vision." That's what robots need if they are to identify and target enemy missiles, harvest fruits and vegetables, serve as mechanical housemaids, or explore space or the sea depths. In any such application, the challenge for computer vision systems is to pick out specific objects from a wide and changing field of vision. But until recently, such active vision systems have existed largely on paper because of the enormous number-crunching required and the costs of the systems' various components.

That's why participants in a workshop dcvotcd to the topic at the cognitive science conference were quite excited by the great strides being made in two critical areas: the development of algorithms that allow computers to select desired images from a visual melange and the miniaturization of the cameras that serve as the robots' "eyes." Where progress is still needed, says Pete Bonasso of the MITRE Corp. in McLean, Virginia, is in the development of compact, lightweight power sources, especially for robots that would move out on their own—in unmanned vehicles for exploring planetary surfaces, for example. For that reason, computer vision is more likely to be used first in applications, such as spotting speeders or red-light runners, where the system as a whole doesn't have to move.

When researchers first tried to build computer vision systems, they ran into trouble, says computer scientist Michael Swain of the University of Chicago, who chaired the workshop, because they designed their machines to "look" at everything in their visual were unable to process the large amounts of information in the vision fields fast enough to allow the robots to respond in real time. So much of the recent progress with the algorithms came with the realization that the machines' vision can be more selective. "The new rules for the design of computer vision are that you don't have to know everything, everywhere," Swain says. "You need only information that meets the goals of a particular behavior."

Eric Schwartz

In a nutshell. *The miniature camera, measuring 0.3 x 0.3 x 0.4 inches, may one day help catch red-light runners.*

Take the system designed by Eric Schwartz of New York University and his colleagues. It uses a program that enables it to survey a wide field of vision, but focuses clearly only on objects in the center of the field. That, of course, could have its downside, so the system was also designed with "attention algorithms" that detect action at the periphery, thereby telling it where to look next.

Schwartz's group has also attacked the problem of camera miniaturization. At the workshop, the team unveiled a piece of nifty hardware: a miniature video camera, small enough to slip inside a pistachio shell, that could serve as the system's eye. In fact, Schwartz envisions his system in actual use—catching red-light runners. It will first read the lawbreaker's license plate and then the computer will write a ticket on the spot. Other potential applications of the camera chines and as a built-in target finder for guns.

But while these algorithm and camera improvements have helped reduce the size of the hardware needed to run robots, further reductions are needed if the hardware is to be used in more mobile robots. Consider the problem encountered by MITRE's researchers. They've just built a robot with a state-of-the-art active vision system that may eventually be used to help an unmanned space vehicle avoid potentially lethal obstacles. But their prototype robot was a clumsy, rough-moving device, burdened by 10 pounds of computers and about 100 pounds of batteries needed to power it. So the engineers still have their work cut out for them as they try to build mobile and all-seeing automatons.

Computer Learning Gets Mixed Grades

For about 2 decades, computers have been touted as tomorrow's helpful assistant to the teacher. Students of all ages could learn much better—or so the theory goes—with the aid of computers that could simulate such real-life experiences as flying an airplane or conducting an ecology experiment. They could get immediate feedback on how they were doing, and the simulations would be cheaper (and in the case of flying, safer) than the real thing.

But while such computer-assisted learning works quite well in some situations, usually with adult professionals such as pilots, it hasn't been completely successful so far with the inhabitants of kindergarten to grade 12, according to a panel at the cognitive science conference. The panel members, all from Apple Computer's labs in Cupertino, California, conceded that, in trials of their own software as well as that of other manufacturers, "big problems" had been encountered in constructing simulations that work well for youngsters.

The main problem seems to be that schoolchildren, many of whom cut their computer teeth on "Super Mario Brothers" and other video games, get seduced by the whiz-bang nature of the technology, says Apple's Wayne Grant. He cites as examples experiences with two schoolroom simulations adapted for use on Apple computers. One is a program that explores the predator-prey relations between ants and beetles and the other probes the environmental impact of dam construction. Instead of patiently changing variables, such as ant-colony size or the health of the ants, one at a time to see how each affects the beetles' ability to prey