Technology

A leg up for Logo robotics

Children in many elementary schools are already familiar with the computer programming language Logo. Using simple sets of commands, a child can instruct the computer to create and manipulate images on a display screen. Now researchers Stephen Ocko and Mitchel Resnick of the Massachusetts Institute of Technology's Media Laboratory have developed an extended version of Logo, which children can use to program a computer to operate machines they have built themselves.

"Kids don't get enough chances in the classroom to be inventors," Resnick says. The combination of the new version of Logo with LEGO building pieces (including motors, gears, wheels and sensors) provides a novel outlet for this creativity. Children can build model cars, elevators, toasters and other mechanical contraptions; then, using computer commands such as ON (turn on the motor) and RD (reverse the motor's direction), they can control their machines.

To make the system work, Ocko and Resnick developed an interface box for connecting LEGO machines to an Apple IIe computer, a special circuit board that fits into the computer itself, and the necessary software. After extensive classroom testing, the initial LEGO/Logo package has just become available commercially. Resnick demonstrated the system at a recent Human Factors in Computing Systems conference.

By teaching engineering design principles, the system moves the curriculum into areas not usually covered in schools, says Resnick. Ocko and Resnick are now studying ways of improving and expanding the system. One possibility is the addition of magnetic and other types of sensors to the optical and touch sensors already available so high school students could build their own instruments for laboratory experiments.

The researchers also are looking into ways of modifying Logo further so a single computer can operate several machines at the same time. Another way of operating a fleet of robots is to use "program bricks," which could be programmed by being temporarily connected to a keyboard and display screen, then disconnected and plugged directly into a machine.

"We're trying lots of different things," says Resnick. "Both of us regret we didn't have things like this when we were growing up. It's a chance for us to be kids again."

Quick prints for textiles

Fashion is fickle. The cartoon superhero that appears on matching sheets, pillowcases and curtains sometimes has a shorter lifetime than the time it takes to design, print and distribute the fabrics. To shorten the time it takes to produce new patterns, Fred Cook and his colleagues at the Georgia Institute of Technology in Atlanta are studying the possibility of using photocopying machines, similar to office copiers, to print designs on fabrics. Such a technique would replace existing water-based printing processes that rely on metal rollers to apply the necessary colors. The textile photocopier project is part of a larger effort to save energy in the textile industry by reducing the amount of water used for processing.

Photocopiers work by putting an electrostatic charge on a metal drum. Light reflected from the document being copied modifies the charge, creating an invisible, electrostatic image of the document on the drum. Particles of toner — a blend of pigment and binder — stick to the charged areas, and the whole image is transferred to paper or fabric. Heating fixes the pattern.

Cook's team has modified standard office copiers to use toners appropriate for cloth and to print continuous images onto moving sheets of material. Within the next few months, they expect to test a computer-controlled system of three photocopying machines designed to lay down three different colors to create more complicated patterns.

ER fluids: The plot thickens

Imagine turning a liquid into a solid at the flip of switch. That's what a class of materials called electrorheological (ER) fluids can do. When these fluids — made of particles suspended in oil or other nonconducting liquid — are put in an electric field, the particles stick together and the flowing liquid becomes increasingly viscous, sometimes to the point of solidifying. Research on ER fluids, discovered in the 1940s, has been jealously guarded by companies that see an estimated $20 billion a year market for improved valves, clutches, brakes and other hydraulic devices based on ER fluids. Such devices promise lower costs, better performance and more precise control if the electric field is directed by a computer.

But the problem with most ER fluids developed so far is that they contain adsorbed water, says Frank E. Filisko at the University of Michigan in Ann Arbor. This means that at the high temperatures often found in engines, the water boils off, and if the ER effect depends on the presence of adsorbed water, the fluid will not operate. Moreover, the escaping water can corrode the device and lead to "thermal runaway," in which the fluid gets increasingly hotter while more current is needed to maintain the electric field.

Last month, Filisko received a patent for a class of ER fluids he says can operate without adsorbed water, and in fact contain less than 1 part per million of water. Made with aluminosilicate ceramic particles, the fluids operate above water's boiling point and beyond at least 120°C. Success, he says, involved finding materials whose structure and chemistry do roughly what he suspects the adsorbed water does in other ER fluids.

Researchers at the Cranfield Institute of Technology in Cranfield, England, already have announced making an ER fluid containing less than 5 percent water. According to team member Jeff Kelly, their fluids, which consist of semiconducting particles or polymers immersed in oil, operate at temperatures between −30°C and 200°C. Filisko, however, contends the Cranfield group has not proved the fluids can operate without water.

In general, scientists are uncertain how ER fluids work. The Cranfield group believes that the electric field impedes the particles in their fluid from rotating — something the particles normally do when the fluid is flowing — and that this in turn makes the fluid more viscous. Another theory holds that water molecules form strong bridges between the particles. Filisko believes that neither of these ideas explains his fluid, but without more work he is reluctant to discuss his own model.

Whatever their disagreements over mechanisms, most scientists agree the possible applications of ER fluids are enormous, and not only for the auto and machine industries. "We have the potential of directly connecting tiny hydraulic flow devices to a computer brain [for making agile robotic fingers and other robotic machines]," says Filisko. "Ultimately a whole new generation of devices is going to develop out of this."

Nearly an open-and-shut case for DEZ

The Library of Congress estimates that 25 percent of its 14 million books have become so brittle from acids in their pages that they can't be handled. To save the rest of its collection, Library chemists are developing a process using diethylzinc (DEZ) vapors to deacidify paper (SN: 3/5/83, p.154).

In a recent report, the Congressional Office of Technology Assessment (OTA) put its qualified stamp of approval on the DEZ program. While finding that the program has a high potential for success, OTA says more data are needed to determine how long DEZ treatment will extend a book's life. The DEZ process also needs testing to compare it with alternative deacidification techniques, OTA says. A full-scale DEZ plant is scheduled to be built and operating by 1991.