Hands-On Learning at Motorola

Production line workers learn about automation as they program robots in Motorola's new learning lab.

By Alex F. Cheng

When employees walk into Motorola's Programmable Automation Literacy (PAL) lab for the first time, they see 10 neatly arranged workstations. Each station has its own five-axis robot, machine vision system, operational electronics board for sensors, and personal computer.

To most of the trainees, the technology is unfamiliar. Many have been manual assembly workers for years and have never touched a computer, let alone programmed a robot.

Motorola Inc., which manufactures cellular phones, pagers, and other electronic products, opened the PAL lab last year to teach automation concepts to factory workers and to provide them with practical, hands-on, laboratory-based training. One of Motorola's goals is for manufacturing employees at all levels to achieve literacy in modern automated factory concepts.

The PAL laboratory is at Motorola's Galvin Center for Continuing Education in Schaumburg, Illinois—a location isolated from the factories. The intent was for students to train in a relaxed environment that encourages learning.

Before entering the lab, employees receive a two-hour introduction to factory automation, including an overview on why Motorola considers Computer Integrated Manufacturing (CIM) important to the future success of the company.

As soon as trainees start becoming familiar with the new vocabulary and concepts, they are introduced to the PAL lab to face the array of automation hardware.

Hands-on experience

Training managers at Motorola knew that an introductory course on factory automation would be just so many words, especially to employees who were not computer literate. The training had to include hands-on keyboard experience in which students could make things happen.

To begin, trainees pair up at the workstations. They are then led step by step through the different types of equipment and computer controls. The sequence is designed to be fun and non-threatening.

Guided by a very simple menu on their computer monitors, the trainees start by using the robot jaws, or gripper, to measure the width of a plastic part. The computer monitor displays the dimension of the part. Trainees press a key on the computer keyboard to set up the measuring function, grasp the plastic part with the gripper, and finally, watch the jaws close on the part. The simple exercise is a significant first step for those who have never used a computer.

Building on their new confidence, the trainees learn to operate the robot themselves, pushing the appropriate buttons to make the arm move. The next step is robot programming. Trainees plan a series of robot motions to pick up and move an acrylic block. They must "teach" the robot to remember key positions. The trainees can test and run their programs many times.

For most trainees, operating the robot is their first introduction to programmable factory automation. They usually find it easier than they anticipated, and they enjoy working with the robots.

The next exercise shows how metallic and optical sensors can tell the difference between a penny and a plastic part. Trainees interact again with the computer to execute the test. Zeros on the screen change to ones when a particular sensor is activated. The penny will trigger both the metallic sensor and the photocell light beam, while the plastic part acts only on the light beam.

From the first simple steps, the trainees advance logically, and more confidently, to making the robot move, through programming or through triggering from the external sensors. Trainees see how a machine vision system can be taught to recognize the silhouette of the plastic part. They learn how to teach the robot arm discrete motions with a pendant controller and the keyboard. In the process, they gradually become conversant in modern automated factory terminology.

By the end of the program, assembly workers who had never dreamed they could understand a computer are excitedly programming their robots in creative ways. Many ask specific questions about applying robotics to their own jobs on the line, exactly the connection Motorola trainers expect and want students to make.

Linking training equipment to the job

Before Motorola set up its new automation lab, PAL's director, Aaron Agrawal, and other company executives visited industrial training centers around the world.

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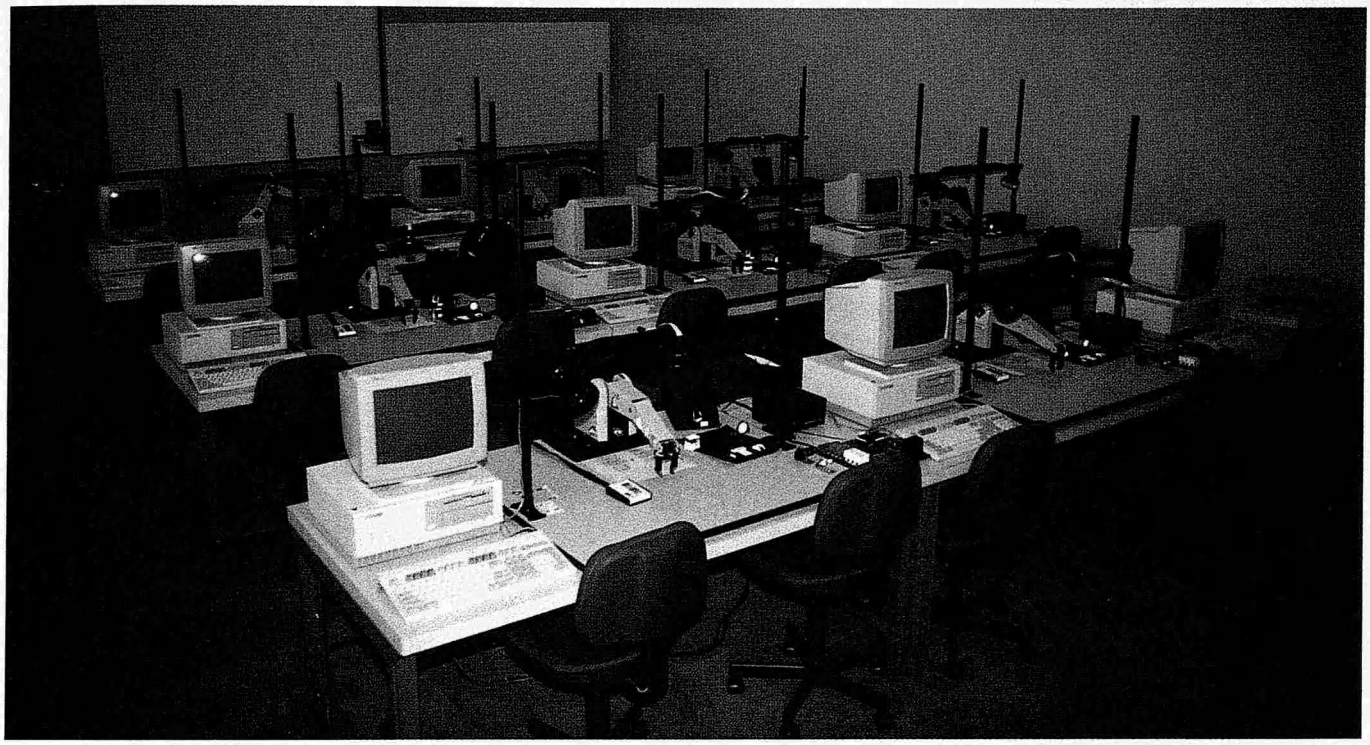

Agrawal emphasizes that equipment in such training labs must be oriented to education. "We saw many training centers with industrial automation equipment that was impressive but could be intimidating for beginners," he said.

Agrawal observed two common flaws in many of the technology training programs at the industrial facilities he visited:

- The programs showed a lack of understanding of how people learn.
- The equipment at the centers was not conducive to learning.

Agrawal decided that using real industrial equipment in training would be too expensive and too complex, as well as potentially intimidating to trainees. Arthur Paton, training project supervisor at Motorola, stressed the importance of self-confidence in learning advanced technology, saying that people first have to be convinced they are capable of learning technology before they can learn it.

Motorola's training program builds on its factory workers' knowledge of everyday technology, and that foundation of knowledge is extended to the lab's technology. The training equipment has the features of industrial equipment but is smaller and easier to operate.

Although smaller, the lab equipment had to be designed to resemble its industrial counterpart in form and function. The similarity provides a link between the training and the knowledge participants will use back on the job.

"In terms of laboratory use, concepts should be introduced in small, logical steps, and they should be fun," advises Agrawal. "After our students finish programmable manipulation and working with sensors and control concepts, they can see it all come together in a table-top factory. There they can watch a custom product actually being made with automation techniques."

The product produced in the table-top factory is a colorful memo holder, fabricated and assembled before the workers' eyes. Each trainee programs the factory to manufacture the product. Each trainee selects a color combination and engraves his or her own name on the holder. Some of the plastic parts used are the same ones that were used in the lab.

Once employees have learned the principles at the workstations, the table-top factory acts as a finale to the training.

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The ultimate test

Motorola set up its training center as a service to be used by manufacturing operations personnel as they wish. The ultimate test of success is acceptance by those individuals. Motorola has to sell its programs and convince manufacturing supervisors that it is worthwhile for their people to take the training offered.

Agrawal was asked what happens when assembly workers go back to the factory after automation training on robots. Would they view their old line jobs as tedious?

"Not really," he replied. "We think that after supervisors and their line workers learn automation concepts, they won't take current procedures for granted. They'll question inefficiencies and work together to improve processes, at the same time improving their own jobs. As for individuals who really get turned on, Motorola certainly has opportunities for them to move into new positions involving a variety of computerized and automated operations." ■