A future within reach

by Dina Lebo

Science fiction author Arthur C. Clarke once said, "The future ain't what it used to be." This definitely applies to the future as it is viewed by York professor Michael Jenkins.

Jenkins, a specialist in vision robotics, is currently working on a mobile robot that can see. According to Jenkins, sighted mobile robots have many potential uses, including a wide variety of applications in manufacturing and heavy industry. They could be useful not only on the production line but as visual inspectors as well. They would also be able to work in hazardous environments where poison gas or radiation might threaten human workers.

Is there an R2-D2 in your future? Probably not, says Jenkins. "Their real life cousins still lag way behind their science fiction counterparts." However, he doesn't deny that the science of robotics is quickly advancing. "I've seen some very impressive robots that move from office to office delivering mail. The robot will enter and stop right in front of your desk."

Yet, while Jenkins admits that it is impressive to look at, "the technology is not. It's old technology really and not much more evolved than the systems which run our transits and subways." With the robot described above, Jenkins explains, "There are runners, rails or electric bands and hidden junctions running along the floor, hidden under the carpet." Jenkins also emphasizes that the robot's tasks are quite limited and that such systems are not intelligent because they don't know anything about the environment. And, practically speaking, there are a lot of places where you can't lay down floor runners.

Eliminating tracks changes the entire technology, says Jenkins, because the challenge then becomes creating a free thinking machine that senses its environment and makes real decisions based on data. This is where the money and energy for research have recently been focused.

Talking about vision, Jenkins comments on how we, as people take our eyes for granted. "A person [can] walk into a room and, without thinking, can identify where the tables, chairs and furniture are located," Jenkins explains, "and he can easily navigate around them by judging distances." While the individual is not even aware of the process which allows him or her to perform this simple task, "the human eye recognizes an object by detecting its outline. Because there are two eyes," he says, "the two different perspectives give the image depth. To create an intelligent autonomous machine, we have to give it that ability."

Jenkins points out that "no computer has been able to completely simulate the working of the human visual system, let alone co-ordinate it with life-like movement." In addition, he says that no computer has ever had a sense of smell, and a computer's touch lacks the sensitivity and dexterity of the human hand. What's needed are state of the art sensors that approach the exact combinations of messages that the human brain normally receives from the senses. This kind of investigative research is leading to some very exciting possibilities.

Robots are slowly becoming fixtures in many types of business, as demonstrated by a story in a recent New York Times article.

With nurses in short supply, it appears that a Connecticut hospital has utilized an offbeat aid to help its overworked staff. Roscoe, a three foot high robot, was designed to deal with the drudgery of meal tray delivery, as well as the retrieval of laboratory samples and medical files.

It seems that all has not gone well for Roscoe, who has quickly learned that hospital halls are tricky and cluttered mazes. He has been back to the drawing board more than once for enhancement of his vision sensors and software. While Roscoe's inventors knew about such barriers as food carts and laundry baskets, they didn't anticipate "obstacles such as intravenous bottle stands with jutting tripod legs that tripped the robot."

The major problem facing Roscoe's designers, as well as Jenkins, is the question of how to programme a machine with these human sensory capabilities. As one can see from Roscoe's experience, it is not easy to duplicate the human mind.

The relatively new science of vision robotics is currently focusing on three different methods of giving robots the ability to see.

The first method is sonar based technology. It is sonar that enables the Polaroid camera to take perfect pictures and beep when you are the right distance from your subject. The beep is the result of sound waves emitted by the camera which bounce back after hitting the subject. This allows the camera, or robot, to calculate distance.

The second method utilizes laser technology. Unlike sound, laser light waves don't bounce back but change their course when confronted with an object. By measuring the shifts and jumps, it is possible to obtain information regarding how high the object is.

The third method being investigated is the use of television cameras, which process incoming images and interpret them in order to describe the environment.

According to Jenkins, each of the three methods has its own limitations. While lasers are non-functional in a mirrored environment, sound bounces around endlessly when it hits glass. TV cameras can't pick up images in a foggy or smokey environment. What Jenkins and his associates intend to do is create a unit which will combine all three systems. The hardware involved will be fast enough, small enough and powerful enough to allow it to avoid moving objects and take alternative routes if a corridor is blocked.

The project is being funded by Precarn Associates Incorporated, a consortium of Canadian companies who are interested in technological research. Along with their university partners, the companies (with a little help from the federal and provincial governments) are becoming involved in the research of a new technology before it hits the competitive market. Precarn was created to provide a coordinated pool for limited research funds and to avoid duplication of project research. Before Precarn, many companies were involved in the same research, because no company was aware of what the others were doing.

Canada's robotics industry is not large and we lag behind the other western nations. According to a recent edition of *The Globe and Mail*, there were 300 robots in Canada in 1982. This population has grown to approximately 2,700, while the U.S. currently has about 12,000 robots. Japan is the world's robotic leader, with an overwhelming 40,000.

70 per cent of this robot population is being used in automotive plants, where they do everything from welding to painting to material handling tasks. Little by little, however, robots are being integrated into other industries, such as electronics and heavy manufacturing. In the long term, robots can be seen as the only way for businesses to remain cost efficient.

Jenkins' corporate sponsors include Ontario Hydro, Atomic Energy of Canada, the National Research Council and the University of Toronto.

With this much help, the reality of a technology capable of producing an intelligent human machine is drawing near. Eshrat Arjomandi, York's chair of computer science, wants York to grow and become a major player in this complex field. Three years ago, the fledgling department was transferred from arts to the faculty of science. Since then, it has experienced tremendous growth. After hiring 10 new faculty members, it put in place a new space and communications program which draws on the experience of Jenkins and his associates. This year, it started a new graduate programme and has experienced a 30 per cent increase in undergraduate enrolment.

"[We have] all this explosive progress," says Arjomandi, "and we don't have the space to accommodate it. There is not a large enough increase in our operating budget to allow for future growth."

She is frustrated and worried about the administration's lack of commitment. "We are responding to a crucial need in society," she says, "and right now there is a severe shortage of post-graduates, especially at the Masters and Phd. levels.

Arjomandi says she has received letters from major corporations, such as IBM, saying they can't find enough students to hire. "The jobs are out there for students," she explains, emphasizing that "the only people lagging behind [financially] are the people in York's administration."

Indeed, York's 260 first year computer science students pale in number before UofT's 2,000. But this also has its benefits. It allows students to be more individual and less competitive. Due to the small size, the department works in conjunction with several of York's other faculties, such as psychology. Jenkins works with cognitive scientists in the fields of perception and vision because he feels computers must learn from humans and analyze how humans function.

In 1992, York's new science building will be ready for occupancy and computer science and chemistry will be moving in. Ken Thomson, director of technical and non-academic allocation services, says the computer science department will have plenty of room to grow over there.

But Arjomandi emphasizes that the proposed building will already be inadequate to service the department's needs. She feels the administration must sit down and discuss common goals and objectives. If they wait, she explains, York will lose out.

"If you're not at the head of research," she says," then you are a consumer. That's not what York wants to be."