

HelpMate Robotics, Inc.

(formerly Transitions Research Corporation)

Robot Navigation Technology

Robots are frequently seen as exotic, make-believe objects in science fiction movies. They walk, talk, crack jokes and worry about whether they are human or have souls. Real robots are much more mundane, but they are becoming increasingly useful in industry. They do work too tedious or dangerous for humans, enduring tedium without erring and danger without harm. They paint cars in factories without needing protective masks. They transport radioactive materials in power plants without suffering from radiation.

Using Robot Technology for Deliveries in Hospitals

Robots are also delivering medicines in hospitals faster and more reliably than humans can. "Do you really see hospitals and nursing homes starting to use that kind of technology?" an interviewer asked Paul Hoffman of Discover magazine after he demonstrated robot technology on CBS Good Morning America in May 1996. Replied Hoffman: "They do. This company, HelpMate Robotics in Danbury, is already using it in hospitals, right now."

Improved Navigation Capabilities

HelpMate Robotics, using ATP funds, has indeed developed the navigational technology needed to create mobile robots that can scurry around a hospital or other industrial environment. And with other funding, it has built them. This advance, set on the technical foundations laid by robotics pioneer and company CEO Joseph Engelberger, has helped to expand the use of mobile robots throughout the country.

These robots do some of the ambulatory work traditionally done by humans. To work well, the robots must have dependable vision systems that can use light from many different sources and recognize light-shading differences. They have to be trainable (programmable). They must make quasi-intelligent decisions - "Go around the gurney with the patient on it." And they have to be able to report to their human supervisor and ask for help when encountering problems they cannot handle - "There is no one here to sign for the parts."

Specifically, HelpMate researchers successfully developed an improved light direction and range (LIDAR) scanner. LIDAR is a device in the "eyes" of the robot that senses light, calculates direction and determines the range to objects in its path. This is a clear advance over previous technology, which used sonar to detect shapes. Researchers also developed navigation capabilities based on new sensing systems and ways of combining data from different sensors. These capabilities permit the control of robots in quasi-structured environments - places with predefined components such as doorways, light fixtures, windows and elevators that are fixed in place and definable from photos or engineering drawings - and among objects that are not predefined, such as a patient on a gurney and human workers moving about the space.

HelpMate in Hospitals

Most of the ATP-funded technology has been embedded in the hospital version of the HelpMate robot. More than 150 HelpMate robots have been rented by scores of hospitals in Europe, Japan, Canada and the United States. Purchased outright, the robots cost about \$110,000. Most are rented for \$4 to \$6 an hour. If a robot is used 100 hours a week, the annual rental fee is about \$25,000.

Marketing Agreements for Distribution Abroad

Company officials say that ATP funding enabled HelpMate to achieve its research and development results much sooner than it would otherwise have been able to do. The award also helped it develop strategic marketing arrangements abroad. The company has signed an agreement for Otis Elevator to distribute HelpMate hospital robots exclusively in Europe. It has also developed marketing arrangements with other parties in Europe and Japan.

HelpMate raised \$6 million through an initial public stock offering in 1996 and used the money to build production and sales capabilities. A second offering of \$5 million did not go through, and the company had to downsize temporarily. New funding, however, has been committed, which should enable rebuilding of staff and marketing, as well as further work on a home-service version of the robot. In addition, the population of HelpMate robots in the field continues to serve well and will back up the company's renewed sales effort.

Benefits From Robots

Hospitals using HelpMate robots are benefiting. HelpMate Robots are delivering medicines, supplies, prepared food, x-ray images and other material in about 100 hospitals in the United States and Canada. They have lowered the cost and improved the quality of these delivery services. One hospital pharmacy director, for example, reported net annual savings of around \$10,000 per robot per year. In addition, the robots made the deliveries faster than humans did. There are about 150 HelpMate robots in these hospitals, according to company officials. If the savings for each robot to the hospital is \$5,000 to \$10,000 per year, then these hospitals are already realizing an annual savings of \$750,000 to \$1.5 million. The cost savings at the 100 hospitals alone over 10 years would be in the millions. These are savings above the rental cost of the robots. As more hospitals, factories and other facilities adopt these robots, cost savings will multiply.

In addition to these cost savings, benefits accrue to hospitals, physicians and patients through improved delivery service. Not only is robot delivery faster than human delivery, but it is also frequently more reliable, according to hospital officials, because of fewer delivery mistakes.

Robots to Serve the Elderly and Infirm

The analysis above is only for robots already employed in hospitals. For in-home nursing services, the use of robots could generate much larger savings. HelpMate plans to expand the use of the ATP-funded technology by developing robots that can assist infirm and elderly persons at home. But for this application, the company must first solve additional technical problems. These robots must have highly functional arms, improved vision, more sophisticated programming and some speech recognition capabilities. The company has estimated that, if successful, this development could substantially reduce health care costs by eliminating some of the need to hospitalize or hire home help for the frail elderly.

Other Potential Uses

Two industrial applications currently being explored are in computer chip fabrication and clinical laboratory work. In clinical labs, vials containing substances, such as the human immunodeficiency virus, that are highly dangerous to human workers could be moved from one workstation to another by robot. In a chip fabrication plant, robots could move supplies to the fabrication line in response to specific orders from operators. For these applications to be realized, capital will have to be raised to support the additional engineering required to tailor robots to the specific needs of each environment. Lab robots, for example, will need to be built to work without bumping into delicate research instruments and materials, and chip-plant robots must be engineered to operate so cleanly they do not contaminate the superclean rooms where chips are fabricated. In addition to these applications, company officials say, the ATP-funded technology is expected to be used for mobile robots in all kinds of factories and has potential applications in warehouses, maintenance facilities, mail distribution centers and shopping malls (for delivery, maintenance and cleaning services). As in hospitals, the use of robots in these environments is expected to lower costs substantially and improve service

PROJECT

To develop the technology for intelligent, autonomous mobile robots, or "robot carts," that can find their way around a factory, hospital or similar place by sensing and avoiding obstacles and taking alternative routes if a path is blocked. Such robots could reduce costs for delivering materials and supplies in many different environments.

Duration: 6/15/1992 - 3/31/1994

ATP number: 91-01-0034

FUNDING (in thousands):

ATP	\$ 699 44%
Company	<u>875</u> 56%
Total	\$1,574

ACCOMPLISHMENTS:

The company achieved the target navigation capabilities, including successful development of a specialized LIDAR (light direction and range) scanner. Evidence of progress includes the following:

- \$ The company incorporated the new navigation capabilities into its original HelpMate robot and is now producing and selling the upgraded version.
- \$ HelpMate raised \$6 million through an initial public stock offering in 1996, and used it to build production and sales capabilities. (A second offering did not go through, and the company temporarily downsized in 1997. New funding commitments are expected to rebuild staff and marketing.)
- \$ The upgraded HelpMate robot was named one of 36 finalists in the Discover magazine competition for technology of the year for 1996.
- \$ CEO Joseph Engelberger, the principal investigator for the ATP project, received the Japan Prize in "systems engineering for an artificial environment" in 1997 from the Science and Technology Foundation of Japan.
- \$ The company and Otis Elevator entered into an alliance in which Otis is to be the exclusive distributor of HelpMate hospital robots in Europe.

COMMERCIALIZATION STATUS:

Robots incorporating the new navigational technology have been rented or sold to about 100 hospitals in the United States and Canada, and the company has entered marketing arrangements with parties in Europe and Japan.

OUTLOOK:

Since the robots are already in use commercially, the outlook for the technology is excellent, despite a temporary downsizing at HelpMate. The company now plans to expand the use of the technology by developing robots that can provide assistance in the home to infirm and elderly persons, a venture that potentially could save billions of dollars by eliminating some need for hospitalization or professional help in the home. Opportunities exist for applying these mobile robots in factories, warehouses and many other environments. Thus, the potential for future utilization of the technology is high.

COMPANY:

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Number of employees:

27 at project start, 14 at the end of 1997.