

Home is Where the Robot is

Vacuum Cleaners, Security Guards, and Old-Age Companions

Are you ready for a robot in your home? According to a report issued last fall by the United Nations Economic Commission for Europe, household robot sales are “on the verge of taking off.”

The U.N. report outlines the major trends in the robotics market, most notably the move from the factory floor to the home. Robots have been used in industry for decades—we are all familiar with the big robotic welding arms that build cars and other consumer goods. According to the U.N. report, there are about 12,400 robots used for other kinds of professional work—mostly for jobs too dangerous for people (inspections at nuclear sites, demolition work, handling bombs) or tasks that require great precision (surgery, lab work). Others are used for tedious or odious work (milking cattle, cleaning sewers).

But the latest buzz is in domestic robots, such as autonomous home vacuum cleaners. While most of these machines are still in the design or testing phase—like the “DC06” from the British firm Dyson, the “Robo Vac” from the vacuum company Eureka, and an unnamed device from Hoover, all mentioned on the *Wired News* website—at least two companies have put

automatic vacuums on the market.

In late 2001, one of the world’s largest appliance makers, Electrolux, announced the creation of its automatic vacuum, the “Trilobite”—so called because it resembles the prehistoric arthropod. The Trilobite is round and red, about fourteen inches in diameter, and weighs eleven pounds. It navigates with ultrasound, and it plugs itself into a charger when its power gets low. The current price: over \$1,500.

A similar machine, the “Roomba” vacuum, is the same size and shape as the Trilobite but weighs several pounds less and costs just a fraction of the price. Introduced last year by the Massachusetts company iRobot, Roomba moves in a random pattern as it vacuums, and it has infrared sensors that allow it to pick up invisible boundaries set up with a separate guide unit.

Before these automatic devices catch on with a general audience, they’ll have to be affordable, effective, and easy to use. According to the U.N. report, about 21,500 such domestic work robots were sold by the end of 2001, and another 700,000 could be sold by 2005, including vacuuming, lawn-mowing, and window-washing robots.

But there’s no reason to believe that peo-

ple will think of these machines as robots at all. Our homes already contain appliances—like dishwashers and laundry machines—that could be considered primitive robots, but we don't regard them as such. Sure, Trilobite and Roomba might have computer chips in them, but so do our cars, as well as some new microwaves, ovens, refrigerators, and phones—and we don't think of those as robotic. *USA Today* recently called these new machines “digital eunuchs” specializing in “life's little drudgeries.” In other words, just the latest high-tech appliances.

Most of the personal and private robots already on the market are “toy and entertainment robots,” like Sony's robotic dog “AIBO.” AIBO comes in different shapes and colors, with memory, voice, and name recognition, and the ability to follow certain basic vocal commands. In addition to dancing, posing, and playing, the latest AIBOs can take pictures and check e-mail.

Some animal-shaped robots are finding their way into the workplace, like the odor-detecting “Banryu” (guard-dragon), which two Japanese firms are releasing this year. More intriguing is the increase in the use of human-shaped robots in places of business, where they work as security guards, guides, or receptionists in some offices. According to the *Japan Times*, a researcher at Sohgo Security says that his company's vaguely-humanoid guard robot was intended to “help in mentally tough night rounds,” but many customers want to know if it can pull double-duty by working as a receptionist during the daytime. Honda's ASIMO robots, perhaps the world's most advanced humanoid robots, have “been leased to several corporations and museums for use in greeting people at offices and events.” An ASIMO also works as a receptionist at Honda HQ.

The next market for humanoid robots is

the home. Although no ASIMOs are yet for sale, Honda hopes eventually to market a version for consumers. Bandai, the company that brought us the Tamagotchi “digital pet” fad a few years ago, is creating a home robot based on a robotic character from a popular and long-running Japanese cartoon. The *Japan Times* quotes a Bandai executive as saying he hopes the robot will be able to help with household chores—“like helping elderly people change light bulbs”—by the end of the decade.

One reason why so many robotics engineers are working on humanoid robots, instead of pursuing more imaginative, mobile, futuristic designs, is that ordinary people (especially the elderly) might interact more comfortably with robots that have familiar shapes. In a country like Japan, with senescing demographics, the desire of an aging population for robots could be enormous, both as personal assistants and as companions. In fact, one Japanese company, Yamatake, has developed a chat robot just for talking with the elderly; it's capable of moving about on its own and carrying on “a brief, meaningful conversation,” according to the company's website, though just how meaningful is not quite clear.

Engineers seem to have mastered the basics of robotic bipedal walking and other humanoid motions—for instance, there is a new Chinese robot capable of performing tai chi—but there are still other essential capabilities that need improvement before robots regularly enter the home, including better skills for interacting with their environment and their owners.

In the former category, there have been a number of recent improvements in robotic navigation systems. Most promising is the development of a new vision system for robots, announced last year by

artificial intelligence guru Hans Moravec (who is discussed at length in Charles Rubin's piece earlier in this issue). According to Moravec's website, the system uses stereoscopic cameras and a computerized grid to map the size and distance of objects, so that robots can "deal with unexpected route hazards" and "locate destinations that move unpredictably."

There have also been advances in robot-human interaction. Engineers at Vanderbilt University are working on a robotic system capable of recognizing human mental states. The robot's input comes from sensors that collect physiological data—heartbeat, sweat production, blood pressure, and other indicators—which are combined to give a general picture of a person's psychological attitude. In a paper in the journal *Robotica* last November, the

engineers said that this technique will "be useful in the future human-robot cooperation activities, where the robot will recognize human stress and respond appropriately." Other researchers have recently made progress in designing robots capable of interpreting human gestures, facial expressions, and speech.

The U.N. report predicts that there will be millions of robots in people's homes by the year 2005, creating a market of more than \$2 billion. Such grandiose predictions aren't new—some experts had forecast that the market for home robots would be that size by the year 1990—but they seem more tenable now, with thousands of robotic dogs and vacuum cleaners already in people's homes. The only question that remains: Will our robots make life better or make us helpless?