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ROBOTICS

# The gentle rise of the machines

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From The Economist print edition

Robotics: The science-fiction dream that robots would one day become a part of everyday life was absurd. Or was it?

WHO would have thought that a Frisbee-shaped contraption that extracts dust from carpets would be the state of the art in household robots at the dawn of the 21st century? In the past year, Roomba, a circular automatic vacuum cleaner made by a firm called iRobot, has swept up millions of dollars from over 200,000 buyers—and was a must-have at Christmas, among geeks at least. Rival firms such as Electrolux and Karcher sell similar but pricier sweepers. Robot vacuum cleaners, it seems, are catching on.

Are these mere playthings, or the beginning of a new trend? Roomba is just the tip of the iceberg, according to Helen Greiner, co-founder of iRobot, which also sells industrial and military robots. Dan Kara of Robotics Trends, a consultancy, agrees. "The tipping point might be Roomba," he says.

Even if this is true, however, it would be quite a come-down compared with the robotic future that seemed, for much of the 20th century, to be just around the corner. Since 1939, when Westinghouse Electric introduced Electro, a mechanical man, at the World's Fair in New York, robot fans have imagined a world filled with tireless robotic helpers, always on hand to wash dishes, do the laundry and handle the drudgery of everyday tasks.

So far, however, such robots have proliferated in science fiction, but have proved rather more elusive in the real world. But optimists are now arguing that the success of the Roomba and of toys such as Aibo, Sony's robot dog, combined with the plunging cost of computer power, could mean that the long-awaited mass market for robots is finally within reach. "Household robots are starting to take off," declared a recent report from the United Nations Economic Commission for Europe (UNECE). Are they really?

## Hand-built by robots

Although the dream of the home robot has not died, robots have had their greatest impact in factories. Industrial robots go back over 40 years, when they first began to be used by carmakers. Unimate, the first industrial robot, went to work for General Motors in 1961. Even at a time when computing power was costly, robots made excellent workers and proved that machines controlled by computers could perform some tasks better than humans. In



Reuters

### Still taking baby steps

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There are now about 800,000 industrial robots around the world, and orders for new robots in the first half of 2003 were up a record 26% from the same period in 2002, according to the UNECE. Demand is increasing as prices fall: a robot sold in 2002 cost less than a fifth of an equivalent robot sold in 1990, for example. Today, in car factories in Japan, Germany and Italy, there is more than one robot for every ten production workers.



Similarly, agricultural robots harvest billions of tonnes of crops every year. There are six-legged timber cutters, tree-climbing fruit-pickers, robots that milk cows, and others that wash windows, trucks and aircraft. Industrial robotics is a \$5.6 billion industry, growing by around 7% a year. But the UNECE report predicts that the biggest growth over the next three years will be in domestic rather than industrial robots. Sales of such devices, it predicts—from toys to lawnmowers to, yes, vacuum cleaners—will grow ten-fold between 2002 and 2006, overtaking the market for industrial robots.

The broader application of robotics is becoming possible thanks to the tumbling cost of computing power, says Takeo Kanade of Carnegie Mellon University's Robotics Institute, who has built robots on both sides of the Pacific. This lets programmers write more sophisticated software that delivers more intelligent robotic behaviour. At the same time, he notes, the cost of camera and sensor chips has tumbled too. "The processing power is so much better than before that some of the seemingly simple things we humans do, like recognizing faces, can begin to be done," says Dr Kanade.

"We may be surrounded by more robots than we realise—just not of the type that Hollywood, or robot researchers, led us to expect"

While prices drop and hardware improves, research into robotic vision, control systems and communications have jumped ahead as well. America's military and its space agency, NASA, have poured billions into robotic research and related fields such as computer vision. The *Spirit* and *Opportunity* rovers exploring Mars can pick their way across the surface to reach a specific destination. Their human masters do not specify the route; instead, the robots are programmed to identify and avoid obstacles themselves.

"Robots in the first generation helped to generate economies of scale," says Navi Radjou, an analyst at Forrester, a consultancy. Now, he says, a second generation of more flexible and intelligent robots will be able to do many more jobs. Hence the UNECE report's suggestion that domestic service robots might now be entering "into a diffusion process similar to that which the PC, the mobile telephone or the internet have had in recent years." But if robots really are poised on the cusp of ubiquity, what will they be used for?

## Robots go home?

A possible robotic foot in the door could be toys. For the past two years, robots have been among the bestselling toys in the world. And they can be more than just playthings, once they have been hooked up to a network. Personal robots, wireless systems and cheap cameras, all tied together by a PC, could enable robots to water the plants while you are on holiday, or provide a roving set of eyes and ears. Sony's robot dog, Aibo, for example, can be linked wirelessly to a PC, so you can remotely monitor your home through its eyes as it walks around.

Another possibility, long touted by robot fans, is the use of robots to provide nursing care and assistance to the old and infirm. Honda, Mitsubishi and scientists at the Korean Institute of Science and Technology are designing machines to help old or disabled people move from room to room, fetch snacks or drinks, operate the television, and even call the doctor when needed. Though it has been notoriously difficult to pull off, Joe Engelberger, the inventor of Unimate, feels care of the elderly is precisely the opportunity the robotics industry should be pursuing. "Every highly industrialised nation has a paucity of help for vast, fast-growing ageing populations," he says.

Given that homes are designed for human inhabitants, the best shape for such robots might be humanoid. In Japan, the development of such robots—by firms such as Honda, Mitsubishi and Toyota—seems to have become a symbol of technological superiority. But ultimately, says Mr Engelberger, who went through this with Unimate, if domestic robots are going to succeed, they will have to be reliable and demonstrate

value for money. You have got to be able to show, he says, "how this damn thing can justify itself."

## They are already among us

Yet for all the progress in computing, there has not been a corresponding leap forward in robotics. Talk of robot helpers for the elderly has been around for years. Only a fervent optimist would take the success of the Roomba as the dawning of a new robotic era. But there is another way to look at things. We may, in fact, be surrounded by more robots than we realise. The trouble is that they have not taken on the forms that Hollywood, or robot researchers, led us to expect. Automated machines have, however, quietly slipped into many corners of everyday life.

Far more prevalent than robot vacuum cleaners are copiers that collate, staple and stack your documents and automated-teller machines that, as their name suggests, save human bank tellers the trouble of dispensing cash. Other machines scan groceries, wash dishes, make bread, sort mail by reading hand-written addresses, and dispense train tickets. Commercial airliners fly and even land themselves using radar and satellite-positioning systems to navigate through fog and storms. Autonomous trains, akin to giant robotic snakes, drive themselves. All of these devices are autonomous computer-controlled machines, capable of responding to changing circumstances in accordance with orders from their human masters. They are, in other words, robots. But they are not the general-purpose mechanical men that most people associate with the term.

Why not? The answer, ironically, could lie in the rapid advance of computing power. Back in the mid-20th century, when the robotic future was being imagined, computers were huge and expensive. The idea that they would become cheap enough to be integrated into almost any specialised device, from a coffee-maker to a dishwasher, was hard to imagine. Instead, it seemed more likely that such intelligence would be built into a small number of machines capable of turning their robotic hands to a range of different tasks. In place of the general-purpose housebot, however, we are surrounded by dozens of tiny robots that do specific things very well. There is no need to wait for the rise of the robots. The machines, it seems, are already among us.