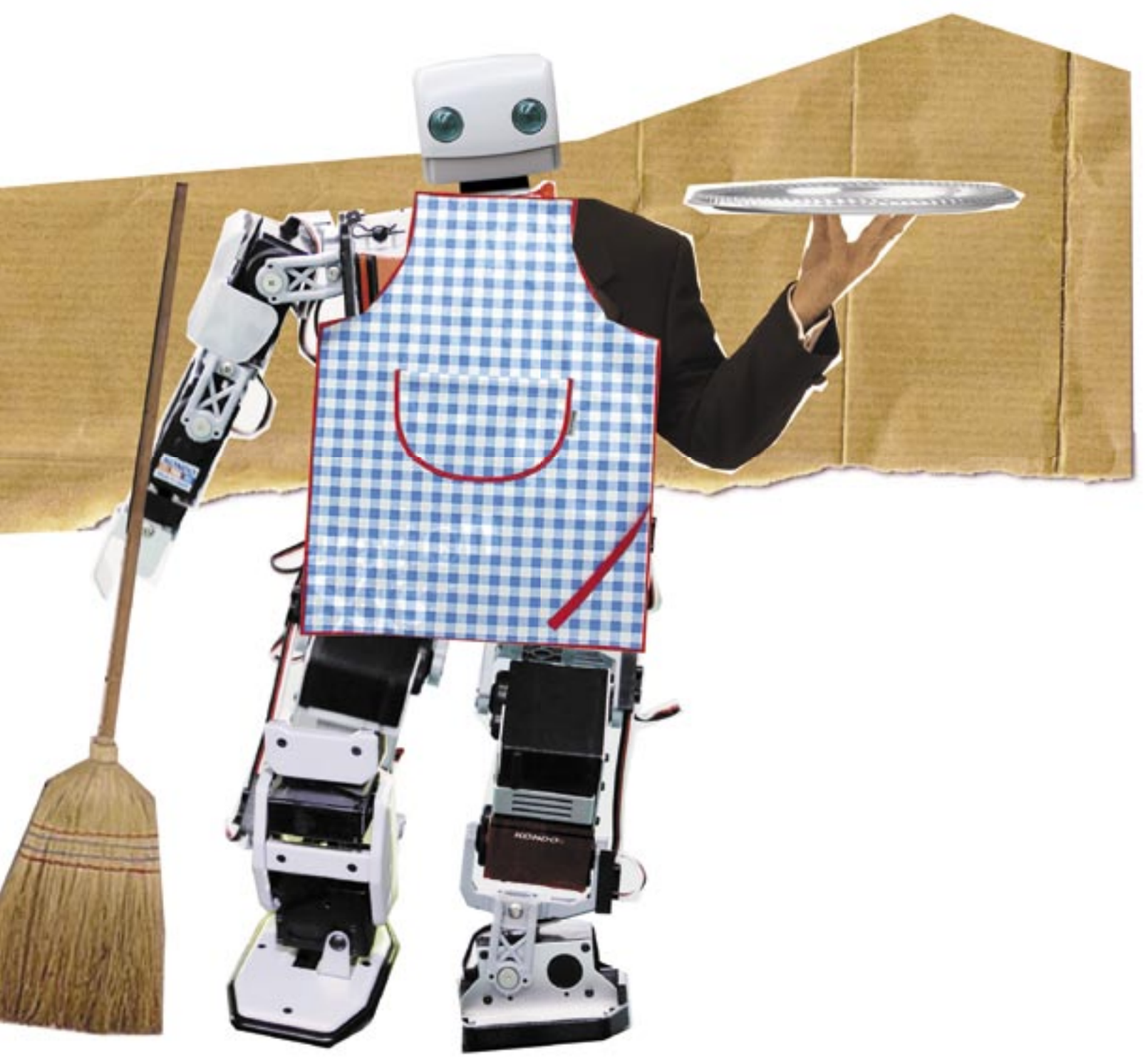
Robots Lend a Hand in Japan



It is no wonder Japan has been called "the robot kingdom." Of the world's at least 923,000 industrial robots, about 4 in 10 are in Japan. Now Japanese interest is turning to so-called service robots, which could play a crucial role in looking after the nation's aging population.

Text: Tony McNicol

Japan has a deep-seated infatuation with mechanical friends, whether it is with the heroes of manga (comic books) and anime (animation), hard-working industrial robots, or the public relations humanoids of major Japanese corporations.

Currently, all eyes are on the service-robot sector. This broad category includes underwater, medical, cleaning, security, fishing, forestry, caregiving, entertainment and pet robots. At present, such robots only make up a small percent of the overall robot market, but expectations for the sector are high. An example is the 2007 International Robot Exhibition due to open this November in Tokyo. Service robots are expected to account for more than a third of exhibits. Basically, the category includes any robot for use outside the factory, but the Paris-based International Federation of Robotics identifies two main types: professional-use robots and private-use robots. Of the former, they estimate that 31,600 were in operation at the end of 2005, the most numerous being underwater robots at 18 percent, cleaning robots at 17 percent, and defense and security robots following at 16 percent.

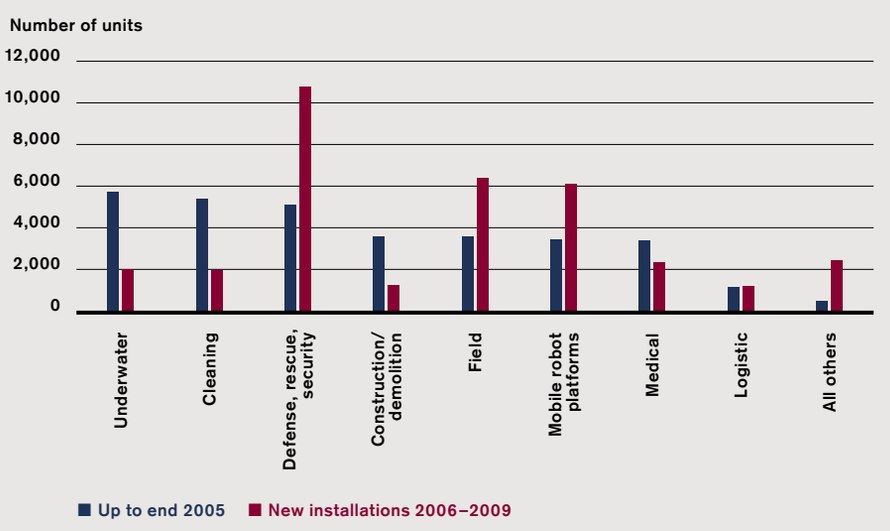
By comparison, private-use service robots are more numerous and much cheaper. Of the 2.9 million such robots accounted for by the International Federation of Robotics (IFR), more than half (1.8 million) were vacuum-cleaning robots like the popular Roomba robot made by the iRobot Corporation in the US. There were also 1 million entertainment and toy and 79,000 lawnmower robots. "Service robots are in the early stage," says Marc-Antoine Haudenschild, a Credit Suisse Global Research Equity Strategist for Japan. "It is difficult and more expensive to build sensitive, highly intelligent machines, however, the market for service robots with minimal intelligence is doing well." He notes that the IFR predicts professional service robots to more than double by 2009, and personal-use service robots to reach 5.6 million by 2008.

The most numerous, and certainly the most high-profile, service robots in Japan are for entertainment. Ever since 2000 when Honda amazed the world with its walking humanoid Asimo, other Japanese companies have been fast on their heels. Notable examples include Mitsubishi's lemon yellow home helper Wakamaru, Toyota's trumpet-playing humanoid, and Murata Manufacturing's bicycle-riding robot. Although such impressive PR robots are too expensive to sell, Japan also has popular home entertainment robots. The best known to date is Sony's robot pooch Aibo, which was produced between 1999 and 2006. Humanoids have been a hit too. Since 2004, Tokyo-based Kondo Kagaku Co., Ltd., have sold several thousand of their walking robot kits, which cost about 795 dollars. Owners build and maintain the robots themselves, often entering them in Japan's popular "robocon" soccer and fighting competitions. This October, toymaker Takaratomy will try to draw new robot fans with the Omnibot 17μ: The i-SOBOT, at about 275 dollars, is much cheaper than previous home humanoids.

Less charismatic robots are also toiling behind the scenes. Service robot development is strong in "hard, mechanical" areas, says Shoichi Hamada, General Manager of the Technical Department at the Japan Robot Association. Japanese construction companies have been using robots since the 1980s, including construction machines adapted for unmanned use and robots to transport materials at building sites. From 1997 to 2002, the Ministry of Economy, Trade and Industry funded a five-year project to produce a humanoid robot for industrial use. The final 154-centimeter, 58-kilogram prototype, HRP-2, had 30 joints, >

Service Robots for Professional Use

At the end of 2005, 31,600 service robots were installed for professional use. Underwater systems were the most popular and accounted for 18 percent of the total. Source: IFR Statistical Department, 2005 World Robotics Executive Summary



Fotos: Tony McNicol | Tom Grill, Corbis

could walk on uneven ground and stand from a prone position.

Robots as Caregivers?

Another potential role for service robots is dealing with Japan's imminent demographic crisis. A low birthrate and unrivalled longevity mean the number of elderly Japanese will increase dramatically over the coming decades. In the absence of mass immigration (which Japan has been keen to avoid) a severe shortage of caregivers seems inevitable. Some people believe robots are the answer. Takanori Shibata, a senior research scientist at the National Institute of Advanced Industrial science and Technology, says that robot caregivers can be divided into physical service and mental service robots. The former are designed to help with tasks such as washing or carrying elderly people, although given the limitations of current technology, not to mention safety concerns, they are some way from commercialization.

Mental service robots on the other hand are already here. One of the best known is Paro, an interactive robot seal designed by Shibata himself. The sophisticated robot can remember its name and change its behavior depending on how it is treated. It has been extensively tested in homes for elderly people and in hospitals. In 2002 the Guinness Book of Records named Paro as "the world's most therapeutic robot." The robot reminds patients of the pets or children they once cared for, says Shibata. "Paro is a kind of trigger to provoke something in the mind of the owner," he suggests. About 1,000 of the robots, which cost about 3,000 dollars, have been produced since 2004. Overseas sales will begin shortly.

Aside from a few limited markets the service robot industry is still in its infancy. One problem is that service robots have considerable technological hurdles to overcome before they are put to practical use. According to the Japan Robot Association, the government is supporting fundamental service robot technology research, such as advanced vision, sound and movement systems. Robot intelligence will be crucial too. "The reason that industrial robots have been so successful is that environments have been constructed to suit them," says Hamada, "but that's not going to work (for service robots) in ordinary environments." Scientists need to develop robots that can work anywhere, he says, even the haphazard changing layout of the average home or office.

Credit Suisse analyst Haudenschild agrees. "A main drawback of robots is their inability to convey tactile sensations and emotions when interacting with human beings," he says. "Although robots are adept at accurate repetition, they have limited powers of judgment when different movements must be performed randomly."

People Want Emotional Robots

Perhaps the answer is a highly advanced kind of robot intelligence known as "kansei," literally "emotion or feeling." Kansei functions enable robots to recognize and convey emotion – something that could be invaluable for service robots working and living alongside humans. "People don't react logically, they react emotionally – robots need to be able to adapt to that," says Shuji Hashimoto, a researcher into kansei technologies and Director of the Humanoid Robotics Institute at Waseda University. Kansei robots could use vision systems to monitor human expressions, gestures and body language. Voice sensors could pick up on intonation as well as individual words and sentences. Robots could sense human emotion through wearable sensors that monitor pulse rate and perspiration.

Scientists at Meiji University in Tokyo have already created a robot that can respond with "feeling" to human speech. When the aptly named Kansei hears a word it searches the Internet to find common associations. The robot then matches the results to emotional categories and generates one of 36 expressions on its polyurethane face.

"We believe that artificial consciousness is necessary," says Junichi Takeno, a professor at the university's Laboratory of Robot and Science. "Robots will understand others and be self-aware." Takeno says that kansei technology may one day give care-giving robots a more friendly face.

It is still too early to say when the service robot industry will really get into its stride, or which country will be at its lead. And, of course, it may not even be Japan. Overall the industrial robot superpower is surprisingly behind in service robot research. The Japan Robot Association reported in 2000 that Japan is internationally competitive in only three service robot areas: industrial robots, construction robots and entertainment robots.

Research into medical robots has been hampered by inflexible safety regulations that prohibit robot surgeons like those already operating in the US. Nor can Japan compete with NASA on space robots. Military robotics research, which takes a huge bite of European and US robot research funds, is out of the question for pacifist Japan. Ironically, the earthquake-prone nation even lags in rescue robots.

According to the Japan Robot Association's Hamada, government and industry are reluctant to assist research for a limited and unproven market. "Japan isn't very good at manufacturing the kind of robots that won't make a profit," he admits. Although, he adds, that might soon change when service robots start to make a profit. "After all, service robotics is a young and heuristic field; someone could produce a great application for service robots tomorrow. It could be an entertainment robot, a companion robot, a commercial cleaning robot, a robot car, or something else entirely."

While we wait to find out, one thing is certain: Japan is looking forward to the robot boom. With its leading industrial robot sector, unrivalled electronics expertise and robot-loving population, the nation will be well placed to catch up quick. A 2004 Ministry of Economy, Trade and Industry (METI) white paper on the future of the Japanese economy predicts that the Japanese robot market will grow to 15.8 billion dollars in 2010 and to 54.5 billion dollars in 2025. By then, it is predicted that three quarters of the market will be for service robots. <

Service Robots for Personal/Domestic Use

So far, service robots for personal and domestic use are mainly in the areas of domestic. Source: IFR Statistical Department, 2005 World Robotics Executive Summary