

# Robot Assistants Coming of Age

The University of Tokyo, jointly with Toyota, Panasonic and other corporations, is pursuing research and development on robots that can support an aging, low birthrate society. Director **Isao Shimoyama** of the Information and Robot Technology Research Initiative (IRT) at the University of Tokyo, the project leader, explains the objectives and outcomes of this research.

**T**he Japanese population will inevitably continue to decrease as society ages and the birthrate continues its decline. Japan's population, which stood at 127 million as of 2005, will decline to about 90 million in 2055, while the percentage of people sixty-five years and older will increase from about 20% in 2005 to about 40% in 2055. Moreover, the nature of households will also change markedly. As of 1995, households with a married couple and a child or children accounted for about 34% of all households, while

single-person households were around 26%. In 2025, households with a married couple and a child or children are expected to decrease to about 24%, with single-person households jumping to about 35%. In other words, the number of households with a single person, aged couple and those requiring nursing care will increase in Japan from this point on. As a result, Japanese society is likely to face issues such as an insufficient labor force, surging social insurance costs and an increase of households that find housework to be a heavy burden.

This applies not only to Japan; it is a common tendency among many developed countries.

To deal with these situations, we must start preparing now. To maintain the current level of economy and quality of life (QOL), it is important not only to provide measures from social aspects, such as measures for immigrants, social system reforms and understanding families, but also to utilize the technologies at which Japan excels.

In line with this perception, the University of Tokyo in 2006 launched Creation of Foundational IRT to Support Aging, Low Birthrate Society as the Ministry of Education, Culture, Sports, Science and Technology's Special Coordination

Fund project, jointly with seven corporations including Toyota Motor Company and Panasonic Inc. In March 2008, the university established the Information and Robot Technology Research Initiative (IRT) as its research base, under the direct management of the university president.

IRT refers to technologies derived by fusion between information technology (IT) and robot technology (RT). Industrial robots are already in wide use, but not in ordinary households. To make robots usable at home, RT alone is not sufficient because robots based on only RT require persons who have special skills to teach in every step of their operation. Robots cannot become commonplace in households until they can be purchased at discount home appliance stores and operated simply in the home, out-of-the-box, without the help of experts. IT is essential in this regard. In the future, numerous operation programs for tools and equipment, as well as data related to daily living, will be accumulated, shared and re-used online. And these data will be utilized for operating robots. Specifically, robots can be connected to the Internet and made to download all data necessary to their operation, from how washing machines are being used to the size of individual plates. In this way, robots can be used immediately in the home.

Just as industrial robots have enhanced productivity in factories, IRT is aiming to enhance the productivity of household activities that are not reflected on the GDP, and rationalizes them. As a result, nursing care burdens can be reduced while the amount of time spent on recreational activities increases and the range of activities for the elderly can widen. This is the IRT innovation. However, we are not aiming to develop an Astro Boy-like, all-powerful robot that can do everything humans can. We are developing robots that can assist humans in their activities and reduce their psychological and physical burdens.



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**Tea is served: An IRT home-assistant robot in action**

Currently, research and development is being conducted by sixty full-time and part-time researchers on the University of Tokyo's side and about sixty on the corporate side. Our university has long engaged in research and development on robot technologies, but the robot industry has yet to emerge. Universities alone could never commercialize products or stimulate innovation. They are good at studying single technologies for software, devices and other items, while corporations excel at assembling these elemental technologies into a system. By combining the merits of both, IRT innovation becomes possible.

## Prototypes

Almost three years have passed since the start of this joint IRT research and



An IRT kitchen robot effortlessly does the dishes.

development and, to date, several robots have been developed to show element technologies.

### Home Assistant Robot

The first is the Home Assistant Robot, for helping housecleaning and straightening up. The robot can carry dishes on a tray, put laundry into the washer, and sweep the floor with a broom. It has conventionally been very difficult for robots to recognize objects that change shape, like clothes, but our robot learned to recognize laundry by memorizing creases in the

cloth as image features. The robot is also equipped with a function to monitor operation status, for detecting errors when it fails to grab laundry or to open or close the washing machine lid properly, and then try again. If knowledge on how to use a certain tool is incorporated into the robot, it becomes able to perform tasks using the tool. In the future, robots will be able to download software that describes how to use additional tools, which adds to the tasks they can handle.

### The Kitchen Robot

The Kitchen Robot has also been developed, for helping with dishwashing. This robot is capable of grabbing dishes on a tray, rinsing them with water, placing them on the dishwasher racks and pressing the start button. The key technology for this robot is the highly sensitive microelectromechanical system (MEMS) touch sensor that reacts to 0.3 grams of weight. There has never been a robot that can skillfully hold and handle an object using hands. One of the reasons is because it was not possible to develop a highly sensitive sensor that can be attached to the hand. In order to grab an object properly in a way that suits its shape and weight, a sensor is needed that can sensitively react to the shearing force generat-

ed when an object slides sideways, in addition to the pressure generated when grabbing an object. Successful formation of a microscopic moving part in the elemental device turned out to be a breakthrough, and enabled us to successfully develop the MEMS touch sensor. This gave the robot the skill to sense the shape and weight of dishes by hand and adjust the grabbing method and force to suit the dish.

### Personal Mobility

Also under development is Personal Mobility Unit, a single-seat robot that



A researcher rides a Personal Mobility Unit, specially built for outdoor use, on the University of Tokyo grounds. The Unit can be operated without the use of the hands.

can support an independent life for elderly people. Indoor Mobility Unit infers the user's intention based on the position of the center of gravity and how the user is in contact with the seat, enabling the user to operate the unit without using hands. The unit also comes close when the user waves at it. Outdoor Mobility Unit has the function to change the route when a person or obstacle has been detected, and also to return to storage on its own if the user had abandoned the unit.

### Killer Apps

Significant responses have also come in from overseas regarding our research and development. Many members of foreign governments and companies, particularly from European countries, have come to observe the University of Tokyo's Information and Robot Research Initiative. Among these was a February visit by Nathalie Kosciusko-Morizet, French secretary of state for Strategic Studies and the Development of the Digital Economy.

Numerous elemental technologies related to IRT have been born through the research and development work so far, and we are confident that we lead the world in this area. From here forward, we will narrow down the technologies we have studied and developed and concentrate on a select few, as we look to present "killer applications" with future potential. □

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