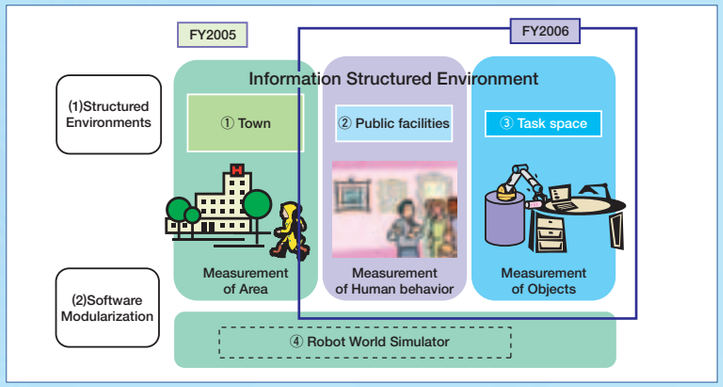

Fig.3 Overview of common platforms

One outcome of this is demonstrated here. As a result of the "Robot Town Project" which commenced in 2005, an environmental platform will be opened in 2008 at Fukuoka Island City. This pamphlet's cover depicts a conceptual diagram of the robot town. Figure 4 shows the scene of the experiment in the robot town. The robot world simulator OpenHRP3 will also be open to robot developers as a result of a "distributed component type robot simulator." Figure 5 shows the simulation and the experimental results of the humanoid robot made by OpenHRP3, which is one example of this.

Fig.4 Scenes from the Robot Town Project

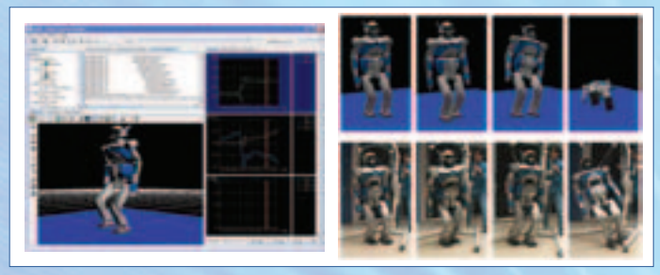

Fig.5 Robot world simulator OpenHRP3

4 STRENGTHENING COORDINATION AMONG MINISTRIES

Another mission of the Next-Generation Robot Coordination Program is to strengthen coordination among the relevant ministries. Utilization of the developed robots is to be promoted by strengthening coordination among the ministries that promote seed projects and the ministries responsible for policy on the introduction of robots for practical use.

Although the market for next-generation robots is expected to be large, it can be difficult for private sector companies to enter this business, since its marketability is unclear. First of all, it is necessary for government to take the initiative by promoting the introduction of robots, and thus to activate the robotics market during the early phase of its market development. From this point onwards, a concrete plan regarding government initiatives to develop the market needs to be proposed.

5 ACTION PLAN FOR DISSEMINATION OF RESULTS

As an action plan of the Next-Generation Robot Coordination Program, an introduction to activities and seminars/lecture meeting for the dissemination of these research results will be held in 2007 as follows.

(1) Seminar: Robot world simulator OpenHRP3
(2) Lecture meetings:
- ◆ Lecture meeting held in cooperation with conferences for robot-related organizations
- ◆ On-site lecture meetings discussing information-structured environmental platforms (Fukuoka, Kansai, and Kanagawa)

(3) Symposium on common platform technology
- ◆ Status report for each platform
- ◆ Panel discussion with officials responsible for policies (planned)

6 MANAGEMENT ORGANIZATION

The Next-Generation Robot Coordination Program is conducted by the MEXT special coordination fund for the promotion of science and technology. Its management is organized as follows.

- **Council for Science and Technology Policy:** Dr. Naoki Okumura
- **Coordinator/Program Director:** Dr. Tomomasa Sato, Professor, The University of Tokyo
- **Program Director:** Dr. Nobuto Matsuhira, Fellow, Toshiba Corporation
- **Program Officer:** Dr. Eimei Oyama, National Institute of Advanced Industrial Science and Technology
- **Task Force Committee:** Dr. Tamio Arai, Professor, The University of Tokyo
  Dr. Hideyuki Tokuda, Professor, Keio University
  Dr. Masakatsu Fujie, Professor, Waseda University
  Dr. Makoto Mizukawa, Professor, Shibaura Institute of Technology
- **Council for Science and Technology Policy secretariat:**
  Mr. Akira Okubo, Director, Information and Communications Technology
  Dr. Kensuke Murai, Deputy Director, Information and Communications Technology

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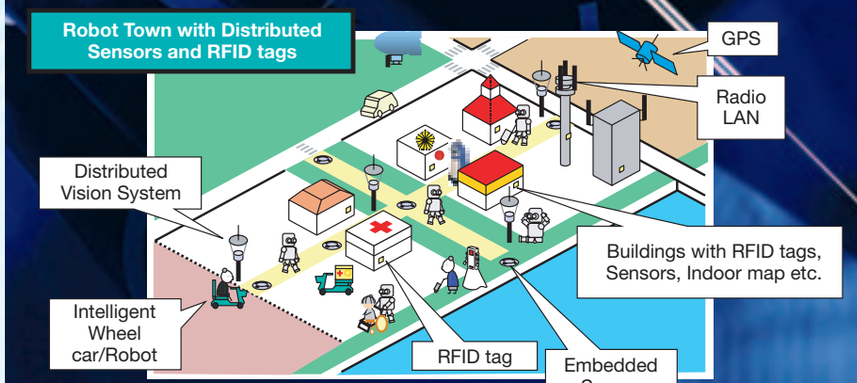
2007.9

ESTABLISHMENT OF COMMON PLATFORM TECHNOLOGY FOR NEXT-GENERATION ROBOTS

Council for Science and Technology Policy
Coordination Program of Science and Technology Projects



From the Robot Town Project

1 THE NEXT-GENERATION ROBOT COORDINATION PROGRAM

The Council for Science and Technology Policy defines themes of national and social importance worthy of promotion, and coordinates related ministries in reconsideration of the conventional separate measures of individual ministries. The Coordination Program of Science and Technology Projects was established in 2005 to promote these themes, in order to strengthen coordination while eliminating unnecessary duplication of related measures. The following eight themes were addressed initially: post-genome, emerging and re-emerging infectious diseases, ubiquitous networks, next-generation robots, biomass utilization technology, hydrogen & fuel cell, nano-bio-technology, and local science & technology clusters. From 2007, six new themes were added to these eight themes, and all 14 themes are currently in implementation. Focusing on "common platform technology for next-generation robots," the core missions of the Next-Generation Robot Coordination Program are to promote the robot research and development of each ministry and to provide society with basic infrastructure technology for robots, thus enabling the development of services to be provided by various robots.

Additionally, the stated objective to "lead the world in developing core robot technology useful in everyday life, both in the home and in urban environments" is a strategically important concern of the "3rd Term Science and Technology Basic Plan of Japan" for 2006-2010. Developing robots useful to society is also a concern of "INNOVATION 25," a governmental long-term strategy indicator.

2 COMMON PLATFORM TECHNOLOGY

Various research and development projects for robots have been carried out in individual ministries. After examination of these projects, it was judged that required research and development were conducted for every application, and that there was no unnecessary duplication. However, certain ministries have clearly indicated technology that might be used as a common infrastructure. It follows that the technology capable of common use by robot developers and engineers when conducting research and development of robots was defined as application-independent "common platform technology". It was raised as an issue to be urgently addressed through the Next-Generation Robot Coordination Program in order to increase the efficiency of future robot development. Specifically, there are two aspects; namely, "information structured environment" and "basic software for robot development," which are each discussed below.

2.1 Information-structured environment

Although a robot's working environment will change depending on its application, technology using sensors to measure a robot's own position in relation to its environment is required for any application. Various developments are underway in regard to such technology. If position information can be acquired on the basis of a common structure, then research and development of robot systems for specific applications can be executed more efficiently.

Furthermore, in the near future, robots themselves are not only expected to be equipped with intelligence and software, but also to utilize knowledge of their environment through integration with other technologies such as IT, ubiquitous computing, network communication technology, and use of GPS and RFID tags. The importance of "environmental information structuring technology" (that is, the embedding of programs, information, and knowledge for robots in the environments in which they operate as a common infrastructure technology for developing various robots) is expected to increase.

Therefore, in utilizing IT and similar technologies from this point onwards, it becomes necessary to research and develop standard models for information-structured environments. Two questions arise: firstly, how should communication among embedded apparatus and robots, both indoors and outdoors, be standardized? Secondly, what kind of equipment (such as RFID tags and so forth) and information (such as environmental maps) should be embedded in the environment? The concept of the information-structured environment is shown in Fig.1.

2.2 Basic software for robot development

At the same time, various types of software are needed in order to develop robots. Since an effective mechanism enabling robot researchers and engineers to share such software has not been established, they have each developed their own software independently in different research projects and research business units. However, similar software is often developed over multiple projects and a considerable amount of shared software exists. Moreover, there has been no means of evaluating the performance of a developed robot in comparison to that of other robots in the same program environment. It is therefore essential to build a social infrastructure that enables the provision of software for shared use.

Towards that end, research and development of a robot world simulator to serve as a common management system for robot software are needed. Based on distributed object technology, such a simulator would be able to simulate the performance of a robot synthetically in terms of its hardware, sensors and sensing functions, control structure, and other functions, including work environment, environmental objects, etc. Furthermore, it would be necessary for the simulator to guarantee the connectivity and reusability of various kinds of developed robot software, as well as its ability to accumulate functions and to be expandable. The concept of a robot world simulator is shown in Fig.2.

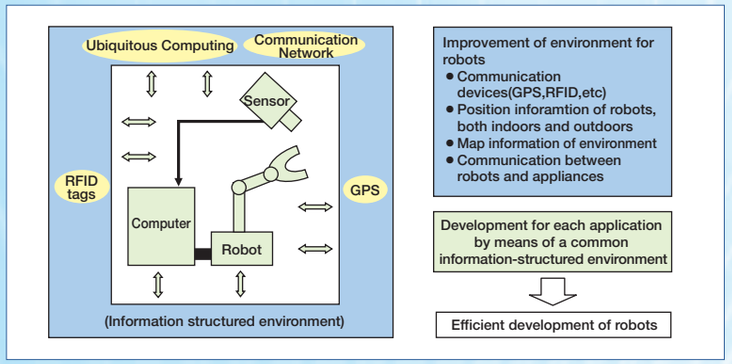


Fig.1 Concept of information-structured environment

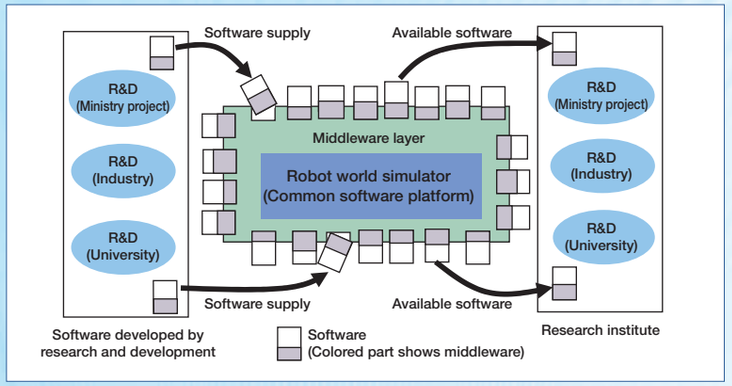


Fig.2 Concept of robot world simulator

3 TOWARDS REALIZATION OF A COMMON PLATFORM

Aimed at the "effective and efficient promotion of coordination programs for science and technology projects" as supported by the special coordination fund for promoting science and technology from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), and towards further development of a common platform technology, the four three-year projects described below are being implemented starting from 2005-06. (The organization responsible for each project is indicated in parentheses.)

(1) The Robot Town Project, in which robots work in an ordinary environment using RFID tags and a distributed vision system integrated by a town management system (Kyushu University)
(2) The Robot Simulator Project, in which the simulator is composed of distributed object modules implemented by RT middleware (National Institute of Advanced Industrial Science and Technology (AIST))
(3) The Structuring of Environmental Information Project, based on human positions, in which spatial information and a record of human behaviors are linked (Advanced Telecommunications Research Institute (ATR))
(4) Universal Design Project for Environment and Manipulation Framework, in which tasks are carried out in the same way in different environments or by different robots (AIST)

As indicated above, the aim of this project is to enable development and construction of a diverse range of environmental information structured platforms, ranging from the structure of a town to the structure of a work-space on a desk. Furthermore, a working environmental platform is to be built and installed, after research is complete, for common use by numerous robot researchers and engineers in the Fukuoka, Kansai, and Kanagawa areas. Additionally, the robot simulator is intended for public release in order to promote the sharing of software. These new trials provide robot developers with a tool set which not only provides software usable solely for robot development, but also includes the environment in which a robot works.

It is envisaged that robotics research will be accelerated by means of this core platform provided throughout society, which will work to disseminate services utilizing robots and will therefore spur development of the robot industry. The overview of the common platforms project is shown in Figure 3.