

TOSHIBA REVIEW

2001. VOL.56 NO.9

Special Reports

Robot Technologies Supporting Human Society and Daily Life

Special Reports Robot Technologies Supporting Human Society and Daily Life	Feature Articles	Techno Notes	Toshiba Technologies for the New Century
*Resonance between Market and Technology *Preparation of Basic Robot Technologies -- Expediting Future Robot System Construction *ORiN: Open Robot Interface for the Network *Open Robot Controller Using Distributed Object Technology *Task-Level Voice Commands for Robots and Visual Feedback *Face Recognition Technology for Robot Vision *Imparting Intelligence to Products and Relationship to Design *Networked Intelligent Machine to Support Daily Life -- Trials of Robotic Room *Advanced Support System for Endoscopic and Other Minimally Invasive Surgery *Pet Robot Using Emotion Triggered Learning Model *Mechatronic Machines Supporting Human Society and Daily Life *Teachingless Finishing Robot System with Robot Controller Based on Multiple Personal Computers	*Analysis of Organic Compounds in Clean Room Atmosphere -- Adsorption by Si Wafer Powder *Libretto L1 Mini-Notebook PC with Totally New Form Factor *Organic Waste Treatment System with Oxidative Decomposition in Supercritical Water *2.15-inch Color Reflective TFT-LCD for Mobile Phones	*Meeting the Challenge of Medical Solutions	*6. Mobile Human Interface

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*Resonance between Market and Technology

YAMAMOTO Setsuo

*Preparation of Basic Robot Technologies --Expediting Future Robot System Construction

TATSUNO Kyoichi MATSUHIRA Nobuto

Many robots have been introduced recently including humanoid robots and dog-like robots. In order to build up robot systems easily, Toshiba is preparing functional modules for robots in various areas such as manipulation, mobile mechanisms, open robot controllers, autonomous navigation, machine vision, face and voice recognition, and task planning.

This paper explains these functional modules and introduces examples of robot systems to support human life in the home and in society. We have the basic technologies to realize automatic machines, i.e., robots, that are required by society. By building up these modules, we will systematize and propose various robots useful for human life.

*ORiN: Open Robot Interface for the Network

MIZUKAWA Makoto OZAKI Yasuo

Since 1999, the Japan Robot Association (JARA) has been implementing standardization of the network interface for robot controllers (ORiN: Open Robot Interface for the Network). At the 1999 International Robot Exhibition, industrial robots from 13 Japanese robot manufacturers, having different specifications and structures, were connected to each other via a communication network using the ORiN application programming interface (API), and applications for production system management and 3D robot motion monitoring were demonstrated.

In this paper, we introduce the objectives and an outline of ORiN technologies, the current activities, and the schedule and plan toward realizing a de facto standard.

*Open Robot Controller Using Distributed Object Technology

OZAKI Fumio OAKI Junji

To cope with various demands for robots, they must be much easier to use. We propose an open robot controller framework using PC/AT compatibles. The openness achieved makes it possible to build up many peripheral elements into a robot system without difficulty. The controller software is made up of object oriented technology and distributed object technology for extensibility. Toshiba has applied the framework to an experimental open controller to verify its validity.

*Task-Level Voice Commands for Robots and Visual Feedback

OZAKI Fumio OAKI Junji TATSUNO Kyoichi

Robots need to be able to understand orders from humans when they work in homes and public places. Such orders are high-level commands such as "I'd like a cup of tea" or "bring me the newspaper," in which the detailed motion of the robot is not described. Robots must therefore analyze the human high-level command and break it down into primitive motion commands such as "move the arm tip to point A." It is also necessary for the robot to recognize and/or measure the concerned object of the task using sensors so as to accomplish the high-level command.

This paper describes an experiment, in which a robot picks up a ball on the floor upon hearing the human order "pick up the ball," to verify the validity of the high-level commands.

*Face Recognition Technology for Robot Vision

FUKUI Kazuhiro YAMAGUCHI Osamu

Face recognition is an important function of robot vision. Face recognition implemented on a robot requires robustness to changes in facial expression and facial direction, because the robot cannot control these changes.

Toshiba has developed a face recognition technology that satisfies these requirements using sequential images. Our method can accurately recognize a face based on information on the three-dimensional shape from the sequential images. Experimental results have verified that our method is robust in comparison with the conventional methods using a single static image.

*Imparting Intelligence to Products and Relationship to Design

TSUBOI Hideki

The rapid advances in digitization and networking have brought drastic changes to our everyday life in recent years. The rapid pace of technological breakthroughs has also brought about revolutionary advances in product performance and convenience. However, this also places demands on the user, who must have sufficient knowledge to be able to properly employ these highly evolved products. Manufacturers must therefore bear in mind the viewpoint of the consumer when making technological innovations, rather than simply making functions and specifications available for the sake of innovation itself.

This paper discusses the relationship between imparting intelligence to products, and design from a human standpoint.

*Networked Intelligent Machine to Support Daily Life -- Trials of Robotic Room

SATO Tomomasa

This paper presents the state of the art and future directions of a human-friendly intelligent machine system that supports people's daily life based on information technology. The "robotic room" research trials conducted by the University of Tokyo are introduced, the aims of which are to create new technology based on behavior accumulation and its utilization, and to realize a "personal-machine" system instead of the conventional human-machine system. This technology will enable not only the realization of personally customized machines but also the generation of new applications fields in the "personal contents industry."

*Advanced Support System for Endoscopic and Other Minimally Invasive Surgery

NAMBU Kyojiro JINNO Makoto MATSUHIRA Nobuto SEKIYA Takaomi

Minimally invasive surgery (MIS) is an ideal surgical operation method because it can improve the quality of life (QOL) of patients and reduce medical costs. However, it requires higher surgical skills for surgeons than in the case of conventional operations.

This paper introduces the "Advanced Support System for Endoscopic and Other Minimally Invasive Surgery" project of the New Energy and Industrial Technology Development Organization (NEDO) for 2000-2004, and describes the results for fiscal year 2000. A goal of this project is to develop a surgical support system for MIS to ensure safety and reliability, consisting of a digital volume tomography (DVT) X-ray imaging system, a high-performance endoscope system, a dexterous manipulator, and a surgical navigation system, which can be applicable to various surgical operations.

*Pet Robot Using Emotion Triggered Learning Model

SUZUKI Kaoru KANAZAWA Hiroshi

We have developed a pet robot called ComoComo which converses with a user on feelings and desires by using human interface technologies such as face, speech, and gesture recognition. This robot has a function of emotion based on an emotion triggered learning model, and can automatically evolve its person discernment capability and interpersonal skills.

The trigger of learning is strong feeling generated in the robot according to the approach of the user. The feeling and the user's facial images are associated, memorized, and used to determine whether the user is good or bad for the robot. Consequently, the robot can detect and attach to a user who gives a good feeling, realizing a mechanism that makes a pet robot become on intimate terms with a specific person.

*Mechatronic Machines Supporting Human Society and Daily Life

UKAI Makoto OKAZAWA Yoshitaka IMAZUKA Katsuo

Toshiba has been developing and manufacturing mechatronic machines that support people's lives and society, such as automatic teller machines (ATMs), ticket gate machines, and letter sorters. These mechatronic devices reduce labor and increase efficiency by replacing the manual handling of complicated operations with intelligent processing by machine. For example, an ATM can process 10 currency notes per second, write in the depositor's bankbook, and turn its pages. Also, a new-style ticket gate machine can rapidly process multiple tickets while passengers walk through a 1.6 m passage.

Such mechatronic technologies are progressing in step with the times, with the machines becoming smaller, faster, and cheaper.

*Teachingless Finishing Robot System with Robot Controller Based on Multiple Personal Computers

JINNO Makoto OAKI Junji TATSUNO Kyoichi

Toshiba has developed a teachingless finishing robot system with a robot controller based on multiple personal computers. By using PCs for robot controllers, flexible robot controllers with force sensors and vision sensors can be realized that enable useful functions to be easily added compared with conventional dedicated controllers. The system performs finishing tasks on steel plates cut by gas cutting machine. When an operator places a steel plate on the worktable, the robot system performs finishing tasks by measuring the unknown shape of the steel plate with a CCD camera.

This paper describes the kinematic definition of finishing tasks, outlines the robot system, and presents automatically generated algorithms for the robot language program.

Feature Articles

*Analysis of Organic Compounds in Clean Room Atmosphere--Adsorption by Si Wafer Powder

SATO Yuka SAKAI Kimito

This paper introduces a selective analysis method for organic compounds that are readily adsorbed on Si wafers in a clean room atmosphere. Airborne molecular contaminants cause a serious problem in advanced semiconductor processes. It has been reported that plasticizers, such as Bis(2-ethylhexyl)phthalate (DOP), cause failure of dielectrics. An analytical technique applicable to such contaminants that have a detrimental effect on device characteristics is required.

In response to this need, Toshiba has developed a method for the selective capture and analysis of organic compounds such as DOP using adsorption by Si wafer powder, and have demonstrated the effectiveness of this method for determining 0.01 ng/m³-level concentration of the target organic compounds.

*Libretto L1 Mini-Notebook PC with Totally New Form Factor

SATAKE Shigeru

As the first mini-notebook PC in the world featuring the full Windows® operating system, the Libretto created a sensation after its launching in 1996 and opened up the new mini-notebook PC market. Since then, Toshiba has introduced a large number of products on the market in the Libretto series, maintaining the same form factor while improving CPU performance, functionality, and other aspects.

Based on a thorough voice of customer (VOC) analysis with respect to mobile PCs including mini-notebook models, Toshiba has focused its attention on simple business usage and developed the Libretto L1 mini-notebook PC. Among the features of the Libretto L1 are long battery life and a totally new form factor including a wide key pitch and wide screen.

*Organic Waste Treatment System with Oxidative Decomposition in Supercritical Water

YAMADA Kazuya AKAI Yoshie TAKADA Takao

Supercritical water (SCW), whose temperature and pressure exceed 374 °C and 22.1 MPa, respectively, can decompose organic substances rapidly and completely and retain all the decomposition products. There have been expectations for the application of SCW to the decomposition treatment of harmful organic substances, but material corrosion and salt precipitation have been serious problems requiring solution before industrial application was possible.

Toshiba has developed two technologies to solve these problems: a coupled two-stage reactor consisting of a corrosion-resistant titanium reactor and stainless steel pressure vessel, and a pH control method. Spent ion exchange resins generated from water purification in a nuclear facility can be reduced to one-quarter in volume by decomposition treatment with SCW.

*2.15-inch Color Reflective TFT-LCD for Mobile Phones

KIMURA Hiroyuki TANAKA Yasuharu MURATA Hiroyoshi

Toshiba has developed a 2.15-inch diagonal, color reflective low-temperature polysilicon (poly-Si) thin-film transistor liquid-crystal display (TFT-LCD) suitable for mobile phones. This TFT-LCD integrates a new 4 bit digital-to-analog converter (DAC) and a new technology called digital memory on glass (DMOG). It can display 4 bit x RGB (4,096-color) images in normal mode and 1 bit x RGB (8-color) still images in power saving mode (still mode). The new TFT-LCD achieves low cost and low power consumption of up to 1.3 mW in still mode.

Techno Notes

*Meeting the Challenge of Medical Solutions

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