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Special Reports

Healthcare Technologies to Realize Health-Smart Communities

Toward Creating New Approaches to Healthcare
KANAZAWA Hiroshi

Toshiba's Approaches to Healthcare Business
NISHIHARA Eitaro / AIDA Satoshi / OUCHI Kazushige
In response to the declining birthrate and aging of society, a variety of schemes to sustain existing healthcare systems including medical care and nursing care services have been implemented in Japan.
Toshiba defined the healthcare business as its third main pillar of operations, along with the energy and storage businesses, in August 2013, and has consolidated all of its healthcare businesses into the new in-house Healthcare Company. The Healthcare Company is making efforts to create unique, innovative products and services in the healthcare business field by integrating a wide range of technology assets of the Toshiba Group through a process of "new concept innovation," toward the realization of a society in which everyone can lead healthy and active lives. In this context, we are promoting the new business through the development of both wearable sensing technologies and "eHealth solutions" in conjunction with sensing devices and information and communication technologies (ICTs), based on the concept of "data-driven healthcare."

Activities Related to Construction of Personalized Medicine and Preventive Healthcare System
TAKAYAMA Takuzo / IWATA Seiji / SATO Hajime
In November 2013, Toshiba was selected as a member of one of the Center of Innovation (COI) sites of the Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program (COI STREAM), together with Tohoku University and Nihon Kohden Corporation. At this COI site, we are planning to construct a personal health record (PHR) database containing personal genome information, information on biomarkers such as proteins, and medical records collected unobtrusively in people's daily lives, with the aim of realizing a personalized medicine and preventive healthcare system capable of predicting future health risks.
In this program, Toshiba is promoting the development of quasi-whole genome sequencing technology based on the Japonica Array to achieve personal whole genome sequencing at a reasonable cost, and the construction of a cloud type PHR platform as an information infrastructure for the personalized medicine and preventive healthcare system.

Wearable Sensors Corresponding to Various Applications in Healthcare Field
MIYAMOTO Koji / HASHIMOTO Kazunori / SUZUKI Takuji
Toshiba has positioned wearable sensors, which are a component of the so-called Internet of Things (IoT), as key devices in a broad range of healthcare fields including preventive medicine, diagnosis and treatment, prognosis and nursing care, and health promotion.
As part of this approach, we have developed two new wearable sensors: a wristband activity monitor that measures the amount of activity and life rhythms of the wearer by means of a built-in acceleration sensor, and the "Silmee^{TM} Bar type" (hereafter abbreviated as Silmee) biosensor, which is attached to the chest and simultaneously measures multiple biological data including cardiac potential, pulse wave, body movement, and body temperature, making it possible to analyze changes in autonomic nerve balance and sleep depth and rhythm using newly developed applications for computers and smartphones. These wearable sensors are expected to be applied to a variety of solutions including healthcare systems for personal users and personnel engaged in specified work fields, home medical care services, and life monitoring systems.

Latest Technologies for Heavy-Ion Radiotherapy Systems for Cancer Treatment
ONO Michitaka / YAZAWA Takashi / HIRATA Yutaka
Toshiba has been focusing efforts on diagnosis and treatment as one of the pillars of its healthcare business. As part of these efforts, we are engaged in the development of heavy-ion radiotherapy systems for cancer treatment. We have been participating in the development of heavy-ion radiotherapy facilities for the National Institute of Radiological Sciences (NIRS) and have developed the following core technologies: (1) a high-speed three-dimensional (3D) scanning irradiation method, (2) a patient positioning system to perform highly precise irradiation, and (3) a treatment management system. We are also developing the following new technologies for the next-generation heavy-ion radiotherapy system: (1) a rotating gantry equipped with superconducting magnets, and (2) an X-ray imaging system for respiratory-gated irradiation.
These advanced technologies, which are crucial for the establishment of heavy-ion radiotherapy as a global standard for cancer treatment, have been adopted in the development of a heavy-ion radiotherapy facility called i-ROCK (Ion-beam Radiation Oncology Center in Kanagawa) at the Kanagawa Cancer Center.

Voice Tweet SNS for Home Medical Care Services to Support Communication among Healthcare Staff
TORII Kentaro / AIDA Satoshi
With the progressive aging of society in Japan, there is a need for integrated home medical care services through close communication among various types of healthcare professionals and caregivers. However, conventional information-sharing tools cannot provide smooth communication because of the difficulty of inputting and sharing information in real time.
As a solution to this issue, Toshiba has developed a voice tweet social networking service (SNS) for home medical care services to support smooth communication among multiple healthcare professionals and caregivers working at different locations. The voice tweet SNS makes it possible for these personnel to input and share information about their patients anytime, anywhere through voice tweets using a smartphone application. It can recognize each input voice in real time and automatically add metadata including the input time, input location, and keywords extracted from the recognized text from each voice. These metadata allow the smart processing of input messages such as the sharing of messages among appropriate ranges of personnel and data mining from the accumulated messages.

Solutions for Pediatrics and Dentistry Aiming at Improvement of Medical Services through Use of Medical IT
MEGURO Yasuyuki / SHIRATORI Eiji
In the field of medical systems such as electronic medical record (EMR) systems for the handling of medical information in electronic form, it has become necessary to respond to a wider range of services and higher specialization with the changes that have recently been taking place in social and administrative conditions.
As a result of this trend, Toshiba Medical Systems Corporation has been offering a wide variety of solutions using medical information technology (IT) for both core hospitals in local areas and university hospitals to support highly specialized medical services, and in particular is promoting the strengthening of solutions for pediatrics and dentistry in line with the advent of an aging society with fewer children. The HAPPY ACTIS^{TM} medical EMR system and HAPPY ACTIS^{TM}-ERD dental EMR system, which were released in 2010 and are being continuously upgraded to strengthen these functions, are contributing to the evolution of support systems to improve not only the efficiency of workflows but also the quality of diagnosis and treatment.

Feature Articles

Digital Refocusing Technology Using Multiple Fixed-Focus Cameras
YAMAMOTO Takuma / MISHIMA Nao / MORI Tatsuya
The ongoing dissemination of mobile terminals with thinner profiles in recent years has now reached a stage at which it has become difficult to further reduce the thickness of such terminals due to the thickness of their onboard camera. One of the critical issues in achieving thinner cameras is the size of the actuator that controls the autofocus operation in the camera module.
As a solution to this issue, Toshiba has developed a digital refocusing technology using multiple fixed-focus cameras that allows users to select the focal point after an image is captured. This technology makes it possible to add an autofocus function to fixed-focus cameras, and will contribute to the realization of thinner mobile terminals.

Improvement of Transportation Efficiency in Large-Scale Factories Using Technology Integrating Mathematical Optimization and Microsimulation
YOSHIDA Takufumi
Automated transportation systems with automatically controlled vehicles have been introduced into large-scale factories equipped with job shop type manufacturing lines in recent years. In such factories, large quantities of semifinished products are delivered to and from the shops by vehicles. Efficient movement of these vehicles is essential because vehicular congestion may lower the production efficiency of the shops. It is therefore necessary to efficiently control the speed of each vehicle according to the flow of movement in relation to the preceding vehicles.
Toshiba has developed a technology integrating mathematical optimization and microsimulation based on traffic congestion theory that incorporates the following processes: (1) visualization of the traffic condition of each vehicle in the factory, (2) modeling and microsimulation using the "Intrafab Transport Simulator," a transportation simulator based on control rules applied to multiple vehicles, and (3) optimization of the control rules to improve transportation efficiency. We have conducted simulation experiments on the "Intrafab Transport Optimizer," a newly developed transportation optimizer applying this technology using actual data of an automated transportation system, and confirmed the effectiveness of this technology.

Newly Developed Material for Realization of Large-Scale Geothermal Steam Turbines
YAN Liangi / YAMADA Masayuki / WADA Kazuhiro
Geothermal power generation has been attracting attention in recent years as a renewable energy resource, and demand has arisen for increases in the size and output of individual geothermal steam turbine units accompanying the expansion of large-scale geothermal power plants.
Under these circumstances, Toshiba has developed a new material for large-scale geothermal steam turbine rotor shafts with a maximum weight in the 50-ton class. This material has the properties of excellent hardenability, high strength, high toughness, high stress corrosion cracking (SCC) resistance, and less center segregation of carbon in the steel ingots. We have verified the manufacturability of the newly developed material in the form of an 8-ton sand mold ingot, and successfully applied it to the manufacturing of geothermal steam turbine rotor shafts for large-scale geothermal power plants.

Fieldbus Support Technologies for Process Control Systems
LIU Liu / ITO Yu / KAWAMOTO Junichi
Toshiba has been expanding its product lineup of the Unified Controller nv series. This advanced industrial controller consists of input/output (I/O) modules, an information/control LAN, and engineering tools.
We have now applied these technologies for the Unified Controller nv series to the development of the following fieldbus support equipment for process control systems: an intelligent I/O module that complies with the HART$^{(\dagger)}$ communication protocol, and a plant asset management (PAM) system to manage all facilities in a plant as a company's assets that adopts the FDT/DTM (Field Device Tool/Device Type Manager) interface specifications of the IEC (International Electrotechnical Commission) 62453 standard. These fieldbus support technologies make it possible to meet users' requirements including low initial cost and reduced engineering work due to improvement of design efficiency when implementing the migration of an aging plant and new plant construction.

1 Tbyte Recording Capacity 2.5-inch HDD with 7 mm Height Form Factor for Mobile Notebook PCs
KUROSAWA Shin / NARUSE Hitoshi / KUBOHARA Ryuki
In the notebook PC market, hard disk drives (HDDs) with a large storage capacity are required for the recording and reproduction of large-volume contents including high-definition videos, while also satisfying mobile performance requirements. In response to this market demand, Toshiba has developed the MQ02ABF100 2.5-inch HDD, which achieves the largest class capacity of 1 Tbyte in the market for HDDs with a 7 mm height form factor. Through the application of newly developed technologies such as a thinner platform specialized for a dual-platter mechanism, as well as a dual-stage actuator (DSA) introduced for the first time in our 2.5-inch HDDs, the MQ02ABF100 realizes a balance between large capacity and high reliability including enhanced vibration and shock resistance.

Kindmover Escalator with Safety Material Affixed to Step Edges
TAKAHASHI Hideo / KIKUCHI Takayuki / NAKAGAKI Shigeo
In escalator riding accidents, more than 90% of serious cases in which the dispatch of an ambulance is requested are the result of tripping or falling. Demand has therefore been growing for an effective measure to mitigate injury in the event of a rider falling, and in particular, to prevent critical injuries.
In response to these circumstances, Toshiba Elevator and Building Systems Corporation developed and released the Kindmover escalator with a safety material affixed to the edges of the steps as a standard safety measure in September 2013, ahead of its competitors in the industry. Through evaluations of the probability of head injury occurrence classified by the head injury criterion (HIC) score, which is used as a safety standard for vehicles and playground equipment, we have confirmed that this safety measure incorporated into the Kindmover is effective in mitigating injury.

High-Efficiency and Small-Form-Factor Control Gear for LED Lighting Using GaN Devices
OTAKE Hirokazu / KITAMURA Noriyuki / TAKAHASHI Yuji
Wide-bandgap semiconductors such as silicon carbide (SiC) and gallium nitride (GaN) are now attracting attention as a material for next-generation power semiconductors, and are expected to contribute to the development of power converters offering both high efficiency and compactness. In particular, GaN devices are capable of performing high-speed and highly efficient on/off switching operation due to their advantages of smaller impedance and higher saturation velocity of electrons compared with other power devices.
Toshiba Lighting & Technology Corporation has developed a built-in GaN control gear and peripheral circuit for light-emitting diode (LED) lighting applying GaN high electron mobility transistors (HEMTs) and an inductor optimized by the adoption of a magnetic material to downsize the dissipation structure and passive components. Experiments on a prototype 50 W mini-krypton replacement LED bulb with the newly developed high-efficiency and small-form-factor control gear and peripheral circuit have confirmed that its performance meets the requirements for practical application.

Frontiers of Research & Development

Lightweight and Versatile Production Scheduler Easily Integrated into Existing System of Manufacturing Sites