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Special Reports

Toshiba's Basic Research Supporting Visual and Imaging Technologies

Importance of Advanced Visual and Imaging Platform Technologies
SHIMODA Kenji

Visual and Imaging Technologies Accelerating Quality and Added Value Enhancement
WATANABE Toshiaki / FUNAKI Hideyuki / MURAI Shinya
Demand for larger screens and multiple functions has been rising in recent years in the field of images and related devices. Under these circumstances, the ability to receive large volumes of image information, transmit such data effectively, and display the images attractively is of key importance.
Toshiba has been engaged in the research and development of fundamental technologies, including efficient compression technologies, Internet transmission technologies, advanced three-dimensional (3D) display technologies, and large organic electroluminescence (EL) sheet display technologies, as well as intelligent cameras equipped with an image recognition processor and far-infrared image sensors. We are continuing our efforts to provide total high-quality solutions by combining individual fundamental technologies and adjusting the parameters for optimum performance.

Far-Infrared Image Sensor with Improved Temperature Stability and Response Speed
ISHII Koichi / HONDA Hiroto / FUNAKI Hideyuki
A far-infrared image sensor is a two-dimensional temperature sensor that can visualize temperature distribution by detecting infrared radiation emitted from objects. Far-infrared image sensors make it possible to detect unusual temperature conditions, which is impossible with visible and near-infrared sensors, in the main application fields including automotive night-vision systems for pedestrian detection and the maintenance and surveillance of buildings and facilities.
Toshiba has been developing far-infrared image sensors using single-crystal silicon fabricated on a semiconductor mass-production line, and refined the pixels by applying advanced semiconductor processes. However, the temperature stability required for outdoor use of these sensors and the tradeoff between the sensitivity and response speed are significant issues. To overcome these problems, we have newly developed a read-out circuit to improve the temperature stability and a pixel structure to improve the response speed without reduction of the sensitivity. We have confirmed that, as a result of these developments, the sensor output fluctuation according to the variation in chip temperature is reduced to 1/20 compared with that of the conventional sensor and the response speed is improved by 36%.

Intelligent Camera Incorporating Visconti$_{TM}$2 Image Recognition Processor
KOZAKAYA Tatsuo / WATANABE Tomoki / OKADA Ryuzo
As the number of network cameras increases year by year, the operation and maintenance costs are growing accompanying the expansion of both the network traffic and the monitoring task load. Demand has therefore been rising for a network camera with an image processing function to improve cost effectiveness and save labor.
Toshiba has developed an intelligent camera incorporating the Visconti$_{TM}$2 image recognition processor, which is equipped with several hardware accelerators and offers high-speed image recognition processing such as object detection with enhanced performance. As the Visconti$_{TM}$2 makes it possible to simultaneously capture video frames and apply advanced image recognition processing to these frames in the intelligent camera, operators can efficiently evaluate the worth of each frame and quickly focus on the important scenes. We have confirmed the effectiveness of the intelligent camera through demonstration experiments on the simultaneous real-time detection of four types of objects including a human face, a human upper body, cars, and a cat.

High-Efficiency Motion-Compensated Weighted Prediction Technology toward HEVC Next-Generation Video Coding Standard
TANIZAWA Akiyuki / YAMAGUCHI Jun / CHUJOH Takeshi
The Joint Collaborative Team on Video Coding (JCT-VC) has been established to develop a next-generation video coding standard, called HEVC (High Efficiency Video Coding), which aims at a substantial improvement in coding efficiency compared with the existing H.264/AVC (Advanced Video Coding) standard. The JCT-VC is planning to finalize the HEVC standardization activity by the beginning of 2013.
Toshiba has been promoting the development of video coding technologies to improve coding efficiency even before this activity and has proposed many types of technologies toward HEVC standardization. One of these technologies, a motion-compensated weighted prediction (WP) technology to predict temporal illumination variations in specific video contents with a fade effect, has been adopted as a draft specification for HEVC. HEVC is expected to realize the distribution of high-quality video contents to various audiovisual devices including tablets, TV sets, and PCs.

NPEngine$_{TM}$ Equipped with Direct Storage Access Technology for Video Streaming Servers
YAMAURA Takahiro / YAMAGUCHI Kensaku / HASHI Yasumichi
With the broad dissemination of wideband networks and mobile audiovisual terminals including smartphones and tablets in recent years, the number of video services provided via the network is increasing. However, the performance of conventional video streaming servers is limited by the speed of the central processing unit (CPU) and the bandwidth of the memory.
To overcome these problems, Toshiba has developed NPEngine$_{TM}$ equipped with a direct storage access technology that can directly transfer data from the storage to the network, bypassing the CPUs and memories in video streaming servers. This technology makes it possible to reduce the workload of CPUs and the bandwidth utilization of memories. We have applied it to the ExaEdge$_{TM}$ video streaming server, which can distribute video contents to a large number of users (up to 64,000).

Multiple-Face Tracking Technology for Glasses-Free 3D Displays
SHIMOYAMA Kenichi / MITA Takeshi / HIRAI Ryusuke
Autostereoscopic displays enable viewers to watch three-dimensional (3D) images without wearing dedicated glasses. However, the viewers are forced to watch the display from within a limited area, called the viewing zone, in order to enjoy high-quality 3D images.
As a solution to this issue, Toshiba has developed a multiple-face tracking technology that can automatically control the viewing zone according to the viewers' positions detected by a camera installed in the TV set. This technology makes it possible to find the best position of the viewing zone for multiple viewers so as to maximize the 3D-satisfaction ratio. We have conducted simulation experiments for a family of four and confirmed that the average 3D-satisfaction ratio of four viewers is 3.8 in the viewing zones using our newly developed technology, compared with only 1.7 using the conventional method.

Depth-Adapted Super-Resolution Technology to Achieve Depth Recovery of Images
ONO Toshiyuki / TAGUCHI Yasunori / KANEKO Toshimitsu
With the development of TVs equipped with 4K2K (3,840 x 2,160 pixels)-resolution liquid crystal displays (LCDs), including the REGZA 55XS5 LCD TV developed by Toshiba, the market for such 4K2K-resolution TVs has been expanding. 4K2K-resolution TVs are attracting attention due to their better image quality reproduction with a higher degree of realism compared with full high-definition (1,920 x 1,080 pixels) TVs.
Toshiba has been devoting continuous efforts to the enhancement of image quality appropriate to the resolution of displays through the development of super-resolution technologies. We have now developed a depth-adapted super-resolution technology for 4K2K-resolution TVs, which can recover the depth feel of images by controlling the super-resolution effect based on the depth information of images. With this new technology, we have succeeded in reproducing more realistic images than ever.

OLED Sheet Display Driven by Oxide Semiconductor Thin-Film Transistors
SAITO Nobuyoshi / SAKANO Tatsunori / YAMAGUCHI Hajime
In order to realize a sheet display with ultrathinness, light weight, and flexibility like that of paper, the glass substrate of display panels must be replaced by a material that is not easily broken such as a plastic substrate. However, it is difficult to achieve thin-film transistors (TFTs) with high mobility and stability on a plastic substrate because plastic films are generally less durable under high temperature than glass substrates.
To solve this issue, Toshiba has developed an indium gallium zinc oxide (InGaZnO) TFT with high mobility on a plastic substrate, whose stability is almost equal to that of an InGaZnO TFT fabricated on a glass substrate. This was realized by improving the quality of low-temperature-formed films. Using this technology, we have succeeded in fabricating an 11.7-inch organic light-emitting diode (OLED) sheet display.

Feature Articles

Low-Power Many-Core SoC Integrating 64 Processor Cores for Embedded Applications
TANABE Jun / USUI Hiroyuki / MIYAMORI Takashi
New types of multimedia processing technologies, including image recognition and augmented reality (AR) technologies, have been put to practical use in embedded applications for automotive, digital consumer, and mobile products. To realize higher performance and lower power consumption than ever before, a many-core processor, which has many more processor cores than existing multicore processors, is a promising candidate for multimedia processing.
Toshiba has developed a many-core system on a chip (SoC) integrating 64 processor cores for embedded applications. This many-core SoC has two many-core clusters with 32 processor cores, as well as image recognition hardware accelerators. It achieves a total peak performance exceeding 1.5 tera operations per second (TOPS) and low power consumption of less than 1.6 W under a high-load state operating 64 cores simultaneously thanks to the introduction of low-power technologies for many-core clusters.

Second-Generation Thermal Print Head Achieving 1,200 dpi Resolution and Low Cost
OBA Masato / NORO Seiichi / ABE Yoshihide
A thermal print head is an information recording device used in a wide variety of digital-photo printers for medical imagers and other applications.
Toshiba Hokuto Electronics Corporation has already commercialized a first-generation thermal print head with a 1,200 dots per inch (dpi) heater, which achieved the highest resolution in the market for products with a print width exceeding 4 inches. To accelerate the dissemination of thermal print heads with 1,200 dpi resolution by reducing their cost, we have now developed a second-generation thermal print head with dedicated driver integrated circuits (ICs) and a newly designed structure applying a bond stitch on ball (BSOB) wire bonding process of 19 µm pitch with higher bonding strength.

High-Speed Controller for EHC and AVR Platforms in Nuclear Power Plants
SUSEKI Kohei / MIYAZAWA Keitaro / CHIKARAISHI Kenji
Toshiba has developed and released a high-speed controller, which can be applied to both an electrohydraulic controller (EHC) for turbine control systems and an automatic voltage regulator (AVR) controller for generator control systems, for nuclear power plants targeted at the global market. The newly developed high-speed controller achieves improved reliability and maintainability compared with conventional controllers, and has been comprehensively redesigned to correspond with the diversity required for nuclear power plants in various countries. We are planning to apply this controller to EHC and AVR platforms in both domestic and overseas nuclear power plants.

Verification on Brushless Excitation Turbine Generator with Improved Response Ratio and High Initial Response
NOMOTO Yoshihiro / HIRAMATSU Daisuke / UEMURA Yoichi
High-response excitation is required in turbine generators to improve the transient stability of the electric power system. The static excitation system has been applied to medium-capacity generators (300 MVA class) due to the higher excitation response of this system compared with that of the brushless excitation system. However, a strong need also exists for application of the brushless excitation system to generators of larger than medium capacity, especially in the international market, in order to facilitate operation and maintenance.
To expand the range of applicability of the brushless excitation system so as to satisfy the requirements of electric power systems, Toshiba has developed technologies for brushless excitation turbine generators to improve the response ratio and realize a high initial response. We have conducted excitation response tests using a 400 MVA-class generator and a brushless excitation system, and confirmed that the brushless excitation system achieves high response characteristics equivalent to those of the static excitation system.

TOSGAGE$_{TM}$ LX Series X-Ray Thickness Gauge with Compact Measuring Head for Steel Rolling Lines
FUKUOKA Masayuki / KAGAWA Takeshi / KAWASHIMA Yuki
Rolling line measuring instruments are used to measure the thickness, width, shape, and surface defects of the product at all stages of steel rolling, from upstream processes such as the hot rolling line to downstream processes such as the surface inspection line.
Toshiba has been developing X-ray thickness gauges that are widely used as key rolling line measuring instruments for online measurement of the thickness of steel sheets. In the field of X-ray thickness gauges, downsizing of the measuring head is required for installation in the limited space of rolling lines, in addition to high accuracy and reliability. To meet these demands, we have developed the TOSGAGE$_{TM}$ LX series X-ray thickness gauge with a compact measuring head for steel rolling lines, offering high accuracy and reliability as well as enhanced maintainability.

Development of Technologies Corresponding to Privacy Regulations in Smart Communities
MORIJIRI Tomoaki / KOJIMA Kenji
Smart communities are aiming at the integrated management and optimized control of electric power, water, transportation, logistics, and information through the application of information and communication technologies (ICTs). As ICT systems deal with various data containing the private information of residents in a smart community, privacy protection regulations for smart meter data in particular are being enacted in many countries and regions. In the future, privacy protection regulations will expand to all types of data handled in a smart community.
With these circumstances as a background, the Toshiba group is engaged in the development of technologies for privacy protection that are necessary when an integrated system for a smart community is constructed.

Frontiers of Research & Development

Ongoing Trends in Web and TV Standardization at W3C