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Special Reports
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***Multimedia Technology in the Mobile Internet Era--MPEG-4**
SUGIYAMA Fumio

***Historical and Technical Overview of MPEG-4**
WATANABE Toshiaki
MPEG-4 (Moving Picture Experts Group-phase4), the latest international standard for video coding, has been studied since the mid-1980s. New functionalities such as error resilience in the mobile environment and arbitrary shape coding for computer application, which were not covered by the existing standard, are realized by MPEG-4. Technical discussions have been finalized, and it is now time for MPEG-4 applications to enter the market.

This paper provides a historical and technical overview of MPEG-4

***Error-Resilient Techniques for MPEG-4**
CHUJOH Takeshi NAGAI Takeshi KIKUCHI Yoshihiro
One of the requirements for MPEG-4 standardization is error resilience for mobile video communications. In this paper, we explain the basic concepts of error-resilient video coding and summarize some error-resilient techniques (resynchronization marker, header extension code, data partitioning, reversible variable-length code) that are adopted in MPEG-4 Visual. Toshiba contributed error-resilient techniques to MPEG-4 standardization.

***Video Coding Technology for Arbitrarily Shaped Objects in MPEG-4 Standards**
YAMAGUCHI Noboru
Video coding technology for arbitrarily shaped objects is a technology for realizing this function, which is not in the conventional standard, adopted for the first time in the standardization of MPEG-4. Unlike the conventional technology for rectangular video, this technology makes compressibility possible for an object of arbitrary shape such as the subject in a video (for example, a person).

Toshiba has been taking part in the standardization of MPEG-4, and has significantly contributed to the standardization of video coding technology for arbitrarily shaped objects while studying its applications.

***MPEG-4 RTP--Transport Protocol for Video Signals on Internet and Mobile Networks**
KIKUCHI Yoshihiro NAGAI Takeshi ZETTSU Tatsuya
Toshiba has proposed a transform format, MPEG-4 Real-time Transport Protocol (RTP), for transferring compressed video signals over the Internet and mobile networks. We worked for the standardization of this format jointly with NEC Corporation, Oki Electric Industry Co., Ltd., Matsushita Electric Industrial Co., Ltd., and Nippon Telegraph and Telephone Corporation. It was adopted by the Internet Engineering Task Force (IETF), by the Third Generation Partnership Project (3G-PP) in its transparent end-to-end packet switched streaming service (PSS) for mobile phones, and by the International Telecommunications Union (ITU) in its packet based multimedia communication systems (H.323) for teleconference systems and videophones.

The proposed format provides a packetization scheme utilizing MPEG-4 error-resilient coding tools. We have developed a prototype based on the 3G-PP standard, and will continue to contribute to the promotion of audio-video distribution services and products on the Internet and next-generation mobile networks.

***Transcoding Technology for MPEG Video Format**
YAMAGUCHI Noboru KODAMA Tomoya MASUKURA Koichi
Toshiba is developing Moving Picture Experts Group (MPEG) transcoding technology aiming at application to video archive, home server, surveillance, and other systems. This technology is characterized by automatic detection of changes in a scene and saving of data as metadata, while uniting video compression technology (MPEG-2/MPEG-4) and video structuring technology (MPEG-7) and changing video of MPEG-2 format into video of MPEG-4 format at high speed.

The processing time, especially when processing two or more tasks concurrently, has been greatly shortened by accelerating transcoding processing using side information such as motion vectors output from the MPEG-2 decoder

***Video Browsing Method over Narrowband Network**
TAKAHASHI Toshiya TAKEDA Naomi IMAI Toru
Video streaming over the Internet is highly popular today and video contents can be viewed on PCs and cellular phones. With the increasing volume of video contents, technology for finding a favorite scene among video contents has become more important.

Toshiba has developed a video browsing method over the narrowband network using progressive thumbnail downloading, and a video browsing system implementing this method.

***"Kao Chat" System**
IDA Takashi TAKESHIMA Hidenori HORI Osamu
Communication systems in which facial images are transmitted using a camera connected to a PC or cellular phone are becoming popular. Users of such systems are able to converse while viewing the faces of those with whom they are conversing.

Toshiba has developed an image composing system in which the images of participants are extracted along contours, transmitted, and automatically composed as an image in real time. By sharing the composed image via a chat system, an enriched communication experience characterized by feelings of unity and affinity is achieved. The proposed system is practical for use with current consumer PCs and networks because the required computational load is small and the required transmission bit rate is low.

***MPEG-4 CODEC LSI**
TAKAHASHI Masafumi
Toshiba has developed low-power MPEG-4 codec LSIs for mobile applications. The combination of RISC and hardware accelerators was adopted to cope with the MPEG-4 standard change, because these LSIs were developed when the MPEG-4 standardization process was in progress. Furthermore, various low-power technologies such as clock gating, a low-power motion estimator, and embedded DRAM were adopted to meet the demand for low power consumption in battery-driven mobile products.

The production MPEG-4 LSI, which includes a video codec, a speech codec, and multiplexing/demultiplexing functions, handles the video telephony application with a power consumption of only 75 mW.

***Software of Audiovisual Phone for Mobile Terminal**
WATANABE Eiichi SAMATA Tatsuo UNOKI Yasushi
The third-generation mobile communication service started in 2001. One of its features is multimedia services using large volumes of information such as audiovisual phone and video downloading/streaming.

To realize these services, Toshiba developed an MPEG-4 LSI (TC35273XB). We have developed firmware to be incorporated in this MPEG-4 LSI, a driver that controls the LSI, and middleware to realize the 3G-324M audiovisual phone. A set of these modules realizes the 3G-324M audiovisual phone on a real-time basis, and the middleware has the feature of enabling maintainability and portability by the module architecture.

***MobileMotion$_{TM}$ MPEG-4 Video Streaming Software**
HORIUCHI Chihiro CHIJIYA Masateru
We commercialized a video streaming system called MobileMotion$_{TM}$, which is compliant with the MPEG-4 standard, in 1998. Applications for video streaming systems can be divided into two types: usage for real-time video encoding and distribution, and usage for on-demand distribution with video archives. The first type requires a short delay time; that is, the elapsed time from video encoding to display. The second type requires video display for multiple sources without stream discontinuity. To meet these requirements, MobileMotion$_{TM}$ adopts Real-time Transport Protocol (RTP) distribution and multi-decoding processing.

This paper presents two implementations that cover both types: a real-time distance learning system, and a clip on demand system.

***Real-Time Monitoring System Using MPEG-4**
KOBAYASHI Hiroyuki INAGAKI Kanji SAKUMA Akira
An MPEG-4 monitoring system supervises video in real time in power plants. The concept covers earlier detection of failure symptoms, quick action, and convenient communication between the main control room and other areas such as plant local areas and site offices.

Toshiba has developed a real-time monitoring system using MPEG-4 technologies that can handle not only cable but also wireless applications such as the personal handy-phone system (PHS) and wireless LAN. This system can also detect changes in the color and motion of objects in an MPEG-4 video stream in real time.

***MPEG-4 Real-Time Encoder for Broadcasting**
SASAKI Nobuyuki MUSHA Toshihiko KODAMA Tomoya
Since MPEG-4 is expected to be used in a wide range of applications including digital terrestrial broadcasting and mobile broadcasting, an MPEG-4 real-time encoder for broadcasting use is required. Toshiba has developed a prototype MPEG-4 real-time encoder based on the requirements for these applications.

Feature Articles

***Ergonomic Evaluation of Readability of High-Resolution TFT-LCDs**
IDO Kenji HAYASHI Hisako MIYAGI Hiroaki
High-resolution LCDs with a large work information area are required for PC and monitor applications. However, the high resolution leads to thinner lines and smaller size in characters. In order to clarify the relationship between LCD resolution and character readability, an ergonomic evaluation of the character readability of Japanese fonts was performed using a 15-inch XGA TFT-LCD (86 pixels per inch) and UXGA TFT-LCD (133 ppi). The results indicated that the 15-inch UXGA TFT-LCD offered superior readability. In addition, other factors affecting readability, including the balance of character size and stroke width, were also clarified.

***Efficiently Managed Electronic Toll Collection System**
FUKASAWA Kazuo NAITO Kazutoshi NAKAMURA Junichi
Electronic Toll Collection (ETC) is the latest means of highway toll payment. ETC systems supplied by several system integrators have been installed on toll roads in Japan. ETC services are provided by three highway public corporations. However, the set of a transponder and integrated circuit (IC) card of the Japanese ETC systems enables all of these services to be used. There is no precedent in the world for this ETC business.

Toshiba has developed the entire system including the IC card, the tollgate equipment, and the host computer utilizing its accumulated know-how and skills as a toll collection system integrator and the ETC technologies established through the activities of the Joint Research on Nonstop Toll Collection System project in Japan. During the development, we concentrated on the total management efficiency of both the traditional toll collection system and the ETC system. In particular, management of the ETC tollgate system for collecting tolls from drivers is the most important element. This paper introduces the distinctive features of our ETC system.

***World's Fastest Elevator (1,010 m/min)**
NAKAGAWA Toshiaki KOHARA Hideya SEKIMOTO Youichi NAKAGAKI Shigeo
We have developed a comfortable, ultrahigh-speed elevator with the world's fastest speed of 1,010 m/min. An elevator emergency safety device was developed that is capable of withstanding high temperatures exceeding 1,000 °C under high-speed operation at 1,010 m/min, and a twin-drive control technique for driving a high-power traction machine was adopted. An atmospheric pressure control technique was also developed to ensure riding comfort in high-rise buildings. In response to the trend toward increasingly tall skyscrapers, simulation analysis of rope vibration was performed to realize a vibration-suppressing control system.

These high-technology features were employed in an elevator installed in the Taipei Financial Center Building, which has a height of 508 m.

***Electrical Anti-Biofouling System for Power Plants**
TAKAHASHI Reiji INAGAKI Shuichi NAKASHIMA Shoji
At many power plants, considerable labor and costs are expended to remove marine life from the surfaces of seawater-utilizing cooling equipment. Toshiba has developed a new electrical anti-biofouling system to prevent the deposition of marine life on equipment surfaces without a harmful effect on the environment. This system is remarkably effective.

The newly developed system uses active oxygen generated by seawater electrolysis. It has several salient characteristics such as being maintenance-free and effective over the long term. The system consists of titanium sheets coated with a catalyst, electrodes (cathodes and reference electrode), and an electrical source. The titanium sheets are attached to the equipment's surface with an insulating sheet by an adhesive agent.

Excellent results have been confirmed in a test of model equipment carried out at the site of an actual power station, indicating that adoption of this system will realize more reliable equipment, lower maintenance costs, and reduction of industrial waste. It is expected to be applied to many types of equipment in seawater service.

Toshiba Technologies for the New Century

***14.Small Fuel Cell for Portable Electronic Devices**