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Gadgets and Signal Processing: The 2010 International CES

The city of Las Vegas is known for its massive casinos, the number and variety of entertainment shows, and by an almost-established tradition that brings to this city one of the largest trade shows in the world: the International Consumer Electronics Show (CES). Every January, Las Vegas becomes the center of attention of the consumer electronics industry. This year's show presented hundreds of products, featured exhibitions of 226 companies, and discussed and demonstrated the latest trends in consumer electronics.

In this article, we will take a closer look at the 2010 International CES. Our interest is in discussing the most popular trends that were enabled by signal processing or will have an impact on a venue related to signal processing. The major focus of this year's show was on E-readers and home entertainment. In the home entertainment arena, we will discuss two major technologies that were introduced to the market at this year's show: three-dimensional (3-D) television (TV) (3-D TV) and mobile TV. For E-readers, we will discuss the interaction technology of the touch screen, which has also received attention as it makes its way into the area of tablet computers.

3-D TV

Although there still remain some challenges for widespread dissemination of TVs that display content in three dimensions (3-D TVs), [1], this technology was arguably the one receiving the most attention at the CES. From a technology point of view, the CES showed that the technology of choice to enable 3-D TV is "active shutter HDTV." This technology is based on the use of glasses that alternatively blanks out each of the eyes. The operation of the glasses is synchronized with the 3-D-enabled TV through a wireless (e.g., Bluetooth) or infrared (IR) link, in such a way that the TV shows a different image for the left or right eye so as to generate the stereoscopic sensation of 3-D images. This implies that to avoid flickering effects, the TV sets need to be able to project images at twice the refresh rate as the current two-dimensional TVs.

In addition to 3-D TV sets, the CES was also the venue for some broadcasting companies (e.g., ESPN, Sony, and Discovery) to announce the future launch of channels broadcasting 3-D content. Nevertheless, a number of questions still remain to be answered; most importantly, how to transmit the new stream that will carry information for each of the eyes. As standardizing and industry groups (such as the Moving Picture Experts Group (MPEG) Industry Forum and the Study Group 6 of the International Telecommunications Union-Radiocommunications Sector) began to meet to discuss this issue, it appears that early broadcasting will rely on the adaptation of currently existing technology. For example, in 2009, Eutelsat launched a 3-D demonstration channel that uses MPEG-4 video coding and traditional modulation technology to transmit an 8 Mb/s stream that simulcasts the stereoscopic signals multiplexed into the stream [3]. At the same time, some of the video coding standards have been incorporating mechanisms to encode the left and right view through interpolation in the temporal domain. For example, in MPEG-2 Multiview Profile, while one of the views is encoded as a temporal enhancement layer, the other is encoded at a lower frame rate. Nevertheless, as the standardization efforts make progress, it is expected that some of the many video coding approaches already being researched will find their way into broadcasting standards. Some of these approaches are discussed in [3]. Notably, all these coding and broadcasting technologies are based on fundamental signal processing algorithms, such as predictive coding.

TABLET COMPUTERS, E-READERS, AND MULTITOUCH DISPLAYS

Multitouch technology was first brought to the mass market by the iPhone. Multitouch is the technology that allows users to interact with a computer or smartphone by touching many places on the screen at the same time. At the 2010 International CES, this technology was once again the center of attention, in part due to speculation surrounding a new product by Apple Inc.: a highly portable computer in a tablet form. This speculation also turned into a focus for all the announced Tablet PCs, which will be competing with the Apple product. Tablet PCs have been on the market for several years. They have been used in hospitals, health care clinics, classrooms, and other venues such as manufacturing plants and construction sites. Nevertheless, this renewed focus on Tablet PCs was accompanied by another major technology in this year's show, i.e., multitouch technology and E-readers. One could easily envision the future of textbooks in signal processing courses. In the future, students may only have E-readers and Tablet PCs in their backpacks. All of their textbooks will be on the E-readers with all their own markings and electronic notes.

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Similarly, they will write their notes using their Tablet PCs. This futuristic picture is not far from reality, as we have started to see these ideas being implemented in a small scale in selective classrooms and colleges. With all the discussions on global warming, such future classrooms will be truly green classrooms with paperless classes.

Today's touch sensitive displays relay on two main technologies: resistive touch and capacitive touch. Of the two approaches, capacitive touch is the most popular choice. Capacitive touch screens work by embedding into the display two separate and perpendicular layers of conductive material in such a way that they form a grid of capacitors once a voltage differential is applied to the layers. When a finger or a special pen comes close to the display, they alter the electrostatic field and the capacitance in the area of proximity of the object with the display. Since capacitors are organized in a grid, it is possible not only to identify more than one object touching the display but the location of each object up to the precision given by the density of the grid of capacitors. While the sensing of a finger relies on its inherent electrical properties to change the display electrostatic field, it becomes more difficult to sense an object such as a pen. In this case, the solution is to use a special pen-like device that contains a circuit that picks the electromagnetic energy emitted by a coil located around the display, and uses it to change the electrostatic field around a location of the sensing grid in the display.

A particularly intriguing multitouch technology is the one using IR sensing. In recent implementations of this idea, [4], the back of the display is fitted with a grid of IR emitters and detectors. The display senses the proximity of an object by emitting IR radiation and measuring the energy reflected at a nearby object through analysis of the image formed at the IR detectors. Although at the cost of lower precision in localizing touching objects, the display can also work in a passive mode where it does not emit IR radiation and it only "looks" at the received IR radiation emitted by nearby objects. This is what opens the intriguing possibilities for this technology, because it can also be used to communicate with peripherals through an IR link. Even more, since the multitouch operation is based on IR image analysis, the display could become a distributed camera that "looks" to the area in its proximity and could allow for other forms of interaction where various signal processing algorithms can be incorporated.

MOBILE TV

Following the momentum gained by the approval of the Advanced Television Systems Committee (ATSC)-Mobile digital TV (DTV) Standard A/153 (ATSC-M/H) in October of 2009, free mobile TV service in the United States was also the center of attention at the CES [5]. This standard (developed by the ATSC) follows other standards for mobile TV, such as MediaFLO and DVB-H. The ATSC-M/H standard [6] was developed to allow DTV broadcasting stations to include a bit stream suitable for reception of a TV signal in a mobile handheld device. By inserting a multiplexer into the transmission chain, the standard achieves the goal of letting broadcasters add a digital mobile TV signals without the need to change the existing infrastructure for ATSC-fixed TV broadcasting. After inserting the multiplexer, the broadcaster's transmitted stream may consist of a MPEG-2 encoded stream for high-definition TV, another MPEG-2 encoded stream for standard-definition DTV, and a MPEG-4 Part 10 (H.264) encoded stream (in the baseline profile) for mobile DTV transmission of 416 pixels $\times$ 240 pixels (16:9) digital video. The maximum data rate for the mobile source encoded video ends up being equal to 768 kb/s. The audio data of the mobile TV stream is encoded using the MPEG-4 Part 3 (HE-AACv2) format. This scheme implies that the all the digital video streams, including the mobile TV data are modulated using the same 8VSB scheme of the (fixed) digital standard. Since this modulation scheme is not well suited for the communication over the multipath channels typical of mobile scenarios, the ATSC-M/H stream receives extra protection through the use of more powerful error-protecting codes. Finally, video data is encapsulated into an IP stream. The end result is that the 19.380 Mb/s available in an ATSC channel can accommodate a typical configuration consisting of one HD ATSC service (using up around 9 Mb/s), two standard definition ATSC service (at around 3 Mb/s) each, one mobile ATSC-M/H service (needing almost 5 Mb/s) and one channel for program and system information protocol data (taking up around 0.5 Mb/s of bandwidth).

Through our eyes, this article provides a snapshot of the major attractive exhibited technologies at the 2010 International CES. Some of these technologies are finding their way to the mass market and some others are being regulated through standards. In future issues of *IEEE Signal Processing Magazine*, other columns will cover various aspects of these standards and their background technologies.

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