Display Week 2010 Review: Touch Technology

2010 was a year of incremental improvements and continued strong growth for touch technology.

by Geoff Walker

THERE WAS PROBABLY more touch technology at Display Week 2010 than at any other conference worldwide in the last year. That said, 2010 was an evolutionary year rather than a revolutionary one. There were no new technologies, no major breakthroughs, and no shocking surprises. There were, however, more exhibitors (67 *vs.* 59 in 2009), especially in the materials area. This can be taken as a sign of industry maturation, where the focus is gradually shifting from touch screens themselves to the materials and processes that go into manufacturing touch screens.

The 67 touch-related exhibitors can be classified as follows:

- 28 module manufacturers
- 17 materials suppliers
- 7 display manufacturers
- 5 controller manufacturers
- 5 optical bonding suppliers
- 3 haptics suppliers
- 2 market research firms

The primary focus for the 28 module manufacturers was evenly split between projected capacitive (pro-cap) and analog resistive (both single-touch and multi-touch). Other touch technologies [optical, infrared, SAW, EMR (digitizer), *etc.*] were relatively lightly represented. Again, this can be taken as a sign of industry maturation, since, according to market research firm DisplaySearch, well over 90% of industry revenue in 2010 will be produced by resistive and pro-cap technologies.

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Projected Capacitive (Pro-Cap)

With 18 suppliers exhibiting pro-cap touch screens at Display Week 2010, it was clear that pro-cap touch has fully emerged and should henceforth be considered a "mainstream" touch technology. Besides the number of exhibitors, several other factors point to this emergence. One is that the physical constructions of pro-cap touch screens are starting to fall into well-defined categories (film, glass, on-cell, and wires). Figure 1 (from Sony Chemical) shows a typical film construction.

Another factor is that small quantities of pro-cap touch screens are beginning to be readily available. This is a significant change. Previously, almost all of the pro-cap suppliers were focused exclusively on high-volume consumer-electronics opportunities, and it was very difficult for a small company to find a supplier. Now that pro-cap is spreading into a wide range of devices beyond just smartphones, companies such as RiTdisplay (US Micro Products) can provide samples only 5 weeks after approval of drawings and production in small-quantity batches.

Yet, another factor is that competition has started to shift from simple availability of pro-cap to enhancements in form factor and performance. For example, Wintek showed a 4.3-in. pro-cap touch screen with a 0.6-mm border width on three sides – with the "zero-bezel" (flush design) capability of pro-cap; this exceptionally narrow border width enables products that are literally all screen!

In the performance area, 3M continued to show progress with its exceptional 22-in. pro-cap monitor, reducing response times from 8 to 6 msec for 20 simultaneous touches. 3M pointed out that minimizing response time is important in the big picture because it is part of the overall latency of a touch screen, and latency directly affects user perception of touch-screen performance. In its booth, 3M was using a version of Google Earth that had been enhanced by Perceptive Pixel; the enhancement used a third touch to control panning (two fingers for X-Y zoom and a third finger controlling the altitude of the point of view above the map).

Maxim was also talking about some very exciting controller performance enhancements due in an upcoming product. Although the company was not ready to disclose the details yet, representatives dropped hints about an exceptionally high signal-to-noise ratio that enables the use of any stylus (not just all-metal ones), and an exceptionally low-power-consumption level that equals that of analog resistive.

The 18 exhibitors showing pro-cap included 3M, AMT, EETI (eGalax), LG

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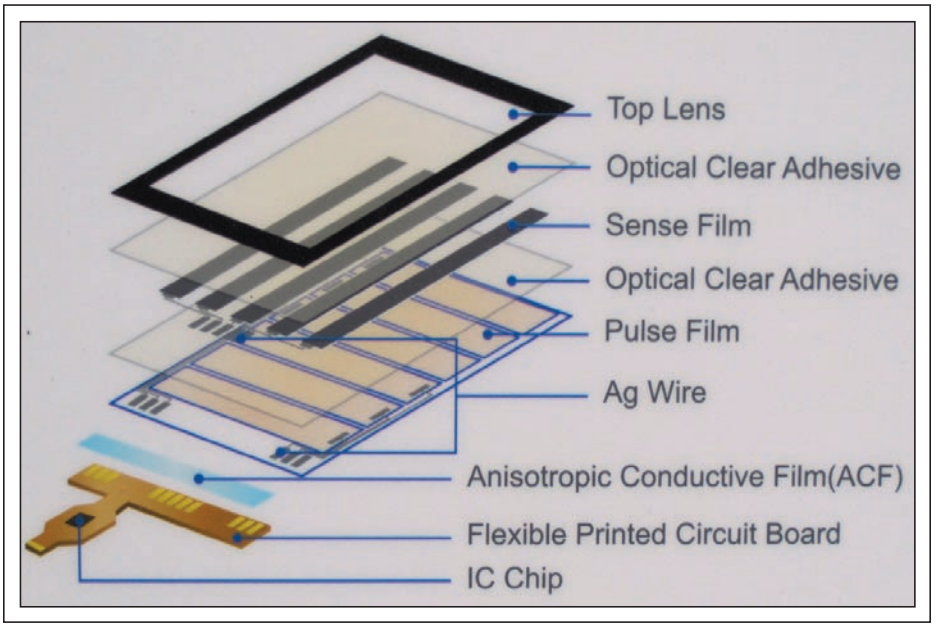

Fig. 1: *This schematic illustration of a film-based projected-capacitive touch screen is typical of one of the two primary forms coming into common use in the touch industry (the other form is glass-based). Source: Sony Chemical.*

Display, Maxim, Microchip, N-trig, Nissha, Ocular, Panjit, RiTdisplay (US Micro Products), Samsung, Sony Chemical, Touch International, Touch Revolution, Wacom, Wintek, and Zytronic.

Analog Multi-Touch Resistive (AMR)

Analog multi-touch resistive touch technology, formerly called "digital resistive," continued its upward trajectory at Display Week 2010. With only one exhibitor in 2008 and three exhibitors in 2009, the total of nine exhibitors this year shows that the technology is beginning to emerge as a serious alternative to projected capacitive. A few suppliers are trying to build their own brand names for the technology (*e.g.*, RMTS by Panjit and MARS by Touch International), but generally the industry seems to be settling on AMR as the name and acronym of choice.

There are actually two different types of AMR, and it is clear from the exhibits at Display Week 2010 that the difference is not yet clearly communicated or even understood. Since neither type has a distinct name yet, perhaps that is not surprising. In the first type, the intersection of each set of conductive (ITO) strips is treated as a switch – it is either making contact or it is not. It is digital. The resolution of this type is therefore typically half of the strip spacing – which is usually quite narrow. For example, if the spacing is 1.3 mm (as in Stantum's very nice demo touch screen shown in Fig. 2), then the resolution is 0.65 mm. This type of AMR could actually be called "DMR" or "digital multi-touch resistive."

In the other type of AMR, the intersection of each set of conductive strips is treated as a miniature four-wire analog-resistive touch screen. Each strip can be considered a type of digital "channel" in this configuration, where contact within one digital channel is always evaluated on an analog basis. While the resolution of this type also depends to some extent on the strip spacing (which is typically wider), the resolution is generally higher than in the first type, sometimes as fine as 0.2 mm. Since a rule of thumb for touch screens is that 1-mm resolution is adequate for most applications, this type is optimum for applications requiring better-than-average resolution. Examples of this type of AMR were shown by EETI (eGalax) and Dawar, among others (see Fig. 3).

The nine exhibitors showing AMR included AMT, Dawar, EETI, Fujitsu, Panjit, Stantum/Sitronix, Techno Print/Nagase America, Touch International, and Wintek.

In-Cell Touch Technology

One of the most surprising aspects of Display Week 2010 was the almost total lack of in-cell touch technologies on display. On-cell touch, where the touch screen is fabricated on top of the color-filter glass, has taken the industry by storm. Exhibitors showing on-cell touch included Samsung (resistive and capacitive), LG Display (capacitive), NEC (surface capacitive), Toshiba (resistive), and Wintek (resistive).

One particularly interesting on-cell demonstration was by NEC, which was showing a very novel version of on-cell surface capacitive (*not* projected capacitive). The demonstration LCD, as described in NEC's Symposium paper, "Touch-Panel-Embedded IPS-

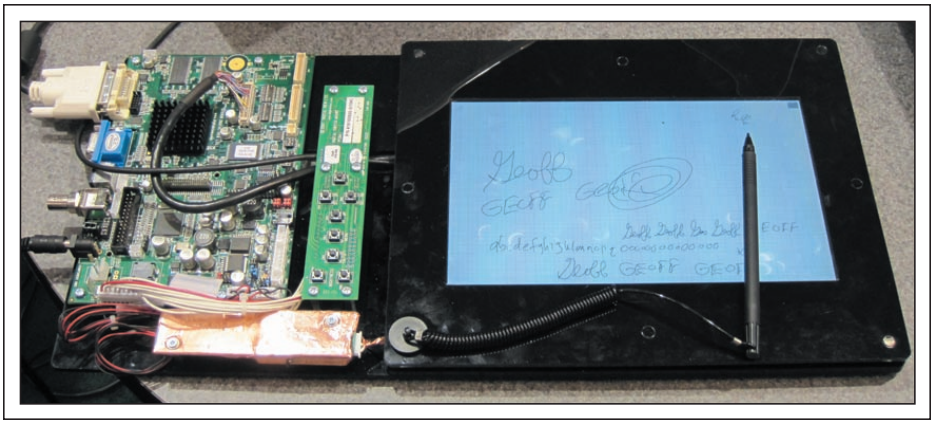

Fig. 2: *Above is Stantum's very-high-resolution (0.65 mm) analog multi-touch resistive (AMR) touch screen, showing extremely fine digital ink. The touch screen uses four Sitronix controller chips around the edge (under the bezel). The left side of the photo is a standard video card used to drive the display electronics on the right.*

LCD with Parasitic Current-Reduction Technique," used as a capacitive sensor the ITO layer (on the color filter) that a standard IPS-TFT display incorporates as an anti-static measure. NEC's enabling technology was a method of minimizing the large parasitic capacitance that exists between the ITO surface layer and the TFT backplane.

On-cell resistive moved into greater prominence this year, with three exhibitors showing it. Similar to on-cell capacitive, it uses the color-filter glass as the substrate in a traditional film-glass analog resistive touch-screen. The film layer is placed between the color-filter glass and the LCD's top polarizer, separated from the color-filter glass by spacer dots, exactly like in a standard resistive touch screen. The primary advantages of on-cell resistive are (a) the elimination of one sheet of glass, with resultant reduction in thickness and ambient light reflections and (b) the cost-savings achieved by integrating the touch screen at the time of LCD manufacture.

It is worth noting that some of the on-cell touch screens shown on the exhibit floor were actually labeled as "in-cell" (for example, in the Wintek booth). When questioned, the exhibitors in question all agreed that their technology was actually on-cell. Samsung has started using a new term for both in-cell and on-cell touch, namely, "embedded touch." This is probably a very good idea because it minimizes the temptation for marketers to mislabel their touch technology for perceived marketing advantage. It is also a good idea because it recognizes that from the perspective of the LCD module, both in-cell and on-cell touch technologies are beneath the polarizer and are thus invisible. The side of the color-filter glass on which the touch technology appears is not actually that relevant.

Other Interesting Bits

RPO showed the latest iteration of its waveguide infrared touch-screen technology in the form of a 13.3-in. touch screen with a profile (bezel) height of only 0.5 mm and a border width of 3–5 mm. The reduction in profile height and border width since the company first announced its technology in 2007 is quite significant. RPO also showed a touch screen integrated with an E Ink electrophoretic display, side-by-side with a resistive touch screen. The difference in optical performance was immediately noticeable. The integration with E Ink was unique in that the waveguides were on top of the screen while the light-spreading glass was mounted *under* the screen. The resulting freedom from any overlay produced excellent optical performance. RPO's touch screen also appeared in two other booths – LG Display, where it appeared in a 13.3-in. notebook, and Qualcomm, where it was integrated on top of the mirasol® reflective display. The clear-glass nature of RPO's touch screen is optimum for a reflective display, where ambient light must travel in both directions through the touch screen.

Elo TouchSystems showed an interesting demonstration based on its acquisition of Sensitive Object in January of this year. The demo, which used a large sheet of acrylic with two acoustic sensors clamped to the sheet in arbitrary locations, illustrated how Sensitive Object's "ReverSys" technology uses stored waveforms of acoustic signatures to identify touches at a specific location. Another interesting demo by Elo TouchSystems was of a surface-acoustic-wave (SAW) monitor with zero-bezel (edge-to-edge glass) design. SAW normally has a set of reflectors around the border of the screen that prevents a bezel-less configuration; Elo has figured out how to locate the reflectors (and the piezo transducers) on the back of the glass, leaving the front of the glass as an entirely flat surface. The trick is in shaping the edge of the glass so that the acoustic waves are guided from the back of the glass around to the top surface.

Optical touch technology made a strong showing at Display Week 2010 with exhibits from three companies. NextWindow demonstrated its new 2500-series large-format touch screen aimed at high-volume monitor OEMs; LG Display showed a prototype of a 21.5-in. optical touch screen; and Baanto, a Canadian startup, showed a technology demonstration of a low-cost 19-in. optical touch solution.

E Ink demonstrated a new method of integrating a touch screen with an electronic-paper (e-paper) display, placing a standard analog-resistive touch screen under a flexible

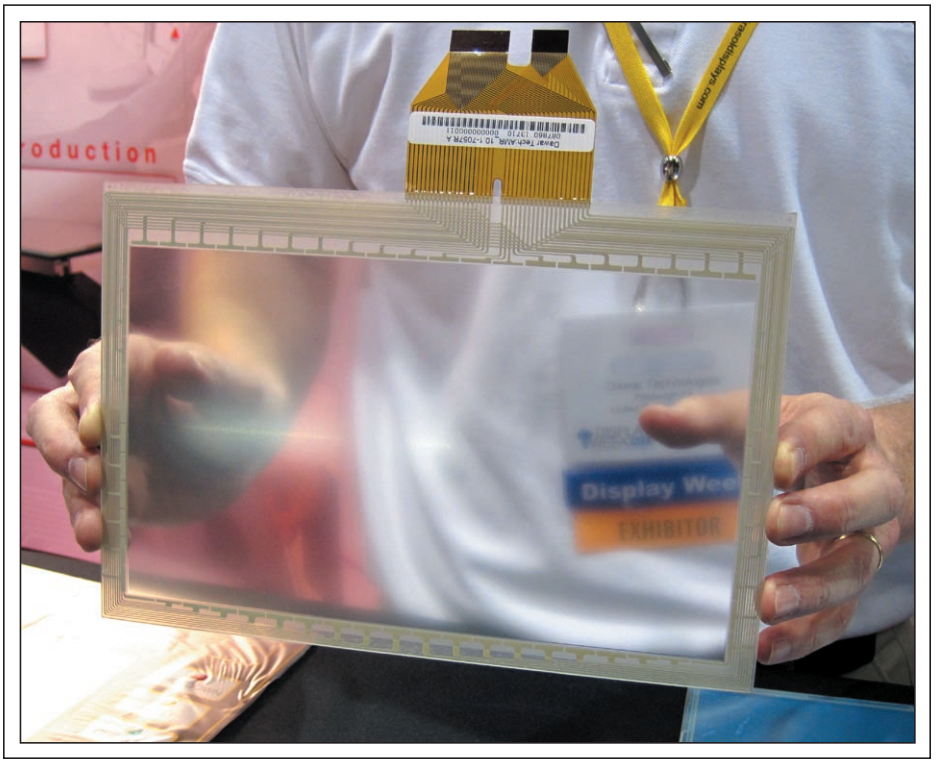

Fig. 3: *Dawar Technologies' prototype analog multi-touch resistive (AMR) touch screen is an example of the type of AMR in which the intersection of each set of conductive strips is treated as a miniature four-wire analog-resistive touch screen. The connections for the 20 relatively wide vertical ITO stripes can be clearly seen across the top of the screen. The relatively large border width of this prototype screen is not typical of production screens.*

e-paper display (*i.e.*, one constructed without a glass substrate). Touch was therefore accomplished by pressing through the e-paper display, which seemed to work surprisingly well.

Kyocera showed a glass–glass touch screen aimed at the industrial market. Glass–glass touchs screens have previously been limited mostly to the automotive market; Kyocera made a fairly convincing argument that glass–glass touch screens are especially appropriate for the industrial market, given their clarity, durability, and ability to be totally sealed.

Other Touch-Related Events

This article has "touched" on only a small fraction of the large amount of information on touch that was presented at Display Week 2010. In addition to the 67 touch-related exhibitor booths, the following activities also took place:

- A 4-hour Short Course on touch technologies on Sunday, attended by over 130 people.
- A panel discussion on touch during Monday's Business Conference and Tuesday's Investor Conference.
- A Symposium keynote speech on the history of touch by Bill Buxton, a world-famous touch researcher currently at Microsoft.
- 14 Symposium technical papers on touch-related topics, covering everything from the history of touch interfaces to driving methods for analog multi-touch resistive (AMR) to in-cell capacitive touch for large LCDs
- Six poster papers on touch-related topics, including one especially interesting paper by Uni-Pixel Displays entitled "Theory, Design, and Production of Fingerprint-Resistant Films for Touch-Enabled Displays"
- Five supplier presentations on touch topics during Tuesday's Exhibitors' Forum; these included talks by 3M, EETI, NextWindow, RiTdisplay (US Micro Products), and Zytronic.
- A 90-minute Applications Seminar on Wednesday on emerging touch applications, attended by about 45 people.
- A full-day Market Focus Conference entitled "The Future of Touch and Interactivity" on Thursday, attended by well over 100 people.

If you are reading this article to see what you missed by not attending Display Week 2010, hopefully it is now clear that from a touch-technology point of view, you cannot afford to miss Display Week 2011! ■