Touch Technology Development Trends

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About NextWindow

NextWindow

- Develops & manufactures optical touchscreens
- Currently focused on two touch-screen markets
  - Windows-7 consumer monitors and all-in-one computers
  - Large-format display applications such as interactive digital signage
- Global presence
  - New Zealand (HQ), Singapore (Ops), USA, Taiwan, Korea, Japan
  - Manufacturing in China, Thailand and Malaysia
  - 120 employees, 55 in engineering
- Brief history
  - 2000: Founded by CTO and private investors
  - 2003: First product to market (optical touch for large displays)
  - 2005: Entered USA market
  - 2006: First major volume contract signed (HP TouchSmart AiO)
  - 2008: Entered Taiwan market with ODM focus
  - 2009: Engaged with many PC OEMs & ODMs on Win-7 products
  - 2010: Acquired by SMART Technologies
Agenda

- Projected Capacitive
- Analog & Digital Multi-Touch Resistive (AMR & DMR)
- Optical
- In-Cell, On-Cell & Out-Cell
- Infrared
- Surface Acoustic Wave (SAW)
- Gesture Touch
- Haptics
- Vision-Based
Projected Capacitive…1

- **Projected capacitive has become mainstream**
  - In 2006 (pre-iPhone), total worldwide sales of pro-cap were approximately $20M
  - According to DisplaySearch, pro-cap was $1.5B in 2009 and will be $3.2B in 2010
    - According to DigiTimes, the largest single supplier in 2010 (TPK Touch Solutions) will be over $1B

- **Mobile phones are driving the market**
  - $1.2B of the $1.5B in 2009 was mobile phones (DisplaySearch)
  - But the iPad is contributing in 2010 – and may be causing a temporary tightness in larger-screen capacity
Projected Capacitive...2

- **Capacity is expanding rapidly**
  - Particularly in 3-to-5-gen converted CF & LCD fabs such as Cando, CPT, CMI, Sintek Photronic, etc.

- **Construction is stabilizing**
  - Film-based for mobile phones
  - Glass-based for larger products (e.g., iPad)

Source: Sony Chemical
Projected Capacitive…3

❖ **Stylus is coming**
   ✦ Cypress has announced the capability to use a 1 mm-tip stylus, which could drive a stake into the heart of resistive

❖ **Availability is increasing**
   ✦ RiTdisplay (US Micro Products) can provide samples of pro-cap screens in 5 weeks and can produce small batches

❖ **The maximum size limit has expanded to 32”**
   ✦ Multiple suppliers were showing samples of ~22” pro-cap screens at Computex 2010 in June
Analog & Digital Multi-Touch Resistive (AMR & DMR)…1

- Both are alternatives to projected capacitive
  - Familiar resistive technology
  - Patterned ITO instead of continuous ITO
  - Lower cost

- Both have standard resistive shortcomings
  - Low durability (PET top surface)
  - Low transmissivity
  - Non-zero touch force
  - Relatively short lifetime
Analog & Digital Multi-Touch Resistive (AMR & DMR)...2

❖ AMR (also called “hybrid analog-digital”)
  ✦ Suppliers: eTurboTouch, Mildex, Mutto, EETI, ATouch…
  ✦ Limited IP on concept
  ✦ Number of touch points is controller-dependent (2-10)
  ✦ Can’t touch with two fingers on the same square
  ✦ Offered in 3” – 23”, but not actually in production in all sizes
Analog & Digital Multi-Touch Resistive (AMR & DMR)…3

Gateway ZX6910 AiO with 23” AMR touchscreen from eTurboTouch

Drawing parallel lines with two closely held fingers (squares are 13 x 15 mm)

“There is no perfect touch technology”
Analog & Digital Multi-Touch Resistive (AMR & DMR)...

- **DMR** (also called “digital matrix resistive”)
  - Stantum (in France) is primary IP holder
  - Stantum’s strategy is to license controller IP to IC manufacturers
    - Sitronix
    - ST Micro
  - Fine pitch results in much higher number of connections than AMR
    - 64 x 36 on 4.3” screen
  - Unlimited number of touch points
  - Aimed at cellphones and netbooks

Stantum’s proof-of-concept 10.1” slate
Optical is starting to mature

- Windows 7 on all-in-one desktops has been a key driver
  - Optical hits the sweet spot of price and performance compared with other touch technologies for all-in-ones
  - Almost all desktop PC OEMs & ODMs are using optical

Large-format (> 30”) optical is growing

- Key applications include interactive information, education (including large LCDs as interactive white boards), and interactive digital signage
Optical…2

❖ **NextWindow 2500-series optical touchscreen**
  ✦ Targeted at high-volume OEM monitor applications
  ✦ Compatible with any display technology
  ✦ Fits screens from 30” to 50” as a component kit or on-glass
  ✦ Microsoft Windows-7 multi-touch ready
  ✦ Low profile and thin borders
  ✦ Lower cost than competitive touch technologies
In-Cell, On-Cell & Out-Cell…1

❖ Definitions

❖ In-cell: Touch sensor is inside the LCD cell, between the two sheets of glass
❖ On-cell: Touch sensor is on top of the color filter glass, underneath the polarizer
❖ Out-cell: Touch sensor is on top of the polarizer (normal)

❖ Technologies

<table>
<thead>
<tr>
<th>Touch Technology</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-sensing</td>
<td>In-cell</td>
<td>Difficult technical problems; no products</td>
</tr>
<tr>
<td>Voltage-sensing</td>
<td>In-cell</td>
<td>Used only in hybrid combinations</td>
</tr>
<tr>
<td>Charge-sensing</td>
<td>In-cell &amp; on-cell</td>
<td>Limited traction in-cell; strong traction on-cell (products in the pipeline)</td>
</tr>
<tr>
<td>Hybrid voltage-sensing &amp; charge-sensing</td>
<td>In-cell</td>
<td>A few products on the market (e.g., digital cameras)</td>
</tr>
<tr>
<td>Projected capacitive</td>
<td>On-cell &amp; out-cell</td>
<td>Very popular in both locations</td>
</tr>
<tr>
<td>All other technologies</td>
<td>Out-cell</td>
<td>Business as usual</td>
</tr>
</tbody>
</table>
In-Cell, On-Cell & Out-Cell…2

- First product with in-cell (hybrid) touch (April 2009)
- First product with optical in-cell touch (May 2009)
- 2nd-gen camera with hybrid in-cell touch (August 2009)
- First OLED product with on-cell touch (Feb 2010)
- Largest (13.3”) in-cell finger-touch product so far (charge-sensing, MP in 2H-2010)
In-Cell, On-Cell & Out-Cell...3

Special case: Integrated Digital Technologies, Inc.

- 21.5” light-sensing in-cell monitor with IR light-pen
- Supports two-touch with two pens

Source: IDTI

Source: Author
Multi-touch in traditional infrared

- 2+ touches
- Suppliers: Groovy Touch, IRTouch, Leading Touch, etc.
- “Ghost” points are the problem
Infrared...2

- Multi-touch in “LED Cell Imaging” infrared
  - 20-30 touches
  - Suppliers: PQ Labs, Citron

Source: PQ Labs

- Issues: Relatively low resolution and slow response time
Infrared...3

- **Infrared in mobile devices**
  
  ![Neonode cellphone (2009)](source)
  
  **Neonode cellphone (2009)**

  ![Mirasol screen](source)
  
  **RPO in Mirasol screen**

  ![RPO waveguide infrared in prototype 13.3” notebook from LG Displays (2010)](source)
  
  **RPO waveguide infrared in prototype 13.3” notebook from LG Displays (2010)**

  ![Sony e-book readers (2010)](source)
  
  **Sony e-book readers (2010)**

  Source: Pen Computing
  
  Source: Author
  
  Source: PC World
Surface Acoustic Wave (SAW)…1

- Multi-touch SAW from Elo TouchSystems
  - Shipping in the 23” Lenovo A700 all-in-one desktop

“There is no perfect touch technology”
Surface Acoustic Wave (SAW)...

X-Y reflectors

Diagonal reflectors

Gesture Touch…1

- **Multi-touch for gestures only**
  - Works by measuring real-time changes caused by two **moving** touch points on a normally single-touch screen
    - Not true multi-touch; won’t pass Windows-7 Logo
  - First announced by Elo on 4-wire resistive in December, 2008
  - Now spreading to other touch technologies
    - Abon Touch – surface capacitive
    - OneTouch – 5-wire resistive

Source: Elo
Gesture Touch...2
Haptics...1

Increasing number of haptic technologies

<table>
<thead>
<tr>
<th>Haptic Method</th>
<th>Description</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inertial</td>
<td>Shaking the surface or the entire device with oscillating rotary or linear-mass actuators</td>
<td>Immersion</td>
</tr>
<tr>
<td>Lateral</td>
<td>Moving the surface laterally with electromagnetic actuators</td>
<td>Immersion</td>
</tr>
<tr>
<td>Piezo</td>
<td>Flexing the surface with piezo disks or strips</td>
<td>SMK</td>
</tr>
<tr>
<td>Bending Wave</td>
<td>Moving the surface with piezoelectric sensors</td>
<td>NXT</td>
</tr>
<tr>
<td>Electro-Active</td>
<td>Moving the surface by contraction and expansion</td>
<td>Artificial Muscle</td>
</tr>
<tr>
<td>Polymer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>Moving the surface with <strong>electrostatic</strong> attraction</td>
<td>Pacinian</td>
</tr>
<tr>
<td>Capacitive</td>
<td>Generating <strong>electrostatic</strong> pressure and stimulation in finger nerve-endings through the application of an electric field</td>
<td>Senseg</td>
</tr>
<tr>
<td>Electrosensory</td>
<td></td>
<td></td>
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<tr>
<td>Interface (CEI)</td>
<td></td>
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</tbody>
</table>

Source: Bruce Banter, *Information Display*, March 2010

Implementation growth is slow but steady

Gaming, automotive, cellphones, cameras, media players…
Haptics...2

Pacinian: A charge differential is generated between the touch surface and a sub-surface, creating an attractive force, which causes motion of the touch surface.

Senseg: An electrostatic pressure (Coulomb force) is generated between finger tissue and the E-Sense surface.

Haptics Research Areas

Source: Virtual Worldlets Network
Source: RWTH Aachen University

Ultrasonic
Fluidic
Vision-Based...1

- Rapidly increasing number of touch tables
Vision-Based...2

Why Does Vision-Based Touch Matter?

- It’s the only touch technology that can do true object-recognition, which enables integrating the physical world and the virtual (digital) world more closely so that digital information becomes more easily available when users interact with a physical object.

Which has more potential to change the world, projected capacitive or vision-based touch?
Thank You!

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