Touch Technology Development Trends

Geoff Walker – NextWindow
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SID
SOCIETY FOR INFORMATION DISPLAY

nextwindow
optical touch

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

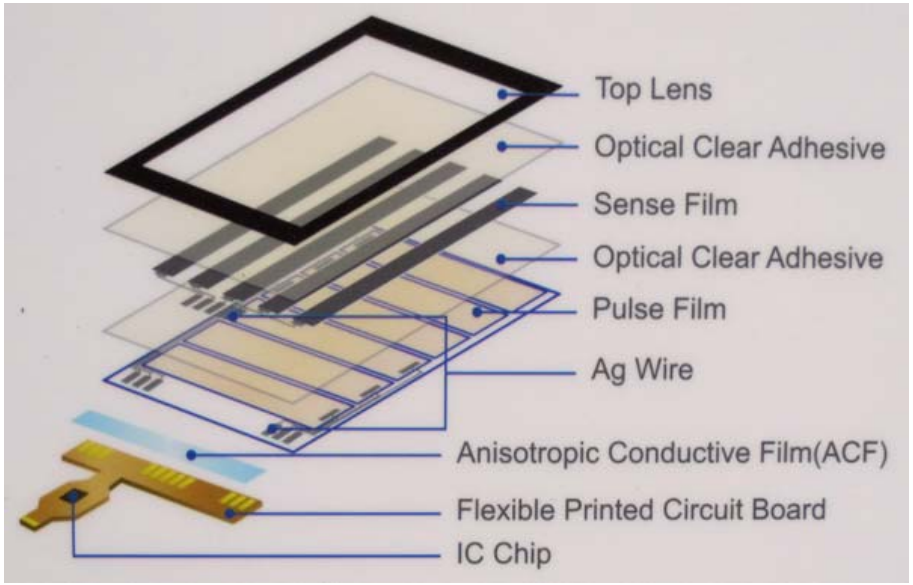
- Projected Capacitive
- Analog & Digital Multi-Touch Resistive (AMR & DMR)
- Optical
- In-Cell, On-Cell & Out-Cell
- Infrared
- Surface Acoustic Wave (SAW)
- Gesture Touch
- Haptics
- Vision-Based

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

21.5”

32”

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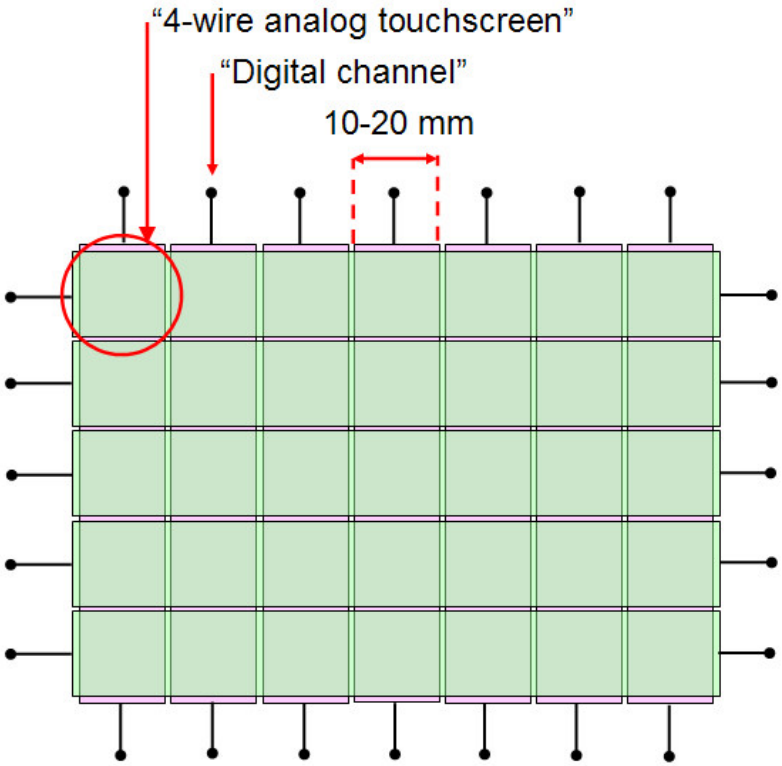
Analog & Digital Multi-Touch Resistive (AMR & DMR)…1

- **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

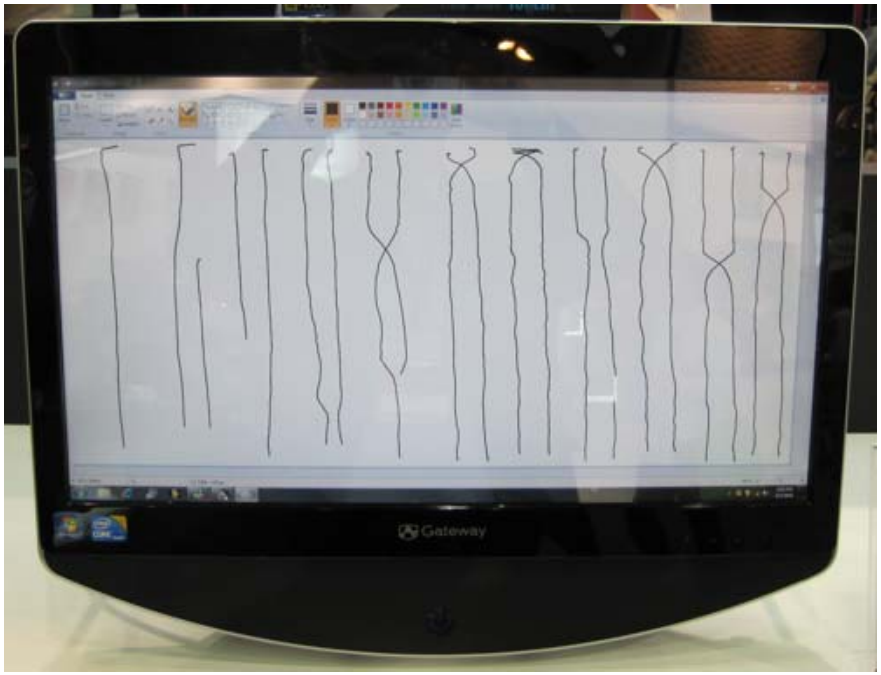
Analog & Digital Multi-Touch Resistive (AMR & DMR)…2

- **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



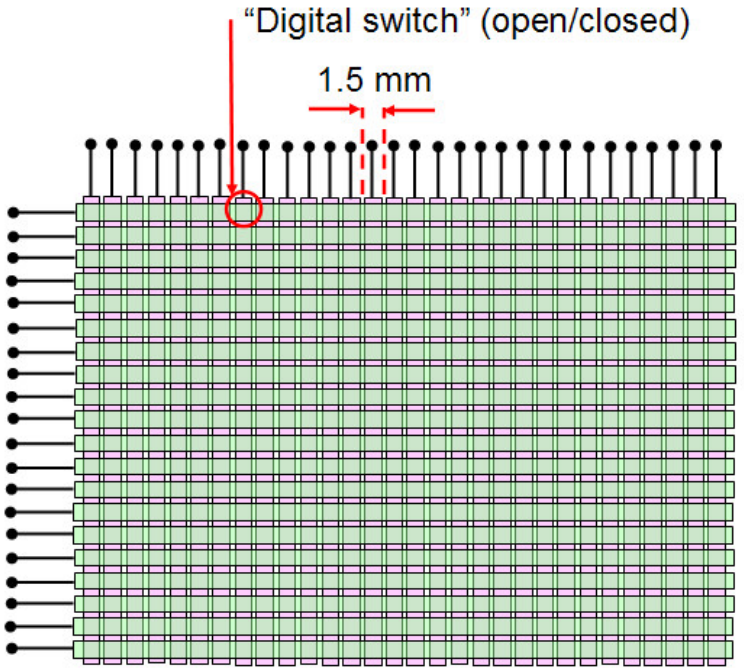
Source: Author

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)…4

- **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



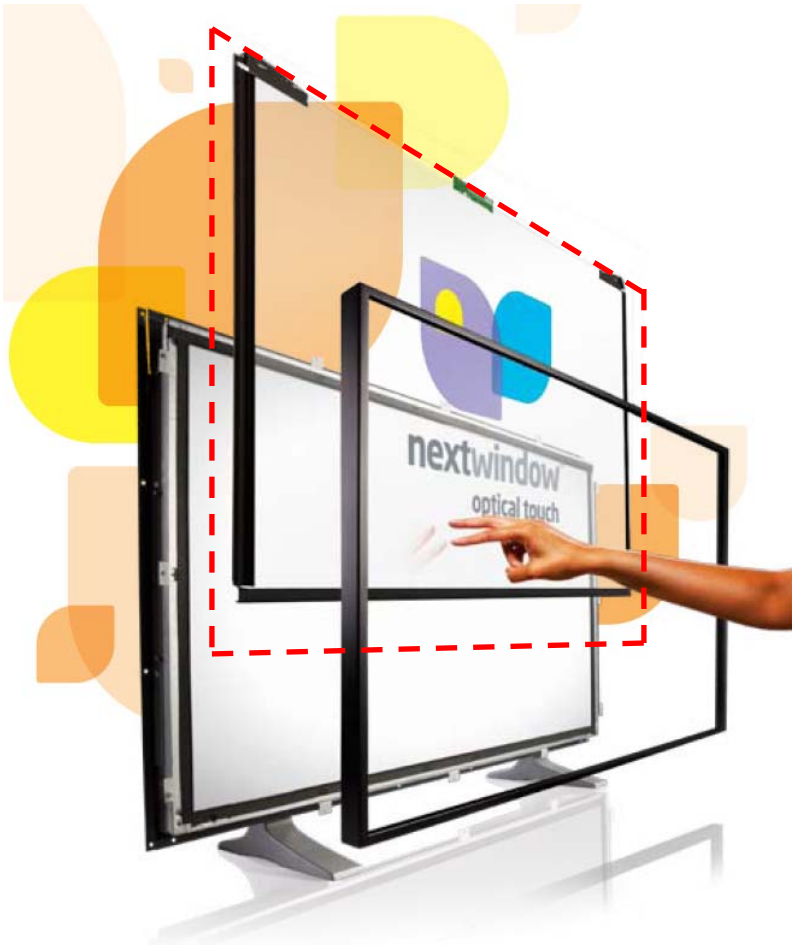
Stantum's proof-of-concept 10.1" slate

Optical…1

- **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**

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

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)

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In-Cell, On-Cell & Out-Cell…3

- **Special case: Integrated Digital Technologies, Inc.**

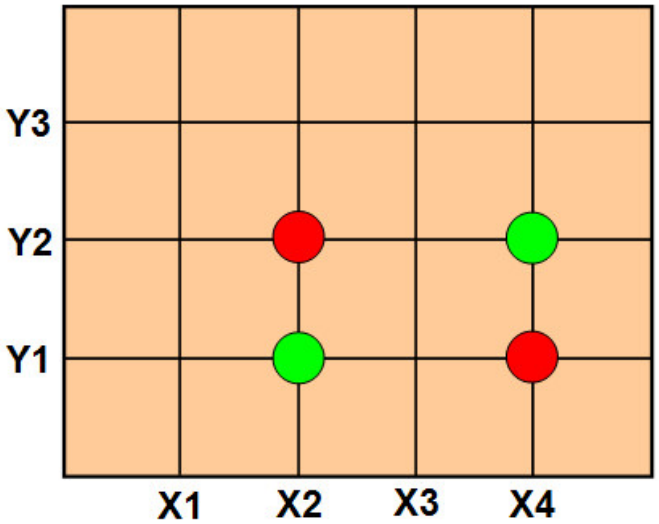
Source: IDTI

Source: Author

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

Infrared…1

- **Multi-touch in traditional infrared**
  - 2+ touches
  - Suppliers: Groovy Touch, IRTouch, Leading Touch, etc.
  - “Ghost” points are the problem



Light beams broken: **X2, X4** / **Y1, Y2**

Real points: **X2, Y1** / **X4, Y2**

Ghost points: **X2, Y2** / **X4, Y1**

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: Pen Computing

RPO waveguide infrared in prototype 13.3” notebook from LG Displays (2010)

Source: Author

Sony e-book readers (2010)

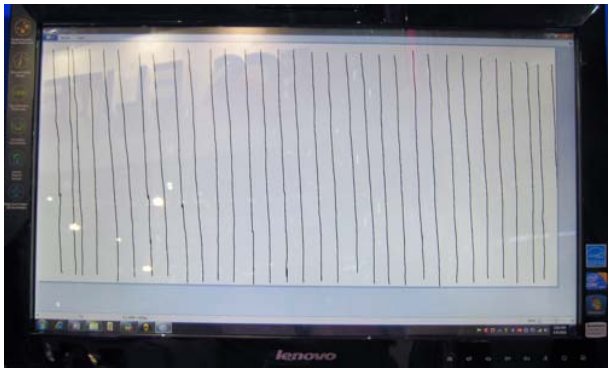
Source: PC World

RPO in Mirasol screen

Surface Acoustic Wave (SAW)…1

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

Source: Lenovo



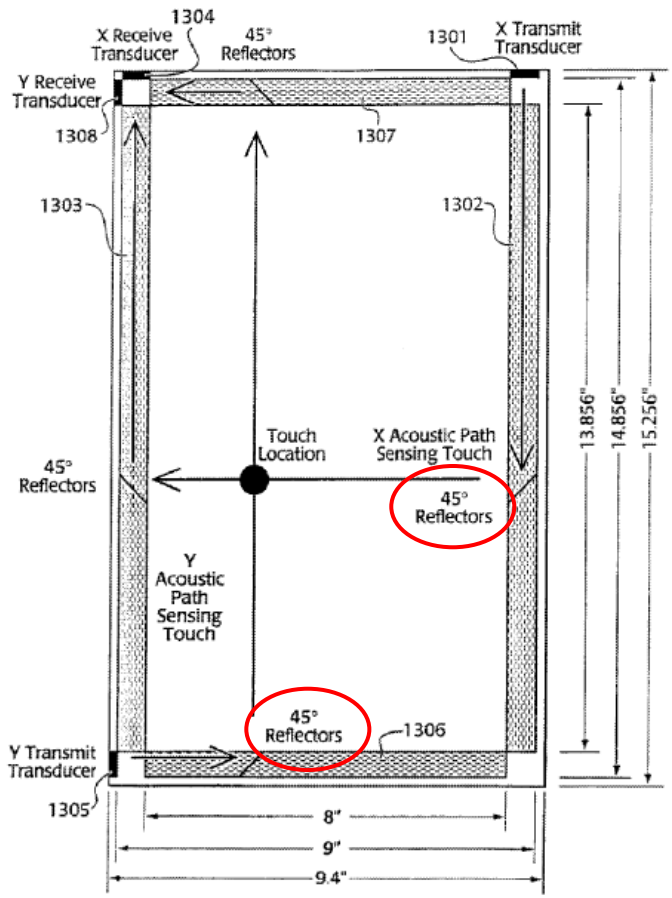
2-finger vertical lines

2-finger diagonal lines

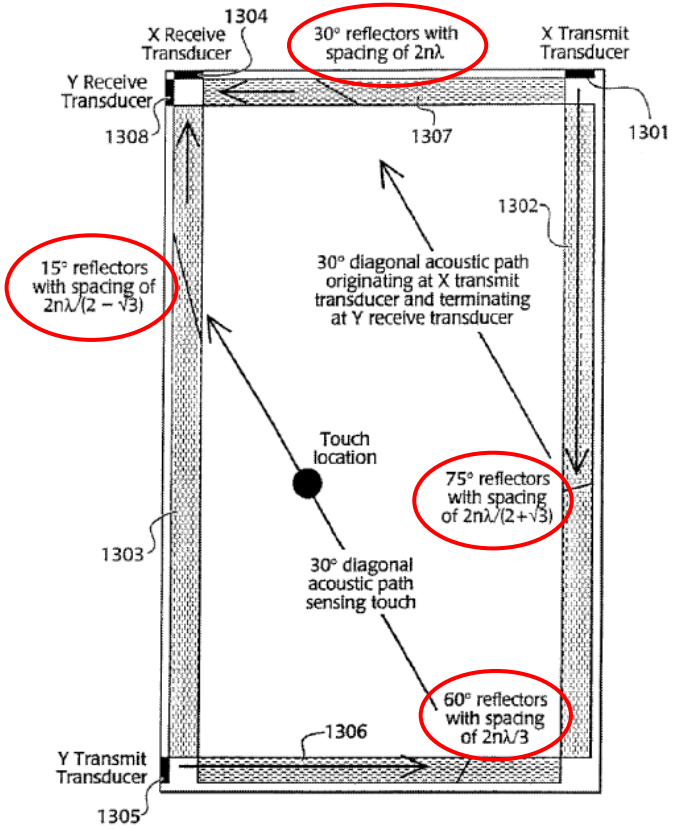
Source: Author

“There is no perfect touch technology”

Surface Acoustic Wave (SAW)…2



X-Y reflectors



Diagonal reflectors

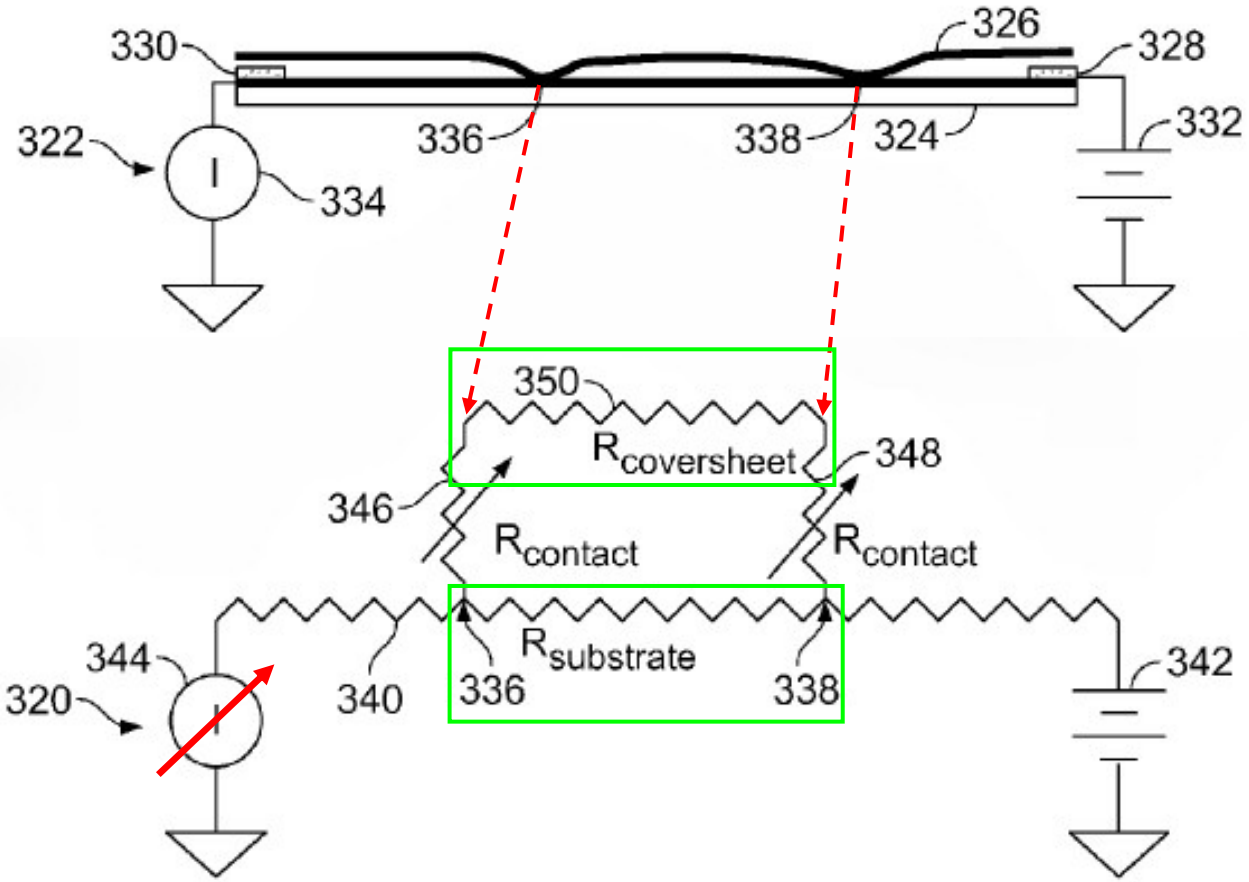
US Patent Application 2010/0117993

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



US Patent Application 2009/0322701

Haptics…1

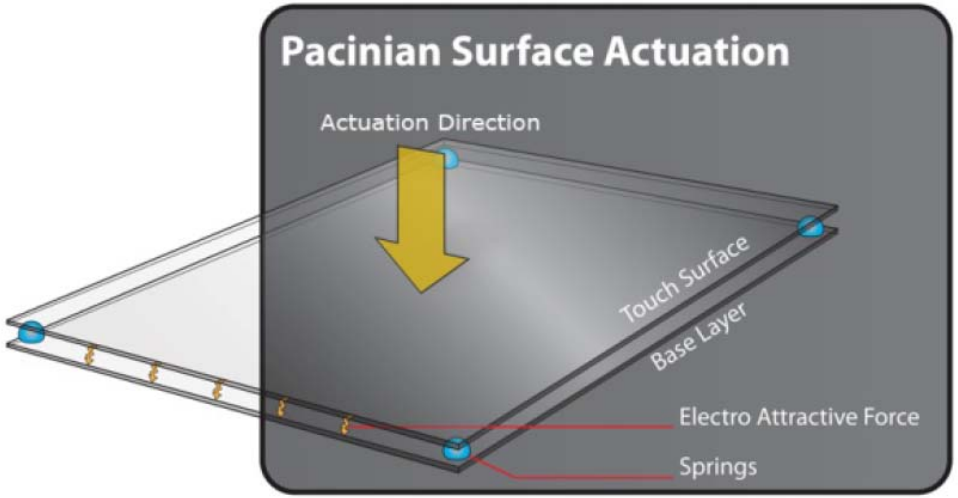
- **Increasing number of haptic technologies**

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

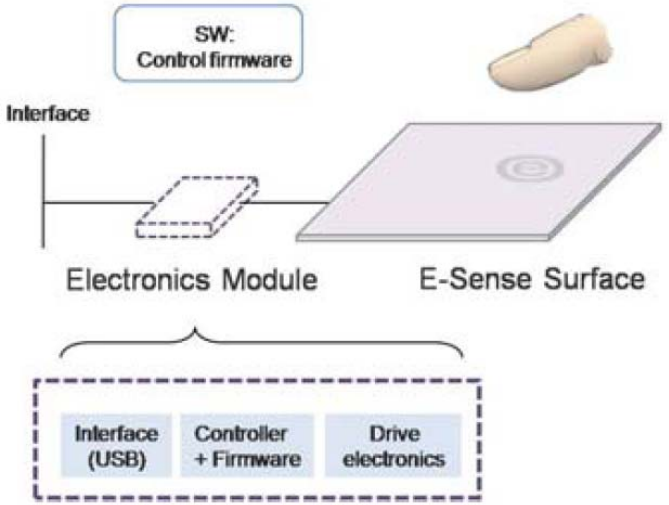
Source: Bruce Banter, Information Display, March 2010

- **Implementation growth is slow but steady**
  - Gaming, automotive, cellphones, cameras, media players…

Haptics…2



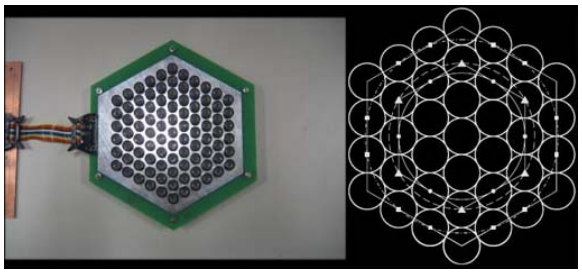
Pacinian: A charge differential is generated between the touch surface and a sub-surface, creating an attractive force, which causes motion of the touch surface



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

Haptics Research Areas

Source: Virtual Worldlets Network



Ultrasonic

Fluidic

Source: RWTH Aachen University

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!

Geoff Walker
Marketing Evangelist & Industry Guru
NextWindow
7020 Koll Center Parkway, Suite 138
Pleasanton, CA 94566
1-408-506-7556 (mobile)
gwalker@nextwindow.com