Emerging Touch Applications

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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
  - 119 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: Majority market share of Win-7 desktop touchscreens
Agenda

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  - Gestures
- Architectural [5]
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- Consumer Desktop [12]
  - All-in-Ones
  - Monitors
  - Laptops
- Flexible Displays [3]
- Interactive Digital Signage [1]
- Surface Computing [4]

[ 46 ] = Total number of content slides
Introduction

Source: Elo TouchSystems
Scope

- Focus on the applications, drivers & impediments
  - Mostly consumer, not enterprise
  - Mostly transparent, not opaque
  - Mostly zero to three years out
- Minimize discussion of the touch technologies
- **Note:** “Emerging” inherently means “uncertain”
## 2009 Touch Applications By Revenue and Units

<table>
<thead>
<tr>
<th>Touch Application</th>
<th>2009 Revenue (US$ M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Phone</td>
<td>$890</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$234</td>
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<tr>
<td>Retail and Point of Sale</td>
<td>$249</td>
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<tr>
<td>Factory &amp; Industry Automation</td>
<td>$235</td>
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<tr>
<td>Point of Information (POI)</td>
<td>$220</td>
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<tr>
<td>ATM &amp; Other Financial</td>
<td>$214</td>
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<tr>
<td>Notebook PC</td>
<td>$184</td>
</tr>
<tr>
<td>Game - Portable</td>
<td>$170</td>
</tr>
<tr>
<td>PMP &amp; MP3 Player</td>
<td>$162</td>
</tr>
<tr>
<td>Medical</td>
<td>$144</td>
</tr>
<tr>
<td>Game - Casino</td>
<td>$114</td>
</tr>
<tr>
<td>Portable Navigation Device</td>
<td>$100</td>
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<tr>
<td>Education &amp; Training</td>
<td>$94</td>
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<tr>
<td>Automobile Monitor</td>
<td>$80</td>
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<tr>
<td>Desktop PC (AiO) &amp; Monitor</td>
<td>$71</td>
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<tr>
<td>Printer &amp; Other Office Equipment</td>
<td>$53</td>
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<tr>
<td>Ticketing</td>
<td>$39</td>
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<tr>
<td>Digital Still Camera &amp; Camcorder</td>
<td>$26</td>
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<tr>
<td>Mini-Notebook &amp; UMPC</td>
<td>$20</td>
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<tr>
<td>Digital Picture Frame</td>
<td>$8</td>
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<tr>
<td>PDA</td>
<td>$3</td>
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<td><strong>Grand Total</strong></td>
<td><strong>$3,309</strong></td>
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<table>
<thead>
<tr>
<th>Touch Application</th>
<th>2009 Units (M)</th>
</tr>
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<td>Mobile Phone</td>
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<tr>
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<td>Portable Navigation Device</td>
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<td>24.4</td>
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<td>20.8</td>
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<td>Factory &amp; Industry Automation</td>
<td>20.5</td>
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<td>Automobile Monitor</td>
<td>11.6</td>
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<tr>
<td>Retail and Point of Sale</td>
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<td>Printer &amp; Other Office Equipment</td>
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<td>Medical</td>
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<td><strong>Grand Total</strong></td>
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</table>

Market size estimates are based on DisplaySearch’s “2009 Touch-Panel Market Analysis Report” with adjustments.
3D Touch – What Is It?...1

Definition

- “Touching” beyond the surface of a display
- Touch is really a continuum:

<table>
<thead>
<tr>
<th>High Precision</th>
<th>Using a mouse</th>
<th>Touching the surface of the display (“2D touch”)</th>
<th>Touching just above the surface of the display (“hover” or “proximity”)</th>
<th>“Touching” in the arm’s-length space between the user and the display (“3D touch” or “3D gestures”)</th>
<th>“Touching” when the display is beyond arm’s-length distance (“3D gestures”)</th>
<th>Low Precision</th>
</tr>
</thead>
</table>

Emerging terminology is frequently confusing

- For example, Sharp’s latest “3D touch-screen display” is actually a 3D LCD with a 2D on-cell touch screen.

Source: Sharp
Another Example

“3D Touch Control Dial”

- Device with touch screen on front and touch pad on back
- Sliding thumb and forefinger mimics turning an actual dial

This is NOT what I mean by “3D touch”…
3D Touch – What Is It?...2

Why does it exist?
- Because we live in a 3D world

What makes it problematic?
- It’s very early and there are no standards for user interaction in a 3D volume
Hover…1

- Why is hover important?
  - You use it every time you use a mouse
  - Using a browser without hover (i.e., with a touch screen) is a different, less-satisfying experience
  - Hover can add precision to touch

- What has hover today?
  - No touch technology has it today except EMR pen digitizer (Wacom)
  - BlackBerry Storm implements it by combining capacitive and force-sensing ("SurePress")
    - But on a phone it has less significance…
Why doesn’t Microsoft talk about hover?

- In the past, they associated hover with the failed Tablet PC
  - To justify their position, MS has claimed that including hover in touch produces a poor user experience, but this has mainly been a matter of poor implementation
  - They’re slowly changing this viewpoint as touch matures

Hover + multi-touch?

- Less significant than in 2D touch
  - More than two points is difficult to execute
Is hover coming to touch?

- Projected capacitive – Mitsubishi demo

- Optical – potential of using area-scan (vs. line-scan) cameras to monitor space above screen

- Impossible with most other touch technologies; theoretically possible with vision-based and LCD light-sensing in-cell
3D Gestures…1

- **Why do 3D gestures exist?**
  - Gestures are very important in human communication
  - Natural extension of Wii-type gaming

- **What makes them problematic?**
  - Lack of a standard “gesture vocabulary” for PC touch
3D Gestures…2

- The leader in applying 3D gestures
Examples...1

- **iPoint 3D**
  - Aimed at hands-free computer control
  - Recognition device (not shown) has two FireWire cameras that read the user’s hand motions and send them to the computer

Source: Fraunhofer Institute for Telecommunications
Examples...2

- Elliptic Labs
  - Uses ultrasonic motion detector (box below screen)
The Death of the Mouse?

- **Gartner analyst Steven Prentice (7/08):**
  - Mouse will be gone in 3-5 years in home entertainment and notebook usage applications, replaced by gestural mechanisms such as touch screens, face-recognition, gesture-recognition, eye-tracking, etc.

- **Logitech SVP & GM Rory Dooley:**
  - Too gloomy a prediction given that the developing world isn’t online yet (only 1B out of 5B people are online today)
Architectural Touch

Source: alibaba.com
Architectural Touch...1

Definition
- Touch incorporated into 3D objects beyond displays, where the objects are often part of a structure such as an elevator
  - Touch with a 3D (non-flat) substrate
  - Transparent or opaque

Touch technologies for 3D substrate
- Currently only one: Force sensing
  - Projected capacitive can work with 2D-curve, but not 3D

What makes it problematic?
- Very limited availability
Architectural Touch...2

Examples

A slab of stone with water running over it; the touch-sensitive slab is also a directory

A piece of etched glass with an inset LCD, soft keys around the LCD, raised metal buttons forming a keypad, and an inset speaker
Architectural Touch…3

Vissumo’s Amazing Demo Box

Irregularly shaped, raised, textured, wooden touch surface

Motor attached to and penetrating touch panel with printed speed control keys and push-pull control lever

Glass-covered LCD integrated into touch panel with “soft keys” printed on back of glass

“Snap-dome” keys attached to touch panel; removable padded and textured keys; speaker attached with holes through the touch panel.

Raised, marble touch surface with toggle switches penetrating touch panel

Multi-page “book” with touchable & movable metal pages

4 strain gauges supporting one touch panel
Sensitive Object’s “ReverSys” technology

- Another approach to making any physical object touch-sensitive
Availability

- Vissumo (spun out of QSI Corp.) was the primary source; they ran out of money in 2009
  - However, their IP is still available for sale or license from QSI
- Sensitive Object was purchased by Elo TouchSystems on xx/xx/xxxx for $62M
Automotive Touch

Source: freefoto.com
Automotive Touch…1

- **Definition**
  - Touch on a display used for control, navigation or entertainment in an automobile

- **Why does it exist?**
  - Touch-screen benefits & enthusiasm
  - Trend away from mechanical buttons
  - Desire to simplify user interface

- **What makes it problematic?**
  - Driver distraction
    - Haptics helps but adds cost
  - Very difficult environment
    - Temperature range, safety considerations, flat surface, glare, etc.
Automotive Touch...2

Next-generation center-stacks

Source: Tech-D-P
Automotive Touch…3

“Digital Dash” Concept

Rear projection in an automotive display…

Source: www.digital-dash.com
Automotive Touch...4

Requirements for center-stack “navi-radio” application

- **Temperature**
  - -30°C to +85°C operating
  - -40°C to +95°C storage

- **Light management**
  - Sunlight readability
    - Relaxed requirement for rear-seat entertainment (RSE)

- **Crashworthiness**
  - Top surface can’t be glass (DOT)

- **Cost**
  - Especially important for dealer-installed vs. OEM-installed

- **Vibration**
  - Cables & connectors
Automotive Touch…5

- **Industrial design**
  - Narrow frame borders & flush surface

- **Usability**
  - Use with gloves

- **Off-angle viewing**
  - Polarizer used for sunlight viewability can be a problem
  - Optical bonding is still too expensive

- **Flammability**
  - Gaskets

- **Humidity**
  - Condensation freezing into ice crystals

- **ISO quality requirements**
  - Difficult for a small or inexperienced company to meet
Automotive Touch…6

Data from DisplaySearch’s “2009 Touch-Panel Market Analysis Report”

DisplaySearch forecasts that Automotive remains 100% resistive through 2015, and Portable is only 1% projected capacitive in 2015.
Automotive Touch...7

The joystick is an emerging alternative to touch screens in automobiles.

Clockwise: Mercedes, BMW, Audi, Lexus
A heads-up display (HUD) with touch control surfaces on the steering wheel (or plain old mechanical controls) is likely to be the preferred solution.
Consumer Desktop Touch

Source: granneman.com
Consumer Desktop Touch…1

- **Definition**
  - Touch on a consumer all-in-one computer, a touch monitor connected to a consumer desktop, or a consumer laptop

- **Why does it exist?**
  - Touch is spreading everywhere
  - Windows 7 enabled touch both for existing applications at a simple level, and for new applications through a new API

- **What makes it problematic?**
  - Touch on a 22-inch desktop product is a very different experience than on a 3.5-inch iPhone
  - Lack of applications, ergonomic issues, and cost
Windows 7 enables desktop touch (10/22/09)

- Touch & multi-touch is a highly visible characteristic of Win-7
- Touch API is easy for ISVs to use to touch-enable apps
- Most PC OEMs are “testing the waters” with multiple products
  - 90% AiOs, 10% monitors
  - OEM touch forecasts are generally quite conservative
  - None of the OEMs has a clear vision of what will drive touch
- Microsoft wins regardless of the outcome
Win-7 versus the iPhone

- Comparison with the iPhone
  - Touch is the iPhone’s **only** user interface
    - Keyboard & mouse are the primary desktop user interface
  - The iPhone’s “killer app” is its versatility & immersive UI
    - (150,000+ apps with billions of downloads)
    - Windows 7 doesn’t have a “killer touch app” yet…

- Would Win-7 touch have been the same without the iPhone?
Desktop Hardware (4/10)

- **AiOs & monitors with Win-7 touch**
  - 27 products from 13 OEMs
  - Acer, Asus, Dell, Fujitsu, Gateway, HP, Ilyama, Lenovo, Medion, MSI, NEC, Samsung, Sony

- **AiOs with single-touch**
  - Estimated at 15

- **AiOs with no touch**
  - Estimated at 25

- **Monitors with single-touch**
  - None
Examples

NextWindow shipped >750K units in the 12 months ending 3/10 to these and other PC OEMs.
Consumer software applications enhanced to take advantage of Win-7 touch
- Estimated at 50
- Microsoft seems reluctant to publicize (or even release) a list

Categories
- Art & creativity, media management, reading, games, educational… mostly consumption-oriented

When will the number of touch-enhanced applications become “substantial”?
- Probably not before mid-2011
Forecasts

- Touch penetration rate is the key measure
- Forecasts are all over the map

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<th>Source</th>
<th>Date</th>
<th>Category</th>
<th>2013 Penetration</th>
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<tr>
<td>DisplaySearch</td>
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<td>Morgan Stanley</td>
<td>6/09</td>
<td>Notebooks &amp; Netbooks</td>
<td>20%</td>
</tr>
</tbody>
</table>

- 2010 total AiO forecasts range from 5-6M to 10-11M
- Some issues…
  - Combining monitors & AiOs obscures the forecast, since the penetration rates will be very different
  - There really aren’t any reliable indicators – it’s all guesswork!
Factor #1: Applications

- **Applications are the key**
  - People don’t spend time using Windows, they use **applications**
  - Consumers must see some **application functionality** that makes them want to spend money for touch

- **The current application outlook is uncertain**
  - Win-7’s UI is poorly optimized for touch, which communicates a negative message to ISVs
  - Touch isn’t the #1 OS feature that ISVs need to adapt to Win-7
  - Many ISVs need education on touch
    - Coding directly to the hardware may be required for high performance
  - Many ISVs are conservative
    - “We’re waiting to see if there really is going to be demand for touch”
  - A surprising number of current applications don’t work smoothly with touch

* See [www.readyset7.com](http://www.readyset7.com)
Factor #2: Ergonomics

- **“Gorilla arm”**
  - “The human arm isn’t designed to be held horizontally away from the body for any length of time while making tiny, precise movements” (Rupert Goodwins)
  - This may be the elephant in the room
    - Reclining monitors & AiOs will help, but that will require wider viewing-angle LCDs ($$)

- **Laptops may be more ergonomic for touch**
  - Smaller screens = less arm movement; elbow support on desk
  - BUT screen hinges are usually too weak for unsupported touch

- **Tablet PCs may be the most ergonomic of all**
  - Win-7 touch may inject some life into the dormant Tablet market
Factor #3: Cost

- **Incremental cost for touch as a percentage of the total device BOM is the key measure**
  - Using optical as an example at $2+ per inch in 2010
    - 22” Monitor: $145 → ~30%
    - 15” Laptop: $300 → ~10%
      - But projected capacitive is $4/inch = 20%!
    - 22” AiO: $400 → 11%
  - For a consumer to pay for touch in a *monitor*, the value proposition must be *very* compelling
  - In an *AiO*, it’s already approaching “no-brainer” level
    - HP launched their 3rd generation of TouchSmart at the end of 2009
    - One OEM with a $100 delta between touch & no-touch AiO versions is experiencing an ~80% attach rate on the touch version
Factor #4: Microsoft

- Touch in Windows 7
  - Microsoft doesn’t market specific capabilities of a new OS at a detail level, so there has been very little promotion of touch by Microsoft.
  - User-interface enhancements such as “No Touch Left Behind” could have a HUGE effect on ISVs’ desire to touch-enhance their applications.
Prediction

Assumptions

- Applications begin to fully support touch by mid-2011
- Touchscreen cost-per-inch drops at typical PC hardware rates
- AiOs sales exceed most forecasts
- Touch on AiOs becomes a “no-brainer” due to the low cost-delta
- Oversupply of capacitive touch for notebooks drives down cost
- Monitors remain resistant until cost-per-inch drops significantly

<table>
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<tr>
<th>Category</th>
<th>2010 Units</th>
<th>2011 Units</th>
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<td></td>
<td>Market</td>
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<td>AiOs</td>
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<td>Monitors</td>
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<td>1.0%</td>
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<tr>
<td>Notebooks</td>
<td>134M</td>
<td>4%</td>
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</table>
Flexible Display Touch

Source: E-Ink
Flexible Touchscreens

- **Definition**
  - Touch on a display that’s classified as “flexible”

- **Why does it exist?**
  - Touch on just about ANY display is currently very desirable; flexible displays are no exception
  - Products that use “flexible” displays such as e-book readers benefit from touch as well as annotation (stylus) capability

- **What makes it problematic?**
  - “Flexible first, then touch”
  - Limited number of flexible touch technologies
    - Pro-cap, pen digitizer, LCD light-sensing in-cell
Examples of Flexible Touch...1

ASU-FDC: Pen substrate, Wacom pen digitizer; Epson display controller also supports resistive touch, but it’s not implemented in this particular prototype

QUE/PlasticLogic: Flexible screen in a rigid device; flexible projected capacitive
Examples of Flexible Touch…2

Bridgestone: Flexible resistive?
(10.7”, 5.8 mm thick)

AUO & SiPix: Potentially flexible pro-cap touchscreen on a glass-substrate e-book reader
(reflectivity 33% → 27%)

(Same screen in Jinke A6 & A9 readers)
Interactive Digital Signage

Source: Key West Technology
Interactive Digital Signage...1

- **Definition**
  - Touch on a digital sign (display) where the intent of the sign is commerce-related
    - Example: An interactive product-selector guide in the pharmacy department of a big drugstore or supermarket

- **Why does it exist?**
  - It barely exists – typical estimates of the percentage of digital signs that are interactive are around 5%

- **What makes it problematic?**
  - The lack of a business model for monetization of the touch
Surface Computing

Source: BNET.com
Surface Computing…1

- **Definition**
  - The goal of surface computing is to integrate the **physical world** and the **virtual (digital) world** through the use of **vision-based touch** so that digital information becomes immediately and easily available when users interact with a physical object or an environment.

- **Why does it exist?**
  - A variety of companies began conducting research on surface computing in the mid-1990s.
  - Microsoft Research commercialized the concept in 2007 and was improperly credited for creating it.
  - Since 2007, implementations of the concept in the form of dozens of touch tables have been created.
Surface Computing...2

Why is it significant?
- Because it is an attempt to totally change the way people interact with computers.
  - Putting a camera down on the surface, having the photos spill out onto the surface, interacting with the photos with multi-touch gestures, and sharing the photos with other people in a table-top environment is very different than tapping icons on an iPhone.

Why is it problematic?
- Surface computing software is all experimental.

What’s available?
- Dozens of touch tables
- Surface computing works with any display, but requires infrared (IR) vision-based touch sensing
  - This tends to make most products rear- or front-projected.
Vision-Based Touch

Microsoft Surface

1 – Screen with diffuser
2 – IR LED light source
3 – Four IR cameras
4 – DLP projector
5 – Vista desktop

Projector resolution
1024x768

Touch resolution
1280x960

Source: Popular Mechanics
Examples of Touch Tables
Thank You!

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