

# The Leading Edge of Touch

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Tyco Electronics – Elo TouchSystems



**"It's a New World, Are You Part of It?"**

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**Hilton Torrey Pines**

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## **Elo TouchSystems**

- ❖ Founded in 1971; invented the touch screen
- ❖ World's largest supplier of large-area (>10") touch screens
- ❖ World's largest supplier of LCD touch monitors
- ❖ Widest selection of touch technologies
- ❖ Approaching a half-billion dollars in revenue with 425 people
- ❖ Manufacturing & integration in China, Japan, Brazil, Belgium, New York & California

## **Business unit of Tyco Electronics**

- ❖ \$15B revenue in 2008
- ❖ 92,000 employees in 54 countries (34,000 in China)
- ❖ One of the world's largest electronic component suppliers

# Agenda

- ❑ Touch Technologies
- ❑ Why There Are So Many
- ❑ What an OEM Should Do
- ❑ What's Coming



# Touch Technologies Today

- ❑ 88% of the touch screens shipped in 2008<sup>1</sup> were one of the four “traditional” touch technologies
  - ❖ Analog resistive
  - ❖ Surface capacitive
  - ❖ Surface acoustic wave (SAW)
  - ❖ Scanning infrared (IR)
  
- ❑ Today there are 8+ additional new technologies competing
  - ❖ Projected capacitive
  - ❖ Camera-based optical
  - ❖ Acoustic Pulse Recognition (APR)
  - ❖ Dispersive Signal Technology (DST)
  - ❖ Waveguide infrared
  - ❖ Force sensing
  - ❖ Digital resistive & hybrid digital-analog resistive
  - ❖ LCD in-pixel sensing (“in-cell”; three different varieties)



(1) iSuppli *Touch Screen Special Report*, May 2008

# Why There Are So Many New Technologies

- 1 Proliferation of touch
- 3 Touch is an indirect measurement
- 2 There is no perfect touch technology
- 4 The drive for fundamental intellectual property
- 5 Vertical integration

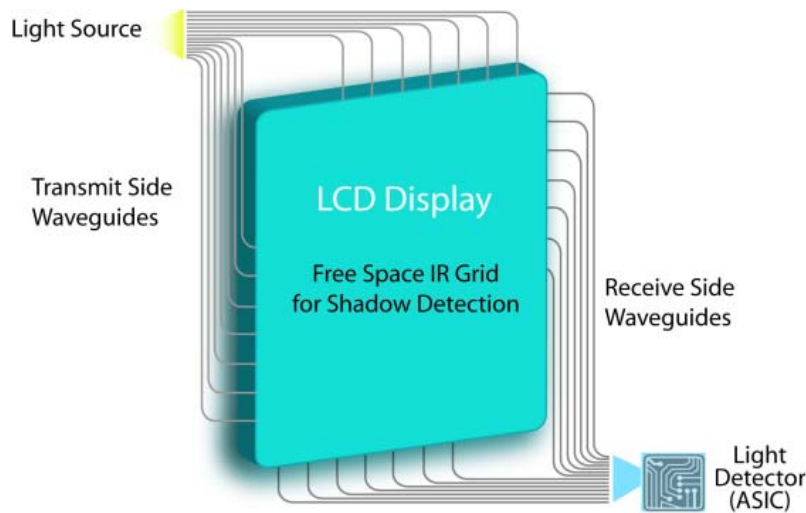


Illustration courtesy of RPO

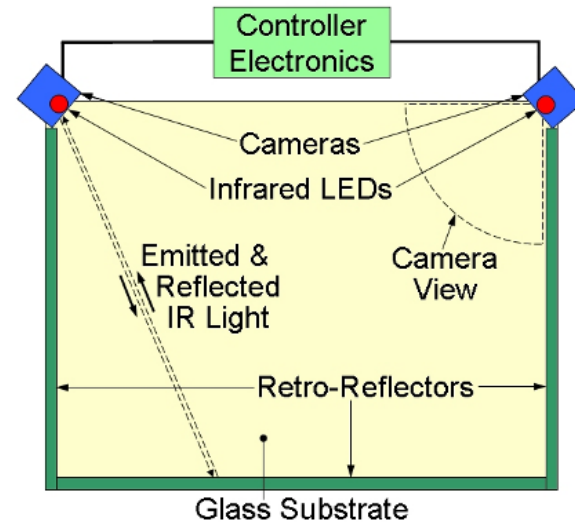


Illustration courtesy of NextWindow

# ① Proliferation of Touch

- ❑ Humans cost \$\$ → Proliferation of self-service
- ❑ Increasing display ubiquity & decreasing display cost
- ❑ Simplification of the user interface
- ❑ Hand-eye coordination
- ❑ Shrinking device size
- ❑ Single global hardware device
- ❑ Increased awareness of value
- ❑ Viral behavior (the iPhone effect)



Photo courtesy of Apple

## ② Touch Is An Indirect Measurement

What's Being Measured	Touch Technology
Voltage	Resistive (all forms)
Current	Surface capacitive
Time delay	Surface acoustic wave
Change in capacitance	Projected capacitive; LCD in-cell (capacitive)
Absence of light	Infrared, camera-based optical, LCD in-cell (optical in high ambient)
Presence of light	LCD in-cell (optical in low ambient)
Sound	Acoustic Pulse Recognition (APR)
Bending waves	Dispersive Signal Technology (DST)
Force	Force sensing
Resistance (contact closure)	LCD in-cell (resistive)

**The ideal method of detecting touch  
has yet to be invented!**

# ③ There Is No Perfect Touch Technology

Desirable Characteristic	Touch Technologies													
	Analog Resistive	Digital Resistive	Surface Capacitive	Projected Capacitive	SAW	Traditional IR	Waveguide IR	Camera-Based Optical	APR	DST	Force Sensing	LCD In-Cell (Optical)	LCD In-Cell (Capacitive)	LCD In-Cell (Resistive)
<b>Usability</b>														
Touch with any object	H	H	L	L	M	H	H	H	H	H	H	L	L	L
No unintended touch	H	H	H	H	H	L	L	L	H	H	H	H	H	H
Multi-touch	L	H	L	H	M	M	M	H	L	L	L	H	H	H
Touch & hold	H	H	H	H	H	H	H	H	L	H	H	H	H	H
High durability	L	L	M	H	H	H	H	H	H	H	H	L	L	L
High sensitivity (light touch)	H	H	H	H	M	H	H	H	M	H	L	H	H	M
Fast response & drag	H	H	H	H	M	M	H	H	M	H	M	M	M	H
Stable calibration	M	M	L	H	H	H	H	H	H	H	H	H	H	H
Very smooth surface	L	L	H	M	M	M	M	M	M	M	M	L	L	L
No liquid crystal pooling	H	H	H	H	H	H	H	H	H	H	H	H	L	L
Resistant to contaminants	H	H	M	H	L	M	M	M	H	H	H	L	L	L
Works in rain, snow & ice	H	H	L	H	L	L	L	L	L	L	H	L	L	L
Works with scratches	L	L	M	H	H	H	H	H	M	H	H	L	L	L

- ❖ 13+ more "Performance" factors
- ❖ 13+ more "Integration" factors



# ③ There Is No Perfect Touch Technology...2

## Selecting touch technology for a smartphone...

Characteristic	Analog Resistive	Projected Capacitive	APR	Waveguide Infrared	Traditional Infrared	Digital Resistive	LCD In-Cell
Stylus Independence	✓	🕷️	💰	✓	🕷️	✓	🕷️
Multi-Touch	🕷️	💰	🕷️	✓	✓	💰	💰
Durability	🕷️	💰	💰	💰	💰	🕷️	✓
Optical Performance	🕷️	✓	💰	💰	💰	🕷️	💰
Flush Surface	✓	💰	💰	✓	🕷️	✓	💰
Power Consumption	💰	✓	💰	✓	🕷️	💰	🕷️
Stable Calibration	🕷️	💰	💰	💰	💰	🕷️	💰
Narrow Borders	✓	✓	💰	✓	🕷️	✓	💰
Substrate Independence	✓	💰	✓	💰	💰	✓	💰
Cost	💰	🕷️	✓	✓	🕷️	✓	🕷️

💰	Best
✓	OK
🕷️	Worst

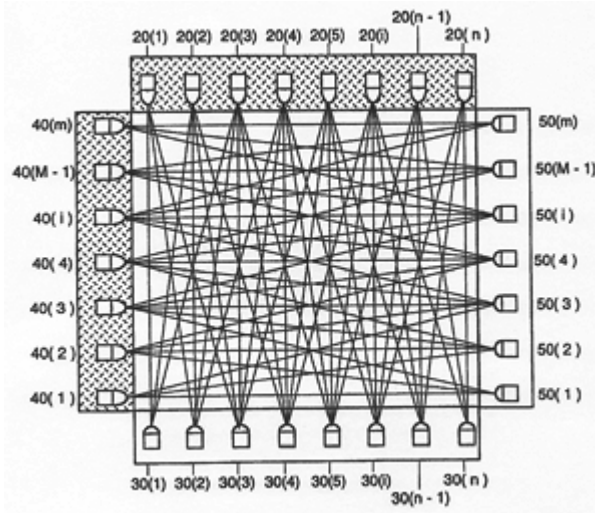
# ③ There Is No Perfect Touch Technology...3

Application	Example	Touch Technologies													
		Analog Resistive	Digital Resistive	Surface Capacitive	Projected Capacitive	SAW	Traditional IR	Waveguide Infrared	Camera-Based Optical	APR	DST	Force Sensing	LCD In-Cell (Optical)	LCD In-Cell (Capacitive)	LCD In-Cell (Resistive)
Amusement Gaming	Bar-top game	X	X	O	X	O	X	X	X	O	X	X	X	X	X
Appliance	Refrigerator door	O	X	X	X	X	X	X	X	O	X	X	X	X	X
Architectural	Elevator control panel	X	O	X	X	X	X	X	X	X	X	O	X	X	X
ATM Machine	ATM machine	X	X	X	O	O	O	X	X	X	X	X	X	X	X
Consumer AiO & Monitor	HP TouchSmart	O	X	X	O	X	X	X	O	X	X	X	X	X	X
Digital Signage	In-store product info	X	X	X	O	O	O	X	O	O	O	X	X	X	X
Healthcare	Patient info monitor	O	X	X	X	O	X	X	X	O	X	X	X	X	X
Industrial Control	Machine control	O	O	O	X	O	O	X	X	X	X	O	X	X	X
In-Vehicle	GPS navigation	O	X	X	O	X	X	O	X	X	X	X	X	X	X
Kiosk Commerce	Digital photo printing	O	X	X	O	O	X	X	X	O	O	X	X	X	X
Kiosk Point of Info (POI)	Museum information	O	X	O	X	O	O	X	O	O	O	X	X	X	X
Kiosk Ruggedized	Gas pump	X	X	O	O	O	O	X	X	X	X	O	X	X	X
Legal Gaming	Casino machine	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Medical Equipment	Medical devices	O	X	X	O	O	X	X	X	O	X	X	X	X	X
Military Fixed & Mobile	Submarine console	O	X	O	X	X	O	X	X	X	X	X	X	X	X
Mobile Device	Smartphone	O	X	X	O	X	O	O	X	O	X	O	O	O	O
Music Controller	Jazz Mutant	O	O	X	O	X	X	X	X	X	X	X	X	X	X
Office Automation	Office monitor	O	X	O	X	O	X	X	X	X	X	X	X	X	X
Point of Sale (POS)	Restaurant; lottery	O	X	O	O	X	O	X	X	O	X	O	X	X	X
Training & Conference	Boardroom display	O	X	X	X	O	X	X	O	X	O	X	X	X	X



## ④ The Drive for Fundamental IP

- ❑ The fundamental intellectual property (IP) on all four of the traditional touch technologies has expired
  - ❖ New patents tend to be on enhancements



“Cross-beam” light paths increases resolution and fault-tolerance in infrared touchscreens (Elo)

- ❑ Companies trying to establish a sustainable competitive advantage in touch create new technologies

# 5 Vertical Integration

## □ LCD in-cell touch

- ❖ When touch was insignificant, LCD manufacturers ignored it
- ❖ Now that it's becoming more significant (~\$3B in 2008<sup>1</sup>), LCD manufacturers want to incorporate it into their products

## □ Three types

- ❖ Optical – phototransistor in each pixel
  - ✗ Can't sense touch on a dark on-screen object in low light
- ❖ “Resistive” – contact-closure sensing in each pixel
  - ✗ User must touch the surface of the LCD (poor durability)
- ❖ Capacitive – laminated projected capacitive sensor (“on-cell”)
  - ✗ Standard shortcomings of projected capacitive (e.g., no stylus)

**“There is no perfect touch technology”**

(1) iSuppli *Touch Screen Special Report*, May 2008

# What an OEM Should Do

- ❑ What should an OEM who wants to implement touch in a new product do when faced with so many technologies?
  - ① Understand the end-user's behavior & the application in depth
  - ② Understand the strengths & weaknesses of each technology
    - ✓ *Interactive Displays Conference*, April 21-23, San Jose <sup>1</sup>
    - ✓ *Touch & Emerging Technologies Conference*, September 3, San Jose <sup>2</sup>
    - ✓ *Veritas et Visus Touch Panel* newsletter <sup>2</sup>
  - ③ Work with a supplier who develops multiple technologies
    - ✗ Force-fit technology
    - ✗ Technology resellers
    - ✗ Biased website information
    - ✗ Herd behavior



- (1) [www.int-displays.com](http://www.int-displays.com)
- (2) [www.displaysearch.com](http://www.displaysearch.com)
- (3) [www.veritasetvisus.com](http://www.veritasetvisus.com)

# What's Coming

## □ The definition of touch

- ❖ Sensing the contact between a human (or a human holding an object) and a target

## □ The purpose of touch

- ❖ Simplify the interaction between humans and information and/or equipment

## □ How else can that interaction be simplified?

- ❖ Voice (mobile phones)

- ❖ Gestures (2D & 3D) ←

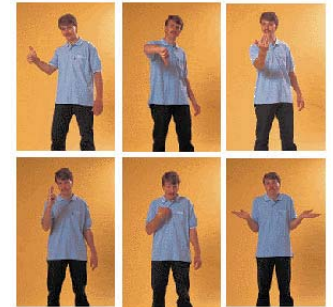
- ❖ Face-reading

- ❖ Eye-tracking

- ❖ Brain waves

- ❖ **And more...**

- *iPhone (2D)*
- *Cellphone 3D gestures*
- *Flexible displays*
- *TV remote at CES<sup>1</sup>*
- *Lexus heads-up display*



# Thank You!

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