

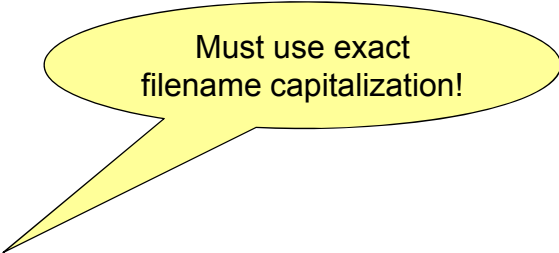


# KDC 2014

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Technologist



# Touch Technology & User-Interface Trends



Must use exact  
filename capitalization!

**File Download:** [www.walkermobile.com/KDC\\_2014\\_Touch\\_&\\_UI\\_Trends.pdf](http://www.walkermobile.com/KDC_2014_Touch_&_UI_Trends.pdf)

# Agenda

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## ❖ Touch Technology Trends

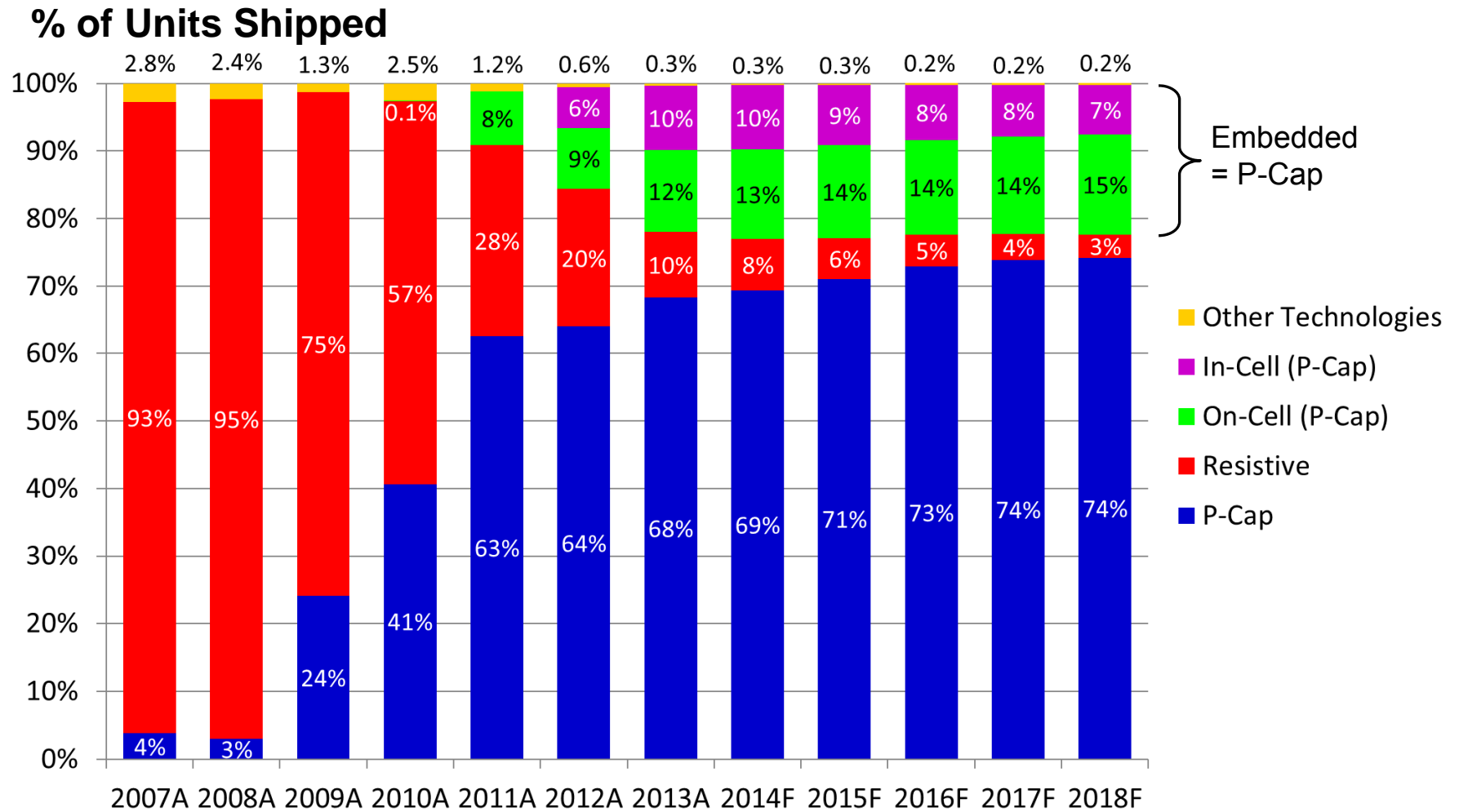
- ◆ P-cap dominates
- ◆ Large-format touch
- ◆ ITO replacements
- ◆ Embedded touch
- ◆ P-cap enhancements

## ❖ User-Interface Trends

- ◆ It still doesn't "just work!" every time
- ◆ Hover
- ◆ Going beyond touch

## ❖ Conclusions

# P-Cap Dominates...1



Source: DisplaySearch Touch-Panel Market Analysis Reports 2008-2014

# P-Cap Dominates...2

## ❖ “Other Technologies” in 2014

Optical Imaging (inc. FF)	1.4M
Digitizer (exc. Wacom)	1.4M
Infrared	0.9M
Acoustic (inc. BW)	0.4M
Others	0.3M
Combo	0.3M
Surface Capacitive	0.1M
<b>Total</b>	<b>4.8M</b>

Source: DisplaySearch Quarterly Touch-Panel Market Analysis Report 1Q-2014

(versus 2.4 **Billion** units for p-cap)

## ❖ Commercial touch versus CE/IT touch

2012	2013	2014	2015	2016	2017	2018
5.6%	5.4%	4.9%	4.5%	4.4%	4.5%	4.6%

(Same Source)

- ◆ As commercial touch units continues to shrink as a percentage of CE/IT touch, will it be marginalized or experience a renaissance?

# P-Cap Dominates...3

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## ❖ “Renaissance” is more likely

- ◆ Consumer p-cap is gradually getting closer to meeting commercial requirements
  - Glove-touch, water-resistance, noise-immunity, etc.
- ◆ P-cap’s capabilities are becoming increasingly attractive in commercial applications
  - Curved touch-panels, particularly in automotive
  - Light touch expected by ALL touch-panel users
  - Flat-bezel in customer-facing applications
  - Multi-touch wherever images are viewed (e.g., photo-printing kiosk)

# P-Cap Dominates...4

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## ❖ Prediction for p-cap penetration into commercial applications (high to low)

- Automotive
- Healthcare
- Casino gaming
- Point-of-information (POI) & digital signage
- Education & training (“interactive whiteboards”)
- Self-check-in, ticketing, & ATM
- Industrial & factory automation
- Point-of-sale (POS)
- Military & aerospace

## ❖ Everything so far has been for < 30 inches; what about large-format?

# Large-Format Touch...1

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## ❖ Large-format touch is a much more wide-open space

- ◆ Multi-touch infrared (IR) has replaced traditional (single-touch) IR
- ◆ Camera-based optical has dropped substantially with the exit of NextWindow (SMART Technologies) from the market
- ◆ Startup: [Sentons](#) is taking a new approach to bending-wave
- ◆ Startup: [RAPT](#) is taking a new approach to in-glass optical
- ◆ P-cap with metal mesh is a threat to all other large-format touch technologies
  - Commonality of user experience (UX) with the 3 billion p-cap units shipped since 2007 may be the driving force
  - Cost and complexity (as always) are the impediment



# Large-Format Touch...2

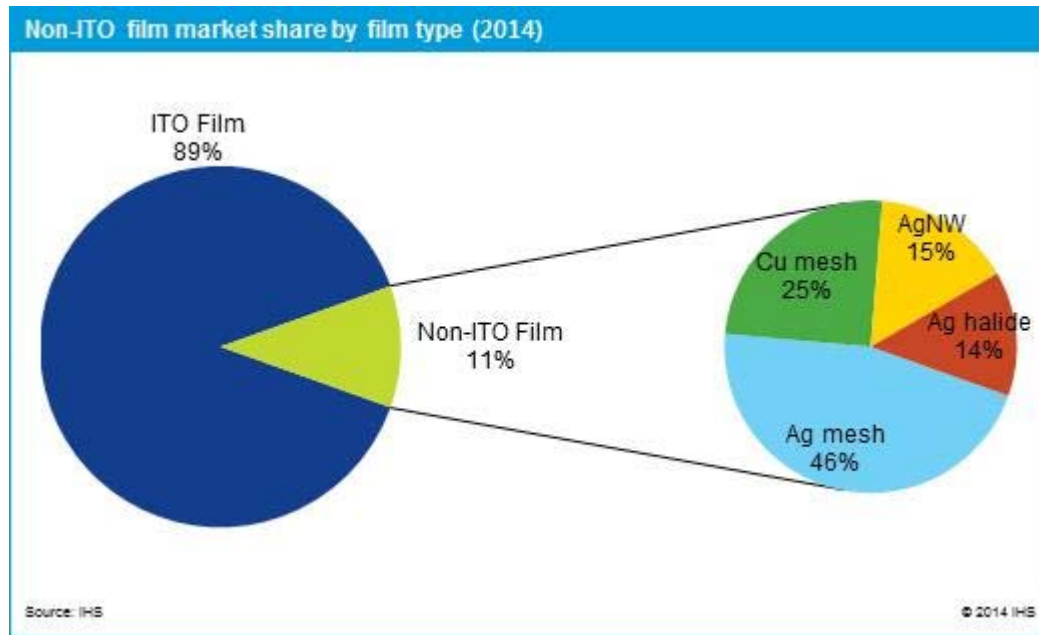
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- ❖ **BUT, stepping back from a technology focus, is the large-format touch market likely to start shrinking?**
  - ◆ Interactive media walls – touch is very necessary
    - [MultiTaction](#) makes the best vision-based touch today (author's opinion)
  - ◆ Point-of-information – touch still seems necessary
  - ◆ Digital signage – interaction via smartphone
  - ◆ Education – interaction via tablets (including multi-user!)
  - ◆ TV – interaction via mobile devices
  - ◆ Horizontal home-gaming tables – will they ever exist?
  - ◆ Other large-format applications??

# ITO Replacements...1

## ❖ ITO-replacement materials are having a definite market impact

◆ See the latest IHS market report



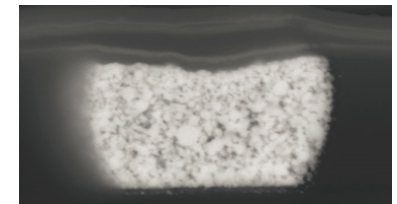
- ◆ Mesh (silver & copper)
- ◆ Silver nanowires
- ◆ Carbon nanotubes (CNTs)
- ◆ Conductive polymers
- ◆ Graphene

- ◆ The value is performance and cost
  - Both unit cost and CAPEX

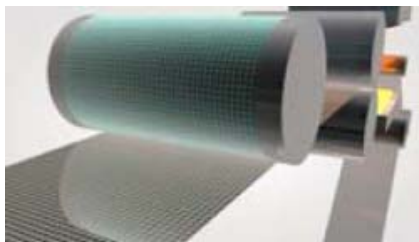
# ITO Replacements...2

- ❖ **Printing** metal-mesh is going to beat litho & laser
- ❖ **O-film is the “800-pound gorilla”**
  - ◆ Largest touch-module maker in China, #3 globally
  - ◆ Like “the TPK of film”; innovative and aggressive
- ❖ **New roll-to-roll printing method**
  - ◆ “Hybrid printing” or “micro-imprinting”

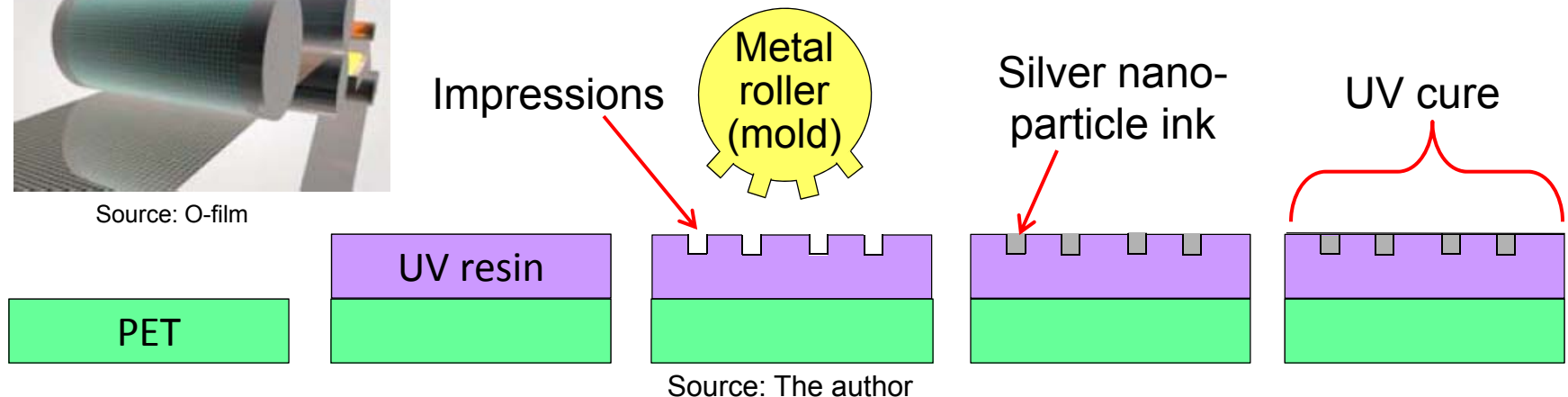
Source: O-film



*Cross-section of embedded metal line*



Source: O-film



# ITO Replacements...3

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## ❖ O-film technical details

- ◆ Additive process with little waste
- ◆  $< 2 \mu\text{m}$  line width
- ◆  $< 10 \Omega/\square$
- ◆ Randomized mesh design
- ◆ Top surface of embedded metal line is blackened & sealed
- ◆ Embedded metal reduces haze and eliminates peel-off
- ◆ Producing  $> 1.5\text{M}$  touch-panels per month (size not stated)

# Embedded Touch...1

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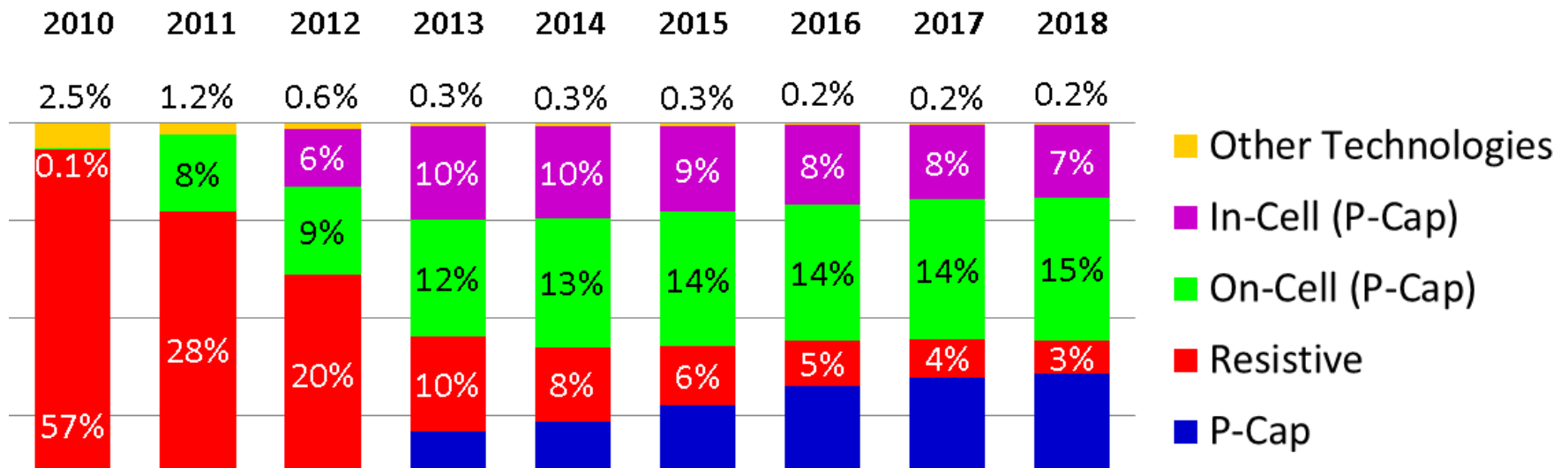
## ❖ Embedded touch defined

- ◆ Touch supplied by a display-maker, not a touch-panel maker
- ◆ Forms: True in-cell, hybrid in-cell/on-cell, on-cell
- ◆ It's all about who gets the \$\$\$, not the technology

## ❖ It's definitely growing

- ◆ But it's become less visible due to competition and IP
  - Primary embedded-touch patent-holders are Apple & Samsung

# Embedded Touch...2



Source: DisplaySearch Touch-Panel Market Analysis Reports 2008-2014

- ❖ **DisplaySearch forecasts that on-cell will beat in-cell**
  - ◆ Least impact on LCD module design and production
  - ◆ Already the default standard for OLED mobile displays
  - ◆ Total 25% embedded probably underestimates OLED penetration

# Embedded Touch...3

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## ❖ Key issues

- ◆ Embedded touch isn't "free"
  - See "[The Touch-Panel Makers vs. The Display-Makers](#)" (FPDI 2013)
- ◆ Cost of cover-glass-based (GF1, GFF, etc. = "OGS-type") touch-panel is dropping, especially with metal mesh
  - Jun Souk: "It's much easier for a display-maker to just go buy an OGS touch-panel and be done with it" (FPDIT 2013)
- ◆ "Supply-chain simplification" is often cited as an advantage of embedded touch
  - But embedded touch greatly limits the selection of suppliers
  - And, most display-makers don't want to manufacture many different model-unique decorated cover-glasses
- ◆ In-cell and hybrid in-cell reduces feature flexibility
  - Also may limit access to the latest controller enhancements
  - Touch latency-reduction from combining touch controller and TCON is not a general-purpose solution

# P-Cap Enhancements...1

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- ❖ **Many of the p-cap controller suppliers have already developed...**

- ◆ Glove-touch
- ◆ Stylus support (both active and passive)

- ❖ **There's also a lot of focus this year on...**

- ◆ Water-resistance
- ◆ Improved interference-resistance
  - With more happening on the analog side, since a lot of work has already been done on the digital (algorithm) side

- ❖ **And everybody seems to be implementing hover...**

- ◆ We'll come back to hover in a minute, but let's talk about stylus first



# P-Cap Enhancements...2

## ❖ Stylus is a difficult situation, but it's on everyone's list

Passive

- ◆ Very low-cost
- ◆ "Good enough"
- ◆ Improves as SNR increases
- ◆ #2 pencil is the gold standard
- ◆ "Artificial finger" in Windows
- ◆ More flexibility in Android

**↑**  
*Passive will probably win...*

versus

Active

- ◆ More expensive
- ◆ Pressure-sensing
- ◆ Hover (required for Windows)
- ◆ Higher resolution
- ◆ Customizable features

P-cap (battery)

- ◆ N-Trig leads
- ◆ Others following
- ◆ **NO** interoperability

EMR (batteryless)

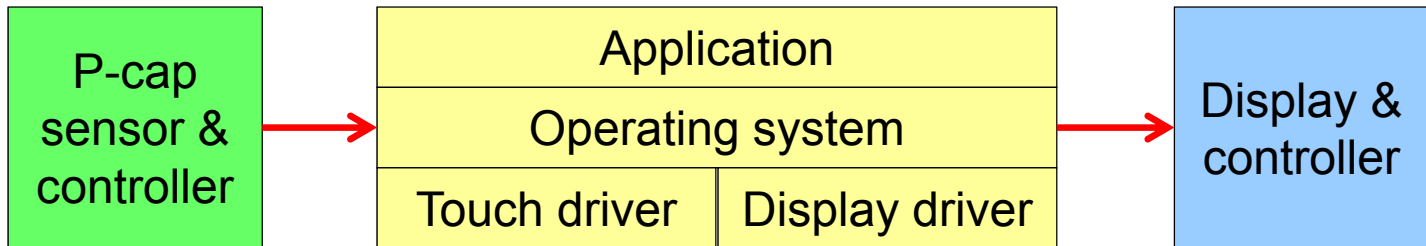
- ◆ Wacom leads
- ◆ Others insignificant
- ◆ 2<sup>nd</sup> sensor

Cost in volume is relatively close

# P-Cap Enhancements...3

## ❖ Other p-cap enhancement areas

- ◆ Latency (time between touch and visible response)
  - Startup: [Tactual Labs](#)



- ◆ Adaptive behavior
  - For example, N-Trig's action as noise-level increases
- ◆ Software integration
  - Intel is working on being able to run the touch-controller algorithms on the GPU
- ◆ Automated "tuning"
  - This will speed the migration of p-cap into commercial applications

# The #1 User-Interface/ User-Experience Trend

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## ❖ Touch still doesn't “**just work!**” all the time

- ◆ Missed touches
- ◆ Unintended touches

## ❖ Why?

- ◆ Other than environmental issues (which are being addressed much more seriously this year), the #1 reason is poor programming, not poor touch-panels (author's opinion)

## ❖ You don't believe it?

- ◆ Download “[Touch Explorer](#)” by Synaptics from Google Play and see if you can make the touch-panel fail to respond properly

# Hover...1

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- ❖ **There are two ways of emulating “mouseover” on a touch-panel**
  - ◆ Hover over something to see it change, then touch to select
  - ◆ Press lightly on something to see it change, then press harder to select
- ❖ **The industry is moving towards hover because nobody has been able to implement pressure-sensing in a way that works well and that OEMs are willing to implement**
  - ◆ Startup: [NextInput](#)
    - Force-sensing using an array of organic transistors where pressure changes the gate current
  - ◆ Startup: [ZRRO](#)
    - Multi-finger hover detection

# Hover...2

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## ❖ What can you do with hover?

- ◆ Enlarge small links when you hover over them
- ◆ Make a passive stylus seem to hover like an active stylus
- ◆ Magnify an onscreen-keyboard key as you approach rather than after you've touched it
- ◆ Preview interactive objects such as an array of thumbnails
- ◆ Use multi-finger gestures for more complex operations
- ◆ And more...

# Going Beyond Touch

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## ❖ Intel RealSense™

- ◆ “Bringing human senses to your devices”

## ❖ User-facing 3D camera use-cases

- ◆ Entertainment and gaming
- ◆ Interactive reality books
- ◆ Immersive collaboration & creation
- ◆ Object capture
- ◆ Control and navigation
- ◆ Broad enabling of 3D in applications



## ❖ World-facing 3D camera

- ◆ Google “Intel CES 2014”

## ❖ Download the [Perceptual Computing SDK](#)

# Conclusions

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## ❖ Touch is continuing to evolve

- ◆ P-cap controller-makers are continuing to innovate
- ◆ Touch startups are plentiful (5 examples in this presentation)
- ◆ The battle between the display-makers and the touch-panel makers is continuing with no clear winner in sight

## ❖ The two biggest threats

- ◆ “Good enough” really isn’t
- ◆ Insufficiently knowledgeable app-programmers



# Thank You!

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