



FPDIT 2013

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Where P-Cap Is Going

File Download: www.walkermobile.com/FPDIT_2013_P-Cap.pdf

12 P-Cap Directions

- ◆ Finger-Hover
- ◆ Glove-Touch
- ◆ Pressure Sensing
- ◆ Active Stylus Support
- ◆ Other Touch-Objects
- ◆ Faster Response
- ◆ Adaptive Behavior
- ◆ Noise immunity
- ◆ Water immunity
- ◆ Software Integration
- ◆ Cost Reduction
- ◆ Automated Tuning



Source: DigitalTrends.com

Finger-Hover & Glove-Touch

- ❖ **“Hover then touch” is an alternative to “touch lightly then press harder”**

- ◆ Hover expands the user experience (UX)
 - Available today in the Galaxy S4

- ❖ **Can be accomplished by adding self-capacitive to existing mutual-capacitive**

- ◆ Mutual-capacitive provides touch location
- ◆ Self-capacitive provides proximity sensing
- ◆ Glove-touch causes the finger to remain a constant distance above the screen; proximity sensing can detect that without the user manually switching modes



Source: TheTechBlock.com

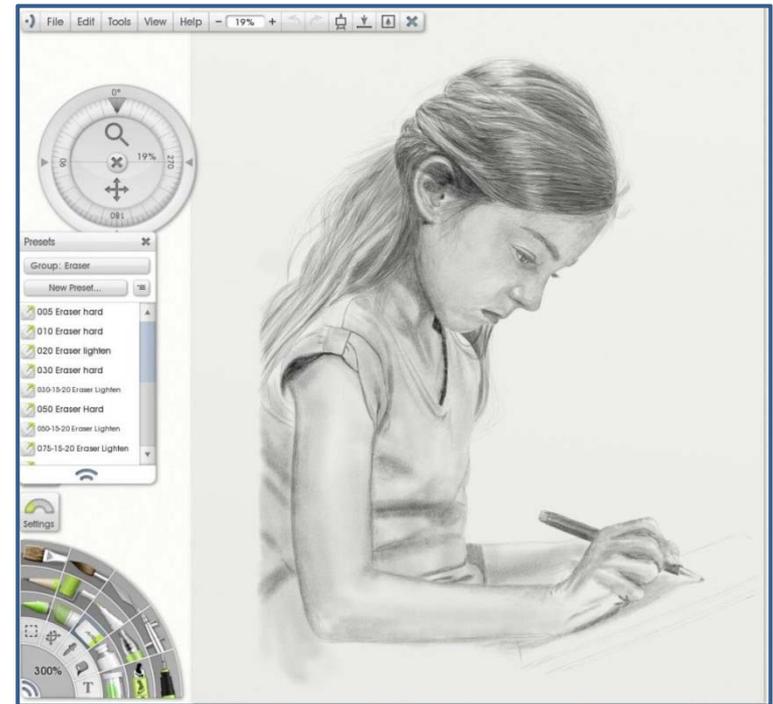
Pressure Sensing

- ❖ **Pressure-sensing is an alternative selection method**
 - ◆ True pressure-sensing in p-cap doesn't exist today
 - ◆ Some (including Microsoft) believe that “*touch lightly to view choices then press to select*” is more intuitive than hover
 - It has never been implemented successfully in a mobile device
 - Blackberry Storm (2 models!) failed due to terrible implementation
 - Nissha/Peratech (QTC) collaboration never made it into mass-production
 - ◆ Multiple startups are working on smartphone pressure-sensing
 - NextInput
 - Uses an array of pressure-sensitive organic transistors under the LCD
 - FloatingTouch
 - Mounts the LCD on pressure-sensing capacitors made using a 3M material
 - ◆ In the meantime, hover may become the standard UI

Active Stylus Support...1

❖ Stylus is coming back into the consumer space

- ◆ The “finger-only” focus of 2007-2013 is ending
- ◆ All the major p-cap controller suppliers support active & passive
- ◆ PC OEMs want to differentiate their products from Apple’s
- ◆ Legacy Windows software on a Win-8 tablet needs a stylus
- ◆ By the end of 2013, Samsung will have shipped ~26M Galaxy Notes (all models)
- ◆ Consumption isn’t enough; a stylus is great for creation



Created with an N-Trig stylus on a Sony VAIO using ArtRage software

Active Stylus Support...2

❖ Intel's user-testing of stylus on clamshells produced some surprising results

- ◆ Intel tested 60 people for 2 hours each in USA, UK, & PRC
 - Tracked 82 specific actions for each user in 4 desktop apps and 2 Modern apps using touch, stylus, and touchpad
- ◆ After testing, **78% of users wanted a stylus in their laptop**
 - 56% touch laptop with stylus; 22% touch laptop with stylus and no touchpad; 20% touch laptop; 2% standard laptop
- ◆ 66% expressed moderate or high likelihood of purchasing an Ultrabook with a stylus in the next year, even with a premium

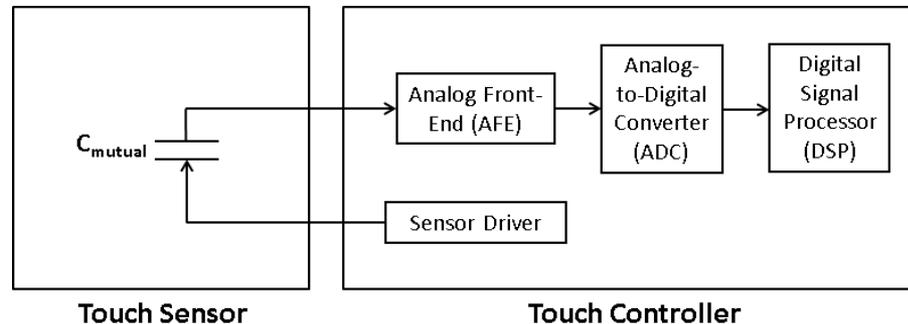
<http://ultrabooknews.com/2013/01/28/digitizers-and-ultrabooks-what-people-want-design-recommendations-and-developer-tips-video-series/>

*Daria Loi – User Experience Innovation Manager at Intel Corporation
Study released to the public on January 28, 2013 (30 minutes of video)*

For more interesting Intel studies, Google ["Daria Loi" Intel]...

Touching With Something Other Than Just a Finger

- ❖ What if you could touch with a fine-tipped passive stylus, long fingernails, a ballpoint pen, a #2 pencil...?
 - ◆ This can and will be accomplished through higher signal-to-noise (SNR) ratios
 - Much of this improvement may come from enhancing the controller analog front-end in addition to focusing on the digital algorithms
 - ◆ This enhancement to the UX will be the end of “finger-only” p-cap

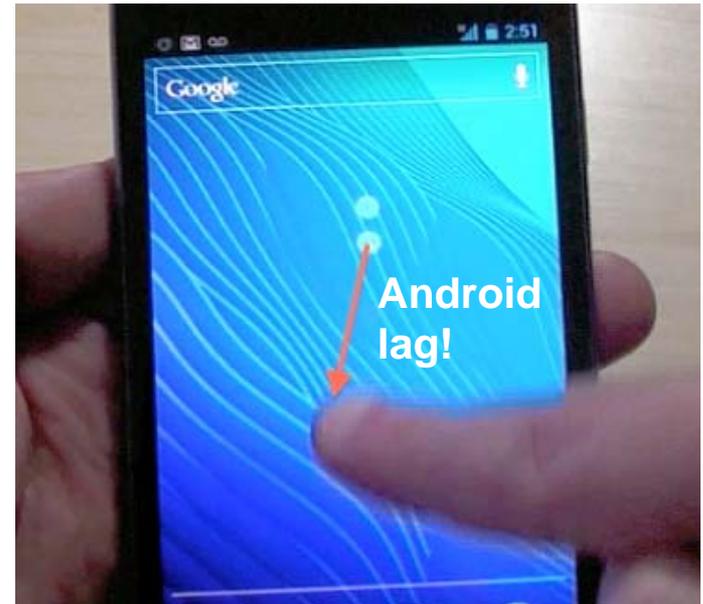


Source: The Author

Faster Response

❖ Make touch more natural by reducing latency

- ◆ The shorter the time is between a touch and the response, the better the user feels about the touch system
 - If an object lags behind your finger when you drag it, or ink lags behind a stylus when you're drawing, it doesn't feel real
- ◆ Latency today is typically 75-100 ms; studies have shown that humans need less than 10 ms for comfort
 - Synaptics is addressing the problem by creating a direct path between the touch controller and the TCON to allow instant screen updates
 - A stealth-mode startup in the USA claims to have a method of reducing latency to just a few milliseconds



Source: Gigaom.com

Adaptive Behavior

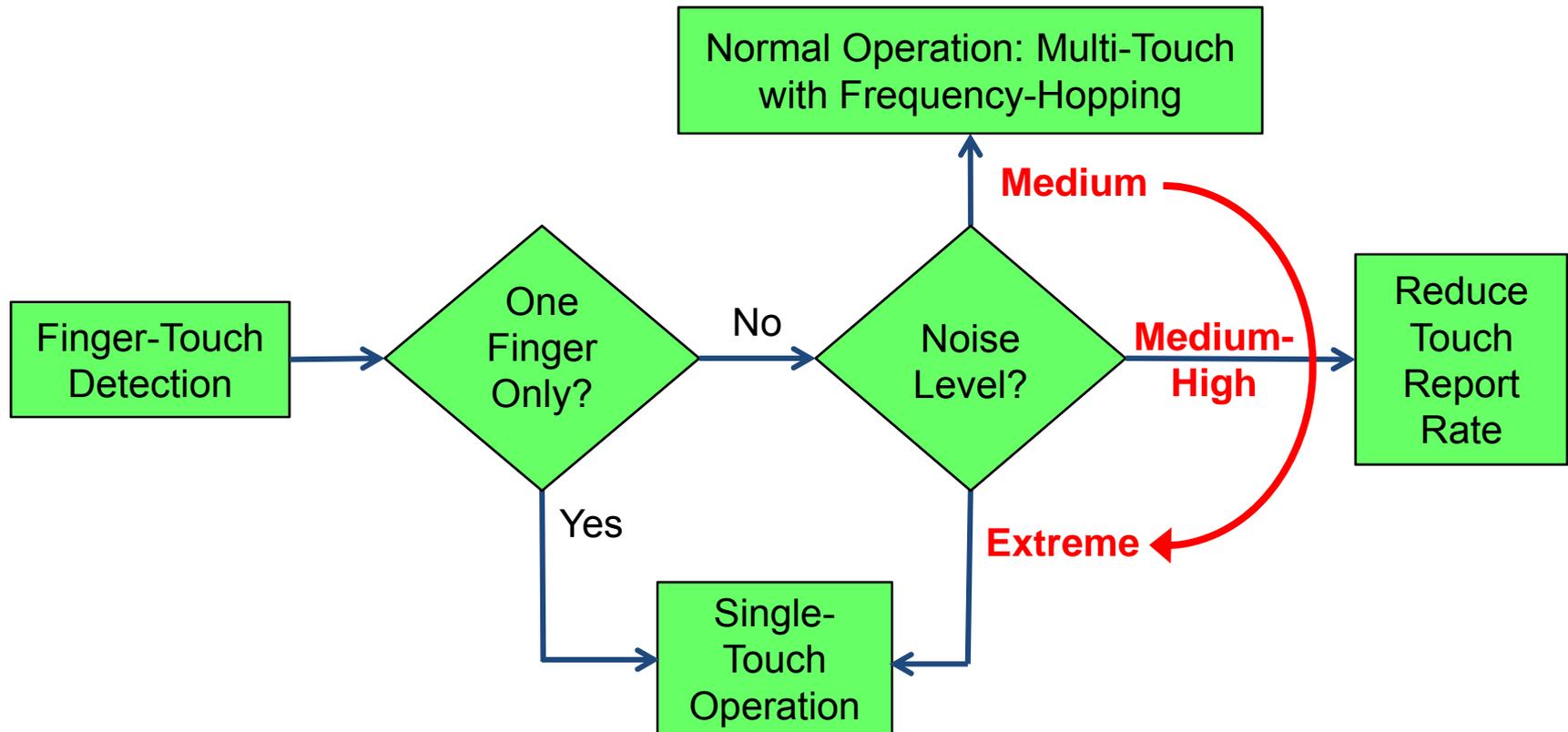
❖ **Touch Should Always “Just Work”**

- ◆ It shouldn't fail to highlight a touched link 1 time out of 10
- ◆ It shouldn't stop working when it's near a florescent desk lamp
- ◆ It shouldn't work erratically when you're using a cheap charger
- ◆ It shouldn't stop working when the screen gets sweaty
- ◆ It shouldn't stop responding when your arm is on the screen
- ◆ Etc...

❖ **The key to the desired UX is much more context-awareness and adaptive behavior by the touch-controller**

Adaptive Behavior: Noise Immunity

❖ Adaptive noise-management by N-Trig



More Adaptive Behavior: Water Immunity

❖ Why is it OK that touch on my Galaxy S3 smartphone stops working when the screen gets sweaty?

- ◆ P-cap touchscreens already exist that can operate with running water on the surface
 - Common commercial market-requirement

- ◆ Adaptive algorithms can adjust for the difference in e-field shape

- ◆ **Touch should always “Just Work”**



WaterSENSE® from UICO (handheld shower spray)

Software Integration

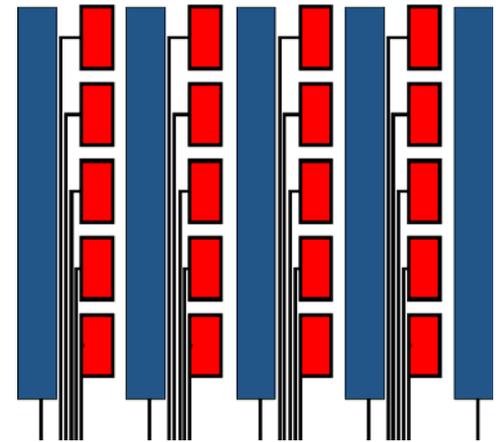
❖ Make more resources available to the touch controller

- ◆ Run touch algorithms on the GPU instead of the controller micro
 - Algorithm-writers can take advantage of much larger resources on the host device (MIPS and memory)
 - This can support higher frame-rate, reduced latency, reduced power consumption, easier support of different sensor designs, etc.
 - Algorithmic code is easier and faster to change when it's in a "driver" than when it's in firmware in an ASIC
 - Most touch-controller suppliers never change the firmware in the touch controller once it ships in a device; N-Trig is the exception
 - Cost-reduction by elimination of one micro
 - Even more cost reduction for large screens by elimination of slave chips
- ◆ Something like this has already been done in NVIDIA's "Direct Touch", but it wasn't widely used in actual devices

Cost Reduction

❖ Intel is focused on reducing the cost of p-cap

- ◆ Intel wants to cut the cost of a 13.3” p-cap touchscreen by 50% in 18 months
 - Reducing the cost of touch is a major factor in touch adoption
- ◆ ITO-replacement materials have the largest potential cost impact
 - Switching from vacuum-deposited & photolithographically-patterned ITO to (for example) flexographic printed copper metal-mesh could potentially drop the cost of a 13.3” sensor from \$20 to \$5
- ◆ Other Intel focus areas:
 - Easier/simpler/higher-yield bonding to LCD
 - High-performing single-layer electrodes
 - Plastic (non-glass) cover-glass
 - Supply-chain improvements
 - Alternative touch-technology for AiOs



Source: Synaptics

Automated Tuning

- ❖ **For true “touch everywhere”, p-cap has to become like resistive: Just slap it on and you’re done**
 - ◆ We’re far from that point today
 - ◆ Atmel says that the typical first integration of a p-cap touch-panel into a new product takes one full day of tweaking up to 200 individual parameters
 - ◆ That’s gotta be automated!

P-Cap Conclusions

- ❖ **Conclusion 1:** *There's lots of room for p-cap innovation*
- ❖ **Conclusion 2:** *P-cap commoditization (at least in the mid to high-end) seems a long way off*

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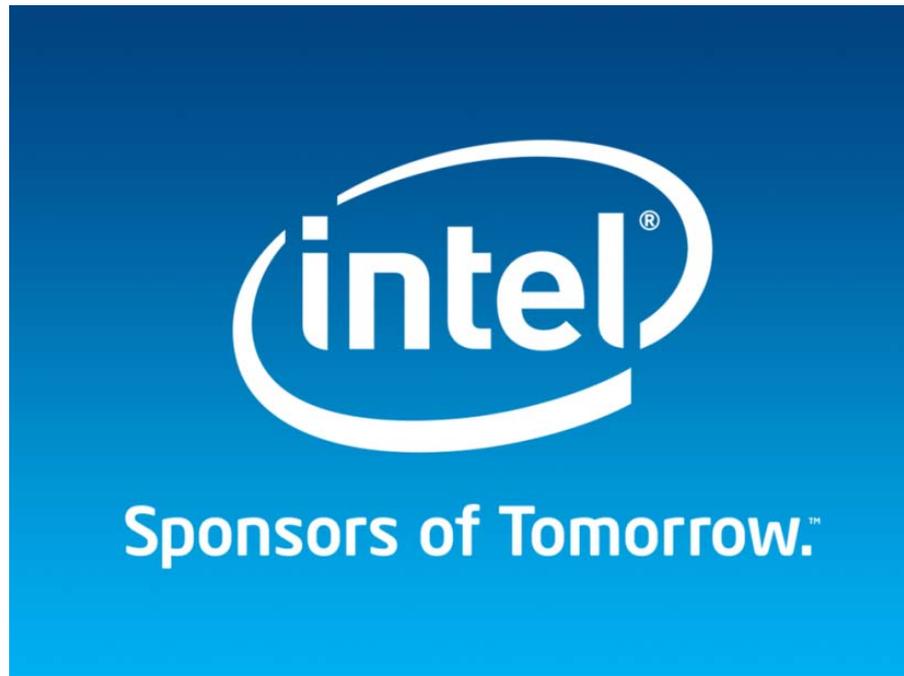
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