



Multi-Touch All-Point Touchscreens: The Future of User Interface Design

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One of the most demanding challenges designers of electronics – especially consumer electronics – face involves user interface design. Interface design requires careful mapping of complex user actions to create an intuitive, usable, and productive experience. Users, with all of their senses – sight, hearing, taste, smell, and touch – sit on one side of this paradigm. On the other side is the device or system that is affected by the output of the user's five senses.

The holy grail for both users and developers is a user interface that most effectively and intuitively leverages the most relevant senses – sight and touch in this case – into the most optimal user experience. Unfortunately, a large majority of commercially available devices predominantly treat these two critical senses as inherently separate. On the surface, these interfaces are comprised of components that seem to do the job well enough. These components range from simple buttons or keys – like those on your computer keyboard, cell phone's keypad, MP3 player, household appliances, and even television remote controls – to more advanced tapping and scrolling features as found in volume sliders, scroll wheels, and trackpads. However, the location of the output, or the result of a user's input or user, is fundamentally displaced from the location of the input. What would happen if those two senses – the output and the input – the sight and the touch - were one and the same? This is benefit that touchscreens bring to system at a very basic level.

What may seem like a basic concept is actually a profound breakthrough that is leading to a revolution in how users interact with the world of electronics. The transparent nature of touchscreens enables a completely different user interaction with devices as the user directly "touches" the varied content within the display. Instead of having this button or that button on the periphery of any electronic device, like a computer mouse or keyboard or even just a regular dial pad button on a cell phone, users can instead directly interact with any application that is inherent within the device's "brains", its operating system.

This direct interaction is revolutionary because the power of the operating system and its applications are then directly at the user's fingertips. For while computer mice and trackpads let users navigate through applications on a screen, the mouse and screen are still separate and distinct. A touchscreen fundamentally brings the display alive by allowing users to physically touch the display and thereby become one with the screen, its inherent applications, and the data displayed. Actions and gestures of all kinds – anything a person can imagine with his or her own eyes – can be realized on the display simply by touching it.

Touchscreens come in three main forms: Single-Touch, Multi-Touch Gesture, and the epitome of it all, Multi-Touch All-Point.

Single-Touch Touchscreen

The power of the touchscreen was first unleashed in its most simplistic form – with just one finger touching one point on the screen. Just think of your everyday POS terminal at your local supermarket or the check-in terminal at the airport. Single-touch was the obvious next step in the evolution of user interfaces, bringing the mechanical button off to the side of the screen back onto the screen.

Single-touch buttons are found in everything around the home, office, or anywhere in between: cell phones, landline phones, remote controls, televisions, computers and all of its peripherals, gaming systems, refrigerators, ovens, toasters, car interior controls like radio and air conditioning, and so on. Single-touch touchscreens like the shown in Figure 1 remove the need for the traditional mechanical button by integrating that user control interface directly onto the screen itself.



Figure 1: Single-Touch Touchscreen Functionality

Single-touch has brought two main advantages to the user interface: 1) Device design space can be optimized, especially in smaller devices, by locating both a screen and buttons in the same area, and 2) devices can now have an unlimited amount of “buttons” since a button could be tied to any application within the device’s operating system. This functionality, predominantly based on resistive touchscreen technology, became quite popular across consumer electronics, airport kiosks, grocery store POS terminals, and automobile GPS systems.

Multi-Touch Gesture Touchscreens

Single-touch touchscreens based on resistive touchscreen technology, while amazing and revolutionary in their own right, had two significant drawbacks: 1) resistive technology relied on the, albeit small, physical movement of the touchscreen, something that proved to cause poor performance after normal wear and tear, and 2) it was just single-touch, i.e. only one finger can do one thing at one time on a particular screen.

This is where Apple made its monumental contribution to the user interface revolution, with its projected-capacitive based touchscreen iPhone. Even in small devices like smart phones, the functionality inherent within the applications and operating system screams for multiple fingers for optimal usability. Already users are wondering how they ever lived without one and two fingers gestures, like manipulating picture sizes like shown below in Figure 2 and orientation of web page views and the like.



Figure 2: Re-sizing picture on a Multi-Touch Gestures Touchscreen

Other innovators are continuing this multi-touch gesture trend across many other devices systems – from other smart phones like the Google G-1 and the Blackberry Storm, computers and laptops like the MacBook Pro and HP touchsmart, portable media players, and a wide variety of other applications. New expectations have been set in how users can connect with electronics and now all electronics are vying to integrate this expectation.

Multi-Touch All-Point Touchscreens

As with Single-Touch touchscreens, Multi-Touch Gesture touchscreens too have a limitation: the number of points the technology can identify on the screen. Why limit device makers to two points at a time? Users have ten fingers across two hands and when users interact with each other the number of fingers and hands grow even more. That is the concept of Multi-Touch All-Point, the ability to handle more just two fingers.



Figure 3: Multi-Touch All-Point Touchscreen Example



Multi-Touch All-Point technology brings touchscreens to the next level of reliable usability across a broader set of feature-rich applications. Reliability refers to the ability to accurately capture all raw data points touched on a screen in the highest granularity in a way that minimizes any confusion on what exact points in the screen were touched. Usability refers to the many powerful applications, within small and large screens, that can benefit from more than two fingers or hands on the screen.

Interactive 3D gaming, keyboard entry, and map manipulation are but a few more examples of applications that are prime candidates for this level of touchscreen functionality. Ultimately multi-touch all-point technology provides device and system OEMs with even more touch data to empower them to unleash their creativity for developing the next generation of user interfaces.

One example of Multi-Touch All-Point technology is the TrueTouch™ touchscreen solution from Cypress Semiconductor. TrueTouch™ is powered by Cypress's PSoC® programmable system-on-chip architecture, which integrates an 8-bit microcontroller with programmable analog and digital blocks. The architecture delivers unparalleled flexibility, and configurability. The TrueTouch solution's projected capacitance touchscreen controllers are scalable in terms of screen size support. It is flexible in supporting single touch, Multi-Touch gesture, and Multi-Touch All-Point technologies. TrueTouch provides a great deal of integration of external components and can specifically work with any touchscreen sensor or LCD display. The flexible PSoC architecture enables designers to accommodate last minute changes -- something no other touchscreen product can deliver. TrueTouch's whole product support can be leveraged to get a quality and cost effective multi-touch all-point touchscreen design into production quickly. More information is available at www.cypress.com/TrueTouch.

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