

# Today's Touch Technology

*~ Keyboard Nerds ~*

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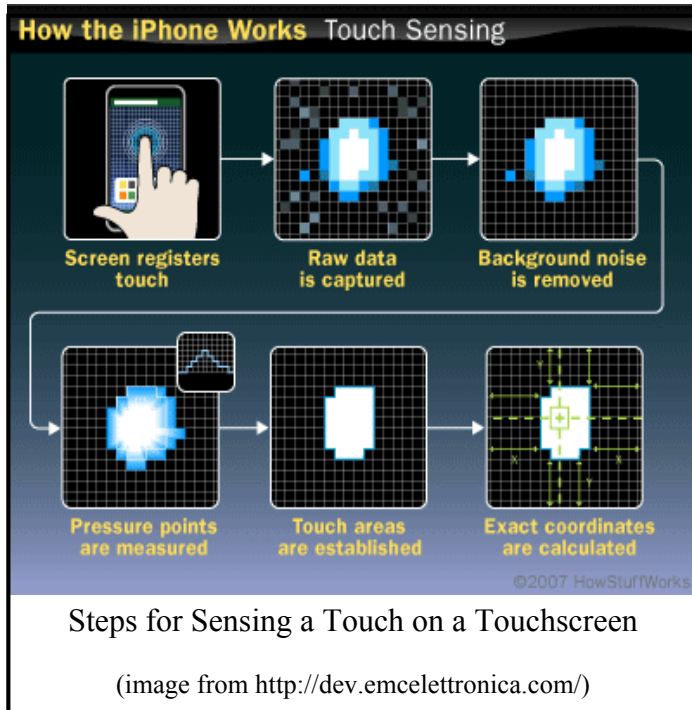
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Global shipments of touchscreens were said to more than double from 2008-2012, and the world-wide market for touchscreens amounted to a value of approximately \$3.4 billion in 2008 (“Touch-Screen Shipments Expected to Reach 833 Million by 2013”). This shows that touchscreens are already efficient and common in everyday life, which will continue to increase with time. It is first important to know how touchscreens have developed throughout history. Today, the parts of a touch screen have improved from those of their predecessors. In addition to their development, touchscreens have branched into various types, including resistive, capacitive, surface acoustic, and multi-touch. However, even with these advancements, there are still improvements to be made. As touchscreens develop, they become more common and efficient in everyday life.

Touchscreens have been part of the newest and trendiest hardware, for over 40 years. The first touch sensor was developed by Doctor Sam Hurst in 1971, and was called the “Elograph” (Sharrieff). Then, the first true touchscreens were produced. They used a transparent surface. The transparent surface was a real breakthrough because it allowed input devices to be integrated with a visual output device, such as a computer screen (Bellis). The first touchscreens using stylists were PDAs (Personal Digital Assistants), like the Apple Newton Message Pad, the first personal and mobile touch screen using a stylist. Multi-touch technology then began in 1982, after that it was further developed through 1984 (Zeldes). Since the 1970s touch technology has come a long way.

Touchscreens are efficient in everyday life, especially considering they are now in many devices, from high-tech government property to everyday items such as MP3 players and computers. But if they are everyday objects, why do people not know how they work? A touch screen has five to seven layers, depending on what type it is and what you are looking at. Most

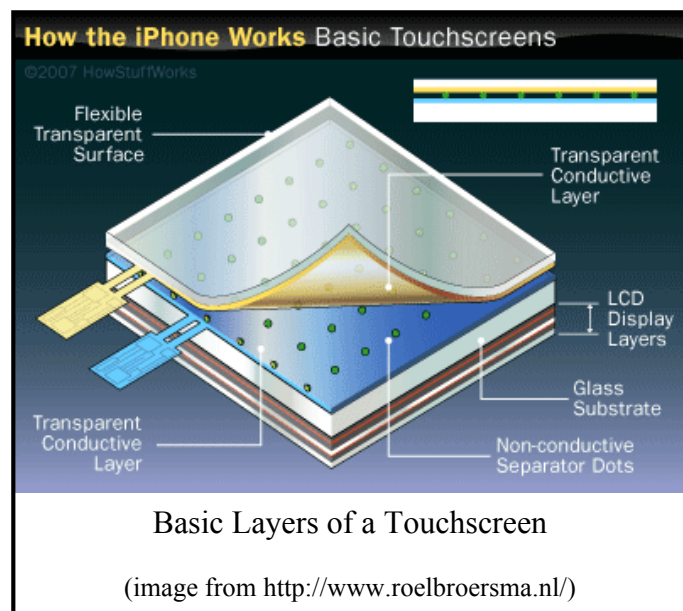
touchscreens are now multi-touch, and be used with a stylus or just the touch of a finger, although Apple's mutual capacitance iPhone device cannot be used with a stylus. The types of touchscreens do not differ by any enormous standard, in most cases, even though some devices



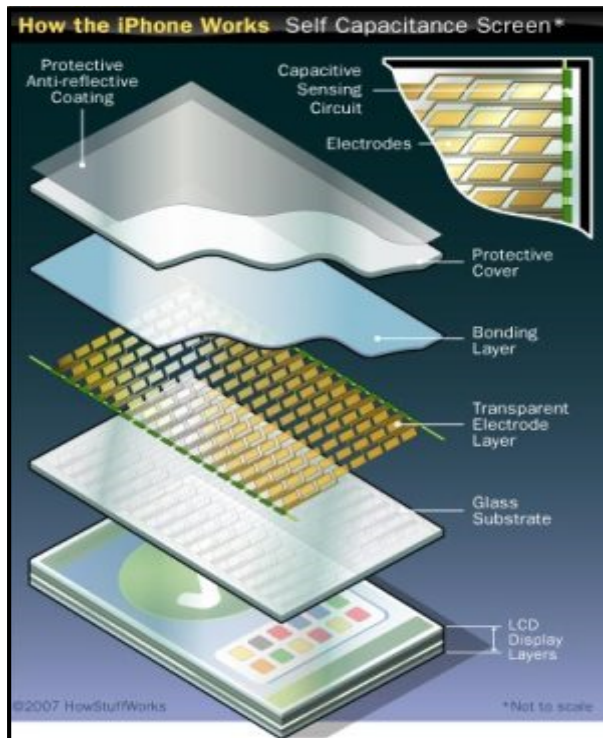
have different layers or a different amount of layers (“Touch Screen | Your Electronics Open Source”). A simple poke or tap will be considered raw data until the signals travel from the screen to the processor as electrical impulses. The processor uses software to analyze the data and determine the features of each touch. This includes size, shape and location of the affected area on the screen. If necessary, the processor

arranges touches with similar features into groups. If you move your finger, the processor calculates the difference between the starting point and ending point of your touch.

The processor then uses its gesture-interpretation software to determine which gesture you made. It combines your physical movement with information about which application you were using and what the application was doing when you touched the screen. The processor of

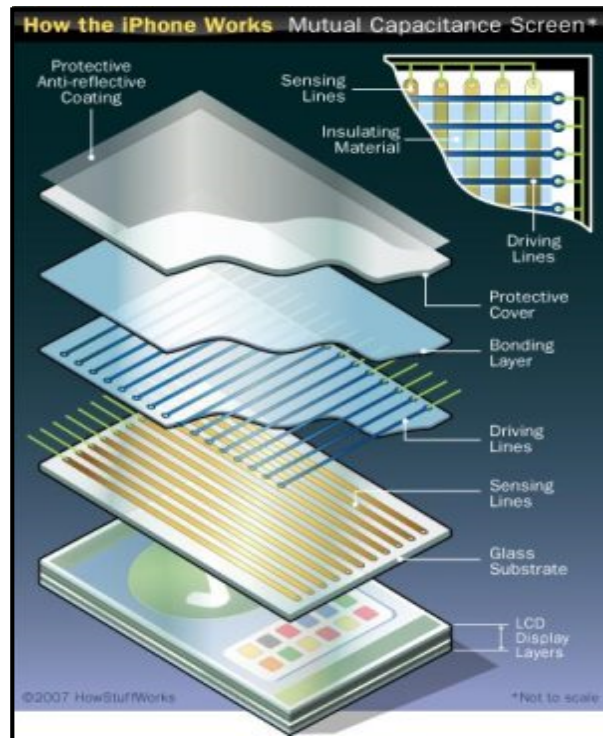


the device then relays your instructions (touch/movement of your finger) to the program you are using. It will also send instructions to the screen and other hardware, like speakers, if needed ("Touch Screen | Your Electronics Open Source"). If the raw data does not match any applicable gestures or commands, it is usually disregarded as superfluous and nothing will happen (Broersma). Apple's iPhone and other devices, some of the most used and common touchscreens, have about seven layers. The outermost layer is the protective cover, which obviously is basic armor, bonding layer, followed by the driving lines or transparent electrode layer-- mutual capacitance and self capacitance, respectively. Then come the sensing lines, which do most of the tracking, glass substrate, and an LCD display layer ("Touch Screen | Your Electronics Open Source"). Despite all of the complicated layers, functions, and even looks, to most they are fairly simple-- touch this, tap that, and you can make birds fly through the air or do homework. But, it never really hurts to understand something seemingly simple.



Layers of a Self Capacitance Screen

(image from <http://dev.emcelettronica.com/>)



Layers of a Mutual Capacitance Screen

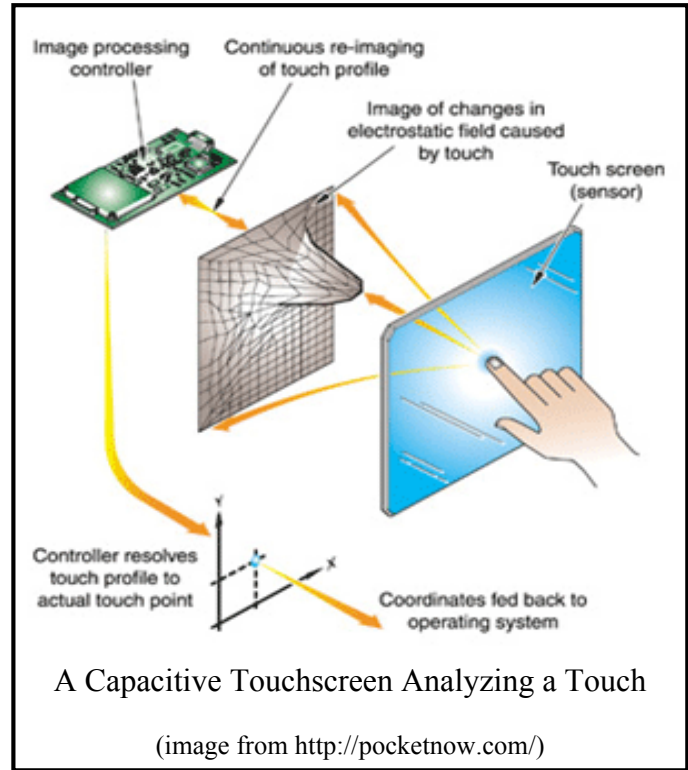
(image from <http://dev.emcelettronica.com/>)

In fact, there are many different types of touchscreens. The most common type is resistive touchscreens! The resistive touchscreen consists of a touch layer on top of a standard display, and when pressing on the display, it touches the two layers together, creating an electrical contact that can be sensed and located on the surface. The touch layer typically includes two clear electrical layers that are separated by a tiny distance (“Resistive Touch Screen.” [phonescoop.com](http://phonescoop.com)). Because the touchscreen senses input from contact with nearly any object, including a finger, stylus/pen, palm, the resistive touchscreens are classified as a type of “passive” technology (“Resistive Touchscreen.” [dictionary.sensagent.com](http://dictionary.sensagent.com)). Due to the resistive touchscreen’s design, the user cannot press their hand on the screen when handwriting with a stylus. Handwriting might be a little more difficult to some users than with less sensitive touchscreens (Kobeszko). The only concern is that the resistive layer can be damaged by a very sharp object (Downs). Also, resistant technology includes only 75% optical transparency (“Resistive Touch Screen Technology.” [tvielectronics.com](http://tvielectronics.com)). Resistive touchscreens are pressure-sensitive electronic visual displays that, when touched within the display area, will detect the exact location of the touch (Kobeszko). Resistive touchscreens, have made using technology easier. Instead of having to use a mouse or keyboard, the user can just easily touch the screen of his/her computer!

Besides a resistive touch screen, one of the many types of touchscreens is the capacitive touchscreen. The capacitive touchscreen consists of a glass screen with a metallic coating and a capacitive layer that holds the electrical charge (“How the iPhone Works”). It uses properties of the human finger, so the owner can’t use styluses or gloves (Orly). Many sources say they have great clarity, fast and light touch, and are scratch resistant; meaning sharp objects won’t damage the screen. The capacitive touchscreen is also waterproof, so it can be used in damp

environments. It can also be stored and the dust won't ruin it. A user can use this touch screen whether the screen is contaminated or dirty with food or sticky materials ("Surface Capacitive Touch Screens").

Also, a user won't accidentally bump a button with another object because again, this uses the finger's electrical charge. A few examples of capacitive touchscreens are the iPhone and T-Mobile G-1. ATMs also have capacitive touchscreens (Orly).



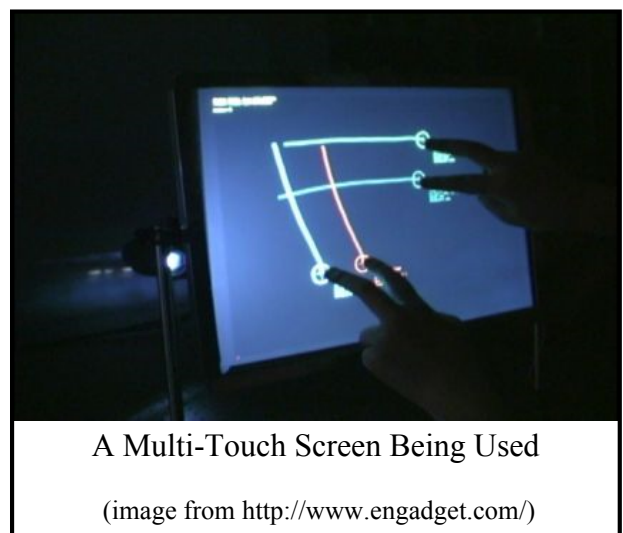
Capacitive touchscreens are more of an investment because they are more expensive than other touchscreens, but if a buyer is clumsy, careless, or has children, then a capacitive touchscreen would be one of the best choices.



Another type of touchscreen is the surface acoustic wave (S.A.W). The surface acoustic wave is made of reflector glass and is one of the most advanced types of touchscreens. It is based on two transducers, transmitting and receiving, that are placed on the X-axis and Y-axis on the touch panel. Here is how it works: the controller sends electrical signals to the transmitting transducer which converts the signals into ultra-sonic waves

and emits the signal to reflectors lined up along the edge of the panel. The reflectors then refract the waves to the receiving transducers, which converts the waves into electrical signals and sends them back to the controller. This is called a touch event. When a finger touches the screen, the waves are absorbed causing a touch event to be conducted at that point. The S.A.W. touchscreen is made of an all glass panel so that the panel cannot be worn down, giving it the highest durability factor and the highest clarity. In order to react, the S.A.W. has to be touched by a finger, gloved hand, or a soft tipped stylus; a pen will not work on the screen. A problem with the surface acoustic wave touchscreen is that it is not completely sealed so it can be affected by large amounts of dirt, dust, and water. Surface acoustic wave touchscreen technology is recommended for ATMs, amusement parks, banking and financial applications, public information kiosks, computer based training, and other high traffic indoor environments.

Multi-touch sensing enables a user to interact with a system using more than one finger simultaneously. Multi-touch screens are becoming common in phones, iPods, and iPads. But, work on multi-touch systems had been going on since 1984 (“Buxton”). Almost all of the more recent touch screen systems include multi-touch, which allows users to easily resize things and move multiple things around on the screen, as shown in the picture below (“Han.” cs.nyu.edu).



Muti-touch screens can also be used to allow several users to work at once. Rearranging blueprints or editing photos is difficult to accomplish if users take turns at a keyboard, screen, and a computer mouse. Touchscreens have come a long way since the first “touch sensors” that required a stylus to the latest multi-user multi-point touchscreens. Each new development has increased the speed and flexibility of the touch screen as an input device.

Even though there are a lot of happy consumers, there are a few that are upset with how touchscreens have problems. When some unfortunate people turn on their touchscreens, they get a “restore error” message flashing across the screen, and they cannot get it to go away.

Touchscreens are bad news for some people around the world whose touchscreens are not cooperating with them. If a touch screen user happens to be a klutz and drop their touch screen, it might crack and freeze for eternity. If it does, then it is very unlikely that he/she will be able to have it repaired. Plus, there is a chance that it will never work again. For most handheld touchscreens, you have got to have wifi to be able to play certain games or activities. Even if one is in a wifi hotspot, one will not be able to do certain things like surf the Internet on troubled devices. Touchscreens also die unexpectedly. If one gets an “unexpected error message,” then one has no choice but to go and get another touch screen (Calouro). Consider this: maybe someone could go out and invent something that does not crash as often and does not have as many errors that occur. Some might get lucky, but one time or another, everyone will experience something along the lines of what has been mentioned.

Many of the errors that touchscreens have encountered have not been fixed. People are getting really frustrated about how touchscreens keep encountering errors. Most of the time, handheld touchscreens have the problems, but occasionally some of the bigger ones have problems, too. Manufacturers are hard at work trying to fix all of the glitches with their

touchscreens. Upgrading, re-marketing, selling, fixing, failure, and frustration are the things that are coming out of their work shops (Calouro). Hopefully soon, inventors will come up with something that is error-free and works as perfectly as you can get. Meanwhile, people will have to live with touchscreens having errors and can only wait until the time in the future when they will not have to live with broken things.

The abundance of touch screen technology in the world today is a testimony to how valuable it is. Though they have come from a simple beginning, touchscreens have come a long way. The variety of touchscreens allow them to be used in many different applications. Though touchscreens may have imperfections, their possibilities far outweigh this. Systematic, clever, interesting, and elegant --- all these and more can describe touchscreens.

Works Cited

- Bellis. "Touch Screen" [inventors.about.com](http://inventors.about.com). (n.d.). 12 Feb. 2011  
<<http://inventors.about.com/library/inventors/bltouch.htm?>>.
- Broersma, Roel. "Touch Screen Seems Broken or Misaligned?". [Roel Broersma](http://www.roelbroersma.nl).  
13 Sept. 2009. Web. 14 Jan. 2011  
<<http://www.roelbroersma.nl/index.php/2009/09/13/touch-screen-seems-broken-or-misaligned>>.
- Calouro, Eric. "Apple iPod Touch 4G Promotional Image Photoshop Errors." [Erictric Media](http://erictric.com).  
5 Sep. 2010. 5 Feb. 2011 <<http://erictric.com/2010/09/05/apple-ipod-touch-4g-promotional-image-photoshop-errors/>>.
- Downs, Rick. "Using resistive touch screens for human/machine interface." [focus.ti.com](http://focus.ti.com).  
Texas Instruments Incorporated. (n.d.). Web. 17 Dec. 2010  
<<http://focus.ti.com/lit/an/slyt209a/slyt209a>>.
- "How the iPhone Works." [electronics.howstuffworks.com](http://electronics.howstuffworks.com). 2011. 12 Feb. 2011  
<<http://electronics.howstuffworks.com/iphone1.htm>>.
- Kobeszko, Andrea. "What is Resistive Touchscreen." [ehow.com](http://www.ehow.com). ehow, Inc. (n.d.). Web.  
3 Sept. 2010. <[http://www.ehow.com/facts\\_6899374\\_resistive-touchscreen\\_.html](http://www.ehow.com/facts_6899374_resistive-touchscreen_.html)>.
- Orly, Micheal F., Jr. "Definition of 'capacitive touchscreen'." [MobileBurn.com](http://www.mobileburn.com). 2009.  
8 Jan. 2011 <[www.mobileburn.com/definition.jsp?term=capacitive+touchscreen](http://www.mobileburn.com/definition.jsp?term=capacitive+touchscreen)>.
- "Resistive Touchscreen." [dictionary.sensagent.com](http://dictionary.sensagent.com). Memodata Corporation. (n.d.). Web.  
7 Jan. 2011 <<http://dictionary.sensagent.com/resistive+touchscreen/en-en/>>.
- "Resistive Touch Screen." [phonescoop.com](http://phonescoop.com). Phone Factor, LLC. (n.d.). Web. 2011.  
13 Dec. 2010 <<http://www.phonescoop.com/glossary/term.php?gid=459>>.

“Resistive Touch Screen Technology.” [tvielectronics.com](http://www.tvielectronics.com). TVI Electronics, LLC. (n.d.).

Web. 16 Dec. 2010 <[http://www.tvielectronics.com/Touch\\_Screen.html](http://www.tvielectronics.com/Touch_Screen.html)>.

Sharrieff. “Touch Screen History.” [ehow.com](http://www.ehow.com), (n.d.) . 13 Feb. 2011

<[http://www.ehow.com/about\\_5535302\\_touch-screen-history.html](http://www.ehow.com/about_5535302_touch-screen-history.html)>.

“Surface Acoustic Wave (SAW) Technology.” [TVI Electronics Easy Solutions](http://www.tvielectronics.com/easy_solutions). 16 Dec. 2010.

21 Dec. 2010 <[Tvielectronics.com/touch\\_screen.html](http://www.tvielectronics.com/touch_screen.html)>.

“Surface Capacitive Touch Screens.” [ezscreen.com](http://www.ezscreen.com). 2011. 8 Jan. 2011

<[http://www.ezscreen.com/capacitive\\_touch\\_screens.html](http://www.ezscreen.com/capacitive_touch_screens.html)>.

“Touch-Screen Shipments Expected to Reach 833 Million by 2013.” [cellular-news](http://www.cellular-news.com). 20

2008. 26 Feb. 2011 <<http://www.cellular-news.com/story/31257.php>>.

"Touch Screen | Your Electronics Open Source." [Your Electronics Open Source](http://www.yourelectronicsopen.com). 17 June 2008.

Web. 14 Jan 2011 <<http://dev.emcelettronica.com/touch-screen>>.

Zeldes. “History of Computing.” [nzeldes.com](http://www.nzeldes.com) (n.d.). 18 Feb. 2011

<<http://www.nzeldes.com/HOC/Newton.htm>>.