TOUCH SCREEN TECHNOLOGY

OVERVIEW:

First computers became more visual, then they took a step further to understand vocal commands and now they have gone a step further and became 'TOUCHY', that is skin to screen.

A touchscreen is an easy to use input device that allows users to control PC software and DVD video by touching the display screen. A touch system consists of a touch Sensor that receives the touch input, a Controller, and a Driver.

The most commonly used touch technologies are the Capacitive & Resistive systems. The other technologies used in this field are Infrared technology, Near Field Imaging & SAW (surface acoustic wave technology). These technologies are latest in this field but are very much expensive.

The uses of touch systems as Graphical User Interface (GUI) devices for computers continues to grow popularity. Touch systems are used for many applications such as ATM's, point-of–sale systems, industrial controls, casinos & public kiosks etc. Touch system is basically an alternative for a mouse or keyboard.

The market for touch system is going to be around $2.5 billion by 2004. Various companies involved in development of touch systems mainly are Philips, Samsung apple, etc. Even touch screen mobile phones have been developed by Philips.

INTRODUCTION:

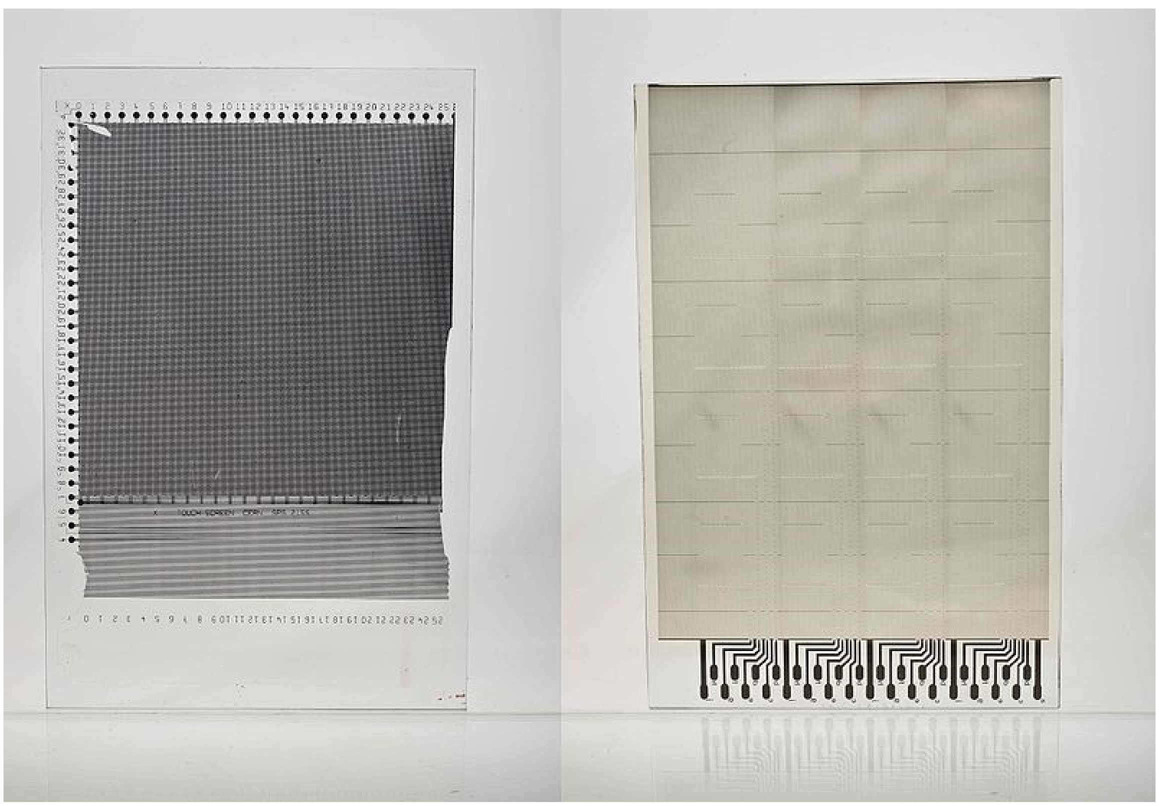
A **touchscreen** is an electronic visual display that can detect the presence and location of a touch within the display area. The term generally refers to touching the display of the device with a finger or hand. Touch screens can also sense other passive objects, such as a stylus.

The touchscreen has two main attributes. First, it enables one to interact directly with what is displayed, rather than indirectly with a cursor controlled by a mouse or touchpad. Secondly, it lets one do so without requiring any intermediate device that would need to be held in the hand. Such displays can be attached to computers, or to networks as terminals. They also play a prominent role in the design of digital appliances such as the personal digital assistant (PDA), satellite navigation devices, mobile phones, and video games.

As the touch sensor resides between the user and the display while receiving frequent physical input from the user vacuum deposited transparent conductors serve as primary sensing element.

Vacuum coated layers can account for a significant fraction of touch system cost. Cost & application parameters are chief criteria for determining the appropriate type determining the system selection. Primarily, the touch system integrator must determine with what implement the user will touch the sensor with & what price the application will support.

Applications requiring activation by a gloved finger or arbitrary stylus such as a plastic pen will specify either a low cost resistive based sensor or a higher cost infra-red (IR) or surface acoustic wave (SAW) system. Applications anticipating bare finger input or amenable to a tethered pen comprises of the durable & fast capacitive touch systems. A higher price tag generally leads to increased durability better optical performance & larger price.



HISTORY

In 1971, the first "Touch Sensor" was developed by Doctor Sam Hurst (founder of Elographics) while he was an instructor at the University of Kentucky. This sensor, called the "Elograph," was patented by The University of Kentucky Research Foundation. The "Elograph" was not transparent like modern touch screens; however, it was a significant milestone in touch screen technology.

In 1974, the first true touch screen incorporating a transparent surface was developed by Sam Hurst and Elographics. In 1977, Elographics developed and patented five-wire resistive technology, the most popular touchscreen technology in use today.

Touchscreens first gained some visibility with the invention of the computer-assisted learning terminal, which came out in 1975 as part of the PLATO project. Touchscreens have subsequently become familiar in everyday life.

Companies use touch screens for kiosk systems in retail and tourist settings, point of sale systems, ATMs, and PDAs, where a stylus is sometimes used to manipulate the GUI and to enter data. The popularity of smart phones, PDAs, portable game consoles and many types of information appliances is driving the demand for, and acceptance of, touchscreens.

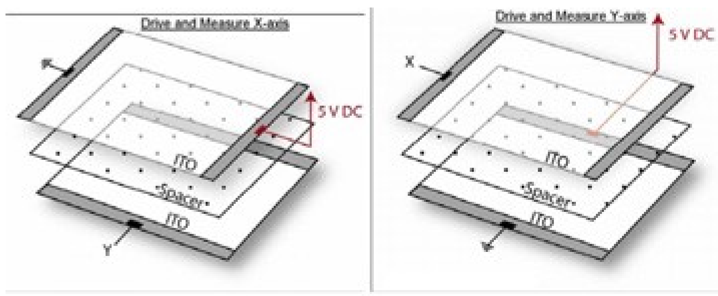
From 1979–1985, the Fairlight CMI (and Fairlight CMI IIx) was a high-end musical sampling and re-synthesis workstation that utilized light pen technology, with which the user could allocate and manipulate sample and synthesis data, as well as access different menus within its OS by touching the screen with the light pen. The later Fairlight series III models used a graphics tablet in place of the light pen.

The HP-150 from 1983 was one of the world's earliest commercial touchscreen computer. It did not have a touchscreen in the strict sense; instead, it had a 9" Sony Cathode Ray Tube (CRT) surrounded by infrared transmitters and receivers, which detected the position of any non-transparent object on the screen.

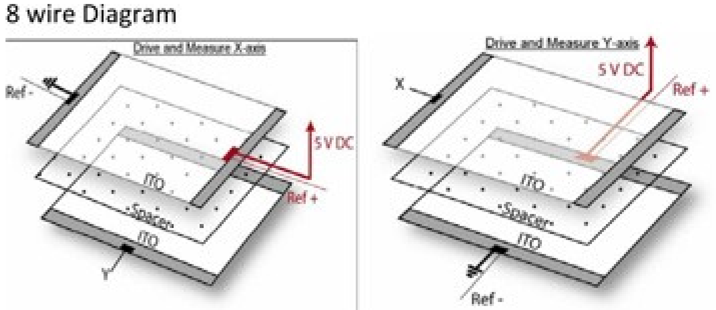
Until recently, most consumer touchscreens could only sense one point of contact at a time, and few have had the capability to sense how hard one is touching. This is starting to change with the commercialization of multi-touch technology.

Touchscreens are popular in hospitality, and in heavy industry, as well as kiosks such as museum displays or room automation, where keyboard and mouse systems do not allow a suitably intuitive, rapid, or accurate interaction by the user with the display's content.

Historically, the touchscreen sensor and its accompanying controller-based firmware have been made available by a wide array of after-market system integrators, and not by display, chip, or motherboard manufacturers. Display manufacturers and chip manufacturers worldwide have acknowledged the trend toward acceptance of touchscreens as a highly desirable user interface component and have begun to integrate touchscreen functionality into the fundamental design of their products.



8 wire Diagram

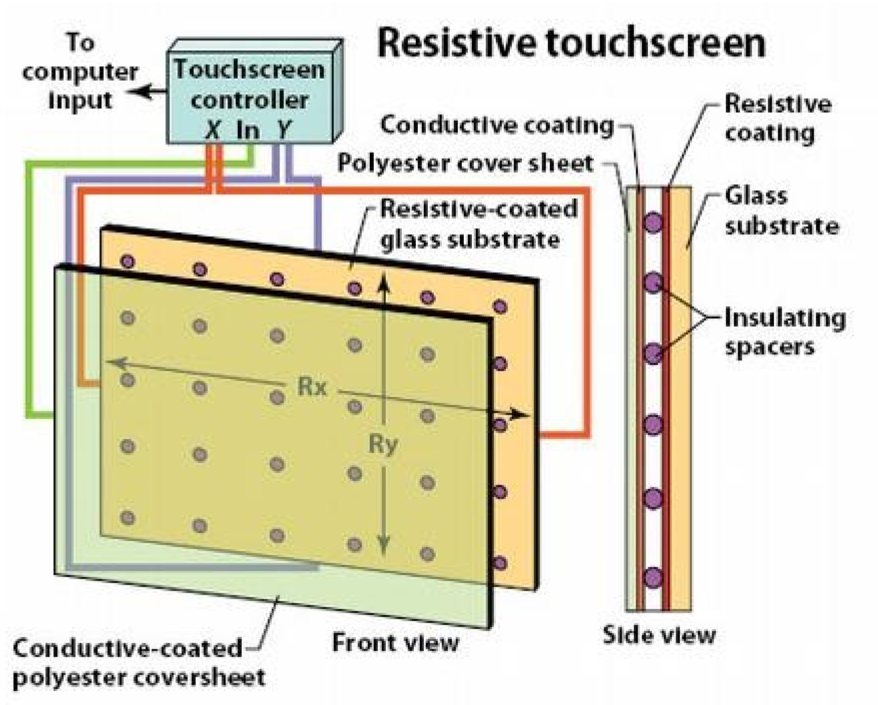


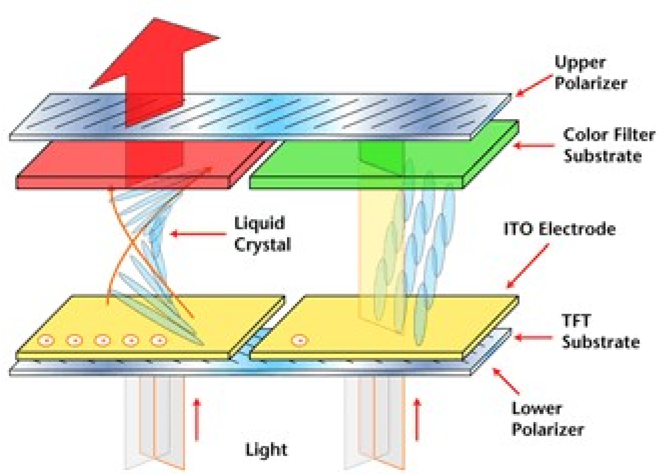
TYPES OF TOUCH SCREENS

Resistive:

Main article: Resistive touchscreen

A resistive touchscreen panel is composed of several layers, the most important of which are two thin, electrically conductive layers separated by a narrow gap. When an object, such as a finger, presses down on a point on the panel's outer surface the two metallic layers become connected at that point: the panel then behaves as a pair of voltage dividers with connected outputs. This causes a change in the electrical current, which is registered as a touch event and sent to the controller for processing.



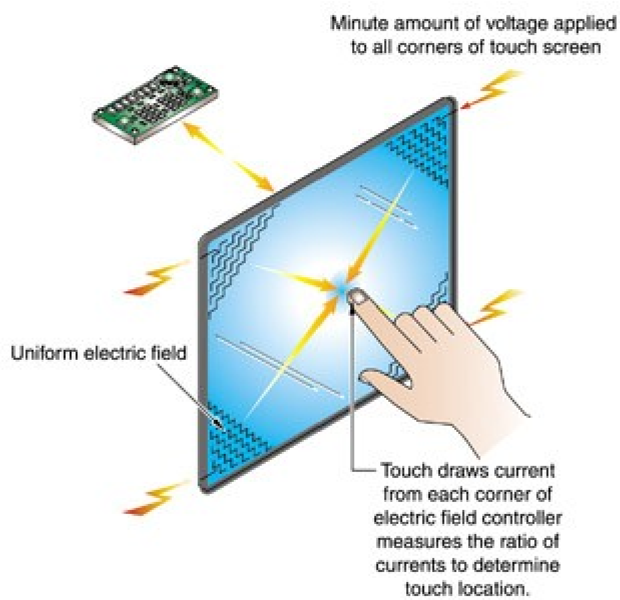


Surface acoustic wave:

Main article: Surface acoustic wave

Surface acoustic wave (SAW) technology uses ultrasonic waves that pass over the touchscreen panel. When the panel is touched, a portion of the wave is absorbed. This change in the ultrasonic waves registers the position of the touch event and sends this information to the controller for processing.

Surface wave touch screen panels can be damaged by outside elements. Contaminants on the surface can also interfere with the functionality of the touchscreen.

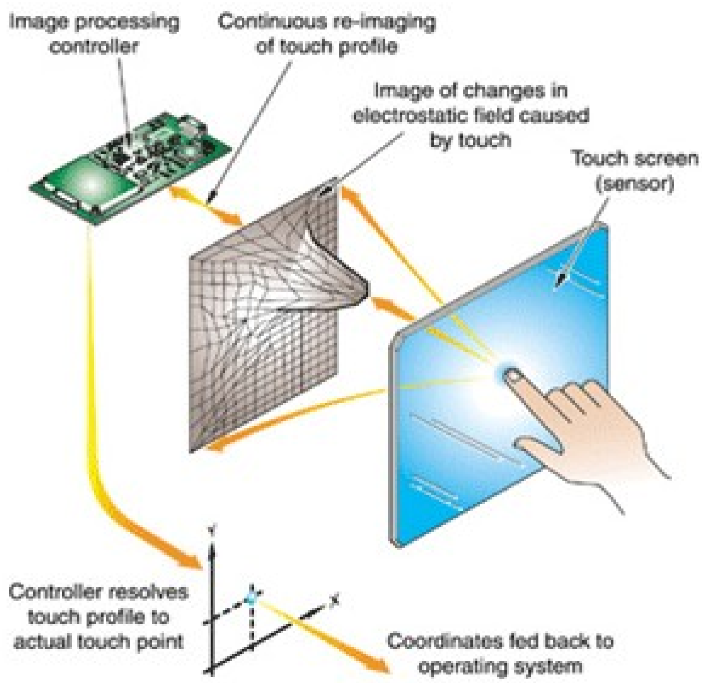


Surface acoustic wave (SAW) is an acoustic wave traveling along the surface of a material exhibiting elasticity, with an amplitude that typically decays exponentially with depth into the substrate.

Capacitive:

Capacitive touchscreen panel is one which consists of an insulator such as glass, coated with a transparent conductor such as indium tin oxide As the human body is also a electrical conductor, touching the surface of the screen results in a distortion of the screen's electrostatic field, measurable as a change in capacitance.

Different technologies may be used to determine the location of the touch. The location is then sent to the controller for processing.



Surface capacitance:

In this basic technology, only one side of the insulator is coated with a conductive layer. A small voltage is applied to the layer, resulting in a uniform electrostatic field. When a conductor, such as a human finger, touches the uncoated surface, a capacitor is dynamically formed. The sensor's controller can determine the location of the touch indirectly from the change in the capacitance as measured from the four corners of the panel.

As it has no moving parts, it is moderately durable but has limited resolution, is prone to false signals from parasitic capacitive coupling, and needs calibration during manufacture. It is therefore most often used in simple applications such as industrial controls and kiosks.

Projected capacitance:

Projected Capacitive Touch (PCT) technology is a capacitive technology which permits more accurate and flexible operation, by etching the conductive layer. An X-Y grid is formed either by etching a single layer to form a grid pattern of electrodes, or by etching two separate, perpendicular layers of conductive material with parallel lines or tracks to form the grid (comparable to the pixel grid found in many LCD displays).

The greater resolution of PCT allows operation without direct contact, such that the conducting layers can be coated with further protective insulating layers, and operate even under screen protectors, or behind weather and vandal-proof glass. Due to the top layer of a PCT being glass, PCT is a more robust solution versus resistive touch technology.

Depending on the implementation, an active or passive stylus can be used instead of or in addition to a finger. This is common with point of sale devices that require signature capture. Gloved fingers may or may not be sensed, depending on the implementation and gain settings. Conductive smudges and similar interference on the panel surface can interfere with the performance. Such conductive smudges come mostly from sticky or sweaty finger tips, especially in high humidity environments.

Collected dust, which adheres to the screen due to the moisture from fingertips can also be a problem. There are two types of PCT: Self Capacitance and Mutual Capacitance.

Mutual capacitance:

In mutual capacitive sensors, there is a capacitor at every intersection of each row and each column. A 12-by-16 array, for example, would have 192 independent capacitors. A voltage is applied to the rows or columns. Bringing a finger or conductive stylus close to the surface of the sensor changes the local electrostatic field which reduces the mutual capacitance. The capacitance change at every individual point on the grid can be measured to accurately determine the touch location by measuring the voltage in the other axis. Mutual capacitance allows multi-touch operation where multiple fingers, palms or stylus can be accurately tracked at the same time.

Self-capacitance:

Self-capacitance sensors can have the same X-Y grid as mutual capacitance sensors, but the columns and rows operate independently. With self-capacitance, the capacitive load of a finger is measured on each column or row electrode by a current meter.

This method produces a stronger signal than mutual capacitance, but it is unable to resolve accurately more than one finger, which results in "ghosting", or misplaced location sensing.

Infrared:

An infrared touchscreen uses an array of X-Y infrared LED and photodetector pairs around the edges of the screen to detect a disruption in the pattern of LED beams. These LED beams cross each other in vertical and horizontal patterns. This helps the sensors pick up the exact location of the touch. A major benefit of such a system is that it can detect essentially any input including a finger, gloved finger, stylus or pen. It is generally used in outdoor applications and point of sale systems which can't rely on a conductor (such as a bare finger) to activate the touchscreen.

Unlike capacitive touchscreens, infrared touchscreens do not require any patterning on the glass which increases durability and optical clarity of the overall system.

Optical imaging:

This is a relatively modern development in touchscreen technology, in which two or more image sensors are placed around the edges (mostly the corners) of the screen. Infrared back lights are placed in the camera's field of view on the other side of the screen.

A touch shows up as a shadow and each pair of cameras can then be pinpointed to locate the touch or even measure the size of the touching object . This technology is growing in popularity, due to its scalability, versatility, and affordability, especially for larger units.

Dispersive signal technology:

Introduced in 2002 by 3M, this system uses sensors to detect the mechanical energy in the glass that occurs due to a touch. Complex algorithms then interpret this information and provide the actual location of the touch. The technology claims to be unaffected by dust and other outside elements, including scratches.

Since there is no need for additional elements on screen, it also claims to provide excellent optical clarity. Also, since mechanical vibrations are used to detect a touch event, any object can be used to generate these events, including fingers and stylus. A downside is that after the initial touch the system cannot detect a motionless finger.

Acoustic pulse recognition:

This system, introduced by Tyco International's Elo division in 2006, uses piezoelectric transducers located at various positions around the screen to turn the mechanical energy of a touch (vibration) into an electronic signal. The screen hardware then uses an algorithm to determine the location of the touch based on the transducer signals.

The touchscreen itself is made of ordinary glass, giving it good durability and optical clarity. It is usually able to function with scratches and dust on the screen.

CONSTRUCTION

There are several principal ways to build a touchscreen. The key goals are to recognize one or more fingers touching a display, to interpret the command that this represents, and to communicate the command to the appropriate application.

In the most popular techniques, the capacitive or resistive approach, there are typically four layers;

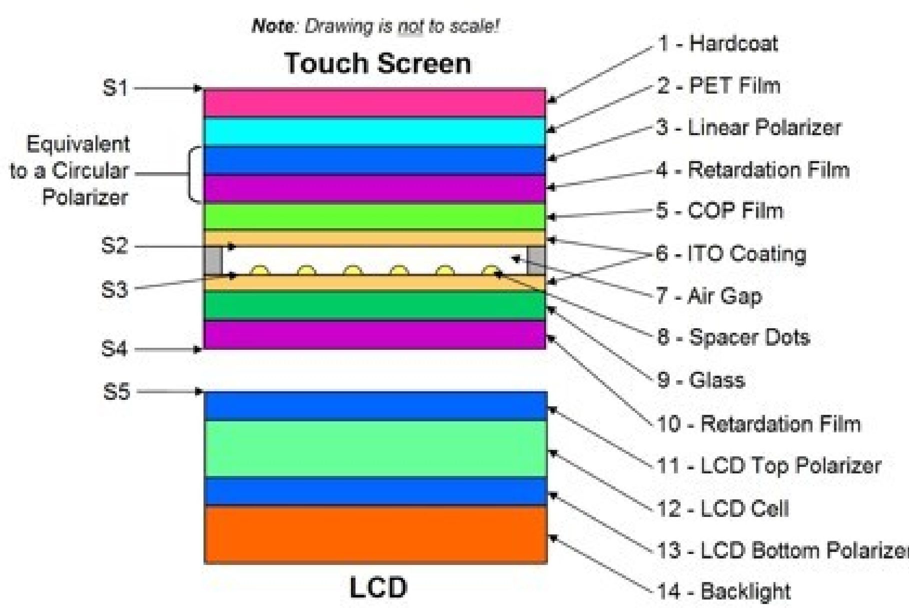
1. Top polyester layer coated with a transparent metallic conductive coating on the bottom
2. Adhesive spacer
3. Glass layer coated with a transparent metallic conductive coating on the top
4. Adhesive layer on the backside of the glass for mounting.

When a user touches the surface, the system records the change in the electrical current that flows through the display.

Dispersive-signal technology which 3M created in 2002, measures the piezoelectric effect — the voltage generated when mechanical force is applied to a material — that occurs chemically when a strengthened glass substrate is touched.

There are two infrared-based approaches. In one, an array of sensors detects a finger touching or almost touching the display, thereby interrupting light beams projected over the screen. In the other, bottom-mounted infrared cameras record screen touches.

In each case, the system determines the intended command based on the controls showing on the screen at the time and the location of the touch.



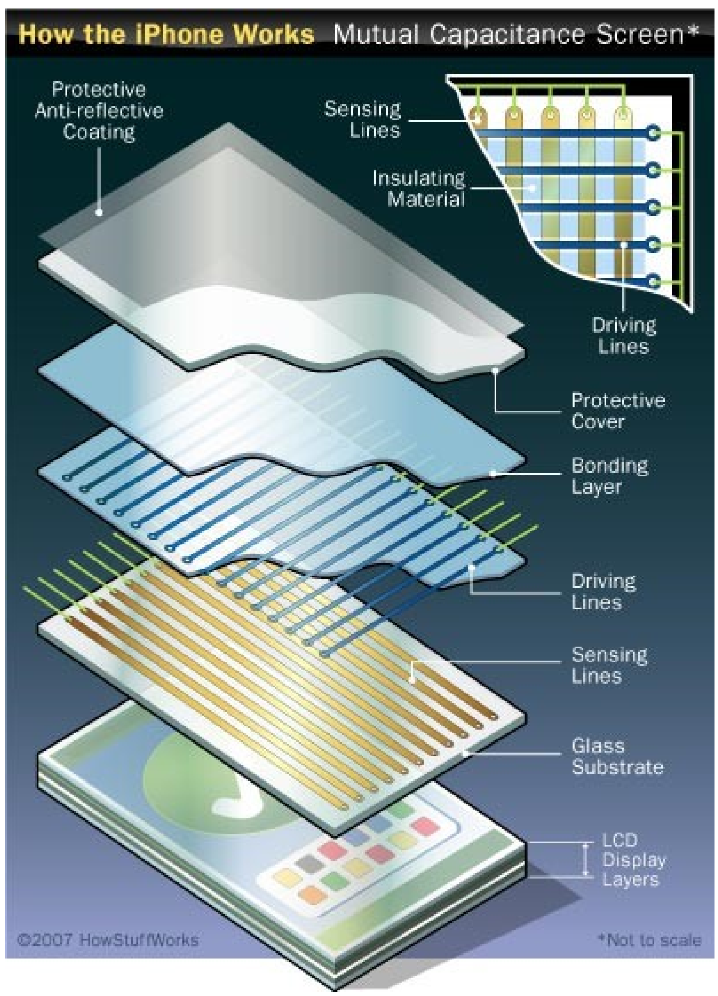
DEVOLOPMENT

Most touchscreen technology patents were filed during the 1970s and 1980s and have expired. Touchscreen component manufacturing and product design are no longer encumbered by royalties or legalities with regard to patents and the use of touchscreen-enabled displays is widespread.

With the growing use of touchscreens, the marginal cost of touchscreen technology is routinely absorbed into the products that incorporate it and is nearly eliminated. Touchscreens now have proven reliability.

Thus, touchscreen displays are found today in airplanes, automobiles, gaming consoles, machine control systems, appliances, and handheld display devices including the Nintendo DS and the later multi-touch enabled iPhones; the touchscreen market for mobile devices is projected to produce US$5 billion in 2009.

The ability to accurately point on the screen itself is also advancing with the emerging graphics tablet/screen hybrids.



USAGE

Finger stress:

An ergonomic problem of touchscreens is their stress on human fingers when used for more than a few minutes at a time, since significant pressure can be required for certain types of touchscreen. This can be alleviated for some users with the use of a pen or other device to add leverage and more accurate pointing.

The introduction of such items can sometimes be problematic, depending on the desired use (e.g., public kiosks such as ATMs). Also, fine motor control is better achieved with a stylus, because a finger is a rather broad and ambiguous point of contact with the screen itself.

Fingernail as stylus:

Pointed nail for easier typing. The concept of using a fingernail trimmed to form a point, to be specifically used as a stylus on a writing tablet for communication, appeared in the 1950 science fiction short story Scanners Live in Vain.

These ergonomic issues of direct touch can be bypassed by using a different technique, provided that the user's fingernails are either short or sufficiently long Rather than pressing with the soft skin of an outstretched fingertip, the finger is curled over, so that the tip of a fingernail can be used instead.

The thumb is optionally used to provide support for the finger or for a long fingernail, from underneath. This method does not work on capacitive touch screens.

The fingernail's hard, curved surface contacts the touchscreen at one very small point. Therefore, much less finger pressure is needed, much greater precision is possible (approaching that of a stylus, with a little experience), much less skin oil is smeared onto the screen, and the fingernail can be silently moved across the screen with very little resistance, allowing for selecting text, moving windows, or drawing lines.

The human fingernail consists of keratin which has a hardness and smoothness similar to the tip of a stylus (and so will not typically scratch a touchscreen). Alternately, very short stylus tips are available, which slip right onto the end of a finger; this increases visibility of the contact point with the screen.

Fingerprints:

Touchscreens can suffer from the problem of fingerprints on the display. This can be mitigated by the use of materials with optical coatings designed to reduce the visible effects of fingerprint oils, such as the oleophobic coating used in the iPhone 3G S, or by reducing skin contact by using a fingernail or stylus.

APPLICATIONS OF TOUCH SCREEN TECHNOLOGY

IPAD

The **iPad** is a tablet computer designed, developed and marketed by Apple primarily as a platform for audio-visual media including books, periodicals, movies, music, games, and web content.

At about 1.5 pounds (680 grams), its size and weight fall between those of contemporary smartphones and laptop computers. Apple released the iPad in April 2010, and sold 3 million of the devices in 80 days.

According to a report released by Strategy Analytics, the Apple iPad had gained a 95 percent share of Tablet PC sales at the end of second quarter 2010. During the second quarter 2010, Apple had sold 4.19 million iPads around the world.

Like iPhone and iPod Touch, the iPad is controlled by a multitouch display—a departure from most previous tablet computers, which used a pressure-triggered stylus—as well as a virtual onscreen keyboard in lieu of a physical keyboard. The iPad uses a Wi-Fi data connection to browse the Internet, load and stream media, and install software.

iPAD TOUCH SCREEN:

The iPad's touchscreen display is a 9.7 in (25 cm) liquid crystal display (1024 × 768 pixels) with fingerprint-resistant and scratch-resistant glass. Steve Jobs backed the choice of screen size, saying a 7-inch screen would be "too small to express the software." He said 10 inches was the minimum for a tablet screen.

Like the iPhone, the iPad is designed to be controlled by bare fingers; normal gloves and styli that prevent electrical conductivity may not be used, although there are special gloves and capacitive styli designed for this use.

The display responds to two other sensors: an ambient light sensor to adjust screen brightness and a 3-axis accelerometer to sense iPad orientation and switch between portrait and landscape modes.

Unlike the iPhone and iPod touch built-in applications, which work in three orientations (portrait, landscape-left and landscape-right), the iPad built-in applications support screen rotation in all four orientations (the three aforementioned ones along with upside-down), meaning that the device has no intrinsic "native" orientation; only the relative position of the home button changes.

OTHER APPLICATIONS:

PUBLIC INFO DISPLAYS:

1. Tourism displays
2. Trade show display

CUSTOMER SERVICES:

1. ATM
2. Restaurants
3. Airline ticket terminals
4. Departmental stores

OTHER USES:

1. Jukeboxes.
2. Computerized gaming
3. Registrations.