WHITE PAPER

visualization re-envisioned

What's New In Multi Touch Technology?

By: D. Walker, Systems Engineer
American Industrial Systems, Inc. | www.aispro.com

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Abstract:

Technology is touching more people's lives every day. Multi touch-enabled devices and equipment can sense touch inputs in more than one location simultaneously, and they are having a profound impact in industrial settings. Nearly everyone is beginning to interact frequently with multi-touch technology, including end-users, panel operators, engineers, managers, purchasers, executives and other decision-makers.

Multi touch technology can make workers more productive and facilities more profitable, because users can simply do so many things with just their fingers than was previously possible.

Executive Summary:

By offering a more complete picture of how modern multi-touch technology is impacting business, we can better understand the environmental, ergonomic, economic and workflow enhancements that are resulting from innovations in this technology.

This paper will focus specifically on new and existing users of equipment in the fields of building automation and HVAC, medical & healthcare, interactive and self-service kiosks. We'll evaluate the most current technologies, features and benefits of multi-touch technology.

In conclusion, readers should have gained a firm grasp on if and how to integrate touch technologies into their businesses.

1.

What Is Multi Touch?

Unlike single touch input – where users can select a single point, drag and drop, push and slide with only a single finger or stylus – multi touch technologies enable devices to recognize and respond to touch inputs at multiple locations simultaneously.

Figure 1 shows what happens in a multi touch monitor: the screen utilizes a grid for locating the inputs at multiple locations, and the device senses whole groupings rather than just one point of intersection, which yields high accuracy.

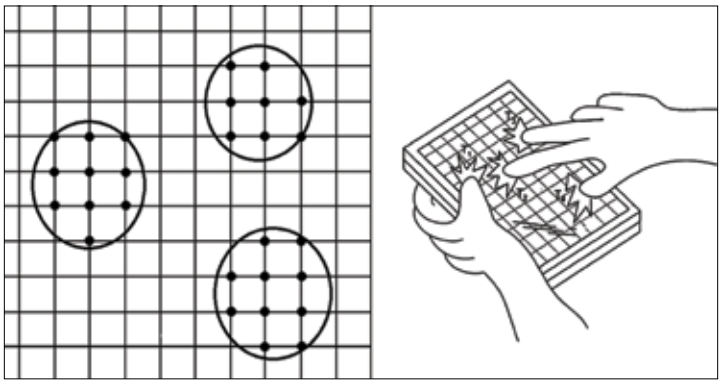


Figure 1. Multi touch

The Benefits Of Multi Touch Over Single Touch

Quite simply, multi touch input expands the range of functionality these devices can support. Two fingers (or activation points) allow users, for example, to zoom in/out or rescale the display, with the right software. The power of this enhanced functionality becomes immediately apparent when we look at industrial applications. Consider Figure 2, at right.

Figure 2. Industrial 2-Hand Lock Out/Activation

In an industrial environment, requiring two activation points – that is, both of the user's hands on the screen – can be used before beginning a process to enhance safety. Three and more activation points are also possible by including "gestures," and here custom software affords the ability to be creative while minimizing or eliminating any learning curve.

For example, secure keyless entry to a room can be implemented with a "secret handshake" via touch display. Different security paradigms can be combined to implement a high level of security, e.g., unique gestures on the touch screen display serve as the new password while the meeting schedule further secures the entry.

Another great example is building automation: imagine your building is big enough that when the floor plan fills a display, details are rendered too small to see. At this level, all you can do is get an overview, which is enough for new visitors trying to find their way around but proves insufficient for others needs.

Consider a user who wants to find an electrical outlet for his or her iPhone: the user must zoom in and out repeatedly in order to examine each likely location. Multi touch gestures greatly simplify an otherwise manual zooming process. That's not the only reason to zoom: in key locations, the display may contain important indicator information, like temperature, moisture, safety indicators, pressure volume, etc. Multi touch literally puts all this information at the user's fingertips.

Similarly, if a user needed to read a manual, multi touch makes two-finger scrolling, pinching, spreading and rotating all available and with no learning curve.

2.

What Is Capacitive Touch Technology?

Capacitance-Based Sensors

A capacitive touchscreen panel (as in Pro-Cap multi touch) consists of an insulator such as glass, which is coated with a transparent conductor, like ITO (indium tin oxide). The user's finger conducts electricity, so touching the surface of the screen results in a distortion of the screen's electrostatic field; that distortion is measurable as a change in capacitance.

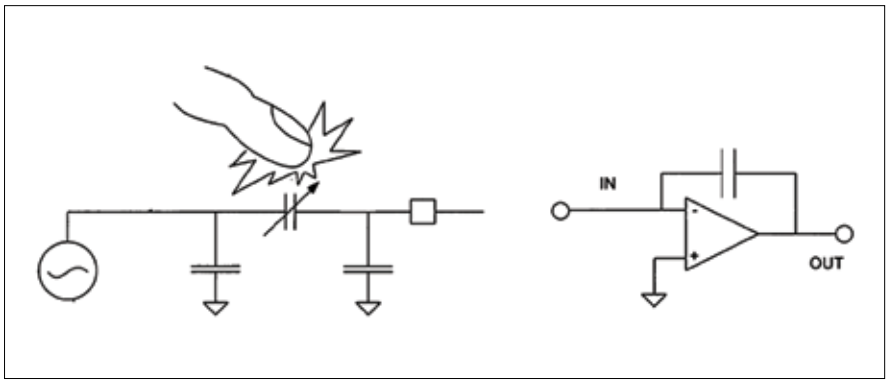


Figure 3. Input power, capacitive sensing and signal amplification[ii]

In other words, a capacitance-based sensor is a circuit designed to sense touch by coupling with the electrical fields; touch causes the capacitance of the circuit to change (Figure 3).

Different technologies may be used to determine the location of the touch; the location is then sent to the controller for processing. The way Apple describes it, the process is fairly straightforward:

1. Read output from sensing points, producing and analyzing the touch data
2. Then compare the current data to past data and perform actions based on the comparison
3. Additionally, receive and filter the raw data, generate gradient data, calculate boundaries and coordinates for each touch region, performing multipoint tracking.[iii]

Unlike a resistive touchscreen, capacitive touch displays require the direct contact of the finger, capacitive stylus, or special-application glove. However, despite this limitation, the benefits of capacitance-based sensors are numerous, including a long lifetime due to the lack of physical contact with the actual sensors.

A projected capacitive circuit is a specially designed sensor that's so sensitive it can sense through glass up to 6mm thick.

Older Touch Input Technologies

Capacitive touch input is only one technology among many. Additionally, many devices use SAW, infrared and analog resistive technologies. These forms of touch input are discussed in the Appendix and are all available from AIS.

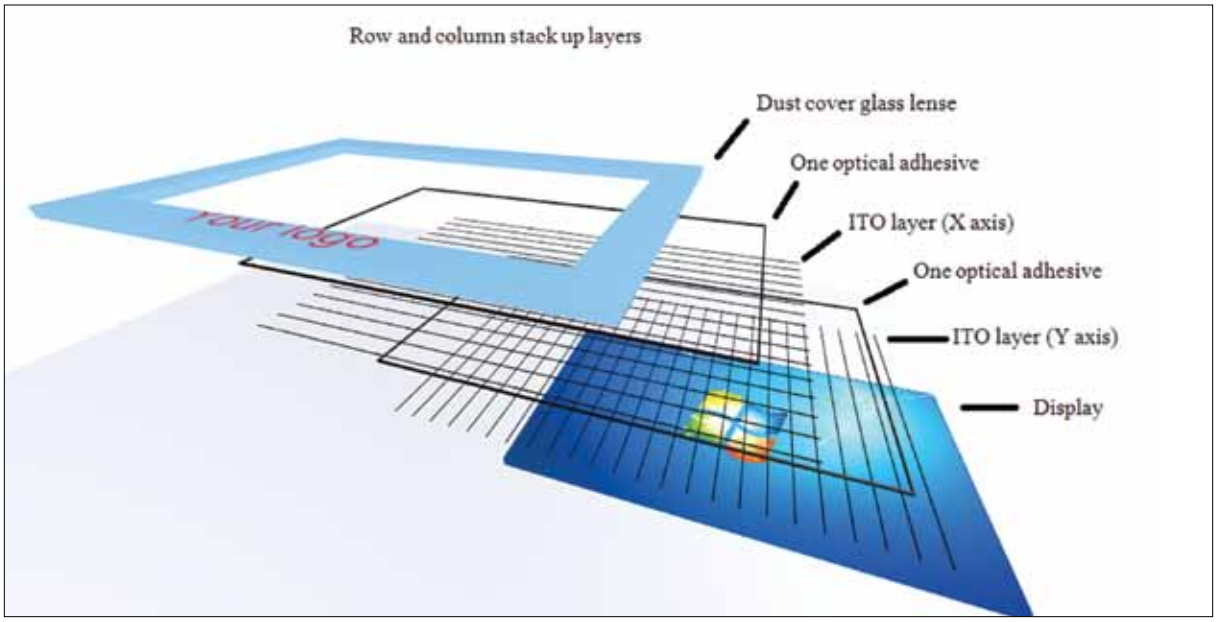


Figure 4. Dust cover glass lenses. Options: 6mm with vandal proof glass.

3. Touchscreen Construction

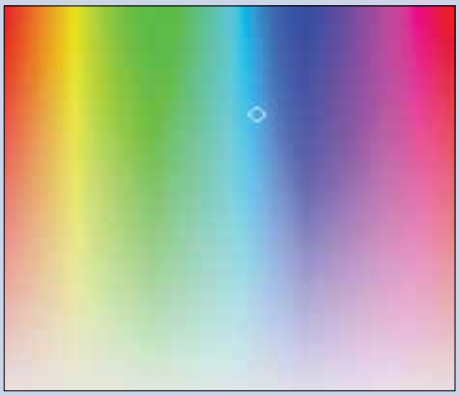
A capacitive touchscreen sensor consists of a large array of indium tin oxide (ITO) conductors on one or more layers of glass or polyethylene terephthalate (PET) plastic. The good optical clarity and low resistivity of ITO make it the overwhelming choice for this very sensitive circuit (see Figure 4).

Customized Touch Screens from AIS.
Color printing on touch screens? Yes!

You are no longer limited to black-and-white printing on glass: here at AIS, we can take your custom orders for Projected Capacitive Multi Touch Displays, with color and logos printed right on the glass.

Brand your touch screen devices with vivid, full-color print on glass.

Utilize any color(s) from the full spectrum.



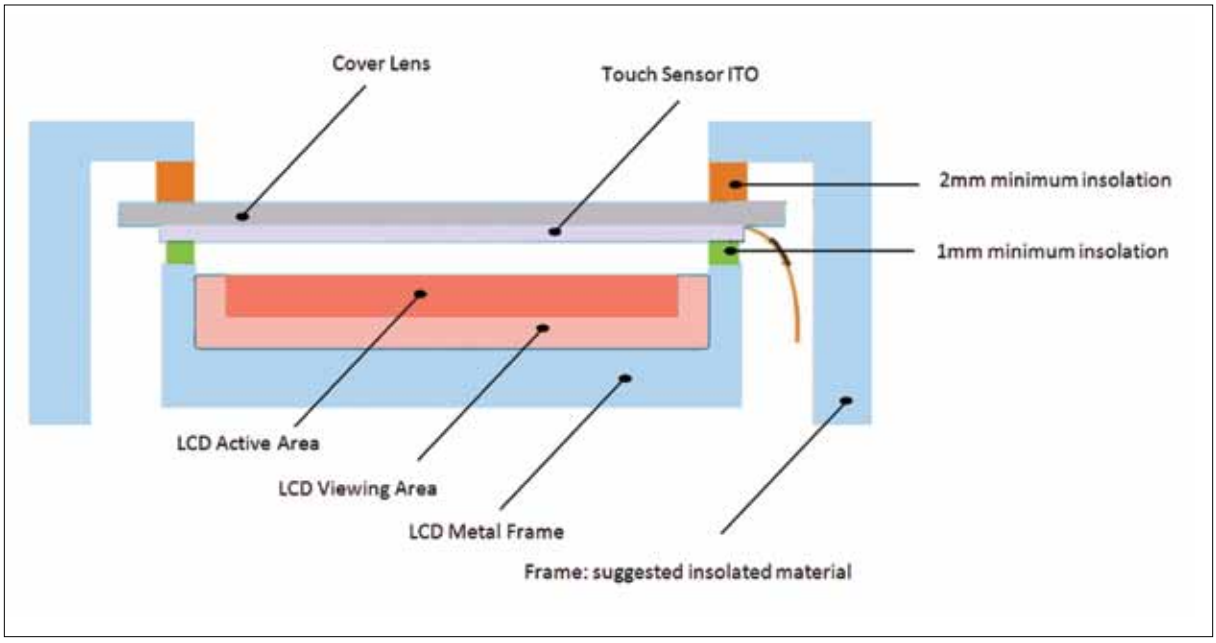


Figure 5. Touch display layers.

Atop the display screen, but before the touch sensor is added, falls an insulating material to avoid interference from capacitive noise. Particularly if a metal bezel is used, an additional insulator is needed for the same reason (Figure 5).

4.

Overview Of Touch-Input Software Windows Multi Touch[iv]

Windows 7

Windows 7, released in October 2009, included many features, such as new ways to work with windows—Snap, Peek, and Shake. It also introduced Windows Multi Touch, a built-in driver enabling users to browse the web, flip through photos, stream multimedia files from a PC to a stereo or TV, and open files/folders, all with their fingers.[v]

Windows Embedded

Additionally, Microsoft made Windows Multi Touch available through WCE7 and the WS7P SKU of Windows Embedded Standard 7 Service Pack 1. According to Microsoft, "The WS70 SKU can satisfy complex scenarios involving multi-touch gestures … ideal for many device categories including digital signage, kiosks and advanced set top boxes."

Windows CE

For mobile devices, Microsoft included multi touch and custom gesture support in WinCE 7. The touch display can operate in a range of different modes with the WinCE7 driver ported on the hardware, easing interaction with the device. Meanwhile, OEMs can customize the browser application to match the shell to their entire experience and change its markup with an expression blend. Altogether, the inclusion advanced rich user experiences with mobile devices.

Off The Shelf (OTS) Software

AIS is a leading purveyor of touch technology with both off the shelf (OTS) and custom made-to-order (MTO) product solutions. One goal of this paper is to bring this technology to light; in this section, we'll summarize various software solutions that complete the functionality of the multi touch technology in industrial control and automation settings.

InduSoft EmbeddedView and CEView

InduSoft Embedded View was designed to give users touch access to every feature available in InduSoft Web Studio. In addition, the software can scale applications from small capacity devices (like smartphones) to large-scale projects. Embedded View includes the full 240+ drives available from Indusoft.

InduSoft CEView is based on the InduSoft Windows-based control and monitoring system, offering virtually all of the same features: object-oriented database, report generation, interfaces for PLCs, remote I/O, TCIP/IP networking, and more.

InduSoft describes CEView as "a full function supervisory control and monitoring system that fits in the palm of your hand and can be embedded in the chipset of a low cost operator interface." [vi]

Progea Movicon™11 and Movicon™ CE

The Movicon ™ 11 technologies are billed as the only kind that are completed based on XML standards and other modern technologies like SQL, XML, .NET and COM. Movicon™ CE is "a runtime engine for Windows CE that offers a powerful and open HMI solution." It's a single platform that can run XML projects on Win32, Win64 or WinCE.[vii]

Copadata Zenon Supervisor

The Zenon Supervisor independent SCADA system enables users to visualize and control complex industrial facilities through a simplified touch interface. Zenon Operator is their embedded HMI system, allowing users to configure and control equipment. Finally, Zenon Logic is an integrated PLC system that offers an integrated, IEC 61131-3-based PLC system. It links PLCs in order to facilitate both process engineering and logical data management.viii

Wonderware Invensys Operations Management ArchestrA System Platform

This scalable software platform integrates existing SCADA, supervisory HMI, MES and EMI systems into a unified operations management hub. The InTouch Compact Edition is widely available via Windows CE devices, offering the ability to connect to multiple I/O drivers simultaneously.[ix]

5.

Conclusion

We've now explored how multi touch technologies open up a world of possibilities: now users can simply do so many things with their fingers that were impossible before. Particularly in complex industrial environments, touch input applications can expand functionality and streamline operations with little-to-no learning curve for operators.

We also examined the underlying electronics and science, to empower readers to better understand and discuss multi touch software and devices with colleagues and vendors. Finally, we provided an overview of OTS software available that makes multi touch devices useful in industrial settings.

For More Information - If you are looking for information or products on multi touch technologies, please contact the multi touch experts at AIS. We believe that you'll find the right solution at the best price on our newly designed website at http://www.aispro.com.

About AIS - Headquartered in the USA, in the IT center of Orange County in Irvine, California, AIS is an ISO 9001:2008 certified supplier and manufacturer of rugged computer and display, and had received completion of the International Traffic in Arms Regulations (ITAR) registration from the Directorate of Defense Trade Controls (DDTC). AIS is an established global manufacturer of a wide range off-the-shelf and customized industrial-grade HMI and display products in different configurations for various industrial, military, and outdoor digital signage applications.

AIS Industrial Touch Panel Computers

Also known as operator interface computers, AIS industrial touch panel computers have been pre-tested and pre-configured for wide availability, high performance, manageability and security appropriateness for workloads running on complete supervisory control, process monitoring and operator interface software.

On the following page, you'll find an appendix that marries history with some of the exciting new technologies and applications we offer here at AIS.

Visit us at http://www.aispro.com or call (888) 485 – 6688 for more information.

Appendix: Earlier Technologies

Touch screen technology evolved out of the desire to eliminate the keyboard and the mouse, alongside an interest to make better use of displays in public place. This section explores how we reached this level of technology.

Introductory Timeline

It began with Siemens Corporation, who funded the development of a curved glass sensor by Elographics' (electronic graphics) coordinate measuring system. Later this would be called the touch screen.

1982 - The first transparent touch-sensitive panels: Elographics[x] displayed 33 televisions covered with the new transparent touch-sensitive panels in the U.S. Pavilion of the 1982 World's Fair in Knoxville, Tennessee. For the public, this was most people's first opportunity to see or use a touchscreen!

1983 - The first touch-sensitive personal computer: In 1983, Hewlett-Packard[xi] introduced the HP-150 personal computer, featuring a touch-sensitive screen that allowed users to activate features by touch. It worked through a built-in grid of infrared beams across the front of the monitor to detect finger movement. The PC had an MS-DOS operating system and an Intel 8088 microprocessor, with twin 3-1/2 inch HP 9121 disc drives. While many of commands could be executed by touching items on the display screen with a finger or a pen, the infrared system reflected a technology still in its beginning stages.

1987 - IntelliTouch & DuraTouch: In early 1987, two new technologies were purchased. First, a surface acoustic wave product (IntelliTouch) was purchased from Zenith (see below for more information). Second, a four-wire resistive technology named DuraTouch was purchased.

1988 - IntelliTouch: A production facility was established in California to manufacture and sell the IntelliTouch product.

1993 - The Apple Newton: In 1993, Apple released the Newton PDA.[xii] Development of the Newton platform started in 1987 and officially ended on February 27, 1998. Most Newton devices were based on the ARM 610 RISC processor and all of them featured handwriting recognition software (touch screen technology).

1994 - AccuTouch: On February 24, 1994, Elographics officially changed its name to Elo Touch Systems, leading to one of the company's most important patents for the separator dot. This new transparent technology was named AccuTouch.

1995 - The IBM Simon Personal Communicator: The IBM Simon Personal Communicator[xii] was a handheld, touch-screen cellular phone and PDA designed and engineered by International Business Machines Inc. (IBM) and assembled under contract by Mitsubishi Electric Corp. BellSouth Cellular Corp. distributed the Simon Personal Communicator in the United States between August, 1994 and February, 1995, selling 50,000 units.

2007 - The Apple iPhone: Leaping forward, the first Apple iPhone[xiv] was released on June 29, 2007. Its touchscreen liquid crystal display with scratch-resistant glass was a notable advance: the first introduction to a large market of the projected capacitance technology, designed for a bare finger or fingers. A proximity sensor would deactivate the display and touchscreen whenever the device was brought near the face during a call; this feature would save battery power while also preventing inadvertent inputs from the user's face and ears. The touch and gesture features of the iPhone are based on technology originally developed by Finger Works.

2013 - AIS: AIS is embracing this technology with off the shelf and custom made-to-order product solutions, including the newly developed ability to imprint color logos and text on glass displays.

Saw - Surface Acoustic Wave: SAW technology uses ultrasonic sound waves that pass over the touchscreen panel. The surface acoustic mode of propagation and predicting its properties was first explained in 1885, described as having a longitudinal and a vertical shear component that can couple with any media in contact with the surface. Electronic devices employing SAWs normally use one or more interdigital transducers (IDTs) to convert acoustic waves to electrical signals.

Simply stated, two sound waves, one emanating from the left of the screen and another from the top, move across the screen's surface. The waves continually bounce off reflectors located on all sides of the screen until they reach sensors located on the opposite side from where they originated. When a finger touches the screen, the waves are absorbed and their rate of travel thus slowed. Since the receivers know how quickly the waves should arrive relative to when they were sent, the resulting delay allows them to determine the x- and y-coordinates of the point of contact and the appropriate touch event to be registered. Unlike other touch-screen technologies, the z-axis (depth) of the touch event can also be calculated.

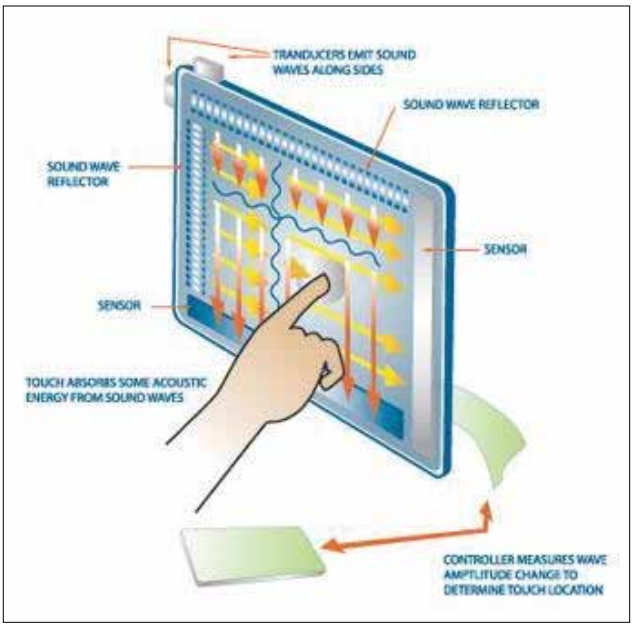


Figure 6. Illustration of SAW touch display technology.

Surface durability is high, with glass construction with a Mohs hardness rating of 7 and high optical clarity. There is no known wear-out mechanism, as there are no layers, coatings or moving parts. SAW technology has been operationally tested to more than 50 million touches in one location without failure, using a stylus similar to a finger. However, surface wave touch screen panels can be damaged by outside elements. Contaminants on the surface can also interfere with the functionality of the touchscreen.[xv]

Infrared: Infrared technology varies; for this paper, we will focus on the infrared with the greatest market share; this infrared technology is available from AIS. The AIS infrared touchscreen uses an array of X-Y infrared LED and photo detector pairs around the edges of the screen. These can detect a disruption in the pattern of LED beams, which cross each other in vertical and horizontal patterns. This helps the sensors pick up the exact location of the touch.

A major benefit to infrared detection is that it can identify essentially any input, be it a finger, gloved finger, stylus or pen. It is generally used in outdoor applications and point-of-sale systems which cannot 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. However, infrared touchscreens are sensitive to dirt/dust that can interfere with the IR beams and suffer from parallax in curved surfaces and accidental press when the user hovers his/her finger over the screen while searching for the item to be selected.[xvi]

Analog Resistive: A resistive touchscreen panel comprises several layers, the most important of which are two thin, transparent, electrically-resistive layers separated by a thin space. These layers face each other with a thin gap between. The top screen (the screen that is touched) has a coating on the underside surface of the screen. Just under it is a similar resistive layer on top of its substrate. One layer has conductive connections along its sides, the other along top and bottom. A voltage is applied to one layer, and sensed by the other. When an object, such as a fingertip or stylus tip, presses down on the outer surface, the two layers touch to become connected at that point. The panel then behaves as a pair of voltage dividers, one axis at a time. By rapidly switching between each layer, the position of a pressure on the screen can be read.

Resistive touch is used in restaurants, factories and hospitals due to its high resistance to liquids and contaminants. A major benefit of resistive touch technology is its low cost. Additionally, as only sufficient pressure is necessary for the touch to be sensed, they may be used with gloves on, or by using anything rigid as a finger/stylus substitute.

Disadvantages include the need to press down and a risk of damage by sharp objects. Resistive touchscreens also suffer from poorer contrast, due to additional reflections from the extra layer of material placed over the screen.[xvii]

Acronyms

CNT – Carbon Nanotube
EMI – Electromotive Interference
ITO – Indium-Tin-Oxide, also called TCE
MARS - Multi touch Analog Resistive Screen
MES – Manufacturing Execution Systems
OTS – Off the shelf
POI – Point of Information
Pro-Cap – Projected capacitance
SAW – Surface Acoustic Wave (Touch Screen technology)
SCADA – Supervisory Control and Data Acquisition
TCE – Transparent Conductive Electrodes
TCF – Transparent Conductive Film
TFR – Thin film resistor

Glossary

This Glossary is intended to provide brief definitions only and is not all-inclusive.

Analog Resistive – A voltage based touch screen technology

Capacitance – In this case, it's when electrical energy has the potential to cross an insulating gap

Embedded – Also: circuit with a microprocessor

Embedded – Inserting a technology subset to a larger design

Embedded Touch Technology - (Touch Screen technology) Light, voltage or charge sensing

Infrared - As in, traditional infrared using absence of light (touch Screen technology)

Interdigital transducers (IDTs) - A device used to convert microwaves to surface acoustic waves

Mohs - One of several definitions of hardness in materials science

Multi touch - The technology enabling 2 or more XY points of simultaneous contact

Multi touch screen – An LCD screen with a multi touch panel attached

Optical Imaging - Using absence of light (Touch Screen technology)

Panel – In this paper, it refers to the touch screen

Piezoelectricity - Electricity resulting from pressure

Projected capacitance – A touch screen technology that uses capacitance in a projected area (around the contact point of a finger or conductive pointer)

Surface Acoustic Wave - A time delay-based touch screen technology

Surface capacitance – A voltage-based touch screen technology

Tablet – A thin display with attached embedded computer

Touch – In this paper, it means to make contact by finger or pointer device

Touch screen – A screen with touch technology

Touch technology – The enabling science and application of it to send XY coordinates to an application

Ultrasonic waves - A cyclic sound pressure wave with a frequency greater than the upper limit of the human hearing range

Windows Embedded – Windows Operation System for embedded designs, e.g., small scale panel

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