ISSN: 2277 – 9043
International Journal of Advanced Research in Computer Science and Electronics Engineering (IJARCSEE)
Volume 2, Issue 1, January 2013

TOUCH-SCREEN TECHNOLOGY

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Abstract

The demand of touch screen gadgets is improving day by day and has proven reliability. This technology is a unique type of visual display device that allows the user to physically interface with the computer or other electronic device by touching the screen. Whether you are using a local ATM (Automatic Teller Machine) or making a phone call on one of the newer cell devices, in one form or another, we are all exposed to touch screen technology. This is starting to change with the commercializing of multi-touch technology. Touch-screens 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 (Personal Digital Assistant),where a stylus is sometimes manipulate the GUI (Graphic User Interface) and to enter data.

Keywords: Touch-Screen Technology, touch-screen, Resistive, Capacitive, Surface-Acoustic Wave and Infrared Technologies.

Introduction

A touch-screen technology 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 finger or hand. Touch-screens can also sense other passive objects such as stylus. Touch screen are common in devices such as all-in-one computers, tablet computers and smart-phone.

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 personal digital assistant (PDA), satellite navigation devices, mobile phones and video games.

The two main attributes of the touch-screen technology are:-

a) It enables one to interact with what is displayed directly on the screen where it is displayed, rather than indirectly with mouse or touchpad.

b) It lets one to do so without requiring any intermediate device that it would be in the hand.

Until recently, most consumer touch-screens could only sense one point of contact at a time, and few have had the capability to sense how hard one is touching.

The first touch-screen technology was a capacitive touch-screen developed by E.A. Johnson at the ROYAL RADAR Establishment, Malvern, U.K.

NOTE: Contrary to many accounts, while Dr. Sam Hurst played an important role in the development of touch-screen technologies, he neither invented the first touch-screen.

Figure 1: First Touch-screen Technology Invented

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Various Technologies

- Capacitive Touch-screen Technology.
  - i. Surface Capacitance Technology
  - ii. Projected Capacitance Technology
- Resistive Touch-screen Technology.
- Surface-Acoustic Wave Technology
- Infra-red Touch-screen Technology.

Capacitive Touch-screen

A capacitive touch-screen panel consists of an insulator such as glass, coated with a transparent conductor such as indium tin oxide (ITO). As the human body is also an electrical conductor, touching the surface of the screen results in a distortion of the screen's electrostatic field, measurable as a change in capacitance.

Figure 3.Capacitive Touch-screen

Different technologies may be used to determine the location of the touch. The location is then sent to the controller for processing. Unlike a resistive touch-screen, one cannot use a capacitive touch-screen through most types of electrically insulating material, such as gloves; one requires a special capacitive stylus, or a special-application glove with finger tips that generate static electricity.

This disadvantage especially affects usability in consumer electronics, such as touch tablet PCs and capacitive smart-phones in cold weather.

- Types of Capacitive Touch-screen are:-

i. Surface Capacitance Technology

In this basic technology, only one side of the insulator is coated with a conductive layer. When a conductor, such as a human finger, touches the uncoated surface, a capacitor is dynamically formed. location of the touch indirectly from the change in the capacitance as measured from the four corners of the panel.

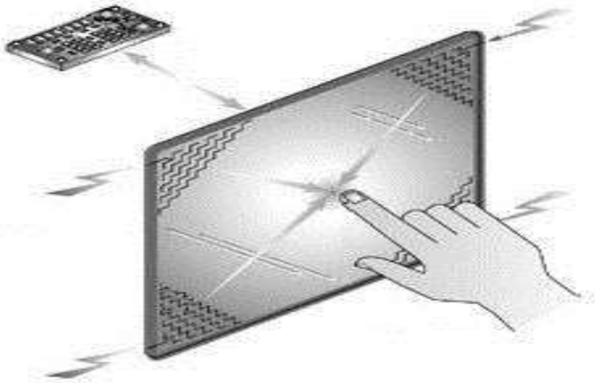

Figure 4.Surface Capacitance Technology

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.

ii. Projected Capacitive Technology

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).

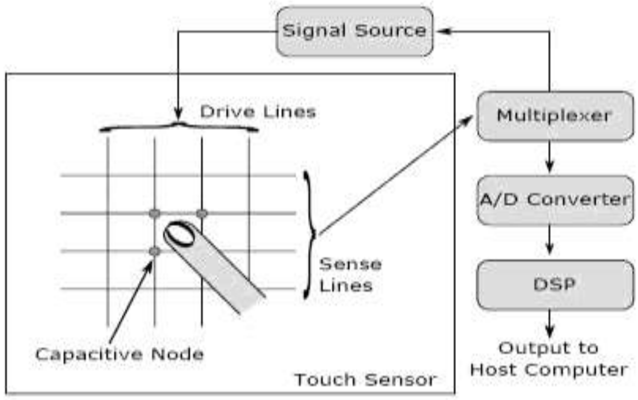

Figure 5.Projected Capacitive Technology

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The greater resolution of PCT allows operation without direct contact, such that the conducting layers can be coated with further protective insulating layers, and operates 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.

Resistive Touch-screen

A resistive touch-screen 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.

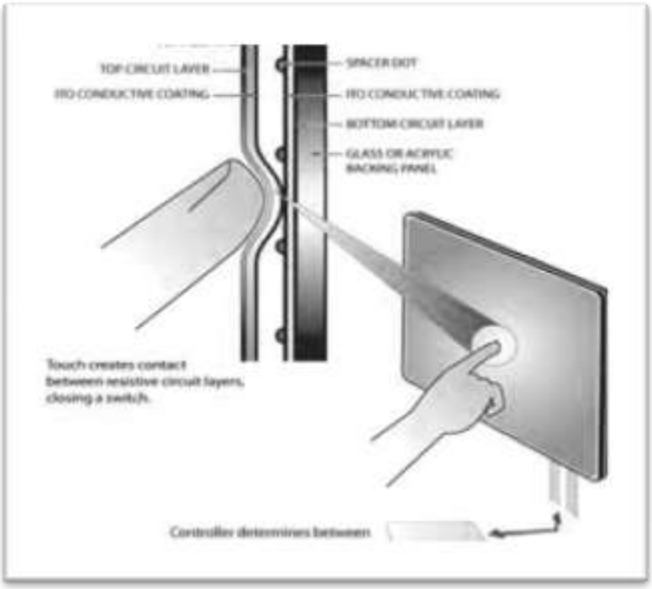

Figure 5. Resistive Touch-screen Technology

The cover sheet consists of a hard outer surface with a coated inner side. When the outer layer is touched it causes the conductive layers to touch creating a signal that the analog controller can interpret and determine what the user wants to be done. 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 it is extremely cost-effective.
- One disadvantage of resistive technology is its vulnerability of being damaged by sharp objects.

Surface-Acoustic Wave Touch Screen

Surface acoustic wave (SAW) technology uses ultrasonic waves that pass over the touch-screen 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 touch-screen.
Surface Acoustic Wave touch-screen technology is based on sending acoustic waves across a clear glass panel with a series of transducers and reflectors. When a finger touches the screen, the waves are absorbed, causing a touch event to be detected at that point.
Like infrared technology, the panel is all glass, so there are no layers that can be worn, or damaged over time. This makes SAW touch screen technology highly durable and suitable for applications where high clarity is desired.

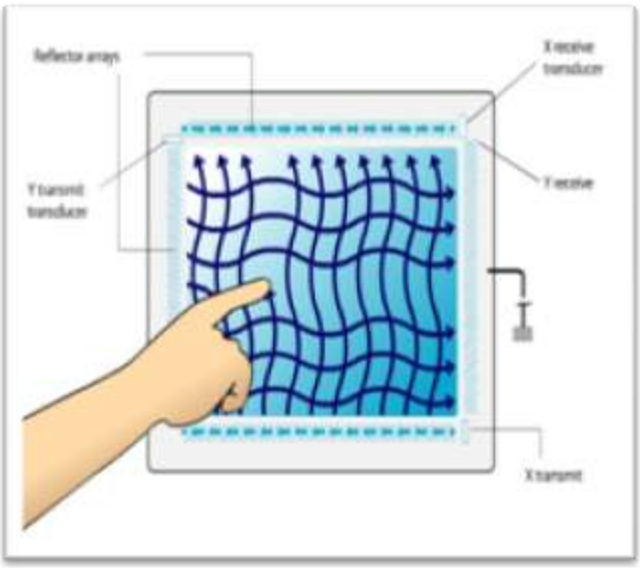

Figure 6. Surface Acoustic Wave Touch-screen

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Infrared Touch-screen

Infrared touch-screens rely on the interruption of an IR light grid in front of the display screen. An opt-matrix frame is integrated into the display bezel that contains a row of LEDs and photo-transistors, each mounted on two opposite sides to create a grid of invisible light.
The opt-matrix frame is isolated from the outside environment by an IR transparent barrier. The IR controller sequentially pulses the LEDs to create a grid of IR light beams. When a stylus enters the grid, it obstructs the beams, causing one or more of the phototransistors to detect the absence of light and transmit a signal with the x and y coordinates.

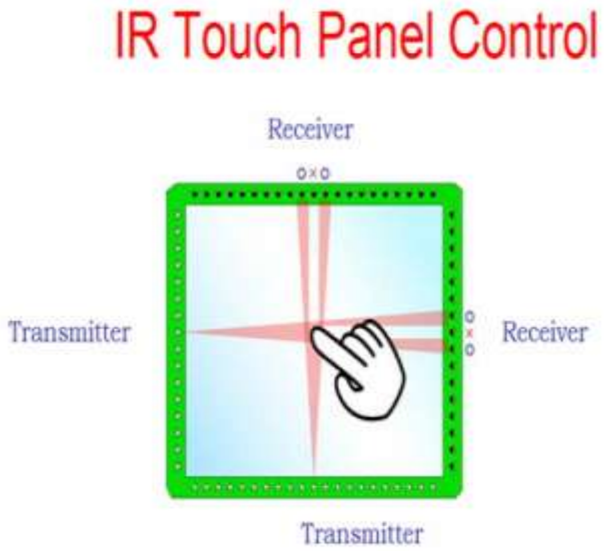

Figure 7:- Infra-Red Touch-screen Technology

Infrared technology has no limitations in terms of objects that can be used to touch the screen, but one of the disadvantages of this technology is that the screen may react before it is physically touched. They are characterized by medium resolution and a small liability to be subject to parallax. They are also difficult to accommodate below 8.4" due to the size constraints of the opt-matrix frame. Otherwise, they are fast, transparent and durability is dependent on the display itself.

Construction

There are several principal ways to build a touch-screen and they are:-

i. 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.
ii. In the most popular techniques, the capacitive or resistive approach, there are typically four layers;
iii. Top polyester coated with a transparent metallic conductive coating on the bottom.
iv. Glass layer coated with a transparent metallic conductive coating on the top.
v. Adhesive layer on the backside of the glass for mounting.
vi. When a user touches the surface, the system records the change in the electrical current that flows through the display.
vii. Dispersive-signal technology which 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.
viii. 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.
ix. 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.

Development

i. Most touch-screen technology patents were filed during the 1970s and 1980s and have expired. Touch-screen component manufacturing and product design are no longer encumbered by royalties or legalities with regard to patents and the use of touch-screen enabled displays is widespread.
ii. The development of multipoint touch-screens facilitated the tracking of more than one finger on the screen; thus, operations that require more than one finger are possible. These devices also allow multiple users to interact with the touch-screen simultaneously.
iii. With the growing use of touch-screens, the marginal cost of touch-screen technology is routinely

absorbed into the products that incorporate it and is nearly eliminated.

iv. Touch-screens now have proven reliability. Thus, touch-screen 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 I Phones; the touch-screen market for mobile devices is projected to produce US$5 billion in 2009.

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

vi. These ergonomic issues of direct touch can be bypassed by using a different technique, provided that the user's fingernails are either short or bit 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. This method does not work on capacitive touch-screens.

Conclusion

The popularity of smart phones, PDAs and tablet computers, portable video game consoles and many types of information appliances is driving the demand and acceptance of common touch-screens, for portable and functional electronics, with a display of a simple smooth surface and direct interaction without keyboard or mouse, between the user and content, fewer accessories are required. Touch-screens 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 touch-screen 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.

Overall, this study shows that touch screen technology has a positive influence on some key aspects of usability, especially for an efficient navigation. There is a tendency that more sensitive touch screens enhance navigation. Nevertheless, users still have some problems when interacting with the device; some functions are not intuitively usable, and there is still room for improvement.

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