Touch Screen-A Comparative Study

Nikita .S. Ranadive[1] ,Prof. Ashok Suryavanshi[2]
[1, 2]Pimpri Chinchwad, College Of Engineering, Pune

Abstract-*Touch screen is the upper layer of an electronic visual display. A touch screen acts as an input and output to a device. A user interacts with the device via tapping a finger or touching a finger on a touch screen of a device. Some touch screens use ordinary or specially coated gloves to work while others use a special stylus/pen only. The user can use the touchscreen to react to what is displayed and to control how it is displayed; for example, zooming to increase the text size.*

Keywords*-*Touch screen, Resistive, Capacitive, SAW, Infrared.

I. INTRODUCTION

Touch screens are very common scenario now a day. Almost every electronic device like mobile phone, PC, tab, laptops, electronic instruments and all the electronics appliances. Touch screen is popular in industrial sector to household. A touch screen basically consists of a display that acts as an input and output for a device. User interacts with a display by tapping the figure/stylus on the picture or word on the touch screen display. Touch screens are basically easy to handle. No specific training is required to deal with the touch screen. Touch screen are so user friendly that a toddler can also operate the touch screen. Whenever the user touches the touch screen, the touch controller finds the location of touch and accordingly it performs the function/operation. Location of touch is known as touch area.

II. RESEARCH FOR VARIOUS TOUCH SCREEN TECHNOLOGY

Touch screen makes the user interaction easy. No special training is required for touch screen. It is cost effective, speedy operation and compact in size.

Touch screens are of the following types

1. Resistive

The resistive touch screen technology is a very simple technology. The touch screen is built using two layers of the conductive material Indium Tin Oxide (ITO) or film layer, separated by a small gap of air or dielectric medium or insulator. The bottom layer is of glass, and the top layer is made up of flexible material, often plastic. When the user presses down on the top ITO layer, it physically bends to make contact with the bottom ITO layer, changing the resistance of the two layers.Resistive touch screen is further classified as 2-wire, 4-wire and 8-wire. [1] Hoye, Timothy, and Joseph Kozak. "Touch screens: A pressing technology." Tenth Annual. 2010.

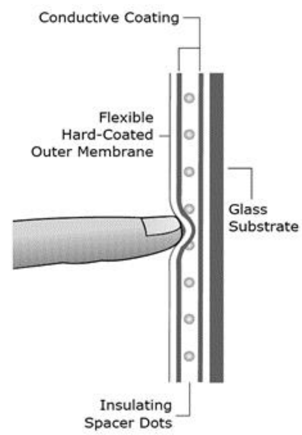

Figure1. Resistive Touch

2.Capacitive

A capacitive touch screen consists of control display that operates on the conductive touch of a human finger or a stylus/pen. When a capacitive panel is touched by a finger or a stylus/pen, a small amount of charge is drawn to the point of contact, which then acts as a functional capacitor. The change in the electrostatic field is measured to find the location. In some designs, the circuits which is located at each corner of the panel measure the charge and send the information to the controller for processing. In multi-touch screens, sensors are arranged in a grid to enable more complex input [1]The capacitive touch screen is further divided into projected capacitive and surface capacitive

2.1 Surface Capacitive

Surface capacitive touch panels got a uniform conductive coating on a glass layer. There is a uniform electric field across the conductive layer. When a human fingers comes in contact with the touch screen panel a small amount of charge gets transported from the electric field of the panel to the field of the touching object. Current is drawn from each corner of the panel; this process is measured with sensors located in the corners, and microprocessor interpolates an exact position of the touch based on the values measured. Panels based on surface capacitive technology can provide a high positional accuracy. [2]

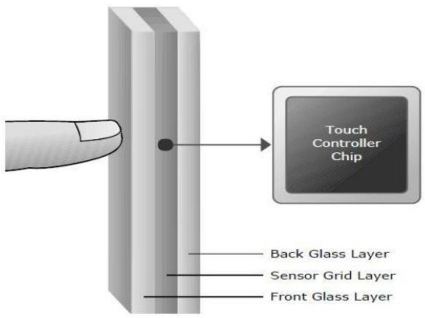

Figure2. A thin grid layer is protected by two glass layers. Capacitance forms between the finger and the grid during a touch. The change of electrical properties is measured to determine the touching position according

2.2 Projected Capacitive

Of the technologies we describe projected capacitive touch devices are the most expensive to produce. Their performanceis rather worse than many of the other approaches we describe; however they afford superb mechanical resilience. Projected capacitive surfaces can also be covered by a nonconductive material (with a maximum thickness of around 20mm) without negatively impacting on their functionality. When used for (multi touch displays, as described by Rekimoto) a very thin grid of microphone wires is installed between two protective glass layers. When touched, capacitance forms between the finger and the sensor grid and the touch location can be computed based on the measured electrical characteristics of the grid layer. The accuracy of projected capacitive technology is similar to surface capacitive technology although light transmission is superior because the wire grid can be constructed such that it.

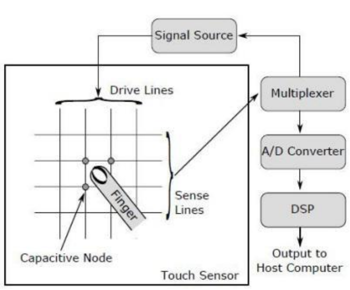

Figure 3. A simplified view of projected-capacitive touch screen

Projected capacitive is further divided into self and mutual touch

2.2.1 Self Touch

In this implementation, the electronics measure the current on each electrode to ground and therefore is called “self- capacitance”. There are two options for how the system can detect touch — multi-pad construction or rows and columns. In a multi-pad construction, each electrode, or “pad”, is individually addressable by the electronics requiring an individual connection between the electrode and the controller. This allows multi-pad self-capacitance to support greater than one touch, but given that each pad must be individually addressed, it makes the implementation of this solution for screens greater than 3.5 inches very challenging. In a row-and-column construction, each row and column is an electrode and therefore is individuallyaddressed by the controller. Even though the intersection of a row and column represents a unique coordinate pair, the electronics are not able to measure each individual intersection as they can only measure each electrode. This limits row and column self-capacitance implementations to single and dual touch detection where “ghost” points can be a problem. Ghost points are the result of imaginary or false row and column in-tersections in locations other than the touch location.To sense touch in a self-capacitance implementation, theelectronics scan through each electrode and measures the amount of current on each electrode to establish a steady-state current. When a finger or grounded conductive stylus approaches the screen, they couple to the electrodes and increase the current draw as it creates a path to ground. By determining which row and column is closest to the touch location, and using interpolation for higher precision, a controller can determine the location of a touch.[2]

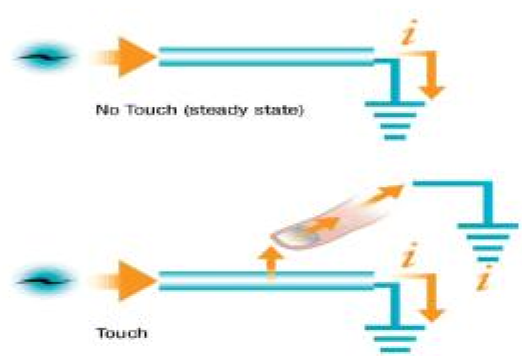

Figure4. How does self capacitance works

2.2.2 Mutual Touch

Mutual capacitance is the intentional or unintentional capacitance between two "charge holding objects." Projected capacitance touch screens intentionally create mutual capacitance between elements of columns and rows in the vicinity where each intersect the other. This allows the system electronics to measure each node (intersection) individually to detect multiple touches on the screen during one screen scan.

When a finger touches near an intersection, some of the mutual capacitance between the row and column is coupled to the finger which reduces the capacitance at the intersection as measured by the system electronics. This reduced capacitance crosses the "touch threshold" set by the electronics indicating a touch has occurred.[4]

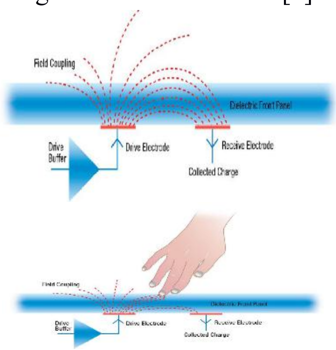

Figure5. How does self capacitance works

3. SAW

SAW (Surface Acoustic Wave) touch screen monitors utilize a series of piezoelectric transducers and receivers along the sides of the monitor's glass plate to create an invisible grid of ultrasonic waves on the surface. When the panel is touched, a portion of the wave is absorbed. This allows the receiving transducer to locate the touch point and send this data to the computer. SAW monitors can be activated by a finger, gloved hand, or soft-tip stylus. SAW monitors offer easy use and high visibility. [4]

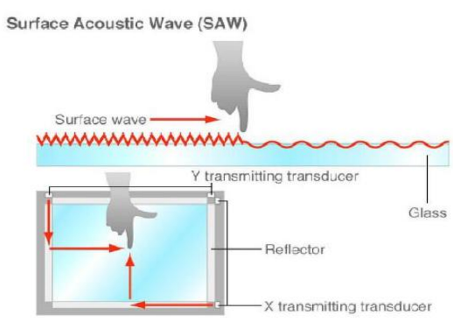

Figure 6 Surface Acoustic wave touch screen technology

4. Infrared

Infrared touch screen monitors do not overlay the display with an additional screen or screen sandwich. Instead, infrared monitors use IR emitters and receivers to create an invisible grid of light beams across the screen. This ensures the best possible image quality. When an object interrupts the invisible infrared light beam, the sensors are able to locate the touch point. Infrared touch screen monitors do not overlay the display with an additional screen or screen sandwich. Instead, infrared monitors use IR emitters and receivers to create an invisible grid of light beams across the screen. This ensures the best possible image quality. When an object interrupts the invisible infrared light beam, the sensors are able to locate the touch point.[4]

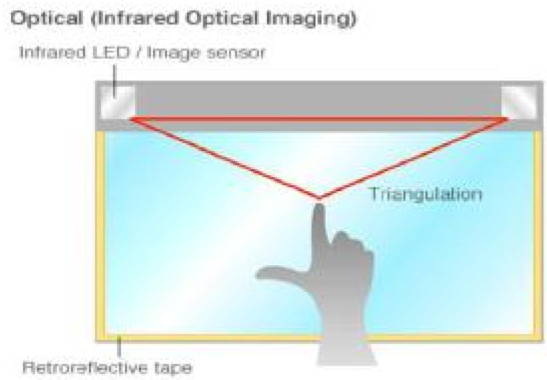

Figure7. Infrared touch screen technology

III. COMPARATIVE STUDY OF ALL THIS TOUCH SCREEN TECHNOLOGY

1. Comparison in between different touch screen technology

	Capacitive	SAW	Infrared	Resistive
Technology	Electrostatic field	Sound Waves	Light Interrupti	Resistive
Activation	Low activation pressure required	Low activa-tion pressure	Zero activation pressure required	Low activation pressure required
Transmitti-vity/optics	Very good >92%	Very good >92%	Very good >92%	<82%, some distortion to graphics due
Drag and drop	Requires constant pressure t	Requires constant pressure to draw smooth lines	Low resolution due t spacing of IR sensors and interpola-	Requires constant pressure to draw smooth lines
Surface contaminant s/ durability	Resistant to moisture and other surface contaminants	Adversely affected by moisture or surface contami-	Potential for false activation or dead zones	Unaffected by surface contami-nants. Polyester top sheet is easily
Display	8.4"-21"	10.4"-30"	10.4"-60"	up to 19"

Size constraints	Originally designed for smaller sizes, and may not scale easily; largest is 19”	Originall y signed for smaller sizes a nd may	Scales t	Originally signed f smaller sizes and may not scale easily; largest sensor is 19”
Touch Methods	Humanto uch	Finger only	Can use any pointing	Can use any pointing device
Main Limitatio n of Technolo gy	Requires human touch, scratches in coatings causes dead zones. Field	Surface contamin an ts ca use dead zones and requires periodic recalibrat	Surface contamin an ts can cause false activation . Thick border area around	Polyester top sheet affects optics and is susceptible to damage. May not scale easily over 19”screens

By comparing all the touch screen technology Capacitive and Infrared touch screen are widely used. But considering Infrared touch screen technology major disadvantage is blind. So mostly capacitive touch screen is used.

2. Comparison in between the surface capacitive and projected capacitive

	SURFACE CAPACITIVE	PROJECTED CAPACITIVE
Size	5-24”	7-24”
Touch Accuracy	Good	Excellent
Operating Force	0g	0g
Light Transmission	Very Good	Excellent
Calibration	Poor	Good
Touch Life	100 Million	Unlimited
Multi Touch	No	Yes
Gloved Hand	No	Yes

By comparing the surface capacitive an projected touchscreen technology, both the technology are nearly same but considering the touch accuracy, light transmission and multi touch factors make projected touch screen technology better than surface capacitive.

3. Comparison in between self touch and mutual touch

	Mutual Capacitance	Self Capacitance
Light Transmission	84% to 90%	84% to 90%
Stylus Type	Finger, Thin Glove, Passive Stylus	Finger, Thick Glove, Passive Stylus
Second Surface	Yes	Yes
Sealability	NEMA 4 / 12 and IP 65 standards	NEMA 4 / 12 and IP 65 standard
Response Time	6 ms	10 ms
Touches	20+	1 (dual)
Accuracy	> 99%	> 98.5%

By comparing the two mutual and self touch projected capacitance touch screen technology, both the technology are used but considering the self touch disadvantage i.e. “Gorilla effect ”, fake key activation it is mostly not preferred.

IV.CONCLUSION

By comparing the touch screen technology infrared touch screen and capacitive touch screen are most widely used. The only problem with infrared is the blind spot creation which leads to malfunction. Also it is impacted with water and ice on the surface. Mostly capacitive touch is mostly preferred. In capacitive touch, projected touch screen technology is mostly preferred. Various technology advances are taking place in projected touch screen technology. Now even just below the touch screen you can place the component to make it compact and to reduce noise. Also user can be identified with touch, this is the latest advancement.

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