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A Study and Analysis of Touch Screen Technologies

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ABSTRACT

The use of touch screen in our day-to-day life is always there. People without touch screen are only a few. Touch screen were built for ease of work and for saving time. It is an assistive technology. This interface can be beneficial to those that have difficulty in using other input devices such as a mouse or keyboard. When used in conjunction with software such as on-screen keyboards, or other assistive technology, they can make computing resources more available to people that have difficulty in using computers. Touch Screen is widely used and emerging technology that is sensitive to human touch, allowing a user to interact with the computer by touching pictures or words on the screen. It provides a very good user interface with applications that normally require a mouse. The touch screen interface is going to revolutionize the electronic interactive devices in a big way. The purpose of this study is to analyse the various technologies used to build the touch screen and it's also helpful for the future gen those who make a study on it.

Keywords : Panel, Touch Screen, Technology, Sensor, PDA, Controller, Software Driver.

I. INTRODUCTION

A touch screen is a display that can detect the presence and location of a touch within the display area. They are generally refers to touch or contact to the display of the device by a finger or hand. The touch screen is also an input device. The screens are sensitive to pressure; a user interacts with the computer by touching pictures or words on the screen, touch screen can also sense other passive objects, such as a stylus. The touch screen has two main attributes. First, it enables one to interact with what is displayed directly on the screen, where it is displayed, rather than indirectly with a mouse or touchpad. Secondly, it lets one do so without requiring any intermediate device, again, such as a stylus that needs to be held in the hand. Such displays can be attached to computers or, as terminals, to networks. 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. The main components of a touch screen are touch sensor, controller and software driver. There are different technologies for building a touch screen. The most commonly used touch technologies are the Capacitive & Resistive systems. The other technologies used in this field are Infrared technology, Optical Imaging & surface acoustic wave technology. These technologies are latest in this field but they are very much expensive. Ergonomics and usage is the another important factor in touch screen technology. Touch systems are used for many applications such as ATM's, point-of–sale systems, public information display, tourism displays, restaurants etc.

II. COMPONENTS OF A TOUCHSCREEN

A basic touch screen has three main components: a touch sensor, a controller, and a software driver. The touch screen is an input device, so it needs to be combined with a display and a PC or other device to make a complete touch input system [1,4,5,7].

2.1 Touch Sensor

A touch screen sensor is a clear glass panel with a touch responsive surface. The touch sensor/panel is placed over a display screen. There are several different touch sensor technologies on the market today, each using a different method to detect touch input. The sensor generally has an electrical current or signal going through it and touching the screen causes a voltage or signal change. This voltage change is used to determine the location of the touch to the screen.

2.2 Controller

The controller is a small PC card that connects between the touch sensor and the PC. It takes information from the touch sensor and translates it into information that PC can understand. The controller is usually installed inside the monitor for integrated monitors or it is housed in a plastic case for external touch overlays. The controller determines what type of interface/connection you will need on the PC. Integrated touch monitors will have an extra cable connection on the back for the touch screen.

2.3 Software Driver

The driver is a software update for the PC system that allows the touch screen and computer to work together. It tells the computer's operating system how to interpret the touch event information that is sent from the controller. Most touch screen drivers today are a mouse-emulation type driver. This makes touching the screen the same as clicking your mouse at the same location on the screen. This allows the touch screen to work with existing software.

III. TOUCH SCREEN TECHNOLOGIES

There are several principal ways to build a touch screen. 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. Different touch screen technologies [1,2,3,4,5,7,9,10] are explained in the following sections.

3.1 Resistive Touch Screen

A resistive touch screen panel is composed of several layers. The most important are two thin metallic electrically conductive and resistive layers separated by thin space. When some object touches this kind of touch panel, the layers are connected at a certain point; the panel then electrically acts similar to two 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. The Nintendo DS is an example of a product that uses resistive touch screen technology [2].

3.2 Capacitive Touch Screen

A capacitive touch screen panel is coated with a material, typically indium tin oxide, which conducts a continuous electrical current across the sensor. The human body is also an electrical device which has stored electrons and therefore also exhibits capacitance. Capacitive sensors work based on proximity, and do not have to be directly touched to be triggered. It is a durable technology that is used in a wide range of applications including point-of-sale systems, industrial controls, and public information kiosks. It has a higher clarity than Resistive technology, but it only responds to finger contact and will not work with a gloved hand or pen stylus. Capacitive touch screens can also support multi-touch. A good example of this is Apple Inc.'s iPhone and iPod touch, and HTC's T-Mobile G1. The capacitive technology is mainly of two types. They

are Surface capacitive and Projected capacitive technology.

3.2.1 Surface Capacitive

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, 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.

3.2.2 Projected Capacitive

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. 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. The two technologies are used in PCT: Self Capacitance and Mutual Capacitance.

A. Mutual capacitance:

In mutual capacitive sensors, there is a capacitor at every intersection of each row and each column. 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 [6].

B. 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 is placed location sensing.

3.3 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.

3.4 Strain Gauges Touch Screen

In a strain gauge configuration the screen is spring-mounted on the four corners and strain gauges are used to determine deflection when the screen is touched. This technology can also measure the Z-axis. A mounting for supporting a portion of a touch-panel or display and for measuring the force at the mounting due to a force applied to the touch-panel is described incorporating a touch-panel or display, a frame, a spring or beam having one end rigidly attached to the touch-panel or to the frame with the other end free to rotate and attached to a torsion bar, wire, or strap. The torsion bar may have portions at

right angles to one another to permit limited motion in the plane of the touch-panel. The invention overcomes the problem of a strain gauge mounting with a mounting which may withstand excessive forces during shipping, subsequent distortion in the frame over time, and some lateral movement of the touch-panel in the plane of the touch-panel as well as some deflection during use. Typically used in exposed public systems such as ticket machines due to their resistance to vandalism.

3.5 Optical Imaging Touch Screen

A relatively-modern development in touch screen technology, two or more image sensors are placed around the edges or corners of the screen. Infrared backlights are placed in the camera's field of view on the other sides of the screen. A touch shows up as a shadow and each pair of cameras can then be triangulated to locate the touch or even measure the size of the touching object.[8]

3.6 Dispersive Signal Touch Screen

Introduced in 2002, 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.

3.7 Acoustic Pulse Recognition Touch Screen

This system uses more than two piezoelectric transducers located at some positions of the screen to turn the mechanical energy of a touch into an electronic signal. The screen hardware then uses an algorithm to determine the location of the touch based on the transducer signals. This process is similar to triangulation used in GPS. The touch screen 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 with good accuracy. The technology is also well suited to displays that are physically larger. As with the Dispersive Signal Technology system, after the initial touch, a motionless finger cannot be detected.

IV. ERGONOMICS AND USAGE

Ergonomics is the study of people's working efficiency in a working environment [4].

4.1 Finger Stress

An ergonomic problem of touch screen is the stress on human fingers when used for more than a few minutes at a time, since significant pressure can be required and the screen is non-flexible. This can be alleviated with the use of a pen or other device to add leverage, but the introduction of such items can sometimes be problematic depending on the desired use case. For example, public kiosks such as ATMs.

4.2 Fingernail as Stylus

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 top of the forward edge of a fingernail can be used instead. The fingernail's hard, curved surface contacts the touch screen at a single very small point. Therefore, much less finger pressure is needed, much greater precision is possible 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.

4.3 Fingerprints

Touch screens also 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.

4.4 Gorilla Arm

Gorilla arm was a side-effect that destroyed vertically-oriented touch-screens as a mainstream input technology despite a promising start in the early 1980s. Designers of touch-menu systems failed to notice that humans are not built to hold their arms at waist- or head-height, making small and precise motions. After a short period of time, cramp may begin to set in, and arm movement becomes painful and clumsy — the operator looks like a gorilla while using the touch screen and feels like one afterwards. Gorilla arm is not a problem for specialist short-term-use devices such as ATMs, since they only involve brief interactions which are not long enough to cause gorilla arm. Gorilla arm also can be mitigated by the use of horizontally-mounted screens such as those used in Tablet PCs, but these need to account for the user's need to rest their hands on the device. This can increase the amount of dirt deposited on the device, and occludes the user's view of the screen.

V. COMPARATIVE ANALYSIS

The comparative analysis of advantages and disadvantages of different touch screen technologies are listed in Table 1.

Table 1. Comparative Analysis Touch Screen Technologies

Technologies	Advantages	Disadvantages
Resistive Touch Screen	• High Resolution and Accuracy • Fast Response • Pressure-activated by finger or gloved hand with a very light touch • Durable hard-coat front surface can be non glare treated for reflection • control or polished for maximum clarity • Touch screens and controllers are safety agency-approved components, so certification of your system is easier	• 75 % Clarity • Resistive layers can be damaged by a sharp object

Capacitive Touch Screen	• High Touch Resolution • High Clarity • Completely Seal able	• Must be touched by finger- will not work with any non-conductive input • Can be affected by electricity • May need re-calibration often
Surface Acoustic Wave Touch Screen	• Excellent Image Clarity • Very High Light Transmission • Excellent Durability • Stable "No-Drift" Operation • High Resolution • Finger or Gloved-Hand Operation • Very Light Touch • Fast Touch Response • X-, Y-, and Z-axis Response • Overlay That Can Be Antiglare-Treated	• Must be touched by finger, gloved hand or soft-tip stylus. • Something hard like a pen won't work • Not completely seal able, can be affected by large amounts of grease, water, or dirt on the touch screen
Strain Gauges Touch Screen	• High accuracy • Measures the movements in Z – axis too • Requires less force	• Zero shift with temperature • Works on the basis of stress/pressure
Optical Imaging Touch Screen	• Scalability • Versatility • Affordability	• Costly • High maintenance cost
Dispersive Signal Touch Screen	• Unaffected by dust, scratches etc. • Excellent optical clarity. • Fingers and stylus can be used.	• After the initial touch the system cannot detect a motionless finger.
Acoustic Pulse Recognition Touch Screen	• Made of ordinary glass • Good durability • Optical clarity. • Function with scratches and dust.	• After the initial touch the system cannot detect a motionless finger.

As the two sides of a coin, the touch screen has advantages and disadvantages too. Some of them are listed in Table 2.

Table 2. Overall Advantages and Disadvantages of Touch Screen

Advantages	Disadvantages
• Ideal for web browsing, picture and movies. • Simple user interfaces, which are more intuitive. • Touch screen devices have fewer buttons. • Ease of use while in combination with other devices. • Increased speed of tasks. • By combining the data entry method with the display, you reduce the overall size of the computer or device.	• Big screen leads to low battery life. • Touch screen means screen can't be read too well in direct sunlight as it applies an additional not 100% transparent. • Screens get very dirty. • These devices require massive computing power which leads to slow devices and low battery life. • The screen has to be big enough to be able to touch the buttons without missing • If a touch screen device were to crash the whole screen would be unresponsive, and because of the lack of buttons recovering it would be very difficult.

VI. CONCLUSION

The touch screen interface is going to revolutionize the electronic interactive devices in a big way. The future multi touch systems which has limit of imagination as drawback are going to substantially dominate the field. The exponential growth of touch screens are just an indication of the future of these devices. Touch Screen is widely used and emerging technology that is sensitive to human touch, allowing a user to interact with the computer by touching pictures or words on the screen. It provides a very good user interface with applications that normally require a mouse. It is very useful in various fields like Museum / tourism displays, railway station, casino and other gaming systems, Airport, telephone exchange etc. It has good future in many new technologies like in cell phones, palmtops, laptops etc. In this paper we analysed the advantages and disadvantages of various touch screen technologies.

VII. REFERENCES

[1] Mudit Ratana Bhalla & Anand VardhanBhalla, "Comparative Study of Various Touch screen Technologies", International Journal of Computer Applications, Vol. 6, No.8, September 2010.

[2] Anjul Jain, Diksha Bhargava and Anjani Rajput, "Touch Screen Technology ", International Journal of Advanced Research in Computer

Science and Electronics Engineering (IJARCSEE), Vol.2, Issue1, January 2013.

[3] Harshit Sharma, "A Review Paper on Touch Screen", International Journal of Engineering Research & Technology (IJERT), Vol.5, Issue 23, pp.1-3, 2017.

[4] Gaurav Kalia, Gursharan Sandhu and Aseem Kaushal, "Touch Screens: Technology for Better Tomorrow", Vol.4, Issue 5, pp.81-83, Sep.2013.

[5] M.Krithikaa, "Touch Screen Technology – A Review", International Journal of Trend in Research and Development, Vol. 3(1), pp.74-77, Feb.2016.

[6] Chaouki Rouaissia, "Enhancing Touchscreen Experience by Adding Proximity Detection and Haptics Feedback".

[7] https://www.explainthatstuff.com/touchscreens.html.

[8] Kamalakannan J, Chepuri Saikiran, "Different paradigm for Touch-Screen Technology".

[9] V Bhavya Keerthi, E Annadevi, "Touch Screen Technology", International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE), Vol. 6, Issue 1, January 2019.

[10] Gaurav Kalia, Gursharan Sandhu, Aseem Kaushal, "Touch Screens: Technology for Better Tomorrow", International Journal of Electronics & Communication Technology (IJECT) Vol. 4, Issue Spl - 5, July, Sept 2013.

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