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Touch Screen Technologies

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ABSTARCT

First computers became more visual, then they got advanced to understand vocal commands and now they have gone a step further and became TOUCHY, that is skin to screen. In this paper we will throw light on significance of Touchscreen Technology, its types, components, working of different touchscreens, their applications, multi touch inter action, as well as postive and negative qualities. Nowadays Touchscreen Technology is increasingly gaining popularity as these can be seen at ATMs, cellphones, information kiosks etc. Touch Screen based system allows an easy navigation around a GUI based environment. As the technology advances, people may be able to operate computers without mice and keyboards.

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. Touchscreens are common in devices such as game consoles, all-in-one computers, tablet computers, and smart-phones.

Keywords: Capacitive Technologies, Infrared, Multi-Touch, Resistive Technologies Touchscreen Technologies, Surface Acoustic Wave.

I. 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. In other words, a Touchscreen is any monitor, based either on LCD (Liquid Crystal Display) or CRT (Cathode Ray Tube) technology that accepts touch input. The ability for touch input is facilitated by an external (Light pen) or an internal device (Touch Sensor and Controller) that relays the X, Y coordinates to the computer.

II. TYPES OF TOUCHSCREEN TECHNOLOGIES

There are basically four types of Touchscreen Technologies: Resistive, Capacitive, Surface Acoustical Wave (SAW) and Infrared (IR). The detail of each is given below:

2.1 Resistive

Resistive Touchscreens are touch sensitive displays made up of two flexible sheets coated with a resistive material and separated by an air gap. There are two different types of metallic layers. The first type is called Matrix, in which striped electrodes on substrates such as glass or plastic face each other. The second type is called Analogue which consists of transparent electrodes which do not face each other.When contact is made to the surface of the Touchscreen; the two sheets are pressed together. On these two sheets there are horizontal and

vertical lines that, when pushed together, register the precise location of the touch. Because the Touchscreen senses input from contact with nearly any object (finger, stylus/pen, palm) resistive Touchscreens are a type of "passive" technology. Resistive Technology is divided into two broad categories: 4-wire and 5-wire resistive Touchscreen Technology.

2.1.1 4-Wire Resistive Touchscreen Technology

The 4-Wire Resistive screens are built using two layers of the conductive material Indium Tin Oxide (ITO), separated by a small gap of air [2]. The bottom layer is generally on glass, and the top on a flexible material, often plastic [3]. When the user presses down on the top ITO layer, it physically bends to make contact with the bottom ITO layer, changing the re-sistance of the two layers [3]. A 4- Wire resistive touch screen uses 4 wires, 2 of them on each panel. As in Fig. 1, each panel corresponds to a different axis. These perpendicular axis allow the computer to take the measurements of the change in resistance from each panel, and calculate the position of the touch point from its X and Y components [2].

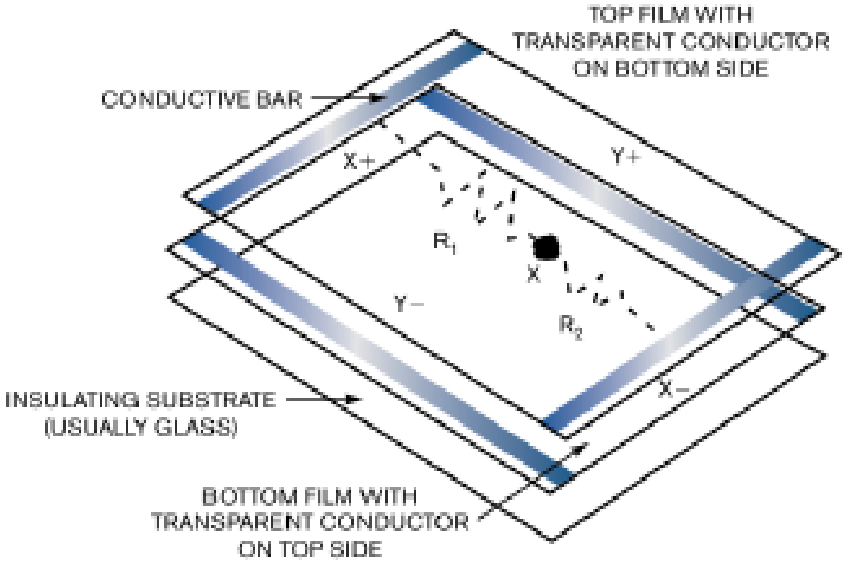

Fig. 1: 4-wire resistive touchscreen technology [2].

2.1.2 5-Wire Resistive Touchscreen Technology

In the 5-Wire Resistive Touchscreen Technology there is one coversheet. In this one wire goes to the cover sheet (E) which serves as the voltage probe for X and Y. Four wires go to corners of the back glass layer (A, B, C, and D). The controller first applies 5V to corners A and B and grounds C and D, causing voltage to flow uniformly across the screen from the top to the bottom. Upon touch, it reads the Y voltage from the coversheet at E. Then the Controller applies 5V to corners A and C and grounds B and D, and reads the X voltage from E again. So, a five-wire Touchscreen uses the stable bottom layer for both X- and Y-axis measurements. This means the Touch-screen continues working properly even with non-uniformity in the coversheet's conductive coating.

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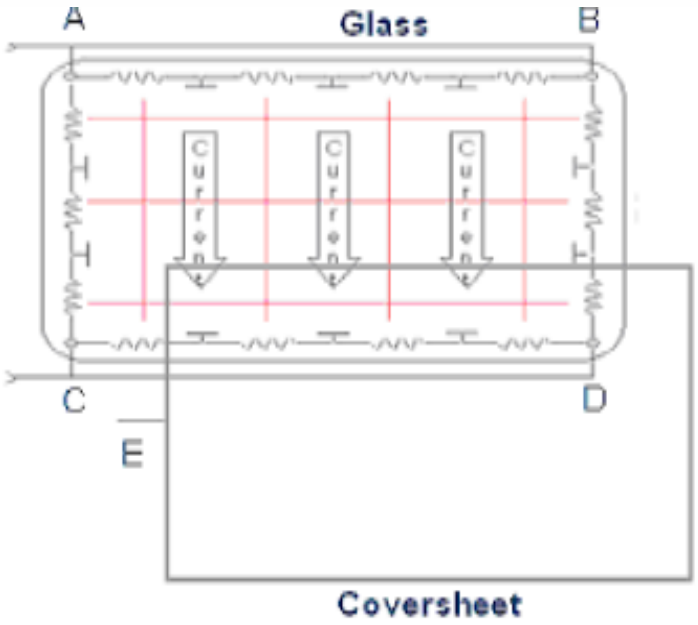

Fig 2.5-wire resistive touchscreen technology [4].

2.2 Capacitive

Capacitive sensing is a technology based on capacitive coupling which takes human body capacitance as input. Capacitive sensing is used in many different types of sensors, which are used to detect and measure proximity, position or displacement, humidity, fluid level, and acceleration. In the 1990, it first appeared in laptops as touchpads and in 2001 it appears in consumer devices, such as MP3-players and smartphones [2].Capacitive sensors provides versatility, reliability and robustness, unique human-device interface and cost reduction over mechanical switches. Capacitive sensing is further of two types Projected Capacitive Technology and Surface Capacitive Technology.

2.2.1 Projected Capacitive Technology

Like Resistive Touchscreens it also has two layers of Indium Tin Oxide (ITO), with perpendicular conductive measuring strips on the ends of each layer [3] enclosed between two glass layers (Fig. 3). This grid, formed by the perpendicular conductive layers, causes the electric field through the top layer of glass- hence the name projected capacitive Touch Screens [3]. When the user touches the top layer of glass the capacitance changes [2]. The change in capacitive value is due to electromagnetic charge contained in the human body. The changes in capacitance are measured and calculated as touch points by using the X and Y components.

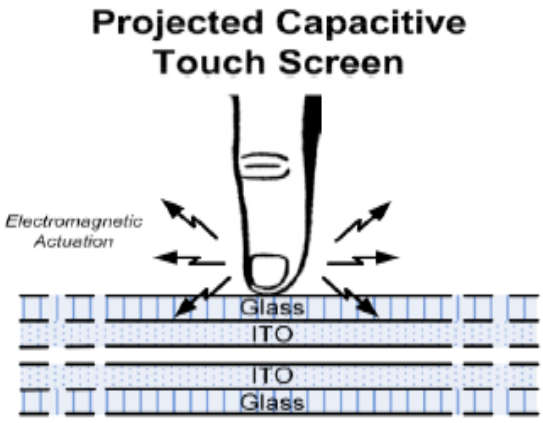

Fig. 3: projected capacitive touch screen layers [3].

2.2.2 Surface Capacitive Technology

The Surface Capacitive Technology uses only one Indium Tin Oxide (ITO) surface. It also calculates touch points using principles that are similar to projected capacitive Touch Screens, in that touch points are observed by changes in capacitance in the ITO layer. But, these touch points are measured in a very different way. The computer measures the change in capacitance from each corner of the ITO layer, and with these 4 separate measurements, the X and Y coordinates of the touch point are calculated [2].

2.3 Infrared

Infrared technology depends on the IR light grid in front of the display screen. The touch frame or optomatrix frame contains a row of IR-light emitting diodes (LEDs) and photo transistors, each mounted on two opposite sides to create a grid of invisible infrared light. Frame assembly consist of PCB's on which the opto electronics are mounted and which are hide behind a IR-transparent sheet which protects the optos from the operating environment and allows the IR beams to pass through. When user touch the screen one or more of the beams are obstructed resulting in an X and a Y coordinate being sent to the control electronics to indicate the exact touch point. A major benefit of such a system is that it can detect any input including a finger, gloved finger, stylus or pen. It is generally used in outdoor applications and Point-Of-Sale systems.

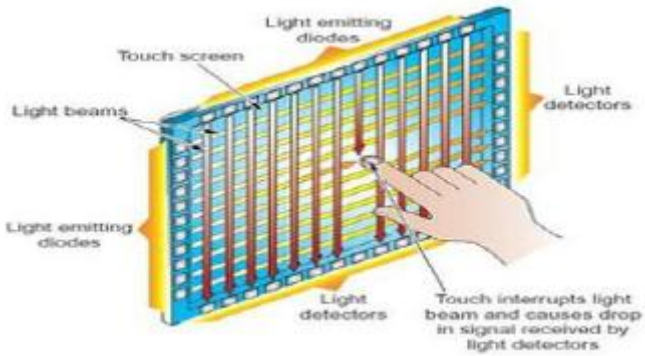

Fig. 4: infrared touchscreen technology [5].

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2.4 Surface Acoustic Wave

The Surface Acoustic Wave (SAW) technology is one of the most advanced Touch Screen types. The technology is based on two transducers (transmitting and receiving) placed on both X and Y axis on the touch panel. It determines touch location by measuring the attenuation of ultrasonic waves across the surface of the glass substrate. SAW is placed on a glass called reflector. The Controller sends electrical signals to transmitting transducer, transmitting transducer converts signal into ultrasonic waves and emit to reflectors that are placed along the edge of panel. Reflector refract waves into recieving transducer, Recieving Transducer convert the waves into electrical signals and send back to the controller. When user touches the screen, the waves are absorbed, causing the touch to be detected at that point. As the panel is made up of glass, so no layers that can be worn, giving this technology highest durability and clarity.

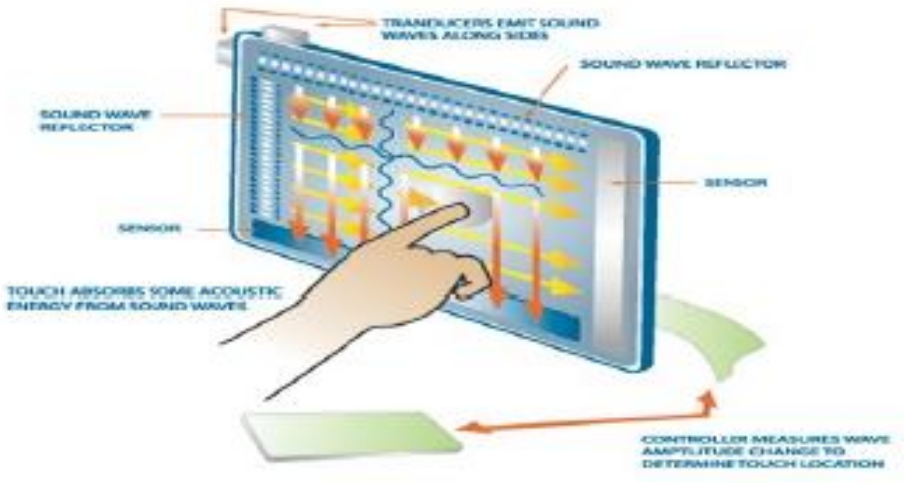

Fig. 5: surface acoustic wave touchscreen technology.

III. COMPONENTS OF TOUCHSCREEN

A basic Touchscreen has three main components: a Touch Sensor, a Controller, and a Software Driver.

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. Basically it provides interactivity of the user or it is a device that detects objects through physical contact with them. The Touch Sensor generally has signal or electric current owing through it. When user touches the screen, the voltage or signal changes, which is used to determine the location of touch on the screen.

2. Controller

Controller is just like an interface or we can say PC card that connects the Touch sensor and the PC. It takes data from the Touch Sensor and translates it into information that PC can understand. It is usually installed inside the monitor or in external plastic case for external touch.

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3. Software Driver

Software Driver tells the computer's operating system how to interpret the touch event information that is sent from the Controller. Some equipment such as DVD do not use Software driver or they have their own built-in drivers.

Fig. 6: components of touch screen [4].

IV. MULTI-TOUCH TECHNOLOGY

Multi-touch is basically a technology which allows users to control graphical interface with several fingers or ability to simultaneously register three or more distinct positions of input touches. These devices are able to accomodate several users simultaneously. Multi-touch technology has been around since early research at the University of Toronto in 1982[6]. The example of Multi-touch Technology is Apple.

4.1 Apple

Apple iPhone allows use of multitouch input, which allows for 15 touches at a time [7]. Apple Corporation is a pioneer in the field of consumer electronics. With their innovative designs, Apple products have been setting new standards to which other technology is compared. Apple revealed iPhone, iPod, iPad which raises the level of telecommunication and multi-touch screen technology. Apple provides superior user interface. There are six main functions of the Apple's multi-touch screen: Single tap to select or activate something, double tap to change the display format, drag and drop to move something, a stroke (swipe or flick) up/down/left/right to scroll, pinching two fingers together to shrink something, and spreading two fingers apart to enlarge something [8].

Fig. 7: apple iphone [9].

V. ADVANTAGES AND DISADVANTAGES OVER OTHER POINTING DEVICES

5.1 Advantages

Touch Screens have several advantages over other pointing devices:

1. Touching a visual display of choices requires little thinking and is a form of direct manipulation that is easy to learn.
2. Touch screens are durable in public access and in high volume usage.
3. Touch screen save space as no keyboard or mouse is required.
4. Touch screens have easier hand eye coordination than mice or keyboards.
5. Touch screens are the fastest pointing devices.
6. Touch screen is ideal for web browsing, picture and movies.

5.2 Disadvantages

1. Touch Screens also have several disadvantages:
2. User's hand may obscure the screen.
3. Cost is more.
4. Touch screen devices require massive computing power which leads to slow devices and low battery life.
5. Touchscreen means screen can't be read too well in direct sunlight.
6. Screens get very dirty.
7. Screens are more prone to scratches.
8. Touchscreen devices usually have no additional keys (see the iPhone) and this means when an app crash, without crashing the OS, you can't get to the main menu as the whole screen becomes unresponsive.

VI. APPLICATIONS

1. Information Kiosks:- Tourism displays, cinema halls uses Touch Screen Technology to provide information to users. They are used by large number of people that have little or no computing experience. The Touch Screen interface is easier to use than other input devices especially for novice users. A Touch Screen is useful to make your information more easily accessible by allowing users to navigate your presentation by simply touching the display screen.
2. Retail Systems:- Nowadays all retail shops uses Touch Screen based billing machine which are easy to use and help them to do their work faster.
3. ATM's:- Most ATM machines use Touch Screen Technology. It allows users to input their information without having to press buttons, which makes ATM use much easier.
4. Nintendo DS:- It is a handeled video game system which has two display screens, the lower used for touchscreen capabilities. Games are played by using a stylus, allowing gamers to move characters, click on items, draw figures and move objects during gameplay, providing a very unique gaming experience.

VII. THE FUTURE OF TOUCHSCREEN

Moving towards the future, consumers will continue to see the growth of the Touch Screen industry, due to extensive engineering advancements in user interfaces. Nippon Electric Company, Limited (NEC) is a Japanese multinational provider of information technology (IT) services and products is attempting to develop a Touchscreen that has texture on the screen. One example of this is that you would be able to feel the thickness of the folders that you are trying to move or copy. A textured Touchscreen on the dashboard in cars would be a useful place. We could feel the movement of whatever we were trying to do without taking our eyes off the road [10]. Nowadays Touchscreens, it doesnt matter how fast we move our finger or how hard we push down; the movement is the same, but research is going on to develop a new device that recognizes the intensity or pressure applied by our finger, and adjusts the movement accordingly. For example, if we are using a book reader, we can use more pressure to scroll through the pages faster. We can also fast forward or reverse through a song or playlist on our music device [10]. It won't be long before keyboards and mice are a thing of the past and the greatest piece of equipment is our own fingers.

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