Different paradigm for Touch-Screen technology: A Survey

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Abstract— **Touch, the present giant ruling the world. One may think how touch is focused on all aspects. Traditionally, people used to work on keypad type systems by pressing hard buttons, but as the days and time progresses the user needs increasing in a huge demand for so it required of doing work in quick and efficient manner. My point in this paper is to describe that how touch evolved from past to present and even to future where the different types of touch-screen technology available in the market. At the present and forth coming generation, the world totally can be composed of unified modeling visualization. So the future is about the *"Technology adopting the user, rather than the user is adopting to the technology"*. As many applications can be run on the touch-screens which provides user-friendly and quick access to known and unknown user. This technology makes users to quickly operate computers without any usage of external devices like mice, keyboards. So, the touch screen is the adaptive technology for the users having the difficulty with carrying of mice, keyboards and external devices.**

Keywords: **Touch-screen technology, Capacitive, Resistive, Surface Wave Acoustic and Infrared touch types.**

1. Introduction

In the past earlier centuries ago for doing certain work on machines it required lots of manpower. Many people have worked on a single computer where it is located on a large room merely acting as a server. As the days approaching the large computer turned to be a PC (personal computer) which is sophificated to everyone usage. PC mainly used for business life, everyone's daily-life activities like Gaming, Entertainment, Official work usage. And within the spot time other hand-held devices which were interacted with the people. The touch when Existed in market had been merely driven up of keypad interaction with people because of its flexibility, rich efficiency and usability. Basically, the computer trends to be changing from centuries to centuries. So, in 1960's there has been a computer era on Mainframes (one computer per many users), in 1980's it has Personal computer (PC) per one user. And in 2000s it has risen up to Mobility era per user i.e., where you go the handheld made computer will be in your hands and so for the next approaching years it will be of Ubiquity era(Pervasive computing) on 2020 and beyond it means of Thousands of computers per single user.

The following figure give a clear depict on computer era trending to modern world.

2.Literature Survey

A touch screen works on the principle of creating the Total Internal Reflection. A voltage drop created on the glass panel where the glass panel acts as a conductor which is situated above the internal layer.

$$C = \frac{\varepsilon_0 . \varepsilon_r . R}{t}$$

Where C is the capacitance R is the common region between two electrodes (i.e., in between user finger/air/palm and the sensor), t is the distance between two electrodes, ε_0 is the free space permittivity which is equal to 8.85*10e-12 F/m (constant) and ε_r is the dielectric relative permittivity.

3.Components of Touch-screen:

Basically to work with touch-screen the following principles are essential which are as follows:

Touch sensor: A touch sensor which detects the physical entity (as input) and converts it to electronic format. It is a glass panel which is a touch responsive that made up of with Resistive or Capacitive or Surface Wave Acoustic or Infrared. These touch sensor is generally placed above the display area where responsiveness can be created. Since, sensors have the electrical energy which draws the voltage drop whenever a physical object touches.

Controllers: It is a hardware chip that supplies the power to touch screens. It is a small PC card which connects the touch sensor and PC that used to make communication between them. It forms an interface between peripheral devices. Usually it installed inside touch monitor.

Software Driver: It is the software which enables the touch system to interact with computer. In instance, it accepts the data from controller and performs calculations to move the cursor on display.

Fig.: Components of a Touch screen

1. Touch sensor 2. Controller 3. Software Driver

4. Types of Touch-screen technology:

Since to monitor person's touch there are 4 common types such as:

4.1 Resistive touch type: Here the touch panel is being covered up with two layers of resistive flexible sheets which are coated with resistive material. It consists of two different layers the first one is of Matrix digital type where it forms the mechanical X-Y plane. It is formed with flexible layer at top and ITO conductive layer at bottom makes contact each other when object touches which forms a shot-circuit. The next type is Analog which consists of flexible layer exposed to user and rigid layer, a bottom layer coated with Indium Tin Oxide (ITO) and these are separated by microdots/air. So pushing an object makes contact each other which results to the shot-circuit. The touch events can be notified by controller and perform calculations which sends to software driver. It is well suited to small application making as for the Hand-writing recognition, PDAs and Media players and point-of-scale. Further it requires of less Integrity efficiency (takes less no. of cycles for embedded system design) to create these applications. But, this technology does not rely on organic parts of human body and it is based on pressure adoption where the user needs to apply high pressure to work on it the things like Stylus, glove of fingers are used. The resistive touch type also works on multi-touch with the advent of 4-wire, 8-wire, 6 -wire and 5-wire technology. The only thing is that this does not work for making larger application development because it reduces image clarity and lack of precision quality due to extra overlays that it has.

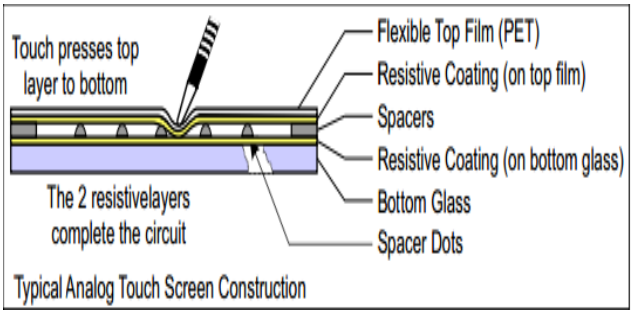

Fig: Resistive touch display

4.2 Capacitive touch type:

Here the capacitive touch panel is being made up of insulator where it is coated with transparent conductor like the indium tin oxide (ITO) to store the electrical energy. A small amount of current is running across the display and a circuit is formed whenever human finger is touched which results to a voltage drop created at the point of contact. The touch coordinate is calculated from differential frequency change of four oscillators provided at each corner of touch panel. The circuit at corner stores the capacitance which then sends to controller for processing of information. It can be composed to Surface capacitive and Projected capacitive where the projected capacitive has the layer made up of numerous electrodes forming a matrix format. The surface is covered with up of insulating glass panel and a voltage drop is created whenever a touch interrupts the surface. Basically, this used to make up of small device touch panels such as iPhone, iPad, iPods touch and Smartphone. While the projected capacitive used to make up of larger applications like ATMs, computer kiosks. So, compared to resistive it has quick responsiveness and high clarity of images and further no need to apply more pressure as it works on light weight interfaces. Vendors like Apple and Smart phone makers use this technology due its support at harsh environment.

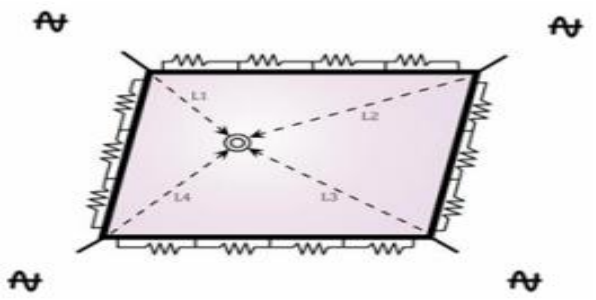

Fig: Capacitive touch display

4.3 Surface Wave Acoustic (SAW) type:

This technology consists of glass overlay of transmitting and receiving transducers on the surface which are placed on either side of X and Y axis. When an object touches on the surface the electrical signals are sent to transducer which then converts it into ultrasonic waves. The waves are directed across the screen by reflectors which are received by other end of transducer which forms grid portion resulting to X-Y coordinate plane. The touch interrupts the invisible waves to reflect each other to create touch event. The controller responsible for sending electrical energy to transducer then the transducer converts signal to ultrasonic waves that reflect to other side of transducer. After reflection, the refracting waves for the receiving transducer then converts the waves into electrical signal. Compared to resistive and comparative touch type, this shows more clarity of images and further it is well-suited for large industry appliances due to its excellent durability. This is the modern touch technology used in ATMs, Traffic management controller, Banking & Finance, Gaming environments, Military applications, Computer kiosks etc.

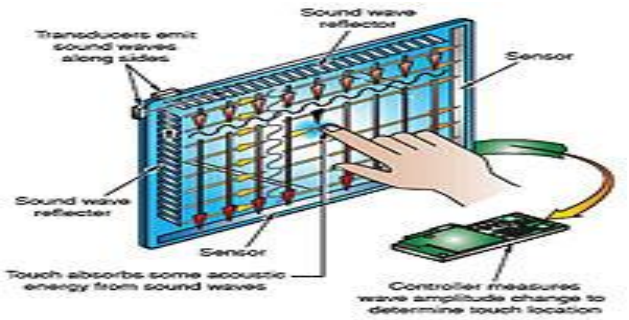

Fig: SAW touchtype.

4.4 Infrared LED/Optical touch type:

This is based on light-beam rays. A touch frame is surrounded across display where each row and the column have the LEDs and Light detectors which placed on edge/corner where LED beam rays are crossing each other in horizontal and vertical alignment creating an optical grid pattern across the display. Whenever an object touches the panel the invisible light is interrupted which then causes a voltage drop. The cameras (light-detectors) observe the absence of light and controller able to calculate the coordinate values from the camera dots. Compared to previous type, this is well-suited for harsh environment as it has very high optical clarity and can be scalable to large applications. The only thing is to keep the cameras properly as depending on the context they align out of order.

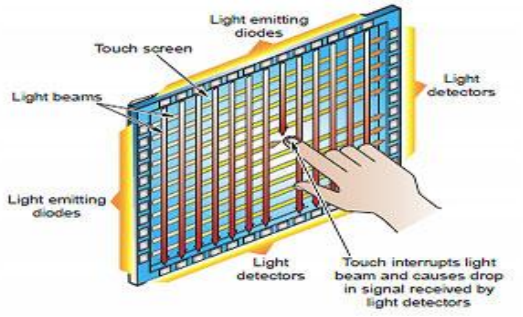

Fig: Infrared touch type

5.Advantages and Disadvantages over the pointing devices:

Advantages:

[1] Provides quick efficiency i.e., gets fast responsiveness
[2] Easy to learn and manage things to known and unknown users.
[3] Adoption to this environment is very easy.
[4] Increased speed up work and time saving.

Disadvantages:

[1] Cost effective, as it requires for developing the equipment.
[2] Should be careful as it not much exposure to dirt environment.
[3] Reducing of battery life as it requires more computing power.

Properties\Type	Resistive	Capacitive	SAW	Infrared
Touch	Anything	Finger	Finger/Pen	Finger/Pen
Dust environment	Workable	Not workable	Not Workable	Not workable
Durability	3 years	2 years	5 years	5 years
Waterproof	Yes	Yes	No	Yes
Pressure applied	More	Less	Normal	Less
Multi-touch support	Yes	Yes	Yes	Yes
Response time	<15ms	<15ms	10ms	<20ms
Speed	Good	Good	Normal	Good
Transparency	Bad	Normal	Good	Good
Monitor option	LCD/CRT	LCD/LED/CRT	LCD/CRT	LCD/CRT
Cost	Low	Low	High	High
Image clarity	Low	Moderate	High	High
Advantages	Low cost, Support to humid environment, Hand-writing recognition	Moderate cost, Quick responsiveness, Visible to sunlight.	Image clarity, Excellent durability	High clarity and light transmission, Power dissipation, Security
Disadvantages	High pressure to be applied, Reduction of visibility in sunlight	Not accuracy as resistive type, Sensitive to humid environment	Cost expensive, Easily damages to external environments	Sensitive to dirt environment, parallelax problem, Speed
Applications	PDAs, Media players, Portable devices	Smartphone, PDAs	ATMs, Gaming environments	Home security systems, Augmented communication system
Examples				

6. Conclusion and Future scope

As technology growing on the evolution of touch is essential. It is quite easy to learn, navigate to known and unknown users. It presents the simplicity and user-friendly having with its flexibility of touch user-interface. Now, at present Smartphone, laptop maintaining this facility to use their product more user friendly. Apps like Gaming, Maps designed to support in Smartphone, this would help for users actually they were involved with them but they are logically connected. The problem with touch display is fingerprints but even though the problem can be solved through use of optical coating. Although now at this point these technology being facing with continuous feedback i.e., a initial touch point not exactly reflected when it is done multiple points. Researchers now continuing their growth of study at more and more touch technologies to work out on multi-touch support and ability to provide high resolution touch screen. So, in future the touch makes more beneficial so that you can do your work and catch all the things around you. Like the common application used by Surface computer used in Restaurants where the user can order their food at table and also make payment through credit card laying on the touch surface. The optimistic goal of future is to enhance usage of technology with low cost and high efficiency. Compared to resistive, capacitive, SAW and infrared LED touch types the resistive and infrared touch types are better which are efficient to durability of touch panel and supports to harsh environment when compared to SAW so no matters when you work on the dust, dirt and stream of water imposed on. If you compare with capacitive you would observe they are resistant to chemicals and the screen can easily broke down. For instance, if you look at these two technologies, the infrared is better option as it provides the excellent image clarity and more accurate than the resistive touch type.

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