

Touch Screen Computer Displays

Introduction

When most people think about a computer display, many may develop a mental picture of an output device. However a computer display can function as both an input device and an output device. A touch sensitive screen provides a computer user with an input interface that doesn't require extensive computer skills or literacy. This interface, operates as a pointing device, much like a mouse or an input device much like a keyboard. Touch screen add-ons and displays with integrated touch screen technology are widely available and in use in many facets of society.

During a recent visit to the Bob Bullock State History Museum I had the pleasure of watching a small child of about four years of age explore Texas history with the use of a touch screen computer display. He easily explored and navigated through the screens without needing mouse or keyboard skills. The following week as I moved about the University of Texas at Austin campus I noticed the use of touch screen computer displays and my interest in this technology was triggered. Even the state government has begun making use of kiosks with touch screen computer displays. As part of the National Partnership for Reinventing Government's Hassle-Free Communities Initiative, the State of Texas has installed interactive kiosks that provide over 150 government services with a quick touch. The kiosks, which are installed in malls, community centers and in government buildings, are an effective method of bringing government services to the people of Texas in an easy to use interactive format without the need for computer literacy. Liz Salih a regional coordinator for the initiative reports that the system



receives hit at all hours of the night and that kiosks systems have far exceeded expectations.

This technology was originally developed and invented for use by physicians whose keyboarding skills were lacking. However, touch screen computer displays are now found throughout society. They can be found in use as public information displays, retail and restaurant systems, computer-based training systems, customer self-service aids, control and automation systems, assistive technology for the disabled, and as tourism kiosks.

Significance

With the higher cost, when compared to standard computer monitors, their need for special software and their vulnerability to outside element damage, what are the advantages of using a computer display touch screen system? Touch screen systems are easy to use for the non-computer literate, and are easy to see for the visually-impaired. For the motor-impaired, a touch screen may be the gateway to communication skills. To accommodate the limitations of a touch screen system, changes must be made to the appearance of screens. Often button sizes must be increased to insure successful targeting of the touch event. Additionally active regions of the buttons are expanded so to dead space exists. Font size is typically also increase to accommodate reduced light transmission present in some systems. Toggle buttons are favored over check or radio buttons to avoid confusion over where to touch the screen. Finally a delay is built into button responses to that multiple touches are treated as single touches. A forced delay after a touch event causes the program to ignore multiple touches.

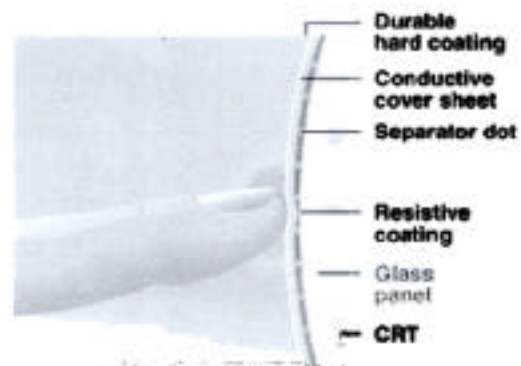
With each advantage of using a touch screen system, a disadvantage also exists and a purchaser must carefully weigh the pros and cons for the system in question. The

following discussion provides a brief insight into the technical aspects of each of the three types of touch screen systems followed by a brief comparison.

Discussion

Touch screen computer displays are available in three basic systems that allow the monitor to detect a person's touch: resistive, capacitive, and surface acoustic wave. A resistive system consists of a several layers that detect and register the location of the touch. The outermost layer is a durable hard coating to protect the more delicate touch sensors and is followed by a glass plate that contains both resistive and conductive properties. This semi-flexible glass plate that is coated with a metallic layers to provide conductance and resistance, each metallic layer is separated with spacers. When the screen is touched, the touch pushes the conductive layer against the resistive layer making an electrical contact. Voltages are then produced as the analog representation of the position touched

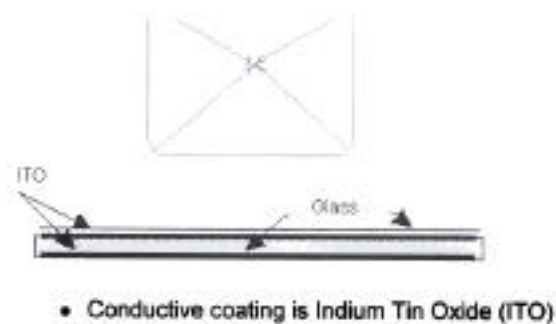
Therefore registering the location of the touched position on an x and y coordinate system. A touch can be made by fingers, a stylus, fingernails, or any pointing device as



long as the conductive and resistive layers are able to make contact. An averaging algorithm is present in the driving software to eliminate noise from contact bounce and produce a clear, detectable signal. Personal digital assistants (PDAs) commonly utilize resistive technology.

Capacitive systems also operate through a systems of layers on the display screen. The layering system is one in which electrical charge is stored. When a use touched the

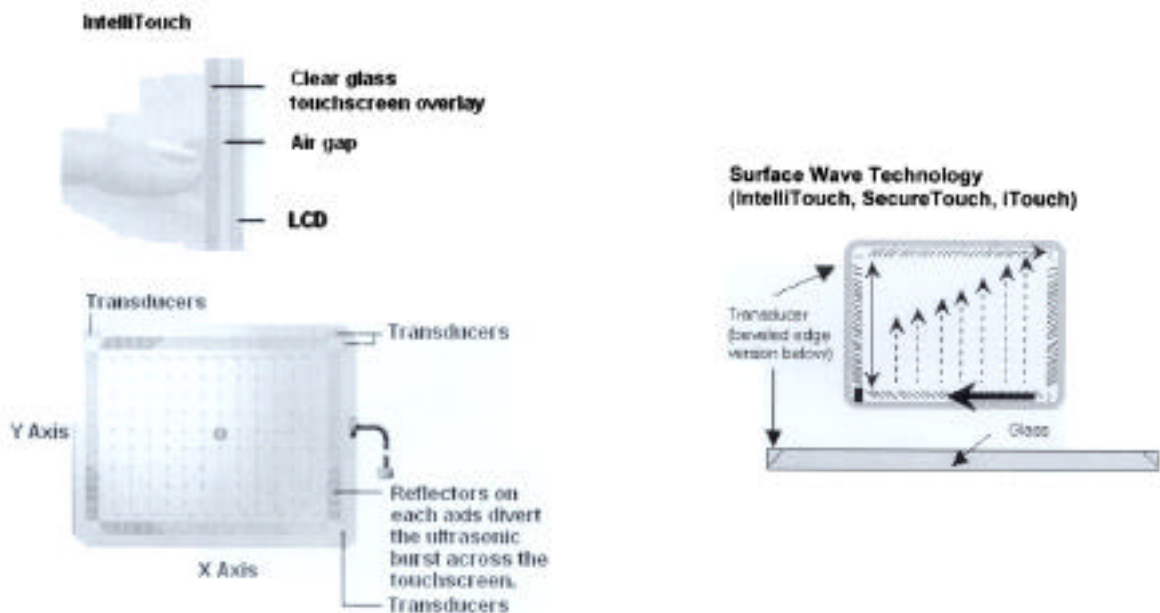
display screen, some of the charge is transferred to the user therefore decreasing the charge on the capacitive layer. The computer software driving the touch screen system calculated the position of the touch from relative differences in charge at each corner. The capacitive system produces a clearer picture over the resistive system due to the decreased number of required layers over the actual screen. The capacitive system can transmit 90% of the light while the resistive system only transmits 75%. The decrease in light transmission is the result of metallic resistive and conductive coatings. A conductive input must be used to touch the screen and register a location. Fingers are ideal.



The third type of touch screen computer monitor system is the surface acoustic wave. The surface wave system consists of two transducers (one receiving and one sending) which are placed along the x and y axes of the glass plate. Reflectors are also placed on the glass plate to reflect the electrical signal between the two transducers. The receiving transducer is able to detect a touch event by the disruption of the ultrasonic wave between the two transducers and can therefore locate the event on the x-y coordinate plane. Each of the points on the x or y axis has a transmitting and receiving

piezoelectric transducer and a set of reflectors. The system controller send a five-megahertz signal to the transmitting transducers that convert the electrical signal into a surface acoustic wave. Surface acoustic waves are mechanical waves that propagate in the surface materials of the glass plate. The reflector strips divert the burst to establish a uniform acoustic wave energy across the surface of the computer display screen. When a pointing device comes into contact with the computer display surface, the pointing device absorbs some of the wave resulting in a change in the received signal. The change in the signal is analyzed and digitized into x-y coordinated locating the position of the touch.

The surface of the acoustic wave system produces a perfect image and is therefore the best for displaying detailed graphics. The 100% transmission of light is accomplished due to the lack of metallic layers such as those found in the previously described systems. Any type of object can register a touch event, although small sharp object, such as pen tips should be avoided.



Summary

All three types of computer display touch systems offer their advantages and disadvantages in comparison. As previously stated, the resistive system, due to its metallic coated layers, decreases light transmittance and the image is not optimally clear. The capacitive system also reduces the amount of transmitted light, 90% as compared to 75%, again due to its metallic coated capacitive layer. An additional image distortion is present in both systems due to the presence of metal particles is the production of a yellow tint. The yellow tint is most obvious with white and light colored objects.

Due to the high traffic nature of their use, the durability of the computer display touch screens is another area of comparison one should consider when considering a purchase. The surface of the surface wave system has a Mohs' hardness rating of 7 while the resistive and capacitive systems average a Mohs' hardness rating of 5. The higher the Mohs' hardness rating, the more durable the surface. Capacitive and resistive systems are sensitive to scratches which can produce non-linearity. The screen durability of the surface acoustic wave system is such that razor blades can be used to remove paint on the display surface.

Environmental elements can also impact the durability of the touch screen computer displays. If the display systems are to be located outside a building, the presence of water can be a critical issue. Although digital mapping can accommodate and learn around water droplets, spilled liquids must be wiped up/removed for proper function to occur with the surface acoustic wave system. The presence of water in either

the capacitive or resistive system can cause the electrical nature of these systems to fail even beyond the point of repair.

The surface acoustic wave system is the most costly, although it does produce the most clear and undistorted image. Additionally, due to its lack of layering it is the most durable and best suited to high use public-access applications and out-of-door applications.

As computers become more common in everyday society and as society demands increased access to information, touch screens may become the entry point to the world of increased information availability. Additionally, as visually and motor-impaired members of society are recognized for the value to society, touch screen technology will allow them access to job skills and life skills that they were previously denied.

Computer system designers must carefully weigh the pros and cons of each available system and design for the needs of the users.

Related Links

<http://www.touchescreens.com>

<http://www.howstuffworks.com>

<http://www.elotouchsystems.com>

<http://www.troll.com>

References

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Lunney, Kellie. (February 24, 2000). Texans get touch-screen access to government. GovEXEC.com.

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This paper is written by Anna Bergstrom for the course EDC385G Multimedia Authoring at the University of Texas at Austin.