MULTIPOINT TOUCHSCREEN

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of U.S. patent application Ser. No. 10/840,862, filed May 6, 2004 now U.S. Pat. No. 7,663,607, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to an electronic device having a touch screen. More particularly, the present invention relates to a touch screen capable of sensing multiple points at the same time.

2. Description of the Related Art

There exist today many styles of input devices for performing operations in a computer system. The operations generally correspond to moving a cursor and/or making selections on a display screen. By way of example, the input devices may include buttons or keys, mice, trackballs, touch pads, joy sticks, touch screens and the like. Touch screens, in particular, are becoming increasingly popular because of their ease and versatility of operation as well as to their declining price. Touch screens allow a user to make selections and move a cursor by simply touching the display screen via a finger or stylus. In general, the touch screen recognizes the touch and position of the touch on the display screen and the computer system interprets the touch and thereafter performs an action based on the touch event.

Touch screens typically include a touch panel, a controller and a software driver. The touch panel is a clear panel with a touch sensitive surface. The touch panel is positioned in front of a display screen so that the touch sensitive surface covers the viewable area of the display screen. The touch panel registers touch events and sends these signals to the controller. The controller processes these signals and sends the data to the computer system. The software driver translates the touch events into computer events.

There are several types of touch screen technologies including resistive, capacitive, infrared, surface acoustic wave, electromagnetic, near field imaging, etc. Each of these devices has advantages and disadvantages that are taken into account when designing or configuring a touch screen. In resistive technologies, the touch panel is coated with a thin metallic electrically conductive and resistive layer. When the panel is touched, the layers come into contact thereby closing a switch that registers the position of the touch event. This information is sent to the controller for further processing. In capacitive technologies, the touch panel is coated with a material that stores electrical charge. When the panel is touched, a small amount of charge is drawn to the point of contact. Circuits located at each corner of the panel measure the charge and send the information to the controller for processing.

In surface acoustic wave technologies, ultrasonic waves are sent horizontally and vertically over the touch screen panel as for example by transducers. When the panel is touched, the acoustic energy of the waves are absorbed. Sensors located across from the transducers detect this change and send the information to the controller for processing. In infrared technologies, light beams are sent horizontally and vertically over the touch panel as for example by light emitting diodes. When the panel is touched, some of the light beams emanating from the light emitting diodes are interrupted. Light detectors located across from the light emitting diodes detect this change and send this information to the controller for processing.

One problem found in all of these technologies is that they are only capable of reporting a single point even when multiple objects are placed on the sensing surface. That is, they lack the ability to track multiple points of contact simultaneously. In resistive and capacitive technologies, an average of all simultaneously occurring touch points are determined and a single point which falls somewhere between the touch points is reported. In surface wave and infrared technologies, it is impossible to discern the exact position of multiple touch points that fall on the same horizontal or vertical lines due to masking. In either case, faulty results are generated.

These problems are particularly problematic in tablet PCs where one hand is used to hold the tablet and the other is used to generate touch events. For example, as shown in FIGS. **1**A and **1**B, holding a tablet **2** causes the thumb **3** to overlap the edge of the touch sensitive surface **4** of the touch screen **5**. As shown in FIG. **1**A, if the touch technology uses averaging, the technique used by resistive and capacitive panels, then a single point that falls somewhere between the thumb **3** of the left hand and the index finger **6** of the right hand would be reported. As shown in FIG. **1**B, if the technology uses projection scanning, the technique used by infra red and SAW panels, it is hard to discern the exact vertical position of the index finger **6** due to the large vertical component of the thumb **3**. The tablet **2** can only resolve the patches shown in gray. In essence, the thumb **3** masks out the vertical position of the index finger **6**.

SUMMARY OF THE INVENTION

The invention relates, in one embodiment, to a touch panel having a transparent capacitive sensing medium configured to detect multiple touches or near touches that occur at the same time and at distinct locations in the plane of the touch panel and to produce distinct signals representative of the location of the touches on the plane of the touch panel for each of the multiple touches.

The invention relates, in another embodiment, to a display arrangement. The display arrangement includes a display having a screen for displaying a graphical user interface. The display arrangement further includes a transparent touch panel allowing the screen to be viewed therethrough and capable of recognizing multiple touch events that occur at different locations on the touch sensitive surface of the touch screen at the same time and to output this information to a host device.

The invention relates, in another embodiment, to a computer implemented method. The method includes receiving multiple touches on the surface of a transparent touch screen at the same time. The method also includes separately recognizing each of the multiple touches. The method further includes reporting touch data based on the recognized multiple touches.

The invention relates, in another embodiment, to a computer system. The computer system includes a processor configured to execute instructions and to carry out operations associated with the computer system. The computer also includes a display device that is operatively coupled to the processor. The computer system further includes a touch screen that is operatively coupled to the processor. The touch screen is a substantially transparent panel that is positioned in front of the display. The touch screen is configured to track multiple objects, which rest on, tap on or move across the touch screen at the same time. The touch screen includes a