DUAL SENSOR TOUCHSCREEN UTILIZING PROJECTIVE-CAPACITIVE AND FORCE TOUCH SENSORS

This application is filed simultaneously with U.S. patent application Ser. No. 09/390,207 entitled TOUCH CONFIRMING TOUCHSCREEN UTILIZING PLURAL TOUCH SENSORS, the disclosure of which is incorporated herein for all purposes.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to touchscreens and, more particularly, to a method and apparatus for discriminating between a false touch event and a true touch on a touchscreen.

BACKGROUND OF THE INVENTION

Touchscreens are used in conjunction with a variety of display types, including cathode ray tubes (i.e., CRTs) and liquid crystal display screens (i.e., LCD screens), as a means of inputting information into a data processing system. When placed over a display or integrated into a display, the touchscreen allows a user to select a displayed icon or element by touching the screen in a location corresponding to the desired icon or element. Touchscreens have become common place in a variety of different applications including, for example, point-of-sale systems, information kiosks, automated teller machines (i.e., ATMs), data entry systems, etc.

A variety of touchscreen types have been developed. Unfortunately each type of touchscreen has at least one weakness limiting its usefulness in at least some applications. For example, the cover sheet in a resistive touchscreen is susceptible to damage such as surface scratches or cuts due to malicious vandalism. Even repeated screen compressions may eventually damage a resistive touchscreen. This type of touchscreen is also susceptible to environmental damage, for example moisture entering the display. A second type of touchscreen, thin dielectric layer capacitive touchscreens, have problems with gloved hands. Thick dielectric layer capacitive touchscreens, also referred to as projective capacitive touchscreens, have problems with non-tactile feel and palm rejection. A third type of touchscreen utilizing surface acoustic waves is susceptible to the accumulation of contaminants, e.g., raindrops, on the surface of the sensor. Contamination can also interfere with the operation of infrared touchscreens. Also infrared touchscreens require special effort to avoid signal problems due to direct sunlight. A fifth type of touchscreen using force sensors is susceptible to shock and vibration.

Various systems have been designed that utilize two different touchscreen technologies for a variety of purposes, primarily as a means of accommodating different touch mechanisms, e.g., a finger and a stylus, for data entry.

U.S. Pat. No. 5,231,381 discloses a multi-purpose data input device utilizing an integrated touchscreen and a digitizing tablet. The touchscreen detects the presence and location of a passive input (e.g., finger touch) through any of a variety of techniques including surface acoustic wave, force, capacitive, or optical touch sensors. The digitizing tablet employs an active stylus mechanism to stimulate a capacitive, inductive, or surface acoustic wave sensor.

U.S. Pat. No. 5,510,813 discloses a touch panel that measures both touch position and touch force. The touch panel uses a resistive, conductive layer and determines touch position by monitoring the current pattern. The force of the touch is determined by monitoring a capacitance value between the touch panel and a second conductive panel that extends substantially parallel to the touch panel. In response to a touch, the system processes both the detected position and the detected force of the touch.

U.S. Pat. No. 5,543,589 discloses a dual sensor touchscreen in which each sensor determines touch position, but with a different resolution. The two sensors are sandwiched together to form a single sensor, thus allowing a single touch by a finger, stylus, etc. to be detected by both sensors. In use, the wide conductors of the low resolution sensor are first scanned in order to determine touch position to within a rectangular area the size of one wide conductor. To determine the touch location with the higher resolution sensor, only the narrow conductors corresponding to the rectangular area of touch determined with the low resolution sensor must be scanned. Thus the system disclosed is intended to reduce the number of scan drivers and receivers required, thus lowering cost as well as speeding up the scanning process.

U.S. Pat. No. 5,670,755 discloses a touch panel that can be used in either of two modes. In one mode, the touch panel operates like a conventional touchscreen, allowing a user to input information by touching the screen with a finger, pen, or other touching medium. In this mode two resistive layers applied to the panel come into contact at the point of touch. The determination of the contact location is based on resistance ratios. In a second mode, the touch panel functions as a digitizer using a specially designed stylus. Capacitance coupling at the contact point of the stylus to the panel is used in determining the contact point.

U.S. Pat. No. 5,777,607 discloses a system that senses finger touch capacitively and stylus touch resistively. In either touch mode the disclosed system is able to determine the x- and y-coordinates of the touch on the touchscreen using a single resistive layer. In the preferred embodiment, the finger detection mode is disabled when the system detects the stylus is in use, thus preventing the inadvertent input of data through capacitive coupling with the user's hand.

U.S. Pat. No. 5,801,682 discloses a dual sensor touchscreen in which the variations in coordinate data from a capacitive sensor are compensated for by the use of strain gauges mounted at the comers of the sensor. Variations in the capacitive sensor data may result from changes in signal path, for example, due to the user wearing gloves.

What is needed in the art is a method and apparatus for discriminating against false touches of the sort that may result from external stimuli or for confirming the presence of touch. The present invention provides such a method and apparatus, a method and apparatus that is particularly well suited for outdoor applications.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for discriminating against false touches in a touchscreen system. The system utilizes multiple touchscreen sensors of differing types to validate a touch on a touchscreen. Thus the invention utilizes the strengths of specific sensor types to overcome the deficiencies of other sensor types, particularly with respect to the demands of outdoor and semi-outdoor applications where supervision is limited and rain drops and/or other contaminants may be present.

The basis of the invention lies in the ability to confirm a touch registered by one touch sensor with another touch sensor. If the touch is confirmed, the touch can be acted