TOUCH INPUT SENSING DEVICE

FIELD OF THE INVENTION

[0001] This invention generally relates to sensing devices. The invention is particularly applicable to capacitive sensing devices.

BACKGROUND

[0002] Touch screens allow a user to conveniently interface with an electronic display system by reducing or eliminating the need for a keyboard. For example, a user can carry out a complicated sequence of instructions by simply touching the screen at a location identified by a pre-programmed icon. The on-screen menu may be changed by re-programming the supporting software according to the application. As another example, a touch screen may allow a user to transfer text or drawing to an electronic display device by directly writing or drawing onto the touch screen.

[0003] Resistive and capacitive are two common touch sensing methods employed to detect the location of a touch input. Resistive technology typically incorporates two transparent conductive films as part of an electronic circuit that detects the location of a touch. Capacitive technology, on the other hand, typically uses a single transparent conductive film to detect the location of an applied touch.

[0004] A characteristic of a touch screen is the touch implement. Capacitive touch sensors generally require a conductive stylus such as a user's finger. Resistive type touch sensors, on the other hand, can generally detect a touch applied by both a conductive touch implement, such as a user's finger, and a non-conductive stylus, such as a user's fingernail.

[0005] Another characteristic of a touch screen is durability. A touch implement can scratch or otherwise damage a touch sensor, thereby reducing the touch accuracy of the sensor or even rendering the device nonfunctional.

[0006] In a capacitive touch sensor, the transparent conductive film is often deposited on an insulating substrate and can be covered with a thin dielectric coating to protect the conductive film from damage. The thin dielectric coating, however, is very thin, typically no more than one micron in thickness and therefore, may not sufficiently protect the conductive film from damage that can be caused by, for example, a sharp touch implement. A thicker dielectric coating can increase manufacturing cost and can generally reduce the coating quality by introducing stress-related cracks and cosmetic defects in the coating. Furthermore, abrasion of the thin dielectric coating under normal use can result in thickness variation in the thin dielectric coating. Such variation can affect touch accuracy and result in undesirable visible cosmetic defects. Therefore, there remains a need for capacitive touch screens with improved durability and overall performance.

SUMMARY OF THE INVENTION

[0007] Generally, the present invention relates to sensing devices. The present invention also relates to methods of sensing.

[0008] In one aspect of the invention, a capacitive touch sensor includes a conductive film that covers a touch sensitive area. The touch sensor further includes a self-supporting flexible glass layer disposed on the conductive film. The touch sensor further includes electrical circuitry configured to detect a signal induced by capacitive coupling between the conductive film and a touch input applied to the flexible glass layer. The signal is used to determine the touch location.

[0009] In another aspect of the invention, a capacitive touch sensor includes a conductive film disposed between and optically coupled to a self-supporting flexible glass film and a substrate. The capacitive sensor further includes electronics configured to determine location of a touch input, applied to the flexible glass layer, by detecting a signal induced by capacitive coupling between the conductive film and the touch input.

[0010] In another aspect of the invention, a capacitive touch sensor includes a conductive film that covers a touch sensitive area. The touch sensor is capable of detecting two or more distinct touch locations within the touch sensitive area. The touch sensor further includes a glass layer disposed on the conductive film. The glass layer has a thickness in the range of 0.1 to 2.0 mm. The touch sensor further includes a controller configured to detect a signal induced by capacitive coupling between the conductive film and a touch input applied to the glass layer. The signal is detected at a plurality of positions on the conductive film and is used to determine the location of the applied touch input.

[0011] In another aspect of the invention, a method of determining location of a touch input to a touch sensor includes the step of capacitively coupling the touch input to a conductive film that covers a touch sensitive area. The capacitive coupling occurs through a self-supporting flexible glass layer disposed over the conductive film. The method also includes the step of detecting a signal induced by the capacitive coupling. The method further includes the step of using the detected signal to determine the touch location.

[0012] In another aspect of the invention, a method of determining a touch location includes the step of defining a touch sensitive area that includes a self-supporting glass layer disposed on a transparent conductive film. The method further includes the step of detecting a signal that is generated in response to a capacitive coupling between the conductive film and a touch input applied to the glass layer. The method also includes the step of using the detected signal to determine the touch location.

[0013] In another aspect of the invention, a touch display includes a display substrate. The touch display further includes a flexible glass layer disposed on the display substrate. The flexible glass covers a touch sensitive area. The touch display further includes an active display component and an electrically continuous optically transparent conductive film disposed between the display substrate and the flexible glass layer. The display component and the conductive film cover the touch sensitive area. A location of a touch input applied to the flexible glass layer is determined by detecting a signal induced by capacitive coupling between the conductive film and the touch input.

BRIEF DESCRIPTION OF DRAWINGS

[0014] The invention may be more completely understood and appreciated in consideration of the following detailed