TOUCH SENSOR AND METHOD FOR OPERATING A TOUCH SENSOR

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field

[0002] The present application relates to an apparatus for touch detection, a touch sensor, a touch sensitive display, a multimedia device with a touch sensor as well as a method for operating such an apparatus.

[0003] 2. Discussion of Related Art

[0004] Personal computers and multimedia devices as well as communication devices provide for a user interface (UI) for interacting with a user. The user interface allows the user for operating the device according to his needs. In order to operate the device via the user interface, input means need to be provided. Through these input means, users can input information such as simple operation instructions as well as letter and digits.

[0005] One kind of input devices known in the art are touch panels, which are known to be simple, easy to carry, reliable, and capable of inputting simple operating instructions as well as letters and digits. Different kinds of touch panels are known, for example resistive type touch panels, capacitive type touch panels, electro magnetic type touch panels, optical or acoustic type touch panels.

[0006] Resistive type touch panels provide for detecting a voltage gradient using an electrode arranged on an upper substrate or a lower substrate of two spaced conductive layers.

[0007] Capacitive type touch panels allow for detecting the location of a touch point based on a voltage change created, when an upper substrate having a conducting layer of an equipotential plane is in contact or in proximity with a conductive piece, i.e. a user's finger or a conductive stylus pen.

[0008] Electro magnetic type touch panels detect the location of a touch point by measuring induced currents within a coil of electronic stylus pen.

[0009] Using capacitive type touch panels is limited to input devices, which are conductive. Stylus pens, which are not conductive, do not allow inputting information into a capacitive type touch panel. Resistive type touch panels usually are intended for usage with a stylus pen, as their resolution is high and operating these with a user's finger might provide for imprecise inputs. Further, resistive type touch panels require higher forces for sensing a point of contact, which reduces the use by fingers and gives advantage to the use by a stylus pen.

SUMMARY

[0010] To provide for an easy-to-use, multi-purpose input device, the application provides for an apparatus with a first conductive layer with first and second electrodes, a second conductive layer with third electrodes, a spacer spatially spacing the first conductive layer from the second conductive layer, the first electrode being arranged at least for capacitive touch detection, and the second and third electrodes being arranged for resistive touch detection.

[0011] It has been found that combining capacitive and resistive touch detection increases the use cases of touch sensors. Resistive touch detection provides for support of a pen use, gives a good resolution for the detected point of contact and provides for force recognition. For example, the point of contact can be located with a high spatial resolution. Further, the force by which the first and second conductive layers are pressed together can be approximated. Capacitive touch sensing provides for sensing multi-touch. Further, it is not necessary to come into physical contact with the first conductive layer, as proximity detection is possible. Proximity detection allows for sensing conductive pieces, such as fingers, in the spatial proximity of the first conductive layer, as already the spatial proximity causes a capacitive sensor sensing a change in the electrical potential. Further, as capacitive touch detection requires only little or even no force applied on the first conductive layer, it is possible to "swipe" scroll bars or the like on a user interface with a simple movement of a finger or a hand of a user.

[0012] Providing only a first and a second conductive layer provides for the advantage of reduced thickness, cost and complexity compared to known touch sensors. Providing the second electrodes on the first conductive layer and the third electrodes on the second conductive layer may allow for resistive touch sensing with only five wires for connecting the second and third electrodes. When the first conductive layer is pressed onto the second conductive layer, a voltage gradient may be measured by the second electrodes on the first conductive layer. The voltage may already be applied by the third electrodes on the second conductive layer and transferred, upon pressing the layers together, to the first conductive layer and further sensed by the second electrodes.

[0013] According to an embodiment, the first electrodes are arranged a opposing positions on the first conductive layer. It has been found that the capacitive touch sensing is best, in case the first conductive layer is applied with an equal potential plane. Therefore, the first electrodes may be arranged at opposing positions on the first conductive layer at not spatially located close to each other.

[0014] Arranging the first electrodes at the corners of the first conductive layer provides for a maximum spatial distance between the electrodes. For example, when the first conductive layer has a rectangular shape, the first electrodes may be four electrodes and may be arranged within the four corners of the first conductive layer.

[0015] The first conductive layer, as well as the second conductive layer may be plane or curved. In particular for user interfaces with a display, the first and second conductive layers are plane. For example, it may be possible, that the first and second conductive layers are placed in front of a display. The display may be plane and the first and second conductive layers may be plane as well.

[0016] The first and second conductive layers are spaced spatially apart by the spacer. The first and second conductive layers together with the spacer may be supported on a supporting plane, for example a glass or resin plate, carrying the stacked first and second conductive layer and the spacer. It may also be possible that spacer dots are arranged between the conductive layers to keep them from contacting without applied force from the outside. These spacer dots may be arranged on the whole surface of the conductive layers.

[0017] In order to provide for an equal potential plane on the first conductive layer, the first electrodes may be supplied with an equal potential according to embodiments. The first electrodes may be connected to sensors applying a same potential. Thus, on the first conductive layer, a substantially equal potential may be applied. This substantial equal potential allows for exact measurement of a touch position.

[0018] The sensors which are applying a potential to the first electrodes may further be arranged as current sensors