BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a schematic representation of one embodiment of a touch-sensing system.

[0013] **FIG. 2** is an exploded view of an embodiment of a touch-sensitive screen.

[0014] **FIG. 3** is a schematic representation of portions of two simplified sensor layers.

[0015] **FIG. 4** is a schematic representation of two simplified operational sensing layers responding to a touch.

[0016] **FIG. 5** is a schematic representation of one embodiment of the invention illustrating the conducting elements' pattern.

[0017] **FIG. 6** is a schematic representation of one embodiment of the invention illustrating a lead-line configuration that saves area around the sensor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] The invention enables a touch-sensing system capable of detecting a position of a touch on a touch-sensitive surface. The touch-sensing system enabled by the invention includes a first layer of sensor bars arranged in a first direction, and a second layer of sensor bars arranged in a second direction. The first and second directions may be substantially orthogonal to each other. In this configuration, a touch to the touch-sensitive surface creates a signal on at least one sensor bar in each layer. The position of the touch is then determined by locating the touch on each of the two sensor bars. The first layer of sensor bars is used to identify the location of a touch along one axis, and the second layer of sensor bars is used to identify the touch location along another axis.

[0019] In one embodiment, the invention is implemented in a touch-sensitive screen in which multiple sensor bars arranged in a lattice configuration are embedded in the screen. Each of the sensor bars is electrically connected at least at one end to a lead line. The particulars of this invention will become apparent from the following detailed discussion of embodiments of the invention.

[0020] **FIG. 1** is a schematic representation of one implementation of the present invention, showing an exemplary touch-sensing system **110** that includes a touch-sensitive screen **120**, a control circuit **130**, and a computer **140**. In operation, the touch-sensing screen **120** generates signals in response to a touch on the screen. The signals are transmitted to the control circuit **130**, which processes the signals. The control circuit **130** then transmits the results from processing the signals to computer **140** for further processing.

[0021] Touch-sensitive screen **120** is a capacitive touch screen that generates signals when it is touched. The components of touch-sensitive screen **120** will be discussed in detail in conjunction with **FIG. 2**. Briefly stated, touch-sensitive screen **120** has two layers of capacitive sensor bars. Each sensor bar in each layer is connected to a lead line at least at one end.

[0022] Control circuit **130** is a circuit that provides excitation current to the capacitive sensor bars in touch-sensitive screen **120**. Control circuit **130** also detects and processes signals generated by the capacitive sensor bars. While driving and sensing signals on one layer, the control circuit **130** could put the other layer in any appropriate state, such as float the other layer or drive the other layer with a known signal or guard signal. Control circuit **130** may be of any type of electronic circuit, such as an integrated circuit. Control circuit **130** may be installed by itself or integrated into a computer, such as computer **140**.

[0023] **FIG. 2** is an exploded view of an exemplary embodiment of touch-sensitive screen **210**. **FIG. 2** only illustrates the principle components in touch-sensitive screen **210**. Other components may be added without deviating from the principles of the invention.

[0024] Touch-sensitive screen **210** is made up of a series of layers laminated together. In this embodiment, touch-sensitive screen **210** includes a touch pane **220** and a lattice touch-sensing element **230**. The lattice touch-sensing element **230** includes a first sensor layer **240**, a second sensor layer **260**, and an intermediate dielectric layer **250** disposed between the first sensor layer **240** and the second sensor layer **260**.

[0025] The touch pane **220** is the uppermost layer of the touch-sensitive screen **210**. The touch pane **220** may be made of an optically clear substance. The touch pane **220** may be manufactured from a chemically strengthened glass, transparent plastic, or any other acceptable dielectric material. One side of the touch pane **220** serves as the touch surface of the touch-sensitive screen **210**, while the other side of the touch pane **220** is attached to the lattice touch-sensing element **230**. The touch pane **220** provides the necessary dielectric material between the touching object and the sensing element, as well as protecting the touch-sensing element **230** from environmental hazards.

[0026] The top layer of the lattice touch-sensing element **230** is the first sensor layer **240**. The first sensor layer **240** includes a plurality of capacitive touch-sensitive sensor bars **270** arranged substantially parallel to each other in a unidirectional manner. They are preferably constructed of indium tin oxide (ITO) for optical transparency, but may be constructed of any conductive transparent material for transparent applications, such as other transparent conductive oxides as well as transparent conductive polymers. Alternatively, the sensor bars may be constructed from conductive non-transparent material for applications that do not require transparency.

[0027] The second sensor layer **260** also includes a plurality of capacitive touch-sensitive sensor bars **290** arranged substantially parallel to each other in a unidirectional manner. The sensor layers **240** and **260** are parallel to each other with the sensor bars **290** of the second sensor layer **260** being oriented substantially orthogonal to the sensor bars **270** of the first sensor layer **240**. As used herein, the terms "orthogonal" or "perpendicular" shall have their ordinary meanings but that the elements referred to as orthogonal or perpendicular do not actually intersect because they lie in different planes. The term intersection shall be used to mean an intersection of bars when projected onto an imaginary plane parallel to the touch sensing planes **240** and **260**, even though the bars do not actually join.

[0028] In accordance with the invention, one end of each first-layer sensor bar **270** is electrically connected to one end of a corresponding lead line in a plurality of lead lines **280**.