opening through which the touch-sensitive display **33** is accessible to contact. The touch-sensitive display **33** may be supported by a support **78** such as a tray. Although not shown, various other components may be disposed in the housing **70**, such as those described and shown in FIG. **1**.

[0038] A sectional view of a touch-sensitive display **33** is shown in FIG. **4**. The touch-sensitive display **33** comprises layers in conjunction with the display **32** and may be attached, for example by an adhesive **82**, such as an Optically Clear Laminating Adhesive available from 3M Company. Although layers are shown in the drawings, the elements disposed among these layers may be implemented in structures other than layers.

[0039] A ground shield layer **84** may be attached to the display **32** via an adhesive **82** that is advantageously translucent or transparent. The ground shield layer **84** may be connected to a ground or voltage supply and may shield the other layers of the touch-sensitive display **33** from the display **32**. The ground shield layer **84** may comprise, for example, indium tin oxide (ITO), antimony tin oxide (ATO), or aluminum-doped zinc oxide (ZAO) applied to a substrate **80**, for example, by sputter coating onto the substrate **80**. The substrate **80** may be a translucent or transparent glass plate or other suitable material, for example, polycarbonate, plastic, glass, polymethylmethacrylate (PMMA), other dielectric materials, and so forth. Other layers shown include a touch sensor layer **88** comprising one touch sensor, a dielectric layer **86**, another touch sensor layer **92** comprising another touch sensor, an insulating layer **90**, and a cover **96**.

[0040] The dielectric layer **86** and the insulating layer **90** are comprised of suitable non-conductive material such as silicon dioxide, silicon nitride, or other suitable material for electrically isolating the touch sensor layers **88**, **92**. The dielectric layer **86** and the insulating layer **90** may be translucent or transparent coatings of suitable thickness, for example, deposited by physical vapor deposition, to provide a dielectric layer, that may be, for example, between 100 nm and 300 nm thick.

[0041] The cover **96** protects the touch-sensitive display from dust and other contaminants. The cover **96** is translucent, and may be comprised, for example, of polymer, plastic, glass, and so forth, or may be a spray coating, rather than a pre-formed part. The cover **96** advantageously has sufficient flexibility or other characteristics to transfer an applied pressure or force to the layers below, such as the touch sensor layers **88**, **92**. The cover **96** may be attached to the insulating layer **90** by an adhesive **94** that is advantageously translucent or transparent.

[0042] One or more touches, also known as touch contacts or touch events, may be detected by the touch-sensitive display **33**. The processor **22** may determine attributes of the touch, including a location of a touch. Touch location data may include an area of contact or a single point of contact, such as a point at or near a center of the area of contact. The location of a detected touch may include x and y components, e.g., horizontal and vertical components, respectively, with respect to one's view of the touch-sensitive display **33**. For example, the x location component may be determined by a signal generated from one touch sensor, for example, the touch sensor layers **88**, and the y location component may be determined by a signal generated from another touch sensor, for example, the other touch sensor layer **92**. A signal is provided to the controller **35** in response to detection of a touch. A touch may be detected from any suitable object, such as a finger, thumb, appendage, or other items, for example, a stylus, pen, or other pointer, depending on the nature of the touch-sensitive display **33**. Multiple simultaneous touches may be detected.

[0043] An example of a touch sensor layer **88** is shown in FIG. **5**. In this example pattern, the touch sensor layer **88** comprises a capacitive touch sensor that includes a plurality of horizontal members **114** that facilitates determination of the x component of a touch location. The touch sensor layer **88** optionally includes four discrete touch-sensitive areas **116** that receive input from corresponding displayed virtual buttons **130**, such as shown in FIG. **2**. Each horizontal member **114** and each of the discrete areas **116** are advantageously connected to the controller **35** by separate electrical conductors.

[0044] An example of a touch sensor layer **92** with a force sensor is shown in FIG. **6**. As shown, the touch sensor layer **92** comprises a capacitive touch sensor that includes a plurality of vertical members **124** that facilitates determination of the y component of a touch location. The vertical members **124** as shown extend generally perpendicularly to the horizontal members **114** of the other touch sensor layer **88**. Each vertical member **124** is advantageously connected to the controller **35** by separate electrical conductors.

[0045] The horizontal members **114** and vertical members **124** are advantageously sized and arranged to provide x and y touch location components for the display area of the touch-sensitive display **33**. The x and y location components of a touch may be determined by a signal generated from each touch sensor **88**, **92**, for example, as a result of capacitive coupling. Similarly, a touch may be associated with one of the areas **116** by detecting a touch corresponding to one of the virtual buttons **130**, such as are shown in FIG. **2**.

[0046] The touch sensor layer **88** may comprise ITO distributed in a pattern on one dielectric layer **86**. The other touch sensor layer **92** may comprise ITO distributed in a pattern on the other dielectric layer **90**. The touch sensor layers **88**, **92** may alternatively be comprised of other materials such as ATO and ZAO. The touch sensor layers **88**, **92** may be patterned by masking followed by etching of the unmasked areas to provide a thin layer, for example, between 10 nm and 30 nm. Although the examples above associate the x location component with one touch sensor layer **88** and the y location component with another touch sensor layer **92**, the x and y component values are arbitrarily assigned independent of the axes of the touch-sensitive display, and need not be assigned as described above.

[0047] The touch sensor layer **92** may also include at least one force sensor **140**. The force sensor(s) may be force sensitive resistors, strain gauges, strain sensors, piezoelectric or piezoresistive devices, pressure sensors, or other suitable devices. Force as utilized throughout the specification, including the claims, refers to force measurements, estimates, and/or calculations, such as pressure, deformation, stress, strain, force density, force-area relationships, thrust, torque, and other effects that include force or related quantities. In the example of FIG. **6**, the force sensor comprises a continuous, serpentine pattern disposed in the gaps between the vertical touch sensor members **124**. The force sensor **140** is electrically isolated from the touch sensor members **124**. Conductors electrically connect the force sensor **140** to the controller **35** or the processor **22**. The force sensor **140** may be formed in the same manner, of the same material, and/or at the same time as the touch sensor members **124**. Alternatively, the