

interruption in the surface 115. Alternatively, the surface 115 may include features that facilitate the user in distinguishing one region from another. The surface 115 is also preferably planar. The surface 115 is preferably arranged in a flat plane, but may alternatively be arranged in a curved plane or on a first plane and then wrapped around to a second plane substantially perpendicular to the first plane, or any other suitable arrangement. The surface 115 may alternatively include lumps, bumps, depressions, textures, or may be a surface of any other suitable type or geometry. The fluid vessel 127 preferably includes a cavity 125 and the displacement device 130 preferably influences the volume of fluid 112 within the cavity 125 to expand and retract the cavity 125. The fluid vessel 127 may alternatively be a channel 138 or a combination of a channel 138 and a cavity 125, as shown in FIG. 4b. As shown in the variation shown in FIG. 4b, the substrate 120 preferably defines a fluid outlet 116 that allows fluid to flow between the channel 138 and the cavity 125 to deform and un-deform a particular region of the surface 113. The fluid outlet may be formed into the substrate, for example, the fluid outlet 116 may be a series of bores that are machined into the substrate in between the channel 138 and the cavity 125 as shown in FIG. 4b or an open orifice between the cavity 125 and the channel 138 as shown in FIG. 4a, but may alternatively be a property of the material, for example, the substrate 120 may include a porous material that includes a series of interconnected cavities that allow fluid to flow through the substrate 120. The substrate 120 may define any suitable number of fluid outlets 116 that are of any suitable size and shape. The tactile interface layer may also include a fluid outlet layer (not shown) that defines the fluid outlets 116 that is separate from substrate 120 and arranged in between the substrate 120 and layer 110. However, any other suitable arrangement of the fluid outlets 116 may be used. As shown in FIG. 4b, the portion of the substrate 120 (or the fluid outlet layer) that includes the fluid outlets 116 may also function to provide a support for the layer 110 to substantially prevent the layer 110 from substantially depressing into the channel 138 when force is applied over the particular region 113. However, the substrate 120 may be arranged in any other suitable manner and may provide support for the layer 110 in any other suitable way.

[0014] The layer 110 is preferably attached to the substrate 120 (or fluid outlet layer) at an attachment point 117 that at least partially defines the size and/or shape of the particular region 113. In other words, the attachment point 117 functions to define a border between a deformable particular region of the surface 113 and the rest of the surface 115 and the size of the particular region 113 is substantially independent of the size of the cavity 124 and/or the channel 138. The attachment point 117 may be a series of continuous points that define an edge, but may alternatively be a series of non-continuous points. The attachment point 117 may be formed using, for example, adhesive, chemical bonding, surface activation, welding, or any other suitable attachment material and/or method. The method and material used to form the attachment point 117 is preferably of a similar optical property as the layer 110 and the substrate 120, but may alternatively be of any other optical property. Other portions of the layer 110 and substrate 120 not corresponding to a particular region of the surface 113 may also be adhered using similar or identical materials and methods to the attachment point 117. Alternatively, the layer 110 and substrate 120 may be left unattached in other portions not corresponding to a particular

region of the surface 113. However, the layer 110 and the substrate 120 may be arranged in any other suitable manner.

[0015] The fluid vessel 127 may also include a second cavity 125b. When the second cavity 125b is expanded, a second particular region 113 on the surface 115 is preferably deformed. The displacement device 130 preferably influences the volume of fluid 112 within the second cavity 125b independently of the cavity 125, but may alternatively influence the volumes of fluid 112 within both cavity and second cavity 125 and 125b substantially concurrently. Alternatively, the user interface enhancement system 100 may include a second displacement device 130 that functions to influence the volume of fluid 112 within the second cavity 125b to expand and retract the second cavity 125b, thereby deforming a second particular region 113 of the surface. The second cavity 125b is preferably similar or identical to the cavity 125, but may alternatively be any other suitable kind of cavity. The following examples may be described as expanding a fluid vessel 127 that includes a cavity 125 and a channel 138, but the fluid vessel 127 may be any other suitable combination of combination of cavity 125 and/or channel 138. The tactile interface layer 100 may also include a display 150 coupled to the substrate 120 and adapted to output images to the user. As described above, the tactile interface layer 100 may also include a sensor 140 that functions to detect inputs from the user. The sensor 140 may be a capacitive sensor, a pressure sensor, a touch sensitive display, or any other suitable sensor type that detects the presence of a user input. The sensor 140 may be located within the fluid vessel 127, substantially adjacent to the fluid vessel 127 (as shown in FIGS. 4a and 4b), remote from the fluid vessel 127, remote from a cavity 125 but fluidly coupled to the fluid vessel 127, or in any other suitable location.

[0016] The tactile interface layer 100 of the preferred embodiments has been specifically designed to be used as the user interface for an electronic device 10, more preferably in an electronic device 10 that benefits from an adaptive user interface. The electronic device 10 may or may not include a display and/or a touch sensor, for example, an automotive console, a desktop computer, a laptop computer, a tablet computer, a television, a radio, a desk phone, a mobile phone, a PDA, a personal navigation device, a personal media player, a camera, a watch, a remote control, a mouse, a trackpad, or a keyboard. The tactile interface layer 100 may, however, be used as the user interface for any suitable device 10 that interfaces with a user in a tactile and/or visual manner. The tactile interface layer 100 is preferably integrated with the device, for example, in the variation wherein the tactile interface layer 100 includes a sensor 140, the tactile interface layer 100 is preferably assembled into the device 10 and presented to the user as one unit. Alternatively, the tactile interface layer 100 may function as an accessory to a device 10, the user may be presented the tactile interface layer 100 and the device 10 as two separate units wherein, when coupled to each other, the tactile interface layer 100 functions to provide tactile guidance to the user and/or to receive user inputs. However, any other suitable arrangement of the tactile interface layer 100 may be used.

[0017] As shown in FIG. 5, the surface 115 of the tactile interface layer 100 preferably remains flat until tactile guidance is to be provided to the user at the location of the particular region 113. The displacement device 130 then preferably expands the cavity 125 to expand the particular region 113 outward, forming a deformation that may be felt by a