

in a housing or other structure or may be configured in any other suitable manner as desired.

[0068] FIGS. 19-20 illustrate another example of a controllable skin texture surface structure that employs an expandable gas actuation structure to raise and lower desired portions of a flexible skin structure to provide a controllable tactile surface of a portable electronic device. As shown in FIG. 18, a skin texture surface actuation structure includes an expandable gas actuation structure that includes a gas therein 1802 such as air, or a material such as Freon or alcohol that changes from liquid to gas at a specified temperature and pressure, and a flexible skin structure 1804 such as the type described above. The expandable gas actuation structure includes a gas chamber 1800 that is thermally coupled to a heating element 1808 such as an electrical resistor, or any other suitable structure, that may be turned on and off by control logic as desired to heat the gas 1802 within the chamber 1800 and cause the gas to expand. The expansion of the gas 1802 causes the gas to expand and fill the chamber 1800 of the flexible skin structure 1804. When the heating element 1808 is turned off, the gas cools and the chamber 1800 collapses to put the flexible skin structure in an unactuated state. As such, the flexible skin structure 1804, as also described above, includes pockets corresponding to desired texture features wherein the pockets or chambers are molded into the reverse surface or an undersurface of the flexible skin structure 1804. The flexible skin structure 1804 is attached to a substrate 1814 as described above, which may be part of the housing of the device or any other structure. It is bonded so as to provide a sealed environment so that the gas 1802 in the chamber 1800 cannot escape the chamber 1800. When an electric current is sent through the heating element 1808, the increased temperature causes the trapped gas in the pockets to expand thereby raising the pocket or outer surface over the chamber 1810. The flexible skin structure includes expandable portions (e.g., pockets) that define a plurality of gas chambers. Each of the gas chambers includes a controllable heating element that may be activated together or individually.

[0069] The substrate 1814 includes a heating element(s) 1808 corresponding to each respective texture element. In addition, as noted above, all of the examples described herein may include one or more touch sensors 202 which may be used in any suitable manner. FIG. 19 shows a deactivated state of the flexible skin texture and FIG. 20 shows an activated state of the flexible skin structure 1804.

[0070] FIGS. 21 and 22 diagrammatically illustrate one example of a controllable skin texture surface 2102 with a particular pattern 2102 that may be activated and nonactivated using one or more of the above described actuation structures based on any suitable condition. In this example, the tactile configuration or pattern 2102 may simply be located on an outer surface of the portable electronic device 2106 and need not be part of a user interface but instead provides a unique visual experience and tactile experience for a user.

[0071] FIGS. 23-25 illustrate yet another example of controlling of a controllable skin texture surface 2300 (here shown as multiple hearts) of the types described above wherein a different portion 2302-2306 is activated at different points in time by control logic to give a visual appearance or tactile feel of a moving object. In this example, a "heart" in the pattern is activated at different times. Also, animation of texture, such as variations in surface texture over time, may be

used to animate a character or feature. It will be recognized that the above description and examples are merely for illustrative purposes only and that any suitable configurations, designs or structures may be employed as desired.

[0072] FIG. 26 illustrates a functional block diagram of a device 2600 such as a wireless phone, a laptop computer, a portable Internet appliance, a portable digital media player, a personal digital assistant or any other suitable portable electronic device. The device 2600 includes the control logic 200 that is operatively coupled to a sensor 2602 and to a tactile morphing display 2604. The sensor 2602 includes one or more sensors such as capacitance sensors, resistive sensors, pressure sensors, and/or any other suitable touchpad sensors. The control logic 200 is operatively coupled to a network interface 2606 and memory 2608. The control logic 200 is operative to execute instructions stored in memory 2608 such as operating system instructions, web browser instructions, and/or other suitable instructions.

[0073] The network interface 2606, which may be a wired or wireless network interface, is operative to obtain non-keypad display information 2610 from a network 2612 such as, for example, the Internet in response to the control logic 200 requesting the non-keypad display information 2610. The non-keypad display information 2610 includes information to be displayed by the tactile morphing display 2604. For example, the non-keypad information 2610 can include information such as HTML information and/or other suitable information for the tactile morphing display 2604 to display a webpage.

[0074] In addition, the memory 2608 is operative to store operating system (OS) non-keypad display information 2614, which is communicated to the control logic 200 in response to the control logic 200 requesting the OS non-keypad display information 2614. The OS non-keypad display information 2614 includes information to be displayed by the tactile morphing display 2604. For example, the OS non-keypad information 2614 can include any OS information such as, for example, contents of a file folder and/or other suitable OS information.

[0075] The tactile morphing display 2604 includes a controllable skin texture surface 2616 and a non-keypad display 2618. The control logic 200 controls the tactile morphing display 2604 based the non-keypad display information 2610, 2614. More specifically, the control logic 200 controls the non-keypad display 2618 to display non-keypad information representing one or more selectable elements based on the non-keypad display information 2610, 2614. Exemplary selectable elements include information such as web hyperlinks, menu items, icons, cursors, file folders and/or any other suitable selectable element.

[0076] The selectable elements each represent a location of additional display information that the control logic 200 can access via the network interface 2606 or memory 2608. For example, if the selectable element is a hyperlink representing a location of another webpage, the control logic 200 can obtain the additional display information 2610 from the network interface 2606 based on the location of the other webpage and control the tactile morphing display 2604 to display the additional display information 2610 (i.e., the other webpage) when the selectable element is activated. However, if the selectable element is, for example, a file folder representing a location of a file directory, the control logic 200 can obtain the additional display information 2614 from memory 2608 based on the location of the file directory and control the