

user, and providing tactile guidance for the user. The expanded particular region 113 preferably also provides tactile feedback to the user when he or she applies force onto the particular region 113 to provide input. Alternatively, the displacement device 130 may retract the cavity 125 to deform the particular region 113 inward. However, any other suitable deformation of the particular region 113 may be used.

[0018] As shown in FIG. 5, the cavity 125 of the fluid vessel 127 of the preferred embodiment functions to hold a volume of fluid 112 and to have at least two volumetric settings: a retracted volume setting (shown in FIG. 5a) and an extended volume setting (shown in FIG. 5b). The fluid 112 is preferably a substantially incompressible fluid, but may alternatively be a compressible fluid. The fluid 112 is preferably a liquid (such as water, oil, glycerin, or ethylene glycol), but may alternatively be a gas (such as air, nitrogen, or argon) or any other substance (such as a gel or aerogel) that expands the cavity 125 and deforms the surface 115. In the extended volume setting, the cavity 125 deforms the particular region 113 of the surface 115 above the plane of the other regions of the surface 115. When used with a mobile phone device, the deformation of the particular region 113 preferably has a diameter of 2-10 mm and the cavity 125 may be of a substantially equal diameter as the deformation of the particular region 113 or may be of a smaller or larger diameter. When used with this or other applications, however, the cavity 125 may have any suitable dimension.

[0019] The displacement device 130 of the preferred embodiment functions to influence the volume of the fluid 112 with the fluid vessel 127 to expand and retract at least a portion of the fluid vessel 127, thereby deforming a particular region 113 (and/or a second particular region 113) of the surface 115. When used with a mobile phone device, the displacement device 130 preferably increases the volume of the fluid 112 within the fluid vessel 127 by approximately 0.003-0.1 ml to expand the cavity 125 to outwardly deform a particular region 113. When used with this or other applications, however, the volume of the fluid may be increased (or possibly decreased) by any suitable amount. The displacement device 130 preferably modifies the volume of the fluid 112 by (1) modifying the volume of the existing fluid 112 in the fluid vessel 127, or (2) adding and removing fluid 112 to and from the fluid vessel 127. The displacement device 130 may, however, influence the volume of the fluid 112 by any suitable device or method. Modifying the volume of the existing fluid 112 in the fluid vessel 127 most likely has an advantage of lesser complexity, while adding and removing fluid 112 to and from the fluid vessel 127 most likely has an advantage of maintaining the deformation of the surface 115 without the need for additional energy (if valves or other lockable mechanisms are used). Although the cause of the deformation of a particular region 113 of the surface 115 has been described as a modification of the volume of the fluid in the fluid vessel 127, it is possible to describe the cause of the deformation as an increase or decrease in the pressure below the surface 115 relative to the pressure above the surface 115. When used with a mobile phone device, an increase of approximately 0.1-10.0 psi between the pressure below the layer 110 relative to the pressure above the layer no, is preferably enough to outwardly deform a particular region 113 of the surface 115. When used with this or other applications, however, the modification of the pressure may be increased (or possibly decreased) by any suitable amount.

[0020] The shape of the deformation of the particular region 113 is preferably one that is felt by a user through their finger and preferably acts as (1) a button that can be pressed by the user, (2) a slider that can be pressed by the user in one location along the slider or that can be swept in a sliding motion along the slider (such as the "click wheel" of the second generation Apple iPod), and/or (3) a pointing stick that can be pressed by the user from multiple directions and/or locations along the surface whereby the user is provided with tactile feedback that distinguishes a first directional touch from a second directional touch and/or a touch in a first location from a touch in a second location (such as the pointing stick trademarked by IBM as the TRACKPOINT and by Synaptics as the TOUCHSTYK (which are both informally known as the "nipple")). The deformation may, however, act as any other suitable device or method that provides suitable tactile guidance and feedback. In the variation including a display 150, the shape of the deformation of the particular region 113 also preferably functions to minimize the optical distortion of the image underneath the deformed particular region 113.

2. Retrieving a User Preference and Manipulating the Volume of Fluid

[0021] The user preference retrieved in Step S130 is preferably one of the following embodiments: a first embodiment for the operation of the tactile interface layer 100, a second embodiment for interaction between the device and the tactile interface layer, and a third embodiment for operation of the device. The step of retrieving a user preference S130 of the first embodiment preferably includes retrieving a user preference for the operation of the tactile interface layer Step S132 and the step of manipulating the volume of fluid to deform a particular region of the surface of the first embodiment S140 preferably includes manipulating the volume of fluid to deform a particular region of the surface based on the user preference for the operation of the tactile layer Step S142. The step of retrieving a user preference S130 of the second embodiment preferably includes retrieving a user preference for the interaction between the device 10 and the tactile interface layer Step S134 and the step of manipulating the volume of fluid to deform a particular region of the surface S140 of the second embodiment preferably includes manipulating the volume of fluid to deform a particular region on the surface based on the user preference for the interaction between the device 10 and the tactile interface layer Step S144. The step of retrieving a user preference S130 of the third embodiment preferably includes retrieving a user preference for the operation of the device Step S133. A user preference for the operation of the device may be a user preference for vibrating and/or producing a sound when a particular region 113 is deformed or when a particular application of the device is actuated. Alternatively, a user preference for the operation of the device may include a user preference for the loudness of the sound produced and/or the magnitude of the vibration produced. However, the user preference for the operation of the device may be any other suitable kind of preference for an application of the device.

2.1 User Preference of a First Embodiment

[0022] A user preference of the first embodiment may be one of several variations: (1) a preference for the geometry of the deformation (e.g., the size of the deformed particular