

phone, a mobile phone, a PDA, a personal navigation device, a personal media player, a camera, a watch, a remote, a mouse, a trackpad, or a keyboard. The user interface system 100 may, however, be used as the user interface for any suitable device that interfaces with a user in a tactile and/or visual manner. As shown in FIG. 2, the surface 115 of the user interface system 100 preferably remains flat until a tactile guidance is to be provided at the location of the particular region 113. The surface 115 of the user interface system 100 may also be deformed when a user input is required. At that time, the displacement device 130 may increase the volume of the fluid within the fluid vessel 127 (or at the cavity 125) to deform and/or expand the particular region 113 outward, preferably forming a button-like shape. With the button-like shape, the user will have tactile guidance when navigating for the expanded particular region 113 and will have tactile feedback when applying force onto the particular region 113 to provide input. The resistive sensor 140 preferably senses the force that inwardly deforms the particular region 113, but may alternatively sense the force that inwardly deforms any other suitable region along the surface 115. However, any other arrangement of the user interface system 100 suitable to providing tactile guidance and/or detecting user input may be used.

[0021] As shown in FIG. 3, the user interface system 100 may be display 150 that displays an image. As described above, the volume of fluid 112 and/or the resistive sensor 140 preferably cooperates with the sheet 102 to transmit an image through the sheet 102 without substantial obstruction. Alternatively, the volume of fluid 112 may cooperate with the sheet 102 to transmit an image through the sheet 102 without substantial obstruction only when the fluid vessel 127 is in a particular state, for example, when the fluid vessel 127 is in the retracted state or when the fluid vessel is in the expanded state. Because the deformation of the particular region 113 functions to provide tactile guidance to the user, the user may not need the visual cues from the image to operate the user interface when tactile guidance is present. However, the volume of fluid 112 and the sheet 102 may cooperate to transmit an image through the sheet 102 without substantial obstruction in any other suitable arrangement. Obstruction to image transmission may be defined as any manipulation of the image that provides a visual interruption of the image in reaching the user. Obstruction may include blocking a substantial portion of the image, substantially dimming the image, and/or substantially distorting the image unintelligibly. Manipulations to an image that are preferably not considered obstruction to image transmission may include distortion of the image while allowing the image to be substantially visually intelligible, substantially uniformly tinting the image, and/or substantially uniformly enlarging the image. In a first variation, to decrease distortion of the image, the volume of fluid 112 and the sheet 102 preferably cooperate to allow the light from the display to reach the user's eyes at substantially the same angle from the sheet 102 as directly from the display 150 such that an image from the display is seen through the sheet 102 as it would be seen directly from the display. In a second variation, the volume of fluid 112 and sheet 102 may function to substantially uniformly refract light from the display to maintain substantially the same relative proportions between different regions of the image as seen by the user. For example, the volume of fluid 112 and the sheet 102 may cooperatively function to substantially magnify the image from the display of the device 10

thus increasing the size of the image as seen by the user uniformly or increasing the size of one portion of the image more than another portion. In a third variation, the volume of fluid 112 and sheet 102 may cooperate to refract light from different portions of the image differently (i.e., "warp" the image) to increase the magnification of certain portions of the image. For example, the fluid 112 and the sheet 102 may cooperate to provide a fish-eye type magnification to the image to substantially increase visibility of certain portions of the image. In the first, second, and third variations, the volume of fluid 112 and sheet 102 are preferably each of substantially the same index of refraction to maintain substantially one refraction angle of the light from the display as the light transmits through the sheet 102. Alternatively, the index of refraction of the volume of fluid 112 and the sheet 102 may be substantially different but the fluid 112 and sheet 102 preferably cooperate to decrease detection of the different refraction angles by the user. For example, the volume of fluid 112 may occupy a substantially small percentage of the thickness and/or width of the sheet 102 such that the change in refraction angle in the fluid 112 is substantially undetectable by the user. In a second example, the walls of the channel 138 and/or cavity 125 may be arranged to compensate for differences in the index of refraction between the fluid 112 and the sheet 102, for example, by positioning the walls at a particular angle relative to the sheet 102. Both the sheet 102 and the fluid 112 are preferably substantially transparent to decrease changes in the color and/or intensity of the image. Similarly, the sheet 102 and fluid 112 preferably both include substantially similar light absorptive properties, birefringence properties, and/or chromaticity properties. However, any other suitable translucency, transparency level, absorptive, refraction, and/or any other suitable light transmission properties may be used for the sheet 102 and fluid 112. Similarly, any other suitable method may be used to decrease obstruction to the transmission of an image.

1. The Sheet

[0022] As shown in FIGS. 1 and 2, the sheet 102 of the preferred embodiment functions to provide the surface 115 that interfaces with a user in a tactile manner and to at least partially a fluid vessel 127. As described above, the fluid vessel 127 is preferably a cavity 125 (as shown in FIGS. 1b and 2), but may alternatively be a channel 138 or a combination of a cavity 125 and a channel 138 (as shown in FIG. 4a). The surface 115 is preferably continuous, such that when swiping a finger across the surface 115 a user would not feel any interruptions or seams. 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 surface 115 also functions to deform upon an expansion of the cavity 125, and to preferably "relax" or "un-deform" back to a normal planar state upon retraction of the cavity 125. In a first version, the sheet 102 contains a first portion that is elastic and a second portion that is relatively inelastic. In a second version, sheet 102 is relatively more elastic in a first portion and relatively less elastic in a second portion and is deformed by the