

natively, the motion of two fingers pulled in opposite directions away from a deformed particular region 113 may indicate to the user interface system 100 to retract the cavity 125 and undeform the deformed particular region 113. However, the user interface system 100 may provide any other suitable active response to the motion of two fingers pulled in opposite directions away from a deformed particular region 113.

[0030] In a fourth exemplary interpretation, as shown in FIG. 6 (Example D), and FIGS. 11a and 11b, a “dragging” gesture may be interpreted as a command to move the deformed region from a first location to a second location along the surface 115. For example, once a first cavity 125 has been expanded and a particular region 113 has been deformed, the user may move his or her finger(s) along the surface 115 (preferably in contact with the surface 115, but may also be any other suitable distance away from the surface 115) to indicate successive particular regions 113 to deform. As a successive particular region 113 deforms, the prior particular region 113 preferably undeforms (in other words, the cavity 125 corresponding to the prior particular region 113 retracts), resulting in the user seemingly “dragging” the deformed particular region 113 along the surface 115. As the user moves his or her finger(s) along the surface 115, the successive particular regions 113 are preferably substantially adjacent or continuous with each prior particular region 113 to provide an experience akin to that of dragging a single object along a surface as opposed to touching a first object on a surface and then another object on the same surface. Alternatively, the deformed region may be “pushed” by the dragging gesture. In this variation, the dragging gesture preferably starts on one side of the deformed region and “pushes” the deformed region forward, as shown in FIGS. 11a and 11b. Subsequent particular regions 113 may be deformed forward of the original deformed region (instead of behind as described in the dragging example) to emulate the user pushing the deformed region from a first location to a second location along the surface 115. Yet alternatively, the user may indicate the deformed region that is to be moved by the start of the “dragging” gesture and then indicate the desired location of the moved deformed region by the end of the “dragging” gesture (in other words, where the user lifts the fingers off the surface 115 after the gesture). In this variation, the initial deformed particular region may be “eliminated” and a particular region at the desired location is “created” while deformable regions in between the eliminated and created deformations are not actuated. However, any other suitable actuation of deformable regions may be used.

[0031] In another aspect of the fourth exemplary interpretation, the user may dictate interaction between expanded cavities 125. For example, in the “dragging” example mentioned above, the user may “drag” an object along a path and particular regions 113 are expanded along the path. When an object is dragged over an existing deformed particular region 113, the object and the existing deformed particular region 113 may “react” based on actions of the user. For example, if the user pauses the dragging motion when the object is in the location of the existing deformed particular region 113, the deformed particular region 113 of the object and the existing deformed particular region 113 may seemingly “merge,” for example, the total surface area of the existing deformed particular region 113 may grow as if the deformed particular region 113 of the object is added into the existing deformed particular region 113, similar to the third exemplary interpretation. The user may then also drag the “merged” particular

region 113 to a different location. Alternatively, the existing deformed particular region 113 and the deformed particular region 113 for the object may “repel” each other, for example, the object may represent a baseball bat and the existing deformed particular region 113 may represent a ball, and the user may “hit” the ball with the baseball bat, seemingly “repelling” the two deformed particular regions. Similarly, the user may perform a splitting motion on an existing deformed particular region 113 and the existing deformed particular region 113 may “split,” forming two distinct deformed particular regions 113. Each of the resulting two distinct deformed particular regions 113 is preferably of a smaller surface area than the original existing deformed particular region 113. An example of a splitting motion may be drawing two fingers apart substantially adjacent to the existing deformed particular region 113. However, any other suitable interaction between expanded cavities 125 may be implemented. While an active response to a command given by the user is preferably one of the examples described here, any active response to a command given by the user may be used.

[0032] A fifth exemplary interpretation, as shown in FIG. 6 (Example E), a rotating gesture may be interpreted as a command to change the characteristics of a deformed particular region 113 substantially proximal to the user input. Unlike the first, second, third, and fourth exemplary interpretations where the deformations have binary states of expanded and retracted, the command of the fifth exemplary interpretation allows for a plurality of states in between fully deformed and fully undeformed, respectively. For example, the rotating gesture around a deformed particular region 113 may be interpreted as a command to increase the stiffness of the deformation. This may be particularly useful in a scenario where the command includes a command for the volume of the device and the deformed particular region 113 indicates the location of the “increase volume” button. When the user provides the rotating gesture around the button to indicate an input to increase the volume, the deformed particular region 113 may become progressively stiffer to the touch as the volume becomes higher and reaches the limit of the volume strength, indicating to the user through tactile means where along the volume scale they are currently. The rate of stiffness increase may be selected by the user to be tailored to their tactile preferences and/or sensitivity. The height of the deformed particular region 113 may also be adjusted as the volume level changes. To adjust the stiffness of the particular region of the surface 113, the displacement device 130 may adjust the amount of fluid that is displaced to expand the cavity 125. The more fluid that is displaced to expand the cavity 125, the stiffer the particular region 113 will feel to the touch. Similarly, the more fluid that is displaced to expand the cavity 125, the taller the deformation of the particular region 113. The user interface system 100 may also include a valve that directs the fluid displaced by the displacement device 130. In this variation, when additional fluid is desired to expand the cavity 125 to increase the stiffness and/or the height of the deformed particular region 113, the valve may direct additional fluid into the cavity 125.

[0033] While the interpretation of the gesture as a command is preferably one of the variations described above, the active response may alternatively be a combination of the variations described above or any other suitable combination of gestures and commands.