125 and one of a second group of cavities 125 and a third group of cavities 125 at one time. This variation may be applied to the variation of the user interface system 100 including cavities 125 that are shared between two groups of cavities 125, as shown in the landscape and portrait QWERTY example in FIG. 17 and described in the third preferred embodiment. The first group of cavities 125 preferably function as the shared cavities 125 that expanded whenever either one of the landscape QWERTY group or the portrait QWERTY group are to be expanded, and the second group of cavities 125 preferably functions as the non-shared QWERTY keys in the landscape QWERTY group and the third group of cavities 125 preferably functions as the non-shared QWERTY keys in the portrait QWERTY group. However, the fourth preferred embodiment may be applied to any other suitable arrangement.

[0056] As shown in FIGS. 19*a*-19*d*, similar to the first preferred embodiment, the fourth preferred embodiment includes a channel 138 that couples the first cavity 125*a* to the second and third cavities 125*b* and 125*c*. Similar to the second preferred embodiment, the channel 138 preferably does not directly connect the second cavity 125*b* to the third cavity 125*c*, preferably forms a T-junction between the displacement device 130 and the second and third cavities 125*b* and 125*c*, and preferably includes a valve 139 that directs fluid flow displaced by the displacement device 130 to one of or both of the second and third cavities 125*b* and 125*c*. However, the channel 138 may be of any other suitable orientation. The valve 139 is preferably of the type described above in the second preferred embodiment. Because the fluid flow to either one of the second or third cavities 125*b* and 125*c* passes through a valve 139 while fluid flow to the first cavity 125*a* does not, the valve 139 is preferably of a type that does not increase the pressure required to expand the second and third cavities 125*b* and 125*c*. For example, the valve 139 is preferably not actuated by the pressure of the fluid flow within the channel 138. Similar to the first preferred embodiment, the second and third cavities 125*b* and 125*c* may be of different geometries from the first cavity 125*a* to maintain substantially similar expansion start times and/or the size of the channel 138 leading to the second and third cavities 125*b* and 125*c* may be increased in size (in diameter and/or cross sectional area) to decrease the pressure necessary for fluid to travel through the channel 138. However, any other geometry or method of allowing both the first cavity 125*a* and one of or both of the second and third cavities 125*b* and 125*c* to start expansion substantially at the same time and at the same rate may be used. The first cavity 125*a* and one of or both of the and second and third cavities 125*b* and 125*c* may also be allowed to start expansion at different times.

[0057] Similar to the second preferred embodiment, the fourth preferred embodiment preferably includes a processor that controls the displacement device 130 and the valve 139. The processor preferably regulates the volume of fluid that is displaced by the displacement device 130 and/or the volume of fluid that enters and exits the cavities 125 to expand and retracts the cavities 125 to prevent over expansion and over retraction. The processor preferably also determines if one (and which one) or both of the second and third cavities 125*b* and 125*c* is to be expanded. In the variation of the fourth preferred embodiment where the displacement device 130 functions to expand a first group of cavities 125 and one of a second and third group of cavities 125, if the number of cavities within the second group of cavities 125 is different from the number of cavities within the third group of cavities 125, the processor preferably regulates the volume of fluid that is displaced by the displacement device 130 to accommodate for the difference in volume of fluid necessary to expand each group of cavities 125. In all other respects, the processor of the fourth preferred embodiments is preferably similar or identical to the processor of the second preferred embodiment.

[0058] The user interface system may include a plurality of displacement devices 130 and/or a plurality of valves 139. All of the cavities 125 of the plurality of cavities 125 are preferably arranged within one fluid network 200, but may alternatively be arranged in more than one fluid network 200. The displacement device 130 and/or valves 139 are preferably also arranged within one fluid network 200 and are preferably controlled by one processor, but may alternatively be arranged in more than one fluid network 200 and may be controlled by more than one processor. However, the plurality of cavities 125, displacement device 130, and valves 139 may be arranged in any other suitable arrangement.

[0059] While omitted for conciseness, the invention includes every possible permutation and combination of the various elements described above.

[0060] As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of this invention defined in the following claims.

We claim:

1. A user interface comprising:

a substrate comprising an attachment face and a plurality of support members continuous with the attachment face, each support member including a fluid channel configured to communicate fluid through the support member, the substrate defining a fluid network fluidly coupled to a portion of the fluid channels;

a tactile layer comprising an outer tactile surface and a back surface opposite the tactile surface, the back surface coupled to the attachment face at an undeformable region of the tactile layer, the back surface adjacent to and disconnected from the support members at a plurality of deformable regions of the tactile layer, each deformable region of a thickness at least as great as a width dimension of a corresponding fluid channel, each support member configured to limit inward deformation of a corresponding deformable region due to a force applied to the tactile surface;

a displacement device configured to displace fluid through the fluid network and toward the back surfaces of a portion of the deformable regions to transition each of the portion of deformable regions from a retracted setting to an expanded setting tactilely distinguishable from the retracted setting at the tactile surface; and

a touch sensor coupled to the substrate and configured to detect a user touch on the tactile surface.

2. The user interface of claim 1, wherein the attachment face and the support members are planar.

3. The user interface of claim 1, wherein the deformable and undeformable regions of the tactile layer are adjacent and of substantially similar thicknesses.

4. The user interface of claim 1, wherein, in the retracted setting, the tactile surface of the deformable regions is flush with the tactile surface of the undeformable region.