

of the dome causing the dome to crumple in a way that generates a non-monotonic response. As another example, the mechanism 38 may include a spring that breaks out of column when the operable element 26 is operated. The spring may be contained in an enclosure of appropriate size such that the spring contacts the sides of the enclosure when it breaks out of column producing an audible "click".

[0021] In operation, the processor-based system 10 may generate an image element 24 to be displayed for user selection on display 12 beneath one or more operable elements 26. The image element 24 may serve as a label or legend for operable element 26. The image element 24 is viewed through transparent region 18 of operable element 26. A user may select a particular operable element 26 in response to display of the image element 24. A user may actuate the operable element 26 by applying pressure to the transparent region 18 in a direction orthogonal to and towards the display 12. Depressing the transparent region 18 typically causes its attached frame 20 to move towards the display 12. The frame 20 may be operatively coupled to switch 36 and/or feedback mechanism 38 such that sufficient movement of the frame 20 towards the display 28 causes actuation of switch 36 and/or feedback mechanism 38. In this way, a user operable element 26 having feedback may be provided with the dynamic legends heretofore available only with expensive touch screen systems.

[0022] Rather than viewing the display 12 directly through transparent region 18 of the operable element 26, image enhancing devices may be employed in other embodiments. For example, a light transmitter 30 may be interposed between transparent region 18 and display 12 as shown in FIG. 3. The light transmitter 30 may be, for example, a light pipe or a lens which may magnify the image displayed on the underlying display 12.

[0023] The light transmitter 30 may be positioned to be in optical communication with the display 12 that underlies the operable element 26. The light transmitter 30 may have a rear surface 34 and a front surface 32 disposed to be visible to the user through transparent region 18. The light transmitter 30 may be, for example, a light pipe comprising a bundle of strands of optical fibers. By maintaining the relative position of the many strands within the bundle (a coherent fiber bundle), it is possible to pipe an image from one end of the bundle to the other.

[0024] In another embodiment, the light transmitter 30 may comprise a lens 42 that magnifies the image on the display making the image more readily viewable by the user 12, as shown in FIG. 4. The lens 42 may be in optical communication with display 12 to create an enlarged image of the underlying image element 24 on display 12.

[0025] A visual indication of switch actuation may be provided under program control in a processor-based system 10 by changing the image element 24 on the display 12. For example, the image element 24 associated with a given operable element 26 may be changed upon actuation of the switch 36. Such a change in image may include, among many other possibilities, displaying a different background color, altering the brightness of the display 12 in the region underlying the operable element 26 or, as shown in the embodiment depicted in FIG. 1, causing the image element 24 to appear to "dance" to the right and back.

[0026] The function of a given operable element 26 may be changed under program control. In this way, a limited

number of operable elements 26 comprising an input device for a processor-based system 10 may be used to accomplish a greater number of functions inasmuch as the legend appearing on the face of an operable element 26 may be automatically changed to match a change in the function of the operable element 26.

[0027] Examples of image elements 24 include graphics, textual legends, icons and color blocks. The image element 24 may connote, for example, the function that will be performed when the operable element 26 is operated or the state of the switch 36. The image elements 24 may be static or dynamic.

[0028] A touch screen membrane 40 may be fitted over a display 12, as shown in FIG. 5. The operable element 26 may comprise a feedback mechanism 38 for providing tactile and/or auditory feedback as described above. The operable element 26 may further comprise contactor 44 for actuating touch screen membrane 40 when operable element 26 is operated by, for example, depressing transparent region 18 of frame 20.

[0029] The contactor 44 may concentrate the force applied to touch screen membrane 40 in a smaller and better defined area than would be the case if the touch screen membrane 40 were contacted with the user's finger. This may be advantageous for achieving positive switch actuation with minimal pressure applied by the user.

[0030] In embodiments comprising a touch screen membrane 40, additional switch elements may not be required, but a tactile feedback mechanism 38 for providing a tactile indication of switch actuation may be incorporated. If a touch screen membrane 40 is employed in a programmed system, auditory feedback may be provided under program control by causing a "click" or other sound to be produced when the system controller detects actuation of the touch screen membrane 40. The sound may be produced by a speaker and associated audio circuitry or, as another example, by an electromechanical clicker. An example of such a clicker is device comprising ferromagnetic material which is brought into contact with a pole of an electromagnet when the magnet is energized.

[0031] In this way, the intuitive operation and tactile feedback of a conventional, push-button switch may be achieved in a system comprising a touch screen. Conventional touch screens provide no tactile feedback to provide a sensory cue to the user of how much pressure is required for actuation. A touch screen does, however, provide the ability to change the legend on a "button" under program control. Such legend may also be animated and/or colored with any color that the display may be capable of generating.

[0032] In another embodiment, shown in FIG. 6, operable element 26 may comprise a rocker switch body 50. The rocker switch body 50 may comprise light transmitters 30 and a pivot 48. The rocker switch body 50 may be positioned over a display 12. The light transmitters 30 may have opposing paired surfaces 52, 54 and 58, 60.

[0033] When an operable element 26 is in one state (which may be an "off" state, for example), the surface 52 of the light transmitter 30 may be in proximity and substantially parallel to the region B of the display 12. An image formed by the display 12 in the region B may be transmitted by the light transmitter 30 from surface 52 to surface 54 where it may be viewed by the user.