

[0088] Finally, in yet another embodiment, the interface 10 is configured such that a raised indicia, visible feature, trademark, or icon 46 is caused to be formed thereupon (e.g., reversibly and/or slidably raised from a flush position with respect to the interface 10. In FIG. 6, for example, a musical note 46 is produced upon a volume control knob 10, when the element 22, located at or near the surface, is activated.

[0089] Exemplary inner-workings of the interface 10 are shown in FIGS. 7A-8B. More particularly, FIGS. 7A-B depict an interface 10 including a (top or distal) layer of flexible material 48, defining an interior space 50, and having a shape memory wire actuator 22 formed, for example, of SMA material in the deactivated martensite phase, functioning and at least partially reposed within the space 50. The wire 22 is attached to the interior surface of the layer 48 at its center, and to a fixed structure 38 at the opposite end. In this configuration, when the wire element 22 is activated and caused to contract, it exerts a pulling force against the layer 48 causing it to bend and form a concavely arcuate profile. When deactivated, the wire 22 returns to its softer martensite phase, where it is caused to stretch back to the original or normal length by the modulus of elasticity in the layer 48. It is appreciated that the biasing force exerted by the layer 48, when the wire 22 is in the activated austenite phase, accelerates transition to the martensite phase, which increases response time.

[0090] In FIGS. 8A-C, a pulley 52 and plunger 54 are further disposed within the space 50. The pulley 52 is attached to the interior wall of the interface 10 at a location at or near the layer 48, via an axle rod 56. The plunger 52 includes a base 58 that co-laterally extends to match the cross-sectional shape of the space 50. The base 58 and space 50 are cooperatively configured such that the plunger 54 linearly translates therein. More preferably, to prevent rotational displacement, the interface 10 further defines at least one, and more preferably a plurality of ribs 60 along the interior surface of the wall and the base 58 defines at least one and more preferably a plurality of notches (not shown) within which the ribs 60 slide during translation. The wire 22 passes through an orifice 62 defined by the base 58 and is entrained by the pulley 52 as it is doubled over back towards the base 58. As such, in this configuration, the wire 22 is lengthened, resulting in greater activation displacement and force. The plunger 54 further defines an elongated member 64 that orthogonally extends from the base 58 preferably at its center. The member 64 is caused to engage the layer 48 when the wire 22 is activated (FIG. 8B), and more preferably, further includes an engaging section 66 operable to form the raised indicia or icon 46 within the top surface 44 (FIG. 8C).

[0091] In operation, selective modification of the interface 10 can be effected by controller 26 communicatively coupled to the source 24, sensor(s) 28 and/or an input device for receiving user preferences. The controller 26 can be preprogrammed to have the source 24 deliver the activation signal using stand-alone algorithms or those based on sensory input. For example, the controller 26 may be configured to present a timer, so that activation and modification of the interface 10 results for a predetermined period (e.g., 10 seconds).

[0092] Sensor input is based upon a related or triggering condition. For example, air pressure can be monitored with a sensor to indicate when a window is opened during vehicle movement, when an air bag is actuated, or upon door closing, or the like. When such conditions are determined, likely-used interfaces 10, such as door locks, power window switches,

etc. may be modified so as to facilitate selection and manipulation. The geometric shape of door locks and handles may also be modified, when the ignition of the vehicle 20 is toggled between ON/OFF, or the gear shift is positioned in and out of park. Other sensor inputs such as thermometer measurements indicating an interior cabin temperature exceeding a pre-set temperature threshold, and the like can be employed; here, where an exceedance of temperature is determined, tactile HVAC interface(s) 10 may be modified to facilitate selection and manipulation. Finally, in addition to or lieu of sensory input, it is appreciated that modification may preferably be triggered by receiving data from a telematic, short range, V2V, or cellular communication system (not shown) communicatively coupled to the controller.

[0093] Ranges disclosed herein are inclusive and combinable (e.g., ranges of “up to about 25 wt %, or, more specifically, about 5 wt % to about 20 wt %”, is inclusive of the endpoints and all intermediate values of the ranges of “about 5 wt % to about 25 wt %,” etc.). “Combination” is inclusive of blends, mixtures, alloys, reaction products, and the like. Furthermore, the terms “first,” “second,” and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another, and the terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item. The modifier “about” used in connection with a quantity is inclusive of the state value and has the meaning dictated by context, (e.g., includes the degree of error associated with measurement of the particular quantity). The suffix “(s)” as used herein is intended to include both the singular and the plural of the term that it modifies, thereby including one or more of that term (e.g., the colorant(s) includes one or more colorants). Reference throughout the specification to “one embodiment”, “another embodiment”, “an embodiment”, and so forth, means that a particular element (e.g., feature, structure, and/or characteristic) described in connection with the embodiment is included in at least one embodiment described herein, and may or may not be present in other embodiments. In addition, it is to be understood that the described elements may be combined in any suitable manner in the various embodiments.

[0094] Suitable algorithms, processing capability, and sensor inputs are well within the skill of those in the art in view of this disclosure. This invention has been described with reference to exemplary embodiments; it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to a particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A tactile human-machine interface adapted for facilitating selection and manipulation by a user and for modifying a system, said interface comprising:
  - a reconfigurable body presenting a first geometric shape, orientation, position or characteristic, communicatively