LOCALIZED HAPTIC FEEDBACK

FIELD OF THE INVENTION

[0001] One embodiment of the present invention is directed to haptic feedback. More particularly, one embodiment of the present invention is directed to localizing haptic feedback to a specific region.

BACKGROUND INFORMATION

[0002] Humans interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In an automotive environment, the predominate interface is still a mechanical button or dial. One reason for the popularity of this kind of interface is that the driver of an automobile typically must engage a button or dial while maintaining a view of the road. Mechanical devices allow the driver to feel a mechanical button or dial.

[0003] However, having mechanical buttons and dials introduces several disadvantages. For one, any type of mechanical interface is subject to wear and degradation. Second, buttons and dials on an automobile dashboard include cracks and crevices that build up dirt and become unsightly and unsanitary. Finally, many automobile manufacturers attempt to create a dashboard having a futuristic sleek look, and mechanical buttons can detract from this appearance.

[0004] It is known to use force feedback or tactile feedback (collectively referred to herein as "haptic feedback") in combination with a touchpad or touch control "buttons" in order to eliminate mechanical buttons. However, known haptic feedback devices tend not to isolate the feedback (i.e., vibration) within the boundaries of a specific "button". In many environments, this might not be a large problem. However, in an automobile environment and other environments where a user is not looking at the button when it is being "pressed", it is more important to isolate the haptic feedback to only the targeted region.

[0005] Based on the foregoing, there is a need for a system and method in which haptic feedback is applied to a touch control so that the feedback is isolated to a targeted region.

SUMMARY OF THE INVENTION

[0006] One embodiment of the present invention is a surface that generates a haptic feedback. The surface includes a first region having a first level of stiffness and a second region having a second level of stiffness that is less than the first level of stiffness. The second region defines a deformation region within which the haptic feedback is generally localized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a plan view of the front side of an automotive dashboard in accordance with one embodiment of the present invention.

[0008] FIG. **2** is a cross-sectional view of the rear side of a surface and an actuator in accordance with one embodiment of the present invention.

[0009] FIG. **3** is a plan view of a portion of the rear side of the surface in accordance with one embodiment of the present invention.

[0010] FIG. **4** is a plan view of a portion of the rear side of the surface in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

[0011] One embodiment of the present invention is a surface having a reduced stiffness region and an actuator coupled to the region. The actuator creates an isolated haptic feedback effect within the reduced stiffness region.

[0012] FIG. **1** is a plan view of the front side of an automotive dashboard **10** in accordance with one embodiment of the present invention. Dashboard **10** is formed from a contiguous surface or panel **12**. A plurality of buttons **20** are formed on surface **12**. A steering wheel **14** is coupled to dashboard **10**. Other components typically present on a dashboard, such as gauges, dials, etc., are not shown in FIG. **1**.

[0013] Each button **20** in one embodiment is represented on the front side of dashboard **10** as a graphical icon or other indication of the geographic location of the button. Otherwise, surface **12** in the areas of buttons **20** is contiguous and smooth on the front side, and includes no cracks or crevices that can be unsightly and retain dirt.

[0014] In one embodiment, surface **12** is formed from a layer of wood laminated to a layer of metal. The wood layer is on the front side of surface **12**. In other embodiments, surface **12** can be formed of other materials such as, for example, glass, plastic, composite materials such as carbon fiber, and stone. In one embodiment, in each area substantially behind the location of each button **20**, a portion of the metal and wood layers from the rear side of surface **12** is removed to create a thinner region having a lower level of stiffness than the regions of surface **12** that are not altered or thinned.

[0015] In general, "stiffness" disclosed herein, i.e., flexural or bending stiffness, relates to the amount of deflection of a material resulting from an applied normal force. This is a function of cross-section (thickness), location of the applied force, and a material property of the material used. When defining stiffness, the concept of Young's modulus and moment is typically applied, i.e., where deflection=EI=flexural modulus of elasticity (force×length^2)×moment of inertia (length^4). However, typical calculations for EI use "Timoshenko" equations which assume constant cross section, rigid supports at the ends and homogenous materials. In embodiments of the present invention, stiffness is the result of a cross-section that is varied so as to direct forces toward a location, such as where a button and actuator(s) are positioned. In one embodiment, more than one material is used, such as in a laminate or other form of composite. For instance, with the laminate, the cross section of one or more of the materials can be varied or different materials, having a different modulus may be used in the deformable region which may or may not change the total cross section, and yet both can contribute to a designed stiffness. In one embodiment, features such as rings or other local features can contribute to a chosen stiffness response to a user. In this manner, an effective or resulting stiffness can be tailored by design. Therefore, values for a stiffness resulting from a force applied at a given location may have to be determined either empirically or through finite element analysis. The embodiments disclosed are but a few ways to tailor stiffness and are not meant to be limiting or exhaustive in the methods available.