

## HAPTIC INTERFACE DEVICE

### BACKGROUND OF THE INVENTION

#### [0001] 1. Field of the Invention

[0002] The present invention generally relates to a haptic interface device, and more particularly relates to an apparatus for indicating conditions of the vehicle or circumstances outside the vehicle to an operator, such as the driver, by providing haptic sensations. The apparatus may be mounted in the vehicle by attaching an operating member to the steering wheel of the vehicle.

#### [0003] 2. Description of the Related Art

[0004] The driver of a typical vehicle views an instrument panel to obtain information on the conditions of the vehicle such as the fuel level, and looks at signs, information boards, or the display of a navigation system on which traffic information is displayed to know circumstances outside the vehicle, such as an obstacle ahead or conditions of a road surface, while operating the vehicle. Although the driver can visually perceive a great deal of information, because the driver should concentrate on driving the vehicle, he or she cannot devote continuous attention to the information provided and may, depending on circumstance, miss significant or helpful information.

[0005] To compound the problem, in recent years, many vehicles have been equipped with sophisticated audio and navigation systems. As these devices have grown more sophisticated, the number of operating switches has increased, and they have caused more eyestrain.

[0006] A growing amount of information is being provided from on-vehicle equipment and sources outside the vehicle. Because most of this information is visually perceived, a significant burden, perhaps even strain, is placed on the eyes of the driver. It is therefore desirable to provide an apparatus capable of providing information through other than visual means.

### SUMMARY OF THE INVENTION

[0007] The present invention was made to solve the problem and advantageously provides a haptic interface device capable of providing various information to an operator in a form intuitively perceivable through their haptic sense, without the help of vision.

[0008] To achieve this advantage, a haptic interface device according to the present invention comprises state sensing means for sensing at least one of a state of a vehicle and a state outside the vehicle; indication control means for determining whether or not information sensed by the state sensing means should be indicated to an operator and generating haptic information representing the information when it determines that the information should be indicated to the operator; and haptic presentation means capable of motion based on the haptic information provided from the indication control means.

[0009] According to the present invention, the status inside or outside a vehicle can be provided to an operator through his or her haptic sense without help of vision. In particular, information to be indicated to the operator can be intuitively communicated to the operator by driving the operating member in a direction that relates to the information to be indicated to the operator.

[0010] The haptic presentation means may have two or more degrees of freedom of movement.

[0011] When the operating member can be moved through two or more degrees of freedom, a more intuitive haptic stimulus that corresponds to information to be provided can be generated.

[0012] According to another aspect, the present invention provides a haptic presentation means comprising a base member; an operating member to be operated by the operator; a moving member movably attached to the base member and to which the operating member is fixed; and operating member drive control means for driving the operating member to at least two degrees of freedom by moving the moving member; and the operating member drive control means controls the moving member in a movement pattern according to information to be provided to the operator.

[0013] The haptic interface device according to the present invention may further comprise immobilization means for forcibly immobilizing said moving member when a condition which may require strong gripping of a steering wheel on which the haptic interface device is installed is detected.

[0014] Because the moving member is forcibly immobilized when the haptic interface device attached to the steering wheel determines that a condition has occurred in which the driver is required to strongly hold the steering wheel, the holding power of the driver can be sufficiently transmitted to the steering wheel.

[0015] Furthermore, the immobilization means may have a lock mechanism for physically inhibiting a movable state of the moving member.

[0016] The operating member drive control means may be designed to drive the operating member in a direction relating to information to be indicated to the operator through the haptic information.

[0017] The state sensing means may comprise an information receiving unit for receiving traffic information, such as information sent from a provider, as a state outside the vehicle.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1 is a schematic perspective view of one embodiment of a haptic interface device according to the present invention;

[0019] FIG. 2 is a plan view of the haptic interface device shown in FIG. 1 with the top of its housing removed;

[0020] FIG. 3 is a side elevation view of the haptic interface device shown in FIG. 2;

[0021] FIG. 4 is a perspective view of a haptic interface device according to the first embodiment installed under a vehicle steering wheel;

[0022] FIG. 5 is a functional block diagram of the haptic interface device according to the first embodiment;

[0023] FIG. 6 is a plan view of a haptic interface device according to a second embodiment of the present invention with the top of its housing removed;