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PROVISIONAL APPLICATION COVER SHEET

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Commissioner for Patents
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Sir: This is a request for filing a **PROVISIONAL APPLICATION** under 37 CFR 1.53(c).

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TITLE OF INVENTION (280 characters max)

CUSTOMIZED TACTILE FEEDBACK IN MULTIPLE BUTTONS WITH A SINGLE VIBROTACTILE ACTUATOR

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ENCLOSED APPLICATION PARTS (check all that apply)

☒	Specification, Number of Pages 8	☐	Small Entity Statement
☒	Drawings Number of Pages 1	☒	Other (specify): Cover Sheet

☒ A check is enclosed to cover the Provisional Filing Fee Amount of ($)160.00

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At least some of the inventions were made under a contract with an agency of the United States Government.

☒ No ☐ Yes, the name of the U.S. Government agency and the contract number are:

Respectfully Submitted,

SIGNATURE _____ **DATE** 11/1/01

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PROVISIONAL APPLICATION FILING ONLY

CUSTOMIZED TACTILE FEEDBACK IN MULTIPLE BUTTONS WITH A SINGLE VIBROTACTILE ACTUATOR

BY INVENTORS
Kenneth M. Martin
Steven P. Vassallo

BACKGROUND OF THE INVENTION

The present invention relates generally to computer interface devices that allow the user to experience haptic feedback.

A user can interact with an environment displayed by a computer to perform functions and tasks on the computer, such as playing a game, experiencing a simulation or virtual reality environment, using a computer aided design system, operating a graphical user interface (GUI), etc. Common human-computer interface devices used for such interaction include a mouse, joystick, trackball, steering wheel, stylus, tablet, pressure-sensitive sphere, or the like, that is connected to the computer system controlling the displayed environment.

Cellular phones, personal digital assistants (PDA's), and other electronic devices are commonly used by a large number of people. The physical feedback provided in standard passive buttons on cell-phones and PDA's of the prior art is limited to the mechanical feedback of the switches, e.g., the switch closure force-displacement profile. As the same mechanical switch is usually used for each button, the buttons all feel the same when they are pressed. In addition, the physical feedback that the buttons provide is delivered only in the process of pressing the button. Some cellphones and PDA's have raised bumps on the center key to help orient the user as to the center of the pattern, and some buttons are arranged in unique or characteristic ways to allow the user to determine which button is which by feel without having to look at the buttons. In general, however, users typically must look at the dialpad on their cellphone or PDA to ensure that they are entering the right numbers or characters.

In summary, passive buttons have a single characteristic feel generated by the mechanical design and do not have the ability to provide feedback to the user

regarding displacement or position. This is similar for buttons or keypads provided on other electronic devices.

In other embodiments, a flat touchpad used on a cell-phone or other electronic device for sensing a user's touch can be integrated with an LCD or other flat panel display screen. In some embodiments, "soft" or graphical buttons ("softkeys") are displayed on the screen and are receptive to the user's touch to allow the command of device functions similar to normal mechanical buttons. However, the smooth touchpad/LCD module has no existing mechanism or method of providing the user any kind of feedback as to the graphical button they are about to press.

Thus, the shortcomings of the conventional approach include: if the user attempts to select specific buttons in a distracting environment to perform a primary task or function of the device, the user's attention will be severely divided between the primary task they are trying to complete, and the secondary task of pressing the correct buttons on the device. If the primary task involves looking at objects far from themselves (as, say, in a driving environment in a vehicle), then there is the additional challenge of needing to dramatically change the user's focus point from somewhere far from themselves to the device he or she is manipulating in hand or closeby.

In those devices including a touch-pad, the user does not get any tactile feedback as to which graphical button he or she is going to press. In fact, for the "soft-keys" in an integral touchpad/LCD screen, the user may press between displayed buttons, not realizing that his or her finger is bridging two 'valid' button locations, and leading in some cases to an undesired key being pressed and thus an undesired command sent to the electronic device.

SUMMARY OF INVENTION

The present invention relates to providing tactile feedback for mechanical buttons used on electronic devices such as cell-phones, remote controls, and the like. The invention also relates to embodiments for providing tactile feedback for a touchpad having an integral display such as an LCD screen, and buttons displayed thereon.

Haptic feedback interface devices can provide physical sensations which are felt by the user manipulating the interface device. One or more motors or other actuators are user in the device to output the haptic sensations.

The present invention provides an actuator to output tactile sensations on a set of buttons or keys of an electronic device. The buttons preferably can detect multiple levels of pressure or user selection (variable or analog input devices-- e.g., analog in, analog out) to determine whether the user is desiring to press a button to activate its function (heavier pressure), or is running his or her fingers over the buttons to locate a particular button (lighter pressure). Tactile sensations can be output if lighter pressure is detected to allow the user to locate a particular button more easily.

In the touchpad/integrated display embodiments, the tactile effects of the present invention allow the user to press the desired key or button more accurately. For example, a confirming tactile sensation can confirm that a particular key will be pressed, and a different sensation can confirm the actual press/selection of the desired key. In one example, if the user ignored the absence of a confirming sensation over a valid button and tried to press down , a 'not-valid' tactile sensation can be output indicating to the user that his or her finger was bridging two valid button locations.

Benefits of the tactile button confirmation with a single actuator include:

- Allows selections or entries to be made on a keypad with less user distraction
- Allows customized tactile responses in a keypad with a single actuator

- Allows modes and other non-visible features in the controlled device to be more obvious and intuitive to a user
- Allows highly configurable displays like LCD's to be used to present a changeable user interface to a user while still retaining a tactile feel.
- Allows a single button to potentially deliver multiple selections/characters based on how hard the user presses.

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