HAPTIC EFFECTS WITH PROXIMITY SENSING

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/828,195, filed Oct. 4, 2006.

FIELD OF THE INVENTION

[0002] One embodiment of the present invention is directed to a haptic feedback system. More particularly, one embodiment of the present invention is directed to a haptic feedback system that utilizes proximity sensing.

BACKGROUND INFORMATION

[0003] Electronic device manufacturers strive to produce a rich interface for users. Conventional devices use visual and auditory cues to provide feedback to a user. In some interface devices, kinesthetic feedback (such as active and resistive force feedback) and/or tactile feedback (such as vibration, texture, and heat) is also provided to the user, more generally known collectively as "haptic feedback." Haptic feedback can provide cues that enhance and simplify the user interface. Specifically, vibration effects, or vibrotactile haptic effects, may be useful in providing cues to users of electronic devices to alert the user to specific events, or provide realistic feedback to create greater sensory immersion within a simulated or virtual environment.

[0004] Haptic feedback has also been increasingly incorporated in portable electronic devices, such as cellular telephones, personal digital assistants (PDAs), portable gaming devices, and a variety of other portable electronic devices. For example, some portable gaming applications are capable of vibrating in a manner similar to control devices (e.g., joysticks, etc.) used with larger-scale gaming systems that are configured to provide haptic feedback. Additionally, devices such as cellular telephones and PDAs are capable of providing various alerts to users by way of vibrations. For example, a cellular telephone can alert a user to an incoming telephone call by vibrating. Similarly, a PDA can alert a user to a scheduled calendar item or provide a user with a reminder for a "to do" list item or calendar appointment.

[0005] Increasingly, portable devices are moving away from physical buttons in favor of touchscreen-only interfaces. This shift allows increased flexibility, reduced parts count, and reduced dependence on failure-prone mechanical buttons and is in line with emerging trends in product design. When using the touchscreen input device, a mechanical confirmation on button press or other user interface action can be simulated with haptics.

[0006] For portable devices, cost is an important driving factor. Therefore, to generate haptic effects a single low cost actuator is generally used, for example an eccentric rotating mass ("ERM") motor or an electromagnetic motor. These actuators are able to produce strong magnitude haptic outputs. However, they also require a certain amount of time to achieve their peak haptic output (e.g., approximately 50 ms). These actuators are also used to provide feedback to the user when operating a touch sensitive input of a touchscreen device. For example when the user presses a button on a touchscreen a haptic effect is output to give the sensation of pressing a mechanical button. It is desired to output the haptic effect at the same time the user has selected the button in the interface. However, due to the time it takes to have actuator reach a desired magnitude, the haptic effect lags behind the button press event. If this lag becomes too long the user will not perceive the button press and the haptic effect as a single event.

[0007] Based on the foregoing, there is a need for an improved system and method for generating haptic effects for a touchscreen.

SUMMARY OF THE INVENTION

[0008] One embodiment is a method of generating haptic effects on a device. The method includes detecting the presence of an object near an input area of the device and generating a haptic effect on the device in response to the presence detection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a block diagram of a cellular telephone in accordance with one embodiment.

[0010] FIG. **2** is a flow diagram of the functionality performed by a telephone when generating haptic effects in response to the proximity of a user to a touchscreen in accordance with one embodiment.

[0011] FIG. **3** is a flow diagram of the functionality performed by the telephone when generating haptic effects in response to the proximity of a user to the touchscreen in accordance with one embodiment.

DETAILED DESCRIPTION

[0012] One embodiment is a portable device that includes a haptic feedback system with proximity sensing. The haptic system initiates the haptic feedback before a user actually touches a touchscreen or other input area based on the proximity information.

[0013] FIG. **1** is a block diagram of a cellular telephone **10** in accordance with one embodiment. Telephone **10** includes a screen **11** and an input area, touchscreen **13**, that includes "keys" and can include other types of user interfaces, including menus, etc. In another embodiment, the keys of telephone **10** can be mechanical type keys. Internal to telephone **10** is a haptic feedback system that generates vibrations on telephone **10**. In one embodiment, the vibrations are generated on the entire telephone **10**. In other embodiments, specific portions of telephone **10** can be haptically enabled by the haptic feedback system, including the entire touchscreen **13** or individual keys of touchscreen **13**.

[0014] The haptic feedback system includes a processor **12**. Coupled to processor **12** is a memory **20** and an actuator drive circuit **16**, which is coupled to a vibration actuator **18**. Although the embodiment of FIG. **1** is a cellular telephone, embodiments can be implemented with any type of handset or mobile/portable device, or any device that uses an actuator to generate vibrations. For example, other embodiments may not include touchscreens but are haptic devices with other types of input areas. Other input areas besides touchscreens may be a mini-joystick, scroll wheel, d-Pad, keyboard, touch sensitive surface, etc. As with a cellular telephone, for these devices there is a desire for a haptic effect to be generated on the input area and/or the entire device.

[0015] Processor **12** may be any type of general purpose processor, or could be a processor specifically designed to provide haptic effects, such as an application-specific integrated circuit ("ASIC"). Processor **12** may be the same processor that operates the entire telephone **10**, or may be a