

module **180**, in communication with processor **120**. Display module **170** may include, for example, a liquid crystal device. Audio means **180** may include, for example, a speaker, a microphone, and the like.

[**0022**] For purpose of illustration in the embodiment of **FIG. 1**, processor **120**, actuator **130**, and memory **140** are shown to be enclosed within and coupled to the device body. Such an illustration, however, should not be construed as limiting the scope of the invention in any manner. In alternative embodiments, actuator **130** may, for example, be coupled to the outside of housing **110**, or embedded in housing **110** via a suitable mechanism. Further, user-interface **112** may include one or more user-interface members. As used herein, a user-interface member includes, without limitation, a key pad having one or more keys, one or more buttons, a touch screen or touch pad, a scroll wheel, a direction pad, a trackball, a knob, a miniature joystick, or other user-interface means known in the art.

[**0023**] Device **100** further includes an API (Application Program Interface) **190**, working in conjunction with an operating system **195**. A device driver (not shown) may optionally provide an interface between operating system **195** and processor **120**.

[**0024**] Memory **140** of device **100** stores a program code that includes instructions to cause processor **120** to perform various tasks. The following description provides some examples.

[**0025**] **FIG. 2** shows a flowchart **200** depicting a method of using customized haptic effects to convey information to users of handheld communication devices, according to an embodiment of the invention. At step **210**, an input signal associated with an event is received. At step **220**, a source of the event is determined and a control signal is selected based on the determination. At step **230**, a control signal is output to an actuator coupled to a handheld communication device (see **FIG. 1** for an embodiment of such device). The control signal is configured to cause the actuator to output a haptic effect associated with the event.

[**0026**] Furthermore at step **240**, a collection of haptic effects is provided, each haptic effect being associated with a control signal. For example, memory **140** of **FIG. 1** can store a program code that includes instructions to generate the control signals (e.g., each characterized by a distinct waveform) for rendering the corresponding haptic effects. Haptic effects (along with associated control signals) may also be downloaded or transmitted from a remote source, such as a service provider, a network resource, a Web server, a remote handheld communication device or computer. Such downloaded or transmitted haptic effects can be further edited or modified. At step **250**, a mapping between an event of interest and one of the stored haptic effects is received. By way of example, memory **140** of **FIG. 1** may also store a program code that enables a user to map an event of interest to one of the haptic effects as provided, e.g., via user-interface **112** through API **190**, where the event may be identified by its source. At step **260**, the one-to-one mappings made between various events of interest and the corresponding haptic effects are compiled into a haptic lookup table, which can, for example, be stored in memory **140** of **FIG. 1**.

[**0027**] In the embodiment of **FIG. 2**, the term “selecting” includes, without limitation, looking up a predetermined

mapping between the event of interest and a corresponding haptic effect based on the source determination, and selecting/generating a control signal that is configured to render the desired haptic effect associated with the event (e.g., upon being applied to an actuator). Selection can be made based upon the aforementioned haptic lookup table, for example.

[**0028**] In one embodiment, the input signal may include a communication signal associated with a call event, such as a voice call, an e-mail, or a message in text or multimedia form, which may be received via antenna **150** and transceiver **160** of **FIG. 1**, for example. The “source” of a call event may be related to a characteristic that distinctly identifies or characterizes the call event, such as the caller’s phone number, the sender’s e-mail address, a graphical feature or an icon associated with the incoming message, etc.

[**0029**] In another embodiment, the input signal may be associated with a reminder event, which may be a self-generated message on the handheld communication device serving as a reminder for a pre-scheduled activity (e.g., an appointment or a meeting). The source in this scenario may be associated with the type of a pre-scheduled activity (e.g., a business meeting vs. a restaurant reservation), or the time at which the pre-scheduled activity takes place.

[**0030**] In yet another embodiment, the input signal may include a communication signal associated with a status event, for example, received via antenna **150** and transceiver **160** of **FIG. 1**. Examples of a status event include, but are not limited to: an advertisement (e.g., sale) event, a one-to-one marketing event, a business-transaction event, a stock-trading event, a weather-forecast event, a sports (or game) event, an entertainment event, and an emergency (e.g., 911) event. In this scenario, the source may be associated with a characteristic that distinctly identifies the sender and/or the nature of a status event, such as the phone number of the handheld user’s stock broker, the e-mail address of the user’s favorite store, the logo associated with the user’s favorite TV or radio station, and so on.

[**0031**] In one embodiment, an event of interest can be accompanied by a distinct haptic effect, or overlapping haptic effects, conveying to the user customized information such as “who is calling,” “what is happening,” and so on. The user can also be allowed to update the haptic lookup table, e.g., to include new events, and/or to modify the mappings between the existing events of interest and the corresponding haptic effects.

[**0032**] Moreover, a specific haptic effect can be assigned to any incoming signal event whose source is unknown, so as to alert the user that the incoming message is from an un-identifiable or sender.

[**0033**] As used herein, the term “handheld communication device” includes, without limitation, a mobile phone such as a cellular phone or a satellite phone, a personal digital assistant (PDA), a cordless telephone, a pager, a two-way radio, a handheld or portable computer, a game console controller, a personal gaming device, an MP3 player, or other personal electronic devices known in the art that are equipped with communication or networking capabilities.

[**0034**] In one embodiment, the aforementioned haptic effects can be used as haptic ringers (e.g., counterparts to auditory ring tones) that are customized or personalized to