

be an analog-like button by providing a proportional, stepped, or analog output based on the pressure the user is exerting on the touchpad.

[0194] Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word-processor related region 456 can, when pointed to, cause a pulse of a particular strength, while each game-related region 456 can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region 454 or 456 to another, a haptic sensation (such as a pulse) can be output on the touchpad 450 to signify that a region border has been crossed. For example, a high frequency vibration which quickly decays to zero magnitude can be output when the pointing object enters a designated region. This can be valuable since it provides an indication of the borders to the regions 454 and 456 which the user would not otherwise know. This also allows region reconfiguration of size and/or location and allows the user to quickly learn the new layout haptically. Regions can also be associated with “enclosures” which define areas in a graphical environment and the different haptic sensations which are output when the cursor enters, exits, and is moved within the enclosure and the particular borders having such haptic associations.

[0195] In addition, the regions are preferably programmable in size and shape as well as in the function with which they are associated. Thus, the functions for regions 456 can change based on an active application program in the graphical environment and/or based on user preferences input to and/or stored on the computer 10. Preferably, the size and location of each of the regions can be adjusted by the user or by an application program, and any or all of the regions can be completely removed if desired. Furthermore, the user is preferably able to assign particular haptic sensations to particular areas or types of areas based on types of functions associated with those areas, as desired. Different haptic sensations can be designed in a tool such as Immersion Studio™ available from Immersion Corp. of San Jose, Calif.

[0196] It should be noted that the regions 454 and 456 need not be physical regions of the touchpad 450. That is, the entire touchpad surface need merely provide coordinates of user contact to the processor of the computer and software on the computer can designate where different regions are located. The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc. (e.g. a driver program can provide this interpreting function if desired). A local touchpad microprocessor, if present, may alternatively interpret the function associated with the user contact location and report appropriate signal or data to the host processor (such as position coordinates or a button signal), thus keeping the host processor or software ignorant of the lower level processing. In other embodiments, the touchpad 450 can be physically designed to output different signals to the computer based on different regions physically marked on the touchpad surface that are contacted by the user; e.g. each region can be sensed by a different sensor or sensor array.

[0197] Any of those embodiments described herein which provide haptic feedback to the finger or object of the user that contacts the touchpad or touchscreen may be used with the regions of touchpad 450.

[0198] While this subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.

What is claimed is:

1. A method of conserving battery power in an electronic device capable of outputting haptic effects, the method comprising:

tracking a battery level in an electronic device; and

adjusting a magnitude of a haptic effect output by an actuator coupled to the electronic device upon tracking the battery level below a predetermined level.

2. A method of outputting haptic effects using sound comprising:

processing a sound to be output from a speaker of an electronic device, wherein the sound has a first range of frequencies in a first audio range and a second set of frequencies in a second audio range;

separating the first range and second range of frequencies from one another;

outputting a haptic effect from the first range of frequencies, wherein the haptic effect is output from an actuator coupled to a touch screen of the electronic device;

outputting the sound via the speaker using the second range of frequencies.

3. A mobile communication device comprising:

a housing;

a touch screen coupled to the housing;

a sensor coupled to the touch screen, wherein the sensor is configured to measure a force of a user's digit imparted on the touch screen and output a sensor signal associated with the measured force;

a processor coupled to the sensor wherein the processor outputs an activating signal upon the sensor signal indicating the user's input at a predetermined region, wherein the activating signal varies based on the sensor signal; and

an actuator coupled to the touch screen, wherein the actuator outputs a pulse force upon receiving the activating signal, wherein the pulse force is altered based on the measured force to simulate a physical button.

4. A method of outputting haptic feedback comprising:

sensing movement of a user's digit along a touch screen, wherein the movement is sensed with a sensor coupled to the touch screen;

comparing the sensed movement with a predetermined gesture; and