

[0026] Briefly, an embodiment provides tactile feedback to a user when he activates, or is about to activate, an input device in the electronic device. In an embodiment, the input device has a set of regions that are defined to receive a user action (namely an action imparted by a user on the input device). Depending on what region(s) are affected by the user action, a feedback may be provided. Further exemplary details are provided on a user action, input regions and senses for an embodiment.

[0027] For an embodiment, a user action may be any pre-determined physical action that a user may impart on an input device. A user action may be to scan, hover and / or activate the input device with a body part, such as a finger. More particularly, user actions may include: pressing on the input device at one or more regions around the device; lightly sweeping a body part over at least part of the input device; holding a body part on or slightly above a region around the input device, etc.

[0028] The input device may have, or may be associated with, two or more regions that are used to define sensing regions for user actions relating to the input device. When a user action is imparted on those regions, a feedback is provided. A first region may be defined around the input device to provide an activation region for the input device. For example, on a touchpad, the first region may be a predefined area in the touchpad surface that is associated with a predefined key; on keyboard, the first input region may be the key itself. A second region may be defined as a physical feature on or around the input device to provide a feedback sense to the use. For example, on a touchpad, the second region may be a feature such as a bump, ridge, depression, well, line, score mark, or other distinguishing physical feature on the surface of the touchpad. The physical feature may also be a change in texture, shape and/or material that is present in the second region which differs from material or textures in the first region. The physical features can be combined.

[0029] Tactile feedback is a feedback (sense) that is generated, felt and/or detected when a user action is asserted upon one or more of the above-noted regions of the input device. The feedback may be passive, active or a combination of the two. Passive feedback may be a tactile sense provided by a physical feature on one or more of the regions of an input device. An active feedback may be a physical movement, a generated light and/or an audible signal or any other signal that is triggered to be generated by the electronic device upon detection of the user action. An active feedback may be generated by components in the electronic device (e.g. its buzzer, transducer, display, speaker, ancillary lights).

[0030] Combining elements of the input device, its regions, the senses and the user action, different senses may be provided for different user actions that are applied to one or more of the regions. For example, consider a touchpad having a flat surface and a first region defining a key, where there is a nodule on the surface defining a second region, where the nodule is placed in the middle of the first region defining the key. A first feedback (sense) may be provided when the user places his finger (one type of user action) on the touchpad in the key region (the first region) when he is not touching the nodule (namely the second region). An input signal generator may be associated with the touchpad to receive the signals generated by the touchpad from sensing the user's finger. The input signal generator may then process the signals from the touchpad and then generate a first signal which is meant to be used by other modules in the device to generate the first sense.

As such, the first signal may be provided to other modules in the device to process certain actions (e.g. to update the location of a cursor on the display as the user tracks his finger across the touchpad, to generate a feedback buzz signal for activating the key in the touchpad, etc.).

[0031] In the above situation, a second feedback (sense) may be generated when the user moves his finger such that the finger contact the touchpad in the key area and nodule simultaneously. This user action would represent contact with the first and second regions of the input device. When this user action is detected the input signal generator may generate a second signal. The surface of the touchpad itself may or may not be deflected if the user also presses on the nodule. Any physical deformations would be dependent on the relative dimensions of the feature and elements surrounding the touchpad.

[0032] Next, a third feedback (sense) may be generated when the user moves his finger to touch only the nodule and not the surface of the touchpad. This user action would represent contact with only the second region of the input device. When this user action is detected, a third feedback may be provided. The third feedback may simply be a passive feedback, provided by the texture of the nodule or the realization by the user that the finger is no longer touching the surface of the touchpad. However, additionally or alternatively, a third signal may be generated by the input signal generator, if a signal generated by the touchpad during this time can be analyzed by the input signal generator to generate a third signal. The signal generated by the touchpad may be the loss of the previously detected contact on the touchpad.

[0033] Other user actions may be provided when the user has his finger on the nodule alone, then moves it to touch the nodule and the touchpad simultaneously and then moves it further to touch the touchpad alone. The feedbacks generated may be similar to the three feedback (senses) described above, but may be generated in the reverse order as described above.

[0034] Additionally, when a user action matches a pre-determined action, another signal may be generated by the device. For example, if a user action is detected as an effort to press on a key, then a further signal may be generated to initiate generation of the key on the display. The signals received at the input device for user action would be compared against a template of input signals from the input device expected when the key is being activated.

[0035] The input signal generator analyses signals from the input device and generates one or more input signals based on the analysis. When analyzing signals from the input device, the generator may detect any difference in voltage, frequency, amplitude, current, capacitance and/or resistance between the signals. The output signal may be a voltage or current signal. The output signal may represent a simple change signal (e.g. a positive voltage may indicate an change in one direction of a sense type and a negative voltage may indicate a change in another direction of a sense type). The number of different senses may be determined by the sensitivity granularity desired.

[0036] Other signals and senses may be generated for other user actions, such as moving two or more fingers, two hands and/or other parts of a user's body gliding simultaneously across the input device. One user action may be mapped to be equivalent to another user action. For example, one user action of moving two fingers on two separate hands across a touchpad may be mapped to be equivalent as another user