device and a haptic feedback device. The device includes, at least, a touch sensitive surface, a controller unit, and a mechanical actuator coupled with the controller unit and the touch sensitive surface. The integrated device acts as the force sensing device by generating an output voltage in direct proportion to a force applied to the mechanical actuator by a user touching the touch sensitive surface, sensing the output voltage by the controller unit and converting the sensed output voltage to an indication of the applied force. Only when the sensed output voltage exceeds a voltage threshold level does the integrated device act as the haptic feedback device by halting the sensing of the output voltage by the controller unit activating the mechanical actuator by the controller unit, wherein the activated mechanical actuator imparts a physical force to the touch sensitive surface that results in a vibro-tactile response (subcutaneous tissue activated) felt by the user commensurate with the force applied by the user.

[0014] The invention relates, in another embodiment, to an electronic device. The electronic device includes, at least, a touch pad having a touch sensitive surface arranged to process a user touch event and a plurality of haptic feedback devices each of which is operatively coupled to the touch sensitive surface and each responding to the user touch event only in a specific region of the touch sensitive surface and arranged to provide tactile feedback singly or in combination with others of the plurality of haptic feedback devices in response to the user touch event. When the touch sensitive regions of at least two of the plurality of haptic devices overlap, if the user touch event occurs in the overlapping region, then the at least two haptic devices cooperate to provide a combined haptic feedback response based upon the location in the overlapping region of the user touch event.

[0015] The invention relates, in another embodiment, to an electronic device. The electronic device includes, at least, a touch pad having a touch sensitive surface arranged to receive a user touch event provided by a user, a controller coupled and in communication with the touch pad arranged to at least analyze the user touch event and/or a state of the touch pad and based upon the analysis provide a user touch event signal in response to the user touch event, and at least one haptic device operatively coupled to the controller arranged to receive the user touch event signal, wherein the at least one haptic device responds to the user touch event signal by providing an appropriate haptic feedback response to the user based upon the analysis provided by the controller.

[0016] In one embodiment, the touch sensitive surface is arranged to receive different types of user touch events each being characterized by an amount of pressure applied on the touch sensitive surface by a user and at least one haptic device operatively coupled to the touch sensitive surface arranged to provide a specific type of tactile feedback corresponding to the amount of pressure applied to the touch sensitive surface by the user.

[0017] It should be noted that in each of the embodiments described above, the methods can be implemented using a touch based input device such as a touch screen or touch pad, more particularly a multi-touch touch based input device, and even more particularly a multi-touch touch screen. It should also be noted that the gestures, gesture modes, gestural inputs, etc. can correspond to any of those described below in the detailed description. For example, the gestures can be associated with zooming, panning, scrolling, rotating, enlarging, floating controls, zooming targets, paging, inertia, keyboarding, wheeling, and/or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and in which:

[0019] FIGS. **1**A-**1**E are a series of block diagrams of a system, in accordance with one embodiment of the present invention.

[0020] FIGS. **2**A-**2**B shows a multi-point multi-haptic system having a multi-touch surface that incorporates a plurality of haptic devices in accordance with an embodiment of the invention.

[0021] FIG. **3** shows a schematic diagram of a representative piezo-electric haptic assembly.

[0022] FIG. **4** shows a schematic diagram of the haptic assembly shown in FIG. **3** configured to act as a pressure sensor.

[0023] FIG. **5** shows a flowchart detailing a process in accordance with an embodiment of the invention.

[0024] FIG. **6** shows display device displaying representative haptic active GUI elements in accordance with an embodiment of the invention.

[0025] FIG. **7** shows representative GUI button elements in accordance with an embodiment of the invention.

[0026] FIGS. **8**A-**8**B shows representative GUI button element and associated haptic profile in accordance with an embodiment of the invention.

[0027] FIGS. **9**A-**9**B shows a representative slider element and associated haptic profile in accordance with an embodiment of the invention.

[0028] FIGS. **10**A-**10**B shows a feature edge detection system in accordance with an embodiment of the invention.

[0029] FIG. **11** is a diagram of a zoom gesture method **1100** in accordance with an embodiment of the invention.

[0030] FIGS. **12**A-**12**H illustrates a display presenting a GUI object in the form of a map of North America with embedded levels which can be zoomed.

[0031] FIG. **13** is a diagram of a GUI operational method in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF SELECTED EMBODIMENTS

[0032] Reference will now be made in detail to selected embodiments an example of which is illustrated in the accompanying drawings. While the invention will be described in conjunction with a preferred embodiment, it will be understood that it is not intended to limit the invention to one preferred embodiment. To the contrary, it is intended to cover alternatives, modifications, and equivalents as can be included within the spirit and scope of the invention as defined by the appended claims.

[0033] The invention relates to multi-touch haptic feedback. Multi-touch haptic feedback refers to haptic techniques capable of providing multiple and discretely located haptic sensations across a surface. The haptic system can for example include a plurality of haptic nodes, each of which is capable of issuing vibro-tactile sensations (at the same time or different times and with the same intensity or different intensity). The haptic nodes can for example be configured in