

by touching an area 562 on the side pad 560 with the hand used to hold the device 530, and the user can then adjust the value for the selected attribute by touching the area 552 on the bezel 550 with a finger of the other hand. The side pad 560 can be either a large surface for tracking touch inputs or can include a plurality of small dedicated surfaces, such as touch buttons, for performing dedicated functions. In yet another alternative, the additional pads 560 can also be force sensitive so that a predetermined amount of force or pressure caused by a user touch is required to invoke the user control associated with the touched areas 562 of the pads 560.

[0092] In additional alternatives shown in FIG. 12, a touch sensitive bezel 590 according to the present disclosure can be arranged in a housing 572 around at least a portion of a display 580 of an electronic device 570. In general, the bezel 590 can include one or more discrete touch sensitive surfaces positioned in the housing 572 adjacent one or more sides of the display 580. On device 570A, for example, the bezel 590 has a plurality of discrete touch sensitive surfaces positioned in the housing 572 adjacent each side of the display 580. On device 570B, for example, the bezel 590 has a first touch sensitive surface positioned in the housing 572 adjacent three sides of the display 580 and has a second touch sensitive surfaces positioned in the housing 572 adjacent one side of the display 580. On device 570C, for example, the bezel 590 has a first and second touch sensitive surfaces positioned in the housing 572 adjacent opposing sides of the display 580. These and other alternative arrangements are possible for touch sensitive bezels according to the present disclosure.

[0093] In the embodiment of FIG. 5, the touch sensitive bezel of electronic device 200 has been described as having capacitive sensor array 220 that is used with data acquisition circuitry 230. As alluded to above, however, a touch sensitive bezel for an electronic device according to the present disclosure can include other forms of touch sensitive circuitry. Referring to FIG. 13A, another embodiment of a touch sensitive bezel 620 for an electronic device 600 is illustrated. Only portion of the touch sensitive bezel 620 is illustrated in FIG. 13A, and the housing, display, and other components of the electronic device 600 are not shown for illustrative purposes. In the present embodiment, the touch sensitive bezel 620 includes a Printed Circuit Board (PCB) 622 formed into a ring or frame shape and defining an inner opening 624 in which components of the display (not shown) for the electronic device are positioned. A plurality of conductive pads 626 are formed on the PCB 622, and each pad 626 is interconnected by a resistive element (not shown) according to details discussed below. The PCB 622 in this embodiment can have dimensions of approximately 8 by 10-inches and can have about 100 pads 626 formed around its perimeter.

[0094] The touch sensitive bezel 620 also includes a control module 630, which is housed in the electronic device and is shown here relative to the PCB 622 for illustrative purposes. The control module 630 is connected to the pads 626 of the PCB 622 by connections (not shown). The control module 630 has a plurality of components, including an infrared sensor, communication circuitry, accelerometer/inclinometer sensor, and other components. A suitable infrared sensor is an RE200B pyroelectric passive infrared sensor. A suitable accelerometer/inclinometer sensor is a KXP84 IC.

[0095] The electronic device 600 can also have a plurality of ambient light sensors 604 and a plurality of infrared (IR) modules 606, which are also shown here relative to the control module 630 for illustrative purposes. A suitable ambient light sensor is an ISL29001 light-to-digital sensor. The ambient light sensors 604 can be positioned in various locations on the housing of the electronic device and behind the display. The ambient light sensors 604 detect the level of ambient light near the display so that the electronic device can adjust the contrast, brightness, or backlighting of the display accordingly.

[0096] In FIG. 13B, a schematic diagram of components 632 comprising portion of the control module 630 of FIG. 13A is illustrated. The components 632 in this portion include a QT510 Interacted Circuit 634 available from Quantum Research Group, Ltd. The QT510 IC 634 is connected at three approximately equidistant points 636A, B, and C on the pad element 620, which is shown here schematically. Operation and arrangement of QT510 IC 634 and the pad element 620 is similar to that used for the QWheel™ available from Quantum Research Group, Ltd. However, in at least one exception, the QWheel™ has 18 pads formed into a concentric wheel with resistors of about 15K positioned between each pad and a total resistance of about 270 k. In contrast, the present embodiment of the pad element 620 has about 100 pads formed as a frame for the display of the device. The 100 pads are interconnected by about 100 resistors. Each resistor has a resistance of about 2.67 k so that the pad element 620 has a total resistance of about 270 k.

[0097] In an additional embodiment, the operation and arrangement of IC 634 and the pad element 620 of the present disclosure can use techniques disclosed in U.S. Patent Application Publication No. 2006/0032680, entitled "A Method of Increasing Spatial Resolution of Touch Sensitive Devices," which is incorporated herein by reference in its entirety, to expand the detected sensitivity of the pad element 620.

[0098] In the embodiment shown in FIG. 13A, the pads 626 are formed on PCB 622. In an alternative embodiment shown in FIG. 13C, pads 628 can be formed as layers on a surface of a display 610 for the electronic device 600. For example, techniques associated with Indium oxide doped with tin oxide (referred to herein as ITO techniques) can be used to deposit the pads 626 as transparent conductive thin layers on the surface of the display 620. In this way, the touch sensitive bezel of the device 600 is essentially the perimeter of the display 610, and the housing 602 is practically consumed by the display 610. In addition, a touch sensitive wheel 650 having a plurality of pads 652 can also be deposited as on the display 610 using ITO techniques to provide additional user controls of the electronic device 600.

[0099] In FIG. 14, an embodiment of an electronic device 700 having a touch sensitive bezel 720 capable of force and location detection is illustrated. Portion of the touch sensitive bezel 720 is illustrated in a detailed cutaway. In this embodiment, the bezel 720 includes a force detector combined with a location detector so that the bezel 720 can provide both location and force detection. The bezel 720 includes a cosmetic layer 730, a substrate 740, a dielectric spring layer 750, and a base or support layer 760. The substrate 740 has a plurality of conductive drive paths 742