

potentially harm the operation of the switch pads 5, the embodiments of the present invention allow for a reduced risk that the entire switch pad becomes completely inoperable. Even if one, a few or some of the press detection pads 400-40n were damaged or made inoperable for some reason, it would still be possible to actuate directions associated with the input device 1 since the rest or a sufficient number of the plurality of press detection pads would still be functioning properly, whereby some embodiments of the invention allow for a longer lifetime of the input device and also the electronic apparatus in which it is integrated.

[0084] Furthermore, when a user applies a force to the input device 1 by depressing the button 2, the number of actuated/contacted press detection pads 400-40n may be indicative of the pressure or force that is applied against the input device. Thus, it is possible to detect how hard, i.e. how many press detection pads are actuated, the user presses the input device 1. This may allow for providing a single input device with multiple functions similar to a touch pad on a laptop or a touch-sensitive display on the mobile phone 40 or similar portable electronic terminal. The multiple functions may be selected in dependence of the applied force to the input device. As only one illustrative example, it would be possible to utilize only a certain number of press detection pads 400-40n of the input device for a camera function. By detecting how hard the user presses the key, the input device could be provided with a double function such that when the user presses the key softly, contacting a certain number of pads, e.g. pads 400, 401, 402, it is possible to focus the camera and subsequently, when the user presses the key harder making contact with more pads, e.g. pads 403, 404, 405, a picture can be taken by means of the camera. Moreover, when a user applies a force to the input device 1 by depressing the key/button 2, 3, it is possible to detect where on the press detection pad surface 41 the pressure or force is applied depending on how many press detection pads 400-40n that are contacted and thereby short circuit in that moment.

[0085] When the user applies a force to the input device 1, the key/button 2 will collapse and/or be deformed, i.e. in one embodiment, the key is made of a flexible and conductive material, preferably a soft conductive plastic, silicone or rubber-like material, to different extent in dependence on how much force that is applied, a large force deforms the soft button and its soft actuator surface 42 or bosses 6 more than a smaller force, i.e. the larger deformation the bigger contact area A between the pads 400-40n and the button/key/touch pad (see FIGS. 12, 14, and 16), and hence different press detection pads and different numbers of pads will be actuated by electrical contact with the button in dependence of where on the input device 1 the force is applied and the amount of force used. Thus, the press detection pads that are actuated upon depression of the input device 1 are indicative of what area of the input device 1 and how large area of the pad surface 41 that are activated as a result of the applied pressure. Consequently, the input device having multiple press detection pads 400-40n according to embodiments of the invention may be operable to perform position detection and/or pressure level detection of an applied pressure when the user applies a force to the input device by depressing the button/key/touch pad 2, 3, 6, 42 against the lower surface 41. This has the further advantage that an input device 1 according to some embodiments of the invention may be provided with more functionality than what is offered by known prior art input devices.

[0086] A press detection pad 400-40n can have a small size, e.g. parts of a mm or less, e.g. two to ten times smaller or more than prior art input devices and their single rings 4a, and circles 4b, as shown in FIG. 4. This will make it possible to fit the input device according to the invention under today's normal buttons, key pads and touch pads with switches 4 that is 3-6 mm in diameter or to be adapted to the size of a desired set of keys, e.g. the whole or parts of the set of keys in the mobile phone 40.

[0087] The material in the detection pads 400-40n shall be of a low resistance and be durable to wear and environmental stress, e.g. Au-plated or Ag-plated Cu-pads, ceramic low resistive material, for example Maxphase®, or similar material. The other connection side, i.e. the buttons/keys/touch pads 2, 3 to be actuated by fingers of the user, can be the known metal domes, as in prior art key pads in mobile phones, or the conductive sheet or button according to the invention, i.e. the soft button/rocker key 2, 3 in FIGS. 9-14 or the flexible sheet that is thin and that may be mounted taut/stretched over the detection pads 400-40n similar to a drumhead, as shown in FIG. 15, this material has a low resistance on the connection side, and is preferably sufficiently conductive so that a short circuit is achieved when contacting the switch pads 400-40n.

[0088] If the input device 1 is designed to give a pressure sensitive signal the number of detection pads 400-40n connected, i.e. short circuited, will vary dependent on how hard the user presses the button/touch pad 2, 3, 6, 42 against the pads and the pad surface 41, i.e. the contacting area increases due to deformation of the surface 6, 42 as the larger the force the bigger the deformation and contact area A (shown in FIG. 16). This will then correspond to the pressure level.

[0089] The multiple detection pads 400-40n can be produced with already know technology, as part of the wiring and layout of a PCB or flex film in the same way as the known pad shown in FIG. 4, i.e. the inventive pads 400-40n shown in FIGS. 6-8 and 16 are reduced in size at least between two and twenty times, preferably between three and fifteen times, and more preferably between four to ten times the size of the prior art pads shown in FIG. 4 to be fitted in a greater number on the same area 41 as the prior art pad.

[0090] FIGS. 5A, 10, 15 and 17A-17D shows the soft conductive actuator, i.e. button, key pad, or touch pad 2, 3 with differently shaped deformable lower surfaces for contacting the pads 400-40n: one actuator with a square cross-section in FIG. 5A; another actuator with a triangular cross-section forming a conical shape in FIGS. 5A and 10, another actuator with a rounded shape shown in FIGS. 5A and 17A, yet another actuator with a frustoconical shape in FIG. 17B, one actuator with an elongated triangular or wedge-shape in FIG. 17D with an upper side view and a lower view from above showing its rectangular shape, which of course may be quadratic, another actuator with a triangular hollow cross-section forming a non-solid conical shape in FIG. 17C, and one actuator in the form of a flexible sheet in FIG. 15. The actuators contact the switch pads 5 differently when pressed and deform differently, whereby the pad and actuator contacting areas A vary in size, this depend as explained earlier on how much force is applied by the user when actuating the input device 1.

[0091] The invention creates a parallel function in an input device instead of a serial function as in prior art input devices, whereby this provides a redundancy, i.e. a backup function, with a plurality of press detection pads backing up each other if one or more pads are "out of order". This is done by