

signal. The input end uses a plurality of piezoelectric materials arranged in a column as input cells, electrically connects the piezoelectric materials with a variable resistor, reads a variation of the variable resistor depending on a voltage difference of the piezoelectric material that varies depending on an applied pressure, and detects an input signal of various types.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

[0018] FIG. 1 is a perspective diagram illustrating a portable terminal applying a tactile input/output device according to an exemplary embodiment of the present invention;

[0019] FIG. 2 is a schematic diagram illustrating a construction of a tactile input/output device according to the conventional art;

[0020] FIG. 3 is a schematic diagram illustrating a construction of a tactile input/output device according to an exemplary embodiment of the present invention;

[0021] FIG. 4 is a schematic side diagram illustrating a tactile input/output device according to an exemplary embodiment of the present invention;

[0022] FIG. 5 is a diagram illustrating various arrangements of tactile input/output cells according to another exemplary embodiment of the present invention;

[0023] FIG. 6 is a block diagram illustrating a construction of a tactile input/output device according to an exemplary embodiment of the present invention; and

[0024] FIG. 7 is a diagram illustrating a construction of a tactile input device according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Now, embodiments of the present invention will be described herein below with reference to the accompanying drawings. For the purposes of clarity and simplicity, well-known functions or constructions are not described in detail as they would obscure the invention in unnecessary detail.

[0026] FIG. 1 is a perspective diagram illustrating a portable terminal employing a tactile input/output device according to an exemplary embodiment of the present invention. Note that the inventive tactile input/output device is applicable to a portable terminal and other electronic equipments with display devices known to artisan.

[0027] As shown in FIG. 1, a portable terminal 100 has a display device 110, and can input program execution, numerals, characters, symbols, etc. displayed on the display device 110, by a touch operation without using traditional key buttons. A speaker 111, which is a receiver, is installed above the display device 110. A microphone 112, which is a transmitter, is installed under the display device 110.

[0028] The display device 110 displays and receives input data on a screen and output a variety of tactile sensation depending on an input scheme. For example, when a pressure scheme is applied, if a user lightly touches a corresponding icon, a gentle vibration can be output to the user, and, in response to a harder touch, a stronger vibration can be output. Note that various input schemes can be used and, for example, a light intensity and a pressure can be used. Also, various output schemes can be implemented according to the teach-

ings of the preset invention and, for example, an output scheme of generating varying level of temperature, generating a physical force such as a friction force, an electrostatic force, a magnetic force and other known sensation known to artisans.

[0029] FIG. 3 is a schematic diagram illustrating the construction of a tactile input/output device according to an exemplary embodiment of the present invention. FIG. 4 is a schematic side diagram illustrating a tactile input/output device according to an exemplary embodiment of the present invention.

[0030] As shown in FIGS. 3 and 4, a tactile input/output device according to an exemplary embodiment of the present invention includes an input end 30 and an output end 40 independent from each other. The input end 30 includes a plurality of separate input cells 31. The output end 40 includes a plurality of separate output cells 41.

[0031] According to an exemplary embodiment of the present invention, although the input end 30 and output end 40 are constructed and combined together, the input cell 31 and output cell 41 do not overlap with each other. That is, the input cell 31 is disposed between neighboring output cells 41, and the output cell 41 is disposed in a unit space of a neighboring input cell 31. This arrangement structure optimally reduces a thickness of the tactile input/output device, increases durability of each cell, and suppresses generation of noise due to mutual interference. The input end 30 and the output end 40 can independently act as an input sensor and an output sensor, respectively. Thus, the output end 40 can operate independently and can express a feedback for an operation of the input end 30. For example, with generating tactile sensation using a physical force such as a friction force and an electrostatic force, the output end 40 receives simultaneously a signal from the input end 30. The output end 40 may express a different tactile sensation according to a button input from the input end 30. The conventional scheme has a problem that it has a limitation in reducing a thickness since the input end and the output end are configured to overlap with each other in order to simultaneously implement the input end 30 and the output end 40. However, the present invention provides that the input end 30 and the output end 40 are arranged closely in a line and can reduce the thickness. Also, the present invention provides satisfactorily an expression of tactile sensation that a user can feel with his/her fingertip. Thus, it is possible to independently and effectively implement the input end and the output end. Also, it is possible to promote their own flexibilities and to equip with a thin sensor where the input end and the output end can operate independently from each other on an object having a curve because of applying a cell structure of a long ladder shape of FIG. 5 using flexible materials such as a polymer and a Flexible Printed Circuit (FPC) and materials required to manufacture small-sized sensors such as a piezoelectric element, etc.

[0032] FIG. 5 is a diagram illustrating various arrangements of tactile input/output ends according to another exemplary embodiment of the present invention. As shown, the tactile input/output ends can employ a diversity of sequential arrangements such as a zigzag arrangement, a ladder shaped arrangement, a cross arrangement, etc. That is, the respective input cell and output cell are arranged in alternate sequence. The input cell and output cell can be formed to have a line ladder shaped structure beyond a conventional cross structure with X and Y-axes. This structure can promote relatively a faster output in response to input.