USER INTERFACE DEVICE AND PERSONAL DIGITAL ASSISTANT

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] The present invention contains subject matter related to Japanese Patent application JP 2007-233369 filed in the Japanese Patent Office on Sep. 7, 2007 and the entire contents of which being incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] (1) Field of the Invention

[0003] The present invention relates to a user interface device and a personal digital assistant (PDA) which can convey information to a user according to a tactile and visual mode.

[0004] (2) Description of the Related Art

[0005] In the past, for example, an information display/input device, in which a so-called touch panel is arranged on a display of a liquid crystal panel, displays an image of a virtual key on a display screen and makes it possible to input or select the information allocated to the virtual key, by a user touching the top of the touch panel area corresponding to the display position of the virtual key with a fingertip or a nib of a stylus pen, etc.

[0006] Document 1 (JP-2004-157933 A, FIG. 1 and FIG. 9) discloses a concavo-convex formation device which includes: plural displacement elements possessing a displacement unit arranged on a transparent substrate, and a displacement power generator operable to displace the displacement unit in a separating direction from the substrate correspondingly to a control signal; a transparent film layer provided in the vicinity of these displacement elements and operable to deform a contact portion to convex when the displacement unit receives a displacement power at the contact portion concerned; and a control means operable to output a control signal to each of the displacement elements individually. In the concavo-convex formation device, a transparent substrate and a film layer are laminated with a display device to form structure of a panel, over the surface of which a touch detection means is provided to detect contact. In Document 1, a user is informed of an appointed display position (for example, a virtual key position) to be touched at the time of a touch panel operation, by displacing to a shape of convex the transparent film layer of the concavo-convex formation device.

SUMMARY OF THE INVENTION

[0007] As mentioned above, by employing the constitution which arranges a concavo-convex formation device and a touch panel on a panel surface of a display device, and enabling formation of a concavo-convex shape on the panel surface concerned, not only the communication of information in a visual mode by the displayed content on a screen but also the communication of information in a tactile mode by formation of the concavo-convex shape becomes possible to a user.

[0008] However, in such constitution as described in Document 1, the concavo-convex shape formed in a certain position on the panel surface turns typically into the same concavo-convex shape. Namely, the concavo-convex shape which can be formed in a certain position of the panel surface depends on the shape of the displacement element arranged to the position. Consequently, it is difficult to form a concavo-convex shape at a certain time for example, and to form another different concavo-convex shape at another time. In other words, in the constitution disclosed by Document 1, the information which is conveyed by a visual mode to a user by changing the displayed content on the screen can be changed; however, the information which is conveyed by a tactile mode to a user can not be changed, since the concavo-convex shape turns always into the same shape.

[0009] On the other hand, if the information which is conveyed by a tactile mode can be changed linking to the change of the displayed content concerned (namely, if a concavo-convex shape can be changed), at the same time as the information conveyed by a visual mode is changed by changing the displayed content, a user interface which is more diverse and faithful to a user will be realized.

[0010] The present invention is made in view of the above circumstances and provides a user interface device and a personal digital assistant which enable change of the information conveyed by a tactile mode as well as change of the information conveyed by a visual mode, by employing the constitution which can convey information by a tactile and visual mode to a user.

[0011] The user interface device and personal digital assistant of an embodiment of the present invention solves the subject mentioned above by including: a transparent panel unit including plural layers, each of the layers being provided with plural transparent deformation sections operable to be deformed to a specified shape by injection of fluid or discharge of fluid; a fluid channel unit possessing structure forming a first channel and a second channel in common or separately, the first channel being a transparent fluid channel operable to supply fluid to be injected to the deformation sections and the second channel being a transparent fluid channel operable to pass fluid discharged from the deformation sections; a fluid pump unit operable to perform discharge of fluid at least to the fluid channel unit or suction of fluid at least from the fluid channel unit; a display panel unit including the transparent panel unit provided over an upper surface of the display panel unit and a screen surface operable to display at least an image; and a controller operable to control injection of the fluid to the deformation sections of the transparent panel unit or discharge of the fluid from the deformation sections of the transparent panel unit, according to an image to be displayed on the screen surface of the display panel unit.

[0012] That is, according to the present invention, in the transparent panel including plural layers each of which is provided with plural transparent deformation sections deformable into a specified shape by injection or discharge of fluid, a shape formed on the transparent panel unit can be changed into various shapes by deforming the respective deformation section of each layer.

[0013] In the present invention, providing a transparent panel in which plural transparent deformation sections deformable into a specified shape by injection or discharge of fluid are arranged in each of plural layers, it becomes possible to change the information which is conveyed in a tactile mode as well as the information which is conveyed in a visual mode, by deforming each of the deformation sections of each layer to a specified shape.