

the display panel may be reduced at the reduction ratio corresponding to the magnification ratio of the image due to the deformation section deformed to the convex shape. In this case, the lower layer becomes unnecessary.

[Internal Constitution Overview of a Mobile-Phone Terminal]

[0099] FIG. 17 illustrates an internal constitution overview of the mobile-phone terminal according to the embodiments of the present invention.

[0100] In FIG. 17, a communication antenna 12 is a built-in antenna, for example, and transmits and receives a signal wave for a telephone call or packet communication. A communication circuit 11 performs frequency conversion, modulation, demodulation, etc. of transmission and reception signals.

[0101] A controller 10 possesses a CPU and performs control of communication in the communication circuit 11, signal processing and its control, image processing and its control, control of non-contact communication, and other various signal processing and control of every unit. The controller 10 also performs execution of various kinds of application programs stored in a program memory 16 of a memory unit 15.

[0102] A speaker 21 is used for a receiver speaker provided in the mobile-phone terminal, or for an outputting speaker of a ringer tone, an alarm sound, warning beep, a reproduced music, a digital voice, and a voice accompanying a reproduced moving image and the like. The speaker 21 converts the sound signal supplied from a sound signal processor 20 into an acoustic wave, and emits the acoustic wave into the air.

[0103] A microphone 22 is used for transmission of a voice and for collecting an external voice. The microphone 22 converts an acoustic wave into a sound signal, and sends the sound signal to the sound signal processor 20.

[0104] The sound signal processor 20 performs predetermined sound signal processing, such as decompression/decoding and error correction of the audio data which is processed for compression/encoding and inputted via a data line. The sound signal processor 20 D/A-converts the processed audio data to a sound signal, amplifies the sound signal, and outputs the amplified sound signal to the speaker 21. The sound signal processor 20 amplifies and A/D-converts the input voice signal supplied from the microphone 22, performs compression/encoding and addition of error correcting code, etc., if needed, to the A/D-converted audio data, and outputs the audio data via the data line.

[0105] A display unit 23 includes a display device such as a liquid crystal display panel, and a display driving circuit of the display panel, for example. The display unit 23 displays a character, various messages, a static image, a dynamic image, etc. on the screen of the display panel.

[0106] An operating input unit 24 corresponds to the transparent touch panel described above in the case of the mobile-phone terminal of the present embodiment. That is, in the operating input unit 24, when a user touches the surface of a transparent touch panel with a fingertip, a stylus pen, etc., for example, the contact is detected and the detection signal is outputted to the controller 10 through the data line or a control line. Accordingly, the controller 10 can recognize which place of the transparent touch panel is touched by the user (the input position is recognized), and can perform processing corresponding to the input position. As an example, in the case of the example of FIGS. 12-14, by recognizing which

button is pushed by the user, the function currently assigned to the button can be performed.

[0107] A deformation section 25 is the deformation section of the tactile-visual UI panel of the present embodiment described above, a micro valve 26 is the micro valve of the tactile-visual UI panel of the present embodiment, and a pump 27 is the pump described above.

[0108] A pump control unit 28 controls operation of fluid discharging and fluid suction in the pump 27 based on the control data from the controller 10. Namely, the control data from the controller 10 includes a control value of fluid discharge amount when the pump control unit 28 controls the fluid discharging operation of the pump 27 and a control value of fluid suction amount when the control unit 28 controls the fluid suction operation of the pump 27. When the tactile-visual UI panel of the mobile-phone terminal of the present embodiment is provided with plural fluid channels, the control data also includes a control value indicating which fluid channel the fluid is to be discharged to or the fluid is to be sucked from.

[0109] When the tactile-visual UI panel of the mobile-phone terminal of the present embodiment is provided with plural micro valves, a valve control unit 29 performs a valve opening control and a valve closing control of each micro valve, based on the control data from the controller 10. Namely, the control data from the controller 10 includes a control value to be used by the valve control unit 29 in performing the valve opening control and the valve closing control of each micro valve 26, and also includes a control value for adjusting the amount of valve opening or the amount of valve closing, if the micro valve of the present embodiment is able to adjust the amount of valve opening or the amount of valve closing.

[0110] The memory unit 15 includes ROM (Read Only Memory) and RAM (Random Access Memory). ROM includes a rewritable storage medium such as a NAND-type flash memory, and stores for example, in the program memory 16, a program of OS (Operating System), a control program for the controller 10 to control each unit, a control program for controlling the pump and the valve in the present embodiment, and various kinds of application programs. ROM also stores compressed/encoded music data contents or compressed/encoded moving image data contents, various kinds of initial setting values, font data, dictionary data, machine name information, terminal identification information, and the like. RAM stores data as required, serving as a working area at the time of the controller 10 performing various kinds of data processing. A removable external memory cards may be included in the memory unit 15.

[0111] An image processor 13 generates image data, such as a standby screen and an E-mail sentence, an address book, various user interface screens, and a reproduced moving image of moving image data contents, and a received moving image of digital television broadcasting. The image processor 13 sends the image data to display on the display panel of the display unit 23 via the data line. The image processor 13 possesses a drawing engine 14, and generates an image data by a rendering process. The image data generated with the drawing engine 14 concerned is also sent and displayed on the display panel of the display unit 23. As mentioned above, processing to display a virtual button image on the display screen and to attach shading to the button image can be also performed by the drawing engine 14. About the rendering process or shading attachment to an image, the existing com-