

TOUCH-SENSITIVE DISPLAY WITH TACTILE FEEDBACK

[0001] The invention relates to a touch-sensitive display with tactile feedback.

[0002] Touch-sensitive displays, "touchscreens", are used predominantly in so-called touchscreen terminals which can be operated by a user touching the screen with a finger, whereby the keyboard and mouse known from the PC are generally dispensed with.

[0003] A confirmation that an input effected by a user has actually taken place is in general obtained by means of audiovisual feedback, for example by means of a beep sound or a change of color of the display area when the display is touched.

[0004] Touchscreen terminals are set up at trade fairs, presentations or in the reception areas of companies in order to enable dialog with customers. Touchscreen terminals can similarly also be found at airports and in city centers as information terminals for tourists, and in manufacturing facilities for data entry and control purposes in production processes.

[0005] One disadvantage experienced with the latterly mentioned applications are loud and irregularly occurring ambient noises which occur at airports and in streets and production facilities, with the result that there is a danger of audible feedback being masked by the ambient noises and going unnoticed by the user.

[0006] Visual feedback is similarly dependent on ambient influences. For example, direct or reflected sunlight can cause irritation, with the result that the visual feedback does not achieve the desired effect. In addition, situations also occur whereby users obscure areas of the display intended for the visual feedback with their hand.

[0007] Furthermore, a touch-sensitive monitor is known from U.S. Pat. No. 4,885,565, in which tactile feedback is initiated when an input is made by a user touching the screen, whereby to this end an oscillating coil is driven in such a way by a microprocessor that it triggers a mechanical stimulus which causes the housing of the monitor to vibrate so that the user can also feel that his input has been detected in addition to receiving the audiovisual feedback.

[0008] The disadvantage of this solution is that regardless of which input has been made by the user touching the screen, the same tactile feedback always occurs and a differentiation is only possible when taken in conjunction with the audiovisual feedback which is still present as before.

[0009] The object underlying the invention is to set down a touch-sensitive display with tactile feedback which resolves the disadvantages of the prior art.

[0010] This object is achieved by the features described in claim 1

[0011] According to the invention, a touchsensitive display with tactile feedback has a first mechanically flexible layer which is designed such that it functions as a display, for example a membrane known as electronic paper, a second layer having at least one receptor, a third layer having at least one controllable actuator, whereby the second layer is disposed in such a way that the receptor detects a contact in

at least one section of the first layer and generates at least one first signal, and whereby the third layer is disposed in such a way that the controllable actuator mechanically manipulates the first layer at least in some points of the section, and also a control device which is designed and contacted with the second layer and the third layer in such a way that in an initial state at least one second signal for controlling the actuator is generated, whereby at least one modified second signal is generated on the basis of the first signal.

[0012] The display according to the invention enables the detection of a contact with the display by means of the receptor, whereby a tactile feedback is given directly at the location of the contact, at which, for example in the case of a virtual keypad represented on the display which can be operated by pressing on the corresponding position of the display, for each of the keys represented in the keypad a tactile delimitation and/or a keyboard label is implemented by means of an actuator, which is also useful in particular with regard to the implementation of a terminal for visually impaired or blind persons. It is conceivable, for example, that keyboard and labels are displayed for sighted persons whilst at the same time an output is generated in Braille for blind persons by means of the actuator beneath the displayed key.

[0013] By exercising appropriate control (software), in order to get closer to the impression of a real keyboard it is possible to generate the feeling of the virtual key yielding or locking and it is even possible to simulate a slider control in that a virtual key representing a slider control follows the key being touched or dragged, whereby in addition the surface of a slider control of this type could be generated in particular to be rough and giving a good grip. As a result of the display according to the invention the user receives an intuitive level of feedback which offers the user a greater degree of confidence when handling a touch-sensitive display and minimizes or neutralizes the influence of disruptive noise and lighting conditions.

[0014] Particularly suitable for use as the first layer are display media which are designed in accordance with the "electronic paper", "microencapsulated electrophoretic display" or "organic electro-luminescence" technologies since these are very thin and, designed as a flexible membrane, yield to mechanical forces, such as are generated by the actuator, which in particular act in localized fashion on the membrane surface. In this situation, the membrane is designed to be elastic in such a way that it returns to the initial state prior to the effect of the mechanical force as soon as the force effect is removed.

[0015] An embodiment of the receptor as a light grid enables the indirect detection of contacts since such a light grid situated just above the first layer simply detects the location at which a user interrupts the light of the grid, with his finger for example, in order to touch a virtual key. Furthermore, this embodiment has the advantage that the second layer is formed by the air, which is limited only by the facilities used to implement the light grid, with the result that the actuator experiences no additional resistance when performing mechanical manipulation in localized fashion and requires little drive energy.

[0016] The embodiment of the actuator as a matrix arrangement of electrically and/or magnetically driven pins