TACTILE AND VISUAL DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 2006-122356, filed Dec. 5, 2006, and No. 2007-53118, filed May 31, 2007, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention relates to an active matrix type tactile and visual display device, and more particularly, to a tactile and visual display device in which a portion generating a tactile sensation and a portion generating a visual sensation are integrated.

[0004] 2. Discussion of Related Art

[0005] While the five senses are the visual, auditory, olfactory, gustatory and tactile senses, current display devices focus on the transmission of visual information. That is, they digitize sound and an image of a phenomenon or an object to transmit virtual information. Currently, demand for the transmission and exchange of information related to other senses is on the rise. Particularly, developments in telecommunications have led to the popularization of TV and Internet shopping malls. If Internet shopping malls provide tactile information such as roughness and friction as well as visual information, this will expand and enrich the market.

[0006] Current methods of quantifying and providing information on the tactile sense fall short of meeting the rising demand for such information. Research into a method of interchanging information between media and humans using the five senses has found that the tactile sense is very sensitive to force, vibration, temperature, etc., and thus does not easily lend itself to quantification and simulation.

[0007] Conventionally, a mechanical simulator array has been used to simulate the surface texture of an object. When the mechanical simulator array is used, a DC motor, a piezoelectric device, a shape memory alloy actuator, an ultrasonic vibrator, an air jet, a pneumatic actuator, a Peltier device, a surface acoustic wave device (a device using acoustic radiation pressure), a pressure valve device, an ionic conducting polymer gel film, etc., are used to stimulate mechanoreceptors in the skin.

[0008] Besides mechanical stimulators, there has also been extensive research into the use of electromagnetic force. For example, H. Tang, and D. J. Beebe disclose the use of an electrostatic force without applying mechanical pressure in "A Microfabricated Electrostatic Haptic Display for Persons with Visual Impairments," IEEE Transactions on rehabilitation engineering, Vol. 6(3), (1998), pp 241-248. Also, M. B. Khoudja, M. Hafez, J.-M. Alexandre, A. Kheddar, and V. Moreau disclose the use of an electromagnetic micro-coil in "VITAL: A New Low-Cost Vibro-Tactile Display System," Proceedings of the 2004 International Conference on Robotics & Automation (2004), pp 721-726. H. Kajimoto, N. Kawakami, and S. Tachi disclose the use of electrostimulation in "SmartTouch: Skin to Touch the Untouchable," IEEE Computer Graphics and Application, Vol. 24 January/February (2004), pp 36-43. K. A. Kaczmarek, M. E. Tayler, and P. Bach-y-Rita disclose the use of direct current (DC) in "Pattern Identification On a Fingertip-Scanned Electrotactiel Display," Proc. of the 11th Symposium on Haptic Interfaces for Visual Environment and Teleoperator Systems, Haptic Symposium 2003 (2003), pp 40-46. This literature concerns the generation of attraction, repulsion, and friction to stimulate the skin. The idea of producing artificial texture using electrostatic force was suggested by Mallinckrodt, et al. (E. Mallinckrodt, A. L. Hughes, and J. W. Sleator "Perception by the Skin of Electrically Induced Vibration," Science, Vol. 118 (1953), pp 277-278) and by Strong, et al. (R. M. Strong, and D. E. Troxel "An Electrotactile Display", IEEE Trans. Man-Machine Systems, Vol. 11(1) (1970), pp 72-79) since it can generate a tactile sensation with a simple structure and, unlike current, it does not have a direct effect on humans.

[0009] According to Tang, et al., an electrostatic haptic display with three 7×7 electrode arrays is fabricated on a 4-inch Si wafer using photolithography, and a voltage is applied to produce a tactile sensation and thus form a Braille display. However, in the display, the wiring of each electrode is not easy, and resolution is insufficient to produce the texture of a material. Further, it is not easy to represent a variety of tactile information using the above structures.

SUMMARY OF THE INVENTION

[0010] The present invention is directed to a tactile and visual display device in which an active-driving type display device capable of giving a tactile sensation is manufactured to implement a tactile signal that represents a visual signal representing a display image and information on texture in the form of tactile sensation.

[0011] The present invention is also directed to a tactile and visual display device in which a tactile sensation generator formed using a transparent electrode is mounted on a conventional flat panel type display unit to easily provide visual information and to generate tactile information.

[0012] One aspect of the present invention provides a display unit comprising: a plurality of scan lines, a plurality of data lines and a plurality of pixels; a tactile sensation generator mounted over the display unit, transmitting light emitted from the pixels, comprising a transistor electrically connecting a plurality of corresponding pixels formed to correspond to the pixels with adjacent corresponding pixels, and generating an electrostatic force or a magnetostatic force; and a sensor being in contact with the corresponding pixels to sense the electrostatic force or magnetostatic force generated by the tactile sensation generator.

[0013] The corresponding pixels of the tactile sensation generator may comprise a transparent electrode transmitting the light emitted from the display unit, a plurality of address lines and a plurality of scan lines electrically connected to the transparent electrode; a plurality of transistors transmitting a signal applied to the address line according to a scan signal applied to the scan line, and a capacitor storing a voltage corresponding to the transmitted signal.

[0014] The sensor may comprise a pad portion comprising sensing pixels corresponding to the corresponding pixels and a pad connector having one end electrically connected to the pad portion and the other end electrically connected to the tactile sensation generator.

[0015] The sensing pixels may use a metal material or a conductive material having transparency to sense an electrostatic force. The sensing pixels may use one of Au, Al, Fe, Ag, Pt, ITO and IZO. The sensing pixels may use a permanent magnet to sense a magnetostatic force. The sensing pixels may use a metallic permanent magnet to sense an electric force and a magnetic force. The pad portion may use a mate-