FORCE AND LOCATION SENSITIVE DISPLAY

CROSS-REFERENCE TO RELATED

[0001] This application claims priority to U.S. patent applications entitled "Force imaging Input Device and System," filed 30 Mar. 2006 (Ser. No. 11/278,080) and "Multipoint Touchscreen," filed 6 May 2004 (Ser. No. 10/840,862) and which are hereby incorporated by reference.

BACKGROUND

[0002] This invention relates generally to electronic system input and output devices and, more particularly, to a display unit (output) that detects a user's touch and the force of the touch (input).

[0003] There exist today many styles of input devices for performing operations in a computer system. The operations generally include moving a cursor and/or making selections on a display screen. By way of example, input devices may include buttons or keys, mice, trackballs, touch pads, joy sticks and touch screens. Touch screens, in particular, are becoming increasingly popular because of their ease and versatility of operation as well as to their declining price. Touch screens allow a user to make selections and move a cursor by simply touching the display screen via a finger or stylus. In general, the touch screen recognizes the touch and position of the touch on the display screen and the computer system interprets the touch and thereafter performs an action based on the touch event.

[0004] Touch screens typically include a touch panel, a controller and a software driver. The touch panel is a clear panel with a touch sensitive surface and is positioned in front of a display screen so that the touch sensitive surface covers the viewable area of the display screen. The touch panel registers touch events and sends these signals to the controller. The controller processes these signals and sends the data to the computer system. The software driver translates the touch events into computer events.

[0005] There are several types of touch screen technologies including resistive, capacitive, infrared, surface acoustic wave, electromagnetic, near field imaging, etc. Each of these devices has advantages and disadvantages that are taken into account when designing or configuring a touch screen. In resistive technologies, the touch panel is coated with a thin metallic electrically conductive and resistive layer. When the panel is touched, the layers come into contact thereby closing a "switch" that registers the position of the touch event. This information is sent to the controller for further processing. In capacitive technologies, the touch panel is coated with a material that stores electrical charge. When the panel is touched, a small amount of charge is drawn to the point of contact. Circuits co-located with the panel measure the charge and send the information to the controller for processing.

[0006] In surface acoustic wave technologies, ultrasonic waves are sent horizontally and vertically over the touch screen panel as for example by transducers. When the panel is touched, the acoustic energy of the waves are absorbed. Sensors located across from the transducers detect this change and send the information to the controller for processing. In infrared technologies, light beams are sent horizontally and vertically over the touch panel as for example by light emitting diodes. When the panel is touched, some of the light beams emanating from the light emitting diodes are interrupted. Light detectors located across from the light emitting diodes detect this change and send this information to the controller for processing.

[0007] One drawback to these technologies is that they do not generally provide pressure or force information. Force information may be used to obtain a more robust indication of how a user is manipulating a device. That is, force information may be used as another input dimension for purposes of providing command and control signals to an associated electronic device (e.g., a tablet computer system, personal digital assistant or a mobile phone). Another problem with these technologies is that they are only capable of reporting a single point even when multiple objects are placed on the sensing surface. That is, they lack the ability to track multiple points of contact simultaneously. Thus, it would be beneficial to provide an input display unit that is capable of detecting both the location of a touch and the force with which that touch is applied.

SUMMARY

[0008] A unit to provide both force and location detection includes a first transparent substrate (having first and second sets of conductive traces oriented in a first direction), a second transparent substrate (having a third set of conductive traces oriented in a second direction) and a plurality of deformable members (e.g., rubber beads) juxtaposed between the first and second transparent substrates. The first set of conductive traces, in combination with the conductive traces of the second transparent element, are configured to provide a capacitance signal representing where a user touches the display element. The second set of conductive traces, in combination with the conductive traces of the second transparent element, are configured to provide a capacitance signal representing the amount of force applied to the display element. In one embodiment, the second transparent substrate includes a fourth plurality of conductive traces (oriented in the second direction), each pair of which separates sets of the third plurality of conductive traces. In another embodiment, the two transparent substrates form a closed volume that may be filled with a liquid to mitigate visual aspects of the deformable members. The described force and location sensitive unit may be abutted to a display element (e.g., a LCD or CRT) so that a display unit providing both location sensing and force sensing is possible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 shows, in block diagram form, a display unit in accordance with one embodiment of the invention.

[0010] FIG. 2 shows, in block diagram form, a force and touch cell in accordance with one embodiment of the invention.

[0011] FIGS. 3A and 3B show various views of compressible media elements in accordance with one embodiment of the invention.

[0012] FIG. 4 shows the layout of conductive traces in accordance with one embodiment of the invention.

[0013] FIGS. 5A and 5B show an expanded view of the architecture set forth in FIG. 4.