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Resman

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(54) **TOUCH-SENSITIVE INPUT SCREEN HAVING REGIONAL SENSITIVITY AND RESOLUTION PROPERTIES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/371,159**

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(51) **Int. Cl.**[7] **G09G 5/00**
(52) **U.S. Cl.** **345/173**
(58) **Field of Search** 345/173, 174, 345/132, 901, 902, 600, 475, 698, 699; 178/18.01, 18.05, 18.06, 18.07, 18.03

(56) **References Cited**

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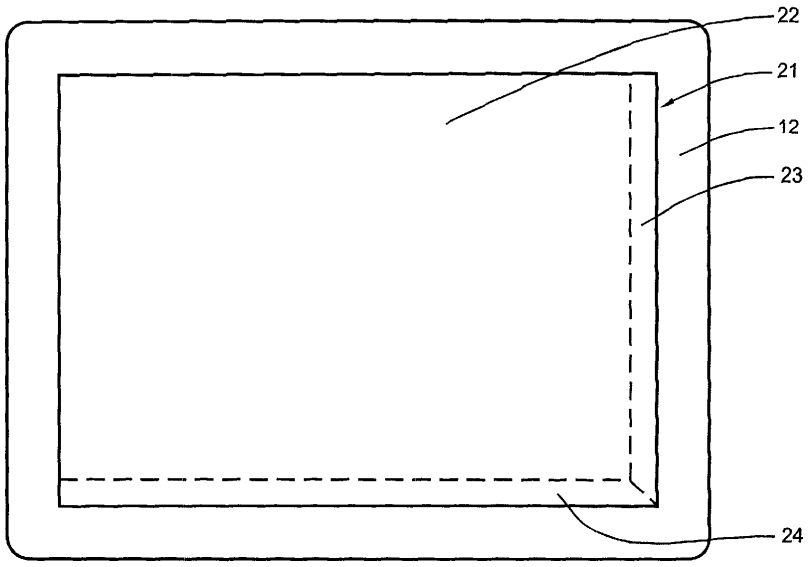
Primary Examiner—Chanh Nguyen

(57) **ABSTRACT**

A touch screen panel having varied region-specific combinations of resolution and touch sensitivity may also incorporate display functionality. For a first embodiment of the invention, the majority of the screen area exhibits low resolution, high touch force characteristics. A smaller area of the screen exhibits low touch force and high resolution properties. For a second embodiment of the invention, at least a portion of the peripheral regions (i.e., regions near the circumferential edge) of the screen are provided with regions of low touch force high resolution properties. These regions may be programmed to act as scroll bars, which would allow the user to change locations in a document of which only a portion is displayed on the screen. In the central regions of the screen, higher touch force and lower resolution provide palm rejection and coarse marking or movement capability with low bandwidth utilization. Either the varied screen properties may be incorporated into the screen during its manufacture, or the screen may be designed so that different resolution and touch sensitivity properties can be assigned to different regions of the screen to suit the user's needs.

23 Claims, 3 Drawing Sheets



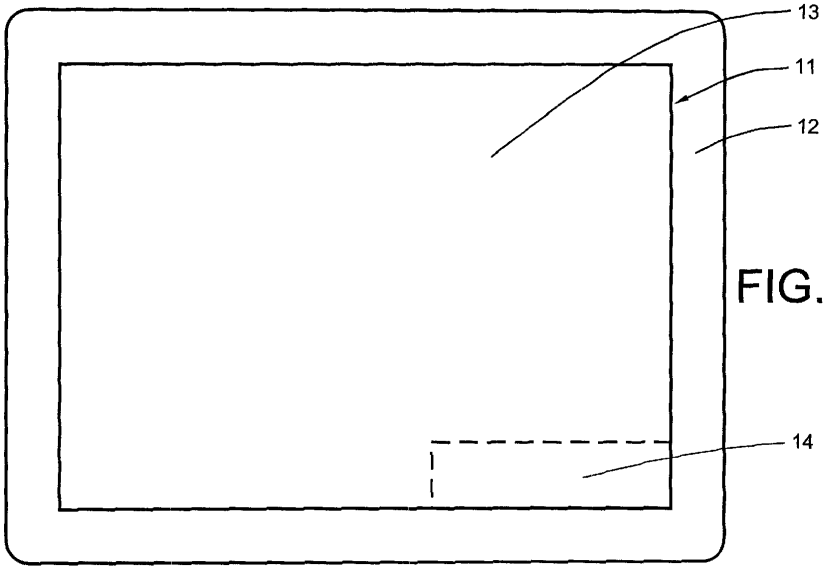


FIG. 1

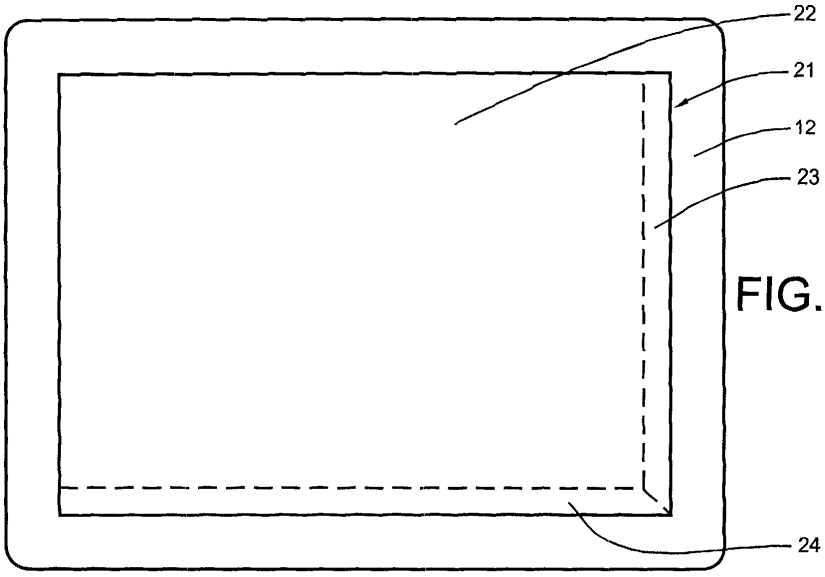


FIG. 2

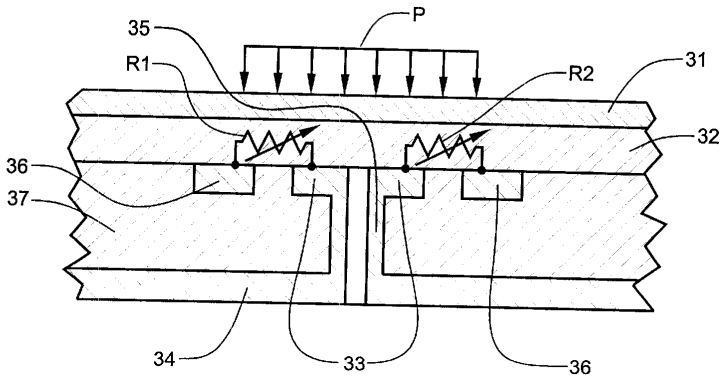


FIG. 3
(PRIOR ART)

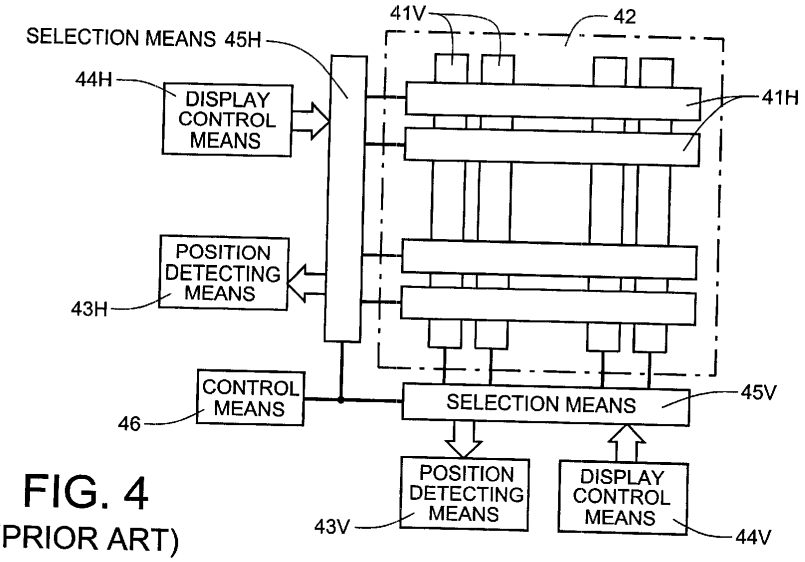


FIG. 4
(PRIOR ART)

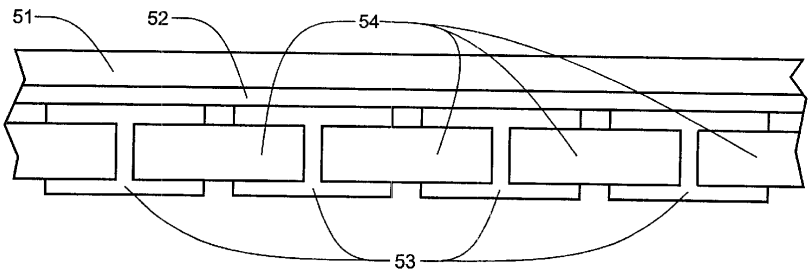


FIG. 5

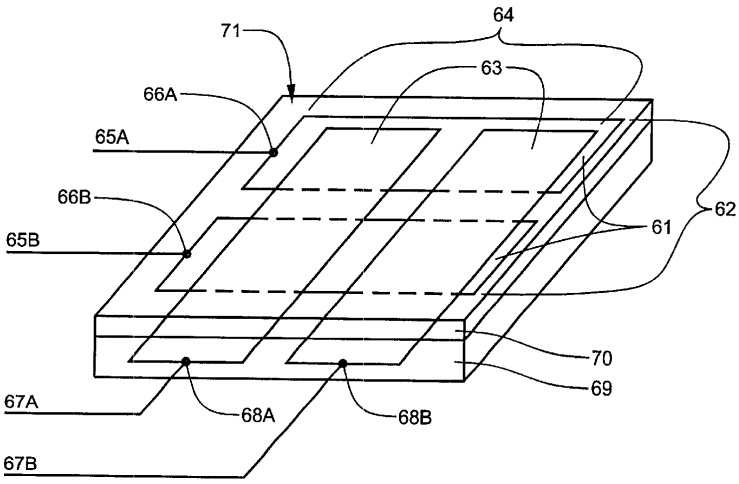


FIG. 6

TOUCH-SENSITIVE INPUT SCREEN HAVING REGIONAL SENSITIVITY AND RESOLUTION PROPERTIES

FIELD OF THE INVENTION

This invention relates to input screens and combined input/display screens for inputting and/or displaying graphic information in connection with a data storage and/or data processing system.

BACKGROUND OF THE INVENTION

Touch-pad display screens have found wide application in Personal Digital Assistants (PDAs), ultra-compact personal computers, with built-in operating systems, that are optimized for scheduling and other high-mobility operations. During the past several years, the popularity of PDAs has soared. Corporations such as Sharp, Casio, Philips, 3-Comm, and Hewlett-Packard have entered the fray. Most have flash memory, a small liquid-crystal-display touch-pad screen, a user input device which may be either a barely-usable, miniature keyboard, and/or a touch pad incorporated into the screen, as well as a communications port for transferring files between the PDA and a less-portable computer. A high-end PDA may incorporate a modem and communications software, as well as drawing, word-processing and spreadsheet software. A writing stylus, or "pen", may be supplied, with which the user may write and draw on the touch-pad screen. The PDA may also be equipped with a menu system which requires low-resolution inputs, thereby allowing the user to simply touch the screen at selected touch key locations with his finger to select menu options. The touch-pad feature has great utility on a PDA, as nearly all PDAs are too small to incorporate a keyboard large enough for efficient touch typing. Thus, handwriting and drawings are initially stored as bit-mapped patterns. With writing recognition software that is supplied with many of the PDAs, a user's handwriting can be converted to ASCII text. Compared with desk-top and lap-top computer systems, PDAs generally have very limited memory storage capabilities. However, the average amount of memory being supplied with PDAs is growing rapidly. Already, PDAs with 16 megabytes of flash memory are available. As it becomes possible to load an entire novel or textbook into the memory of a PDA, it is likely that they will find wide use as electronic editing and annotation devices.

Lap-top computers are equipped, almost exclusively, with LCD displays. Within the past year, flat screen displays utilizing LCD technology have become sufficiently inexpensive that they are beginning to replace cathoderay-tube (CRT) displays used with desk-top systems. Because touch-pad functionality can be readily incorporated in an LCD display, it is likely that large numbers of both lap-top and desk-top systems will soon incorporate LCD display screens with touch-pad functionality. The incorporation of touch pad functionality promises to facilitate rapid user interaction with the computer system. For example, the computer system may be programmed to initiate a particular task when a certain letter is drawn with a finger tip or stylus on the touch pad. An additional example is the programming of the computer system so that the edges of the touch pad mimic on-screen scrollbars. A touch pad will also permit the user to enter data in handwriting and to sign documents with a bit-mapped copy of his signature. With the availability of touch-pad systems, electronic editing and annotating of documents will become much more widespread. There is little doubt that the incorporation of touch-pad functionality

will greatly enhance the flexibility of personal computer systems. The incorporation of the touch pad feature in a desktop system is expected to reduce the frequency of repetitive motion injuries, as little arm or wrist motion is required.

Many different types of devices presently exist which utilize tactile sensing to provide inputs to a data processing system. These devices sense the position of a finger or stylus at successive intervals on a touch sensitive surface. The touch detection mechanism typically relies on localized changes in either conductivity or capacitance from a reference value caused by the presence of the finger or stylus on or near the touch sensitive surface. A touch screen display typically has both horizontal and vertical scanning circuitry. The location and direction of a touch input is determined during the periodic scanning of both horizontal and vertical screen elements. For example, if a screen has 600 elements arrayed vertically along the screen's horizontal axis and 400 elements arrayed horizontally along the screen's vertical axis, a capacitive change from a standard value at the intersection of any horizontal element and a vertical element will indicate a touch input at the intersection location.

In U.S. Pat. No. 4,013,835 to Eachus, et al., a touch pad is formed from a layer of a variable-resistance material, such as a silicone rubber membrane embedded with silver particles, which overlies a first set of parallel conductor strips which, in turn, overlie a second set of parallel conductor strips. Each conductor strip of the first set incorporates a plurality of serially-connected, open rectangles. Each rectangle surrounds a center conductive island which is in permanent contact with a conductor strip of the second set. When the membrane is compressed in the area of an open rectangle by pressure exerted by a finger or stylus, the membrane becomes conductive in the compressed region, and electrical contact is made between the rectangle and the surrounded island. Position can be determined by sequentially scanning the both sets of conductor strips at the periphery of the touch pad and determining current flow from a conductor of the first set to a conductor of the second set. Up to a maximum value, current flow will increase with pressure.

In U.S. Pat. No. 4,698,461 to Meadows, et al., a touch panel incorporates an upper layer of uniform resistivity. Panel scanning signals are applied to excite selected touch surface edges so as to establish an alternating current gradient across the panel surface. When the surface is touched, a current flows from each excited edge through the resistive surface and is either capacitively or conductively coupled to earth ground potential through the user's finger and body. As resistance increases with the distance from the edges of the panel, the touch location can be determined by measuring the current flows during the scanning process.

Cirque Corporation, a company noted for its touch-pad sensing devices, has received several patents covering the technology which descend from U.S. application Ser. No. 7/914,043 filed by Gerpheide, et al. On Jul. 13, 1992. One of the latest of these is U.S. Pat. No. 5,861,875. A touch-sensitive pad includes a plurality of capacitive elements formed by two perpendicularly-overlapping, dielectrically-insulated arrays of parallel electrode strips. The capacitive coupling of an object, such as a finger or stylus, to the capacitive elements is sensed to determine the object's horizontal and vertical (x and y) position with respect to the touch surface of the pad. This device is of interest because capacitive balance measurement circuitry and capacitive balance ratio determination circuitry have been included which increase position detection resolution beyond an

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