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First Named Inventor	Steve Hotelling
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(54) Manual Data Entry in Data Processing Systems

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(73) Granted to Laitram Corporation (The)
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Abstract of the Disclosure

The bottleneck of interfacing manual keyboards with high capacity data processing systems to rapidly enter a large number data input characters and processing instructions is resolved to use fewer keys without compromise on the rapidity of data entry. Thus, data input of either characters or processing instructions is entered in response to a single manual actuation stroke of keyboard keyswitches selected either one at a time or concurrently two or more at a time by a single finger on one hand. Thus, numeric calculators can with only nine keyswitches process all ten decimal digits plus a variety of processing instructions. Full alphanumeric data input can be handled with as few as twelve keyswitches. In this mode of operation fewer keys are needed and there is no delay in entry of data. Also the invention provides a layout pattern for touch entry of data with one hand with contoured finger homing positions that sense the right keyswitches and reduce entry errors. A set of side-by-side keys in a single field arranged for selection of each entry by a single finger is provided to improve accuracy of entries by avoiding mental choices and permitting "mechanical" entry of unmemorized new data.

IMPROVED MANUAL DATA ENTRY IN DATA PROCESSING SYSTEMS

Technical Field

This invention relates to multiple function high capacity data processing systems and more particularly it relates to data processing systems with manual entry keyboards providing a large choice of entries to data processing systems.

Background Art

Modern data processing systems are developed from multifunction chips having capabilities of performing many hundreds of functions, receiving many instructions and processing a wide range of data, and in particular alphanumeric data. Manual keyboard entry techniques have not kept up with the significant increase in capacity and comprehensiveness necessary to permit the effective use of the increased chip capabilities and thus have been a significant bottleneck to the advance of the manual entry data processing art.

In many instances a keyboard with few keys located in a limited space is necessary, as in the case of pocket size computers, or those designed for "touch" entry with a single hand so that the other hand may refer to records, etc. as in the case of an accounting system. Yet the trend is to go to larger and larger keyboards to increase the capabilities of communication with modern data processing chips.

Typical art permitting a keyboard system to be used in different modes thus producing multiple use of the keys is exemplified in my U.S. patent 4,547,860 granted October 15, 1985, in U.S. patent 4,124,843 by H.G. Bramson et al for "Multi-Lingual Input Keyboard and Display", November 7, 1978, and in U.S. patent 3,892,958 by C.C. Tung for "Inverse/Complementary Function Prefix Key", July 1, 1975. In such cases each key can achieve several functions to communicate with a larger number of the chip functions than a single mode keyboard.

In my U.S. patent 4,547,860 the keyboard capabilities are even further increased by adopting a multiple keystroke mode of operation that permits a single key to achieve multiple functions in each operating mode, depending upon whether one or more sequential strokes of the key are employed. There is, however, a price to pay for the significantly expanded range of functions available, namely, the time it takes for entry of data, and the increased chance for operator error. That is, if in order to provide alphanumeric operation a key need be stroked twice for each alphabetic character entry, it is obviously a tedious and time consuming process as compared with using a typewriter.

The problems of coordinating the multiple stroke operational mode of the foregoing U.S. patent 4,547,860 in a "touch" entry manual keyboard by an operator are significant. Also, when the number of keys become significantly larger than the number of fingers as in the foregoing Bramson et al patent, it is not a good environment for "touch" entry because of the frequent need to reposition the fingers and the thus significantly increased chance for operator error.

For appropriate manual entry of alphanumeric data into a touch entry system, it is highly desirable to have access to the entire alphabet plus a reasonable number of punctuation and instruction keys. A conventional typewriter keyboard generally has over forty keys in a bulky array requiring use of both hands to achieve this. These are requirements not always suitable in a data processing system and are certainly not compatible with the pocket sized systems now conventional in the art.

Feedback is most important in a touch system, namely, the ability of the operator to know that the entry is completed. This is achieved in a satisfactory manner by the movement stroke of a typewriter key. Without key movement it is most difficult to coordinate timing and to reduce manual error selections.

Also error free operation needs eliminate the operator errors induced by decision making. In the typewriting art it is well established that faster error free typing occurs when thinking is not required only copying mechanically from a text. For example, U.S. Patent 4,042,777 for "One-Handed Keyboard and Its Control Means", Aug. 16, 1977 requires a thinking decision in selection of a plurality of keys constituting a chord. For sensitive data such as accounting records, etc., it is evident that operator's errors are frequently induced by decisions in choosing the "chords".

Therefore, this invention seeks to improve the state of the art by significantly increasing the capability of a manual entry data processing keyboard to communicate with a modern data processing system in a time saving convenient manner using fewer strokes, fewer keys, and adapatable to the "touch" system of manual entry for fast data entry.

Disclosure of the Invention

The invention in its broader aspects comprehends a manual entry data processing system, including a manually actuated keyboard arrangement with a plurality of individual manually movable keyswitches arranged in a single field side-by-side for selective actuation by the stroke of a single finger engaging selectively either individual keyswitches or sets of at least two concurrently actuated side-by-side keyswitches bridged by the finger. Selection means responsive to the keyswitches actuated for each single finger stroke is provided to derive a set of unique signals numbering substantially in excess of the number of keys. Data processing means responsive to the unique signals is provided to enter data therefrom and select operating modes therefrom for processing entered data in a plurality of different modes. A live keyboard data entry operating mode is provided by the data processing means and provides for the serial entry of multiple digit words one digit at a time in response to a plurality of successive single finger strokes producing corresponding ones of the unique signals and terminated by a further single finger stroke thereby to enter data word by word into the data processing means. Functional control means establish a variety of different manually selectable data processing manipulations on the entered words in response to further ones of the unique signals and means display data processed by the data processing means in response to the functional control means manually selected.

More particularly this invention provides a manual entry data processing system and corresponding mode of operation providing one character entry per keystroke with a capability of a very large number of data and control function entries from a few keys. The manually actuable keyboard has a few keys operable in a "touch" mode with a single hand substantially error free. Thus, for example, twelve keys can afford full alphanumeric communication with a data processing system including a plurality of control functions for directing the functional operation of the data system. With sixteen or seventeen keys, literally hundreds of functional operations may be selected to produce effective use of the multiple capabilities of modern computer chips.

The manual touch mode with a minimal number of keys is achieved by adapting a data processing input system into a mode responsive to the entry of one or more concurrently operated keyswitches for each successive manual entry signal. Thus, a keyboard provides for side-by-side manually movable keys arranged for selection by a single finger stroke either individually or concurrently with two or more keys in unison. In this manner the number of unique combinational selections per keyboard key is significantly increased to permit many functions with few keys.

A graphic keyboard pattern of indicia representative of the key member layout and requisite manual selection of key members for specific data entries and control functions thus designates for example separate indicia for operation of one key at its center, two side-by-side keys at a line intersection between key rows and columns, and three or four adjacent keys at a cross line intersection of columns and rows of keys. For example, a 12 key keyboard will produce in this mode 47 unique signals, and thereby serve as comprehensively as a 47 key type writer keyboard.

Further to aid in the "touch" selection of the data entries the keyboard layout is contoured to produce different "touch feel" for the different single or combinational key selections of a finger stroke. Also in this respect the timing of data is controlled by a movable key entry requirement so that the operator can rest his fingers on a key spot touch wise without entry of data, and so that he can accurately time and sequence the entry of data as in typing. This is significantly important in reducing operator induced entry errors in data processing, and in significantly increasing the speed of data entry from a manual keyboard having far fewer keys than a typewriter.

A set of keys is arranged in a single field of side-by-side keys operable in general by a single hand in a mechanical mode without mental decision making after the keyboard is learned. Feedback feel signals are available in both movable manual keyswitch stroke form and in key contour structure identifying different finger locations. One key feature of the invention is that a single finger strokes a live keyboard for entry of each character by a single stroke. Thus a twelve key field can produce a complete set of alphanumeric characters operable by one hand using a single finger at a time for an entry stroke.

Brief Description of the Drawing

In the drawing:

Figure 1 is a plan view of a multiple-function multi-operating mode manual entry data processing system embodying the invention by providing full selection of any letter of the alphabet by single manual keystroke with a sixteen key keyboard;

Figure 2 is a partial section view through the movable keys on the Figure 1 keyboard showing the keyboard contour for identifying for touch manual control additional signal entry positions at the joint between two side-by-side keys, whereby two keys can be concurrently actuated by a single finger stroke;

Figure 3 is a diagrammatic block diagram view of a data processing system embodying the invention with a twelve key manual entry keyboard permitting direct entry of 47 signals permitting full alphanumeric capability with a single manual keystroke per signal entry.

Figures 4 and 5 are further diagrammatic keyboard layout patterns of 9 and 16 key keyboard embodiments afforded by this invention; and

Figures 6 to 9 are further keyboard layout patterns of 12, 16, 17 and typewriter formal key embodiments respectively, employing a contoured touch pattern enabling an operator to feel the difference between different finger rest positions corresponding to key combinations used in selecting different signal entries.

The Preferred Embodiments

Representative of a manual entry data processing system capable of communicating efficiently with a high capacity chip to use numerous of its functional capabilities is the system represented by the keyboard 16 and display panel 17 of Figure 1. This system is described in detail in my U.S. patent 4,547,860 granted October 15, 1985. Thus, a set of keys 18, in this embodiment sixteen, provides a direct entry set of numeric decimal digits and selected most often used data processing functions. A charted set of indicia 19, preferably located adjacent the key that is first chosen identifies a large number of added functional or data selections provided by a two stroke entry cycle. That is a first key above each chart is selected then the second key designated in the chart will complete selection of the function, etc. designated on the chart for entry into or instruction to the data system.

As afforded by this invention the capacity of the sixteen keys to enter data with a single keystroke is expanded enough to accommodate selection of the entire alphabet plus two control functions. Therefore, sixteen keys provide twenty-eight direct single keystroke entries. The alpha designation 20 for this set is superimposed above the keystroke finger rest position across each row of keys.

As seen better from Figure 2, the keys 18 may be actuated either singly by a finger stroke directly in the center position on the key 21 or two in unison by a finger stroke at the adjacent side-by-side edges of two keys having a contoured finger guide hollow 22 for assuring error free actuation of two keys concurrently. It is recognized therefore that this invention by providing for concurrent actuation of a plurality of keyswitches by a single finger stroke bridging side-by-side keys and corresponding processing of the keystroke signals has further significantly extended the capacity and versatility of data processing systems and has further resolved the keyboard bottleneck by permitting more of the data system capability to be used with manual entry keyboards.

A special side-by-side pattern of keyswitches, such as shown on the keyboard 23 of Figure 3, even more efficiently uses the principle of actuating one or more key switches with a single finger selected keystroke. Note that the side-by-side keys are spaced as closely together as feasible without interference with adjacent keys, in order to provide positive error free finger stroke actuation of the movable keyswitches. Thus, either a conventional single key is selected or a plurality of two, three or four keys at the various side-by-side key positions along the spacing lines between keys at the various rows, columns and intersections of rows and columns.

Therefore, the alphabetic letter A is selected by simultaneous operation of the 0 and 7 keyswitches along the column 24. B is selected by the single keyswitch 7. H is selected by simultaneous operation of three key-switches 0, 7 and 4 at the intersection of column 24 and row 25. J is selected by concurrent movement of key-switches 4, 5, 7 and 8 at the intersection of row 25 and column 26, etc. The combinational keyboard selection of different combinations of concurrently actuated switches in a capacitive action keyboard with spaces between metal oxide vapour deposit keys used for peripheral keys at intersections of rows and columns of key positions is set forth in German publication 2924515, Jan. 1, 1981. However, such keyboards cannot be used with the present invention because of many functional deficiencies, including: the wide spacing between keys, the lack of ability to segregate independently the various combinations by the touch method, the lack of feedback to know when and the timing of the actuation, the general criticality of the capacitive action in generating error signals of various types, and the lack of mechanical movement which equates the keyboard to familiar touch methods thus reducing learning time and error probabilities, and permitting the fingers to find a home resting spot on the keyboard from which the touch system can enable the operator to use the keyboard without "hunting and pecking" or reference to chart, table or key indica.

An important feature of this invention is that all the keyswitches are positioned in a single field of side-by-side keyswitches taking up a minimum amount of space and therefore being fully compatible with pocket size computer systems. Even more important this produces an optimum maximized data processing capability for one hand entry.

As seen from Figure 1, and as described in U.S. patent 4,547,860, it is a most important function in a manual entry keyboard for a data processing system providing many key selection choices that an operator can have displayed on or adjacent the keys a graphic display of the various manually selectable choices available in operation of the keyboard. Thus, although some prior art techniques are known regarding efficient use of a few keys to communicate manually with a data processing system, none can at the same time give a substantially complete set of instructions for a large number of the key selections. For example, consider the one-handed keyboard of U.S. Patent 4,042,777 - F. C. Bequaert et al., Aug. 16, 1977, wherein separate thumb and finger field keyboards are discussed. A complex chord system using a multiple simultaneous combination of fingers to select keys is set forth. This for new unmemorized entry of data leads to input errors due to mental decision operator choices. Also, there is a convenient way to simply graphically display the choices afforded, so that infrequently used functions or combinations can be checked out visually for accurate entry without reference to an external manual or catalog.

The system of Bequaert et al., however, has merit as an element in achieving the principles of the present invention, provided it is segregated from its environment and afforded in different and improved form in manual entry keyboard systems providing a restricted number of live key combinations operable solely by use of a single finger for data entry, as will be made more apparent in the following description.

Keyboards 23, and the like, may be coded in many ways to provide compatible manual input interface with modern data processing systems. Should each keyswitch have an independent lead,a set of thirteen wires comprising a common lead and twelve key identification leads would be provided. Alternatively, as later shown herein, keyboard matrix wiring patterns may be provided to reduce the number of wires that need be handled. In any event, this twelve keyswitch keyboard 23 with single keys operated one at a time produces twelve independent output signals responsive to keyswitch closures as indicated at cable 30.

It is well known in the art how to segregate different combinations of switch closures in a decoder arrangement, generally a matrix, as indicated in block 31. If all combinations of only one, two concurrent, three concurrent, and four concurrent keyswitch closings from a twelve key keyboard are decoded, the number of unique combinations is forty-seven as indicated at cable 32. These forty-seven individual signals are thus segregated into individual transmission channels available for entering data and functional instructions to the data processing system 33. Thus, this invention provides from twelve keys operable by a single hand and taking up little space a keyboard with the full communication capabilities of a full (two handed) typewriter keyboard. It is most important in this respect to note the critical timing. Each of the forty-seven signals takes a single keystroke time. To get such signal capacity in the system of my U.S. patent 4,547,860 a sequence of two keystrokes per entry is required. In most prior systems a much larger number of keys is required. Clearly it is advantageous in terms of the number of switches and wires used to reduce the number of keyboard keys. Also, many applications limit available keyboard space, such as in pocket sized systems. Furthermore, some applications are highly advantageous for single handed touch entry of a large number of entries such as encountered in alphameric data processing systems. Routinely accountants, for example, use only one hand for data entry while using the other to handle records, ledgers and the like.

Clearly the keyboard switch layout and data selection is optional. In the present keyboard 23 layout, for example, the numbers may be accessed by a shift operation, rather than by direct access, in order to provide further punctuation symbols, etc. The shift operation, function selections, and change of modes are achieved by control keys XQ for execute and the decimal point key which operates in dual capacity as a data entry key when stroked twice in succession. The clear and spacing functions are also provided on the graphic keyboard pattern of indicia laying out the requisite manual selection of the data entry and control functions selectable in the data processing system 33.

The control key functions for changing the mode, such as from alphameric to numeric, may be part of the set of forty-seven signals 32, but for illustration purposes are identified at 34 for operation through the mode change block 35. The data processing system 33 is internally programmed to enter and process data in different modes in response to keyboard data entry and control functions. Leads 36, 37, 38 illustrate the features of the Figure 1 embodiment and the prior referenced patent, where the entire keyboard operates live in a single stroke entry pattern in a plurality of selected modes, thereby increasing keyboard flexibility to use the built-in capabilities of the data processing system 33. Illustrated are alpha(meric) and numeric modes to correspond to the keyboard number and alphabetic indicia, and other modes that may be selected by the keyboard 23 from state of the art capabilities in the data processing system 33. Thus, a new data processing interface technique is provided for manual data entry to increase keyboard communication ability and to interface to manual input needs of a touch system entry and fuller employment of the data system capabilities.

As seen from the calculator 40 in Figure 4, a nine key keyboard is now feasible for numeric calculators operable in the single finger stroke manual entry mode. In this embodiment, twenty-three entries are provided for a significant range of function keys in addition to the ten decimal digits, all possible in a single field of nine keys.

The diagrammatic layout of Figure 5 provides for a sixteen key keyboard 42 where the single actuation keys provide for ten decimal digits and six function selections. As in other embodiments herein displayed, one key is saved by using the decimal point key 43 as a dual function key. Since only one decimal point ever appears in a numeric entry, the second stroke of the decimal point key 43 during the word, terminates it and enters the word into the calculator register, thus saving a separate "enter" key.

Note that this keyboard has matrix wired key columns 1, 2, 3 and 4 and rows A, B, C, D. Thus, each single key is identified by a column row intersection, i.e., 5 is at B2. In accordance with this invention, however, where simultaneous keys may be actuated by a single finger stroke, the keystroke position 44 illustrated in circular hatching, at the four corner intersection of a row and column spacing between keys will actuate four keys as designated by C, D, 3, 4, or C3+C4+D3+D4 which is shown by arrow designation in the corresponding blocks 45.

As hereinbefore shown in Figure 2 and as now related to the twelve key pattern of Figure 6, a keyboard contour pattern is provided for "touch" operation. Thus, circular 50 or oblong 51 depressions are indented in the keys for a finger rest "home" position for single key actuation. Two simultaneous keys are actuated at adjacent separation lines between two keys as identified by the back-to-back arrowhead notation 52. A raised contour at the three and four corner intersections where keys meet is provided at regions 53. Thus the touch system produces a definite feel for homing and roaming positions of the fingers on a single hand for direct entry of the various combinations available. Clearly this reduces error potential of manual entries.

Typically, the simple layout of Figure 6A provides single finger strokes with no shifting for a rather comprehensive set of computer functions in a numerical mode computer. Other layouts are, of course, feasible, and mode change to provide two or more sets of graphic keyboard indicia patterns, which may be color coded or otherwise differentiated.

Figures 7 and 8 show corresponding layouts for 16 and 17 keys, respectively that are contoured for single hand touch operation. Figure 9 is a layout adopting a conventional typewriter format which illustrates also the interlacing of key positions in the rows to produce raised finger rest pads 53' for actuation of three keys simultaneously above and below most key positions. Other variations of keyboard configurations may be suggested by this invention.

Having therefore advanced the state of the art, those novel features believed descriptive of the spirit and nature of the invention are defined with particularity in the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A manual entry data processing system, comprising in combination,

a manually actuated keyboard arrangement with a plurality of individual manually movable keyswitches arranged in a single field side-by-side for selective actuation by the stroke of a single finger engaging selectively either individual keyswitches or sets of at least two concurrently actuated side-by-side keyswitches bridged by the finger,

selection means responsive to the keyswitches actuated for each single finger stroke to derive a set of unique signals numbering substantially in excess of the number of keys,

data processing means responsive to said unique signals to enter data therefrom and select operating modes therefrom for processing entered data in a plurality of different modes,

a live keyboard data entry operating mode provided by said data processing means providing for the serial entry of multiple digit words one digit at a time in response to a plurality of successive single finger strokes producing corresponding ones of said unique signals and terminated by a further single finger stroke thereby to enter data word by word into said data processing means,

functional control means establishing a variety of different manually selectable data processing manipulations on the entered words in response to further ones of said unique signals,

and means for displaying data processed by said data processing means in response to the functional control means manually selected.

2. A system as defined in claim 1 including means for providing direct entry of an entire set of alphanumeric characters in response to single finger strokes providing said unique signals consisting of no more than seventeen keyboard switches in said field.

3. A system as defined in claim 1 including contour configurations on said key switches defining a plurality of different contours in separate finger rest regions identifiable by means of touch for distinguishing between finger positions for selecting at least single keyswitch and double keyswitch entries, thereby to aid accurate manual entry of data by the touch method.

4. A system as defined in claim 1 having no more than nine keyboard switches arranged in a row-column matrix layout adapted to enter both decimal digits in sequence and said data processing manipulations in the form of a variety of control signals for designating different numerical data processing functions for numerical data entered by the keyboard.

5. A system as defined in claim 1 having keys arranged in a conventional typewriter keyboard layout format with key rows interlaced to provide selectable combinations of concurrent signals from three different keyswitches in response to a single finger stroke.

6. A system as defined in claim 1 including means for changing the keyboard mode to select one of a plurality of at least two different sets of data input for live keyboard entry by a single keystroke per manual data entry cycle.

7. The system defined in claim 1 wherein the field of keyswitches is laid out in a field for operation by the fingers of a single hand and comprises no more than seventeen keyswitches.

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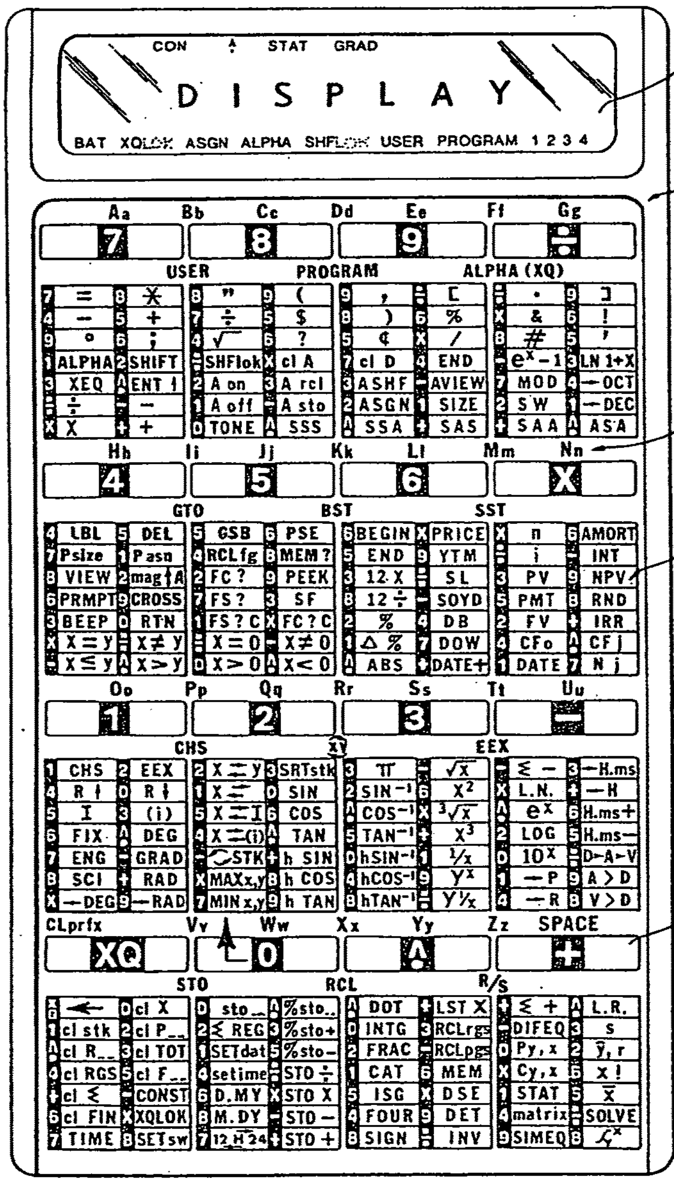

FIG. 1

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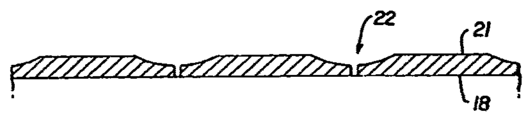

FIG.2

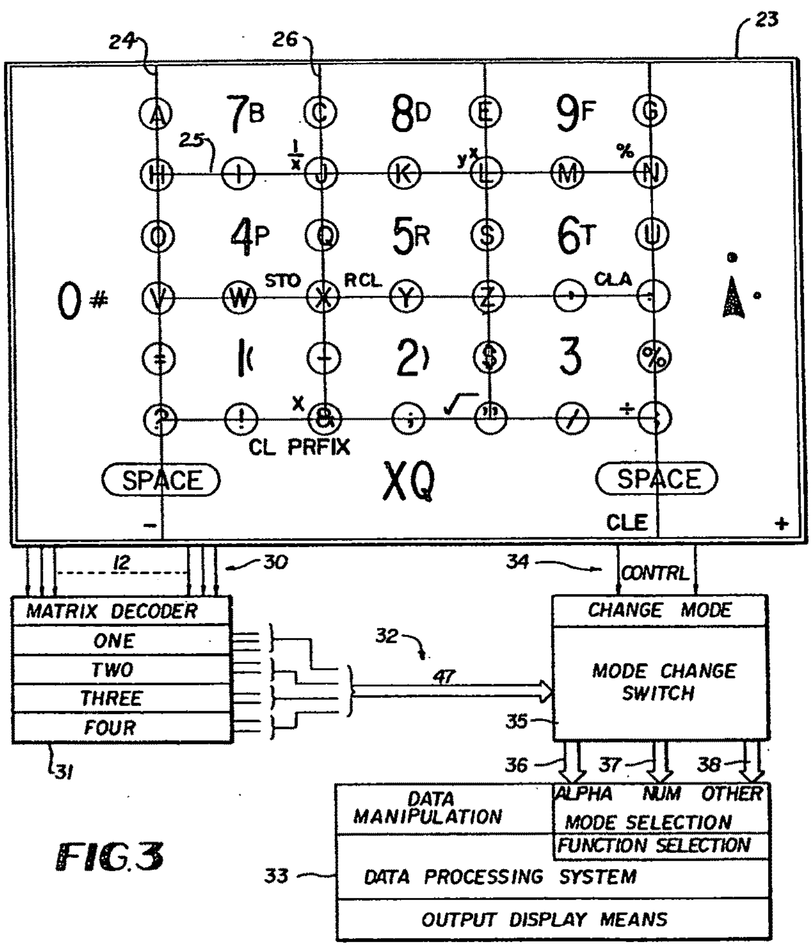

FIG.3

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FIG.4

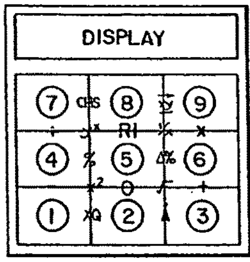
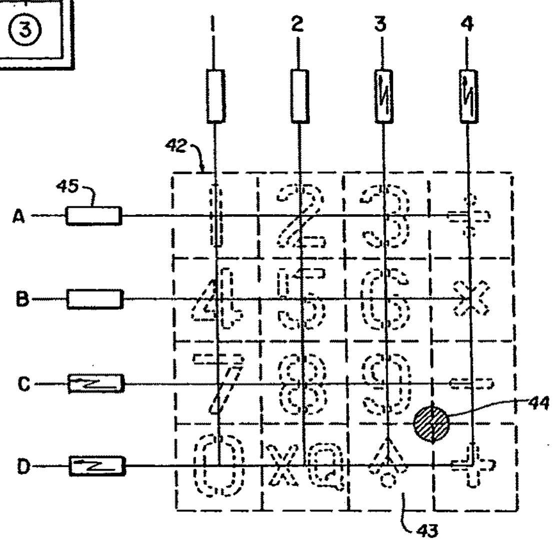


FIG.5



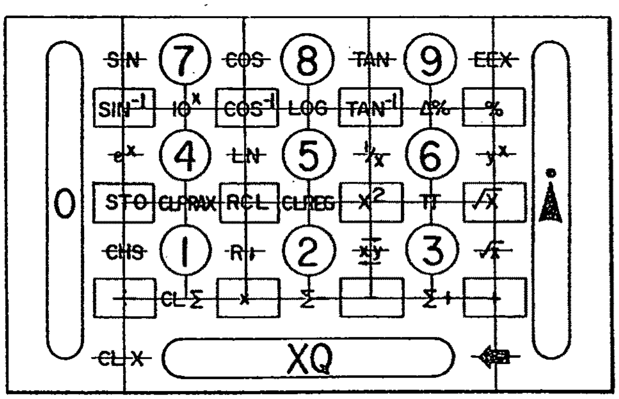


FIG.6A

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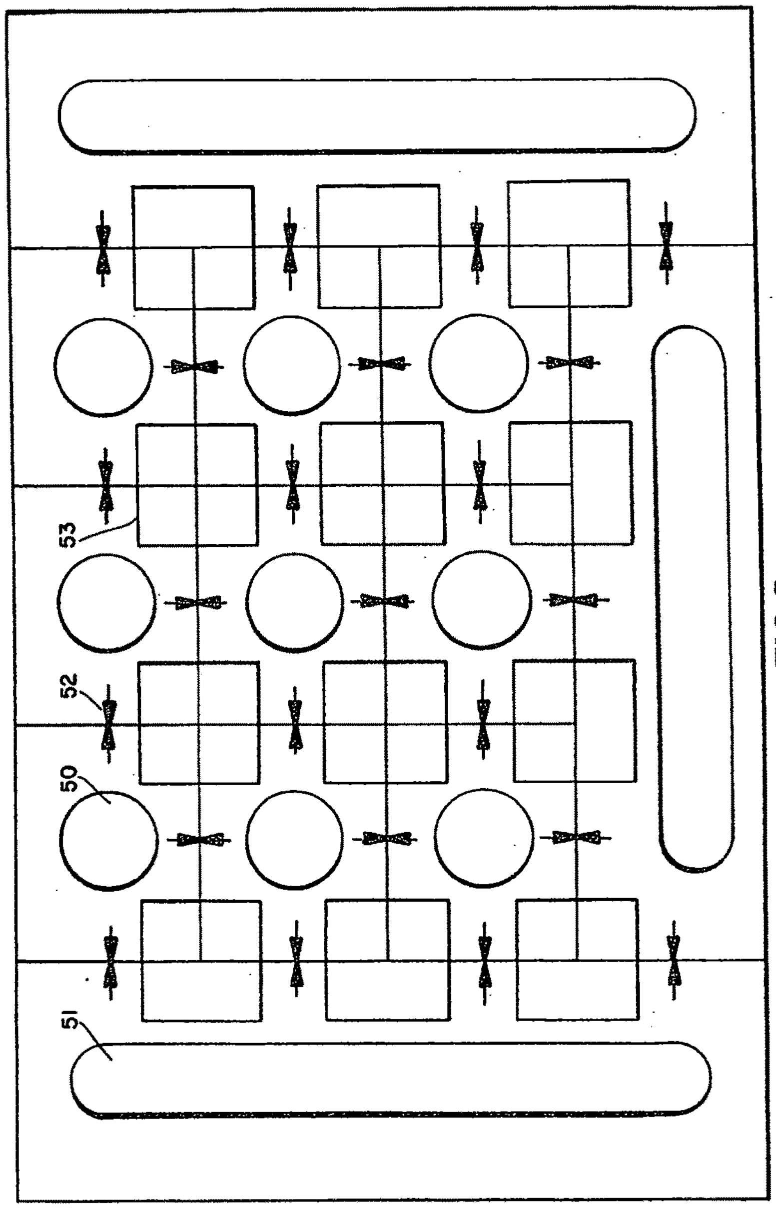

FIG.6

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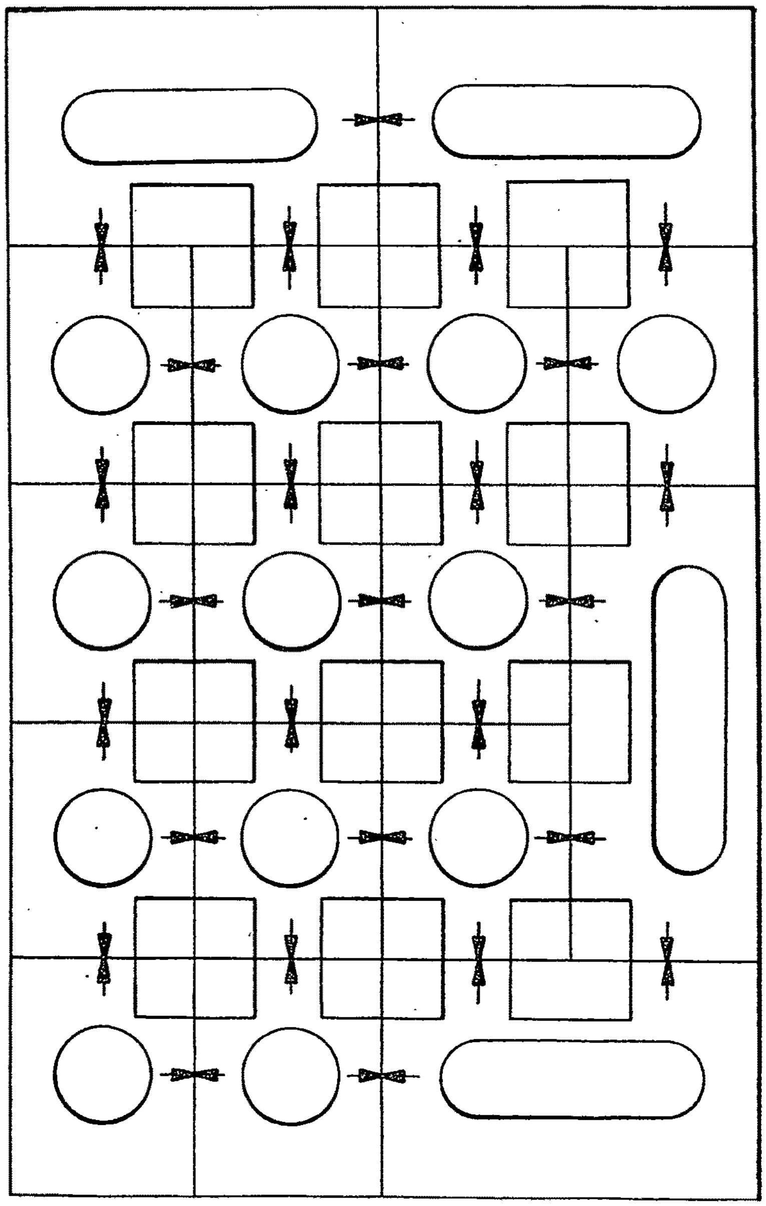

FIG.7

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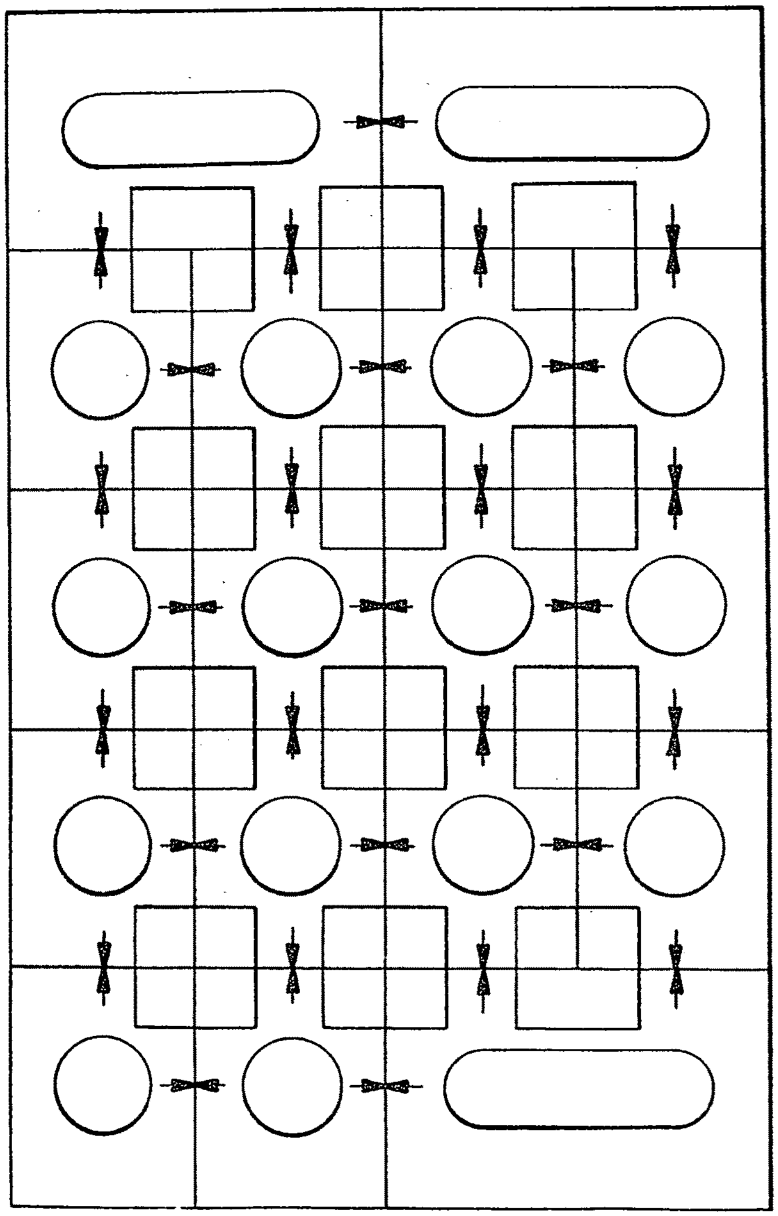

FIG.8

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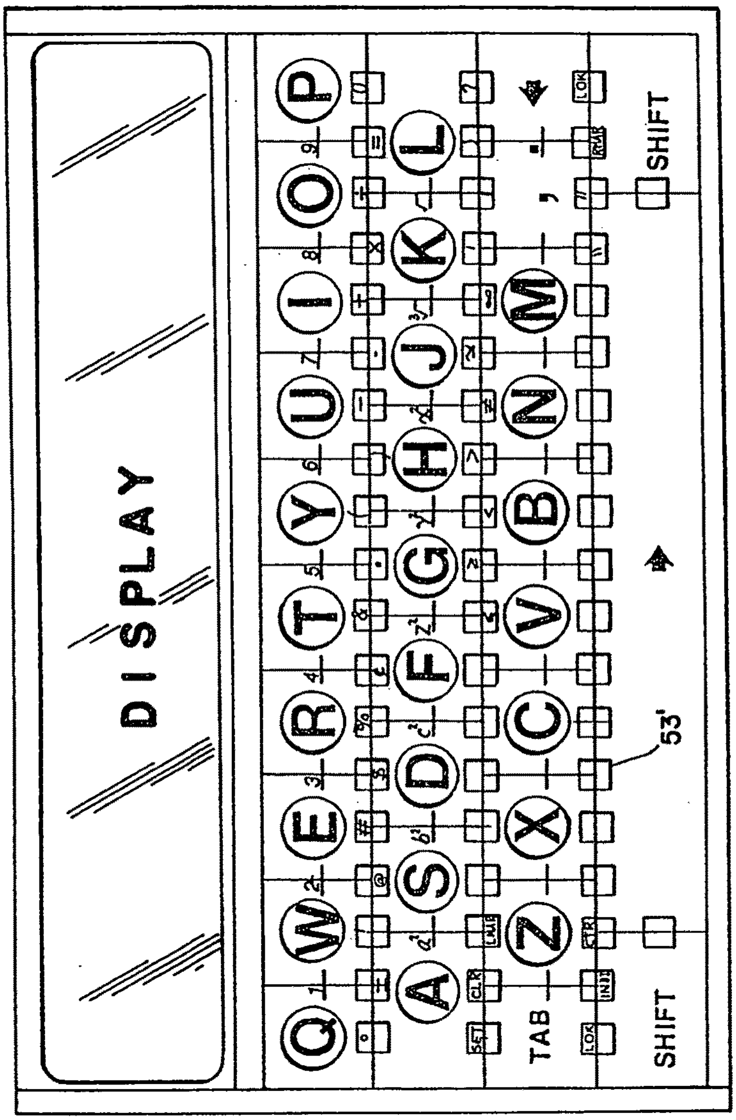

FIG.9

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FingerWorks

Tips and Tricks

Tips - Click on action to view animated tips.

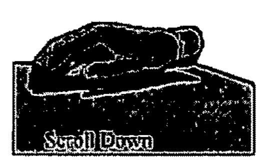
Scroll - For *fine* scrolling, "roll" your fingers instead of slide them. You can also rest your thumb once the scroll starts.

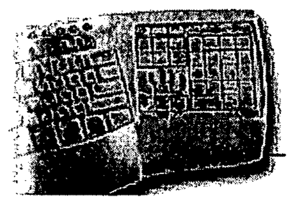
Pointing - Once pointing starts, you can drop the other fingers and point with all five.

Five Finger Pointing - On *iGesture* products, you can optionally start pointing with all five fingers.

Resting - Feel free to rest your hand on the surface often. You can start pointing or clicking from rest if desired.

Scroll by rocking your finger tips





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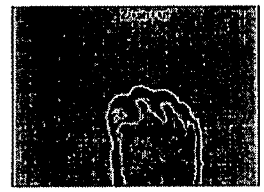
FingerWorks

Browsing Gestures

Web Browsing - Click on action to view animated gesture operation.



Back - Touch and slide thumb & three fingertips to the left.

Forward - Touch and slide thumb & three fingertips to the right.

Scroll - Touch & slide four fingers up/down. Rest thumb after starting if desired.

Zoom In - Touch & expand thumb & four fingers

Zoom Out - Touch & contract thumb & four fingers

Find (in page) - Touch and pinch thumb & two fingertips.

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FingerWorks

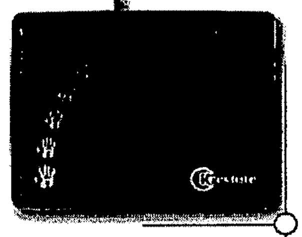
iGesture

User's Guide

- Installation
- Configuring
  - Windows or Mac Mode
  - Third Mouse Button
- Operation
- Quick Reference Guide
- Gesture Guide
  - XWinder Gestures
- Trouble Shooting
- Firmware Upgrade
- Customizing w/ MyGesture Editor

- Technical Details
- FAQs

iGesture Pad



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(54) Mouch screen overlay.

(57) An improved user interface for use in interactive electronic devices. The user interface eliminates the complexity and ambiguity problems encountered in conventional interfaces through the incorporation of a physical overlay designed for use in cooperation with a contiguous touch screen or a plurality of individual touch screens. The physical overlay delineates the touch screen or screens into a plurality of context sensitive task and information display regions which may be accessed by direct user manipulation.

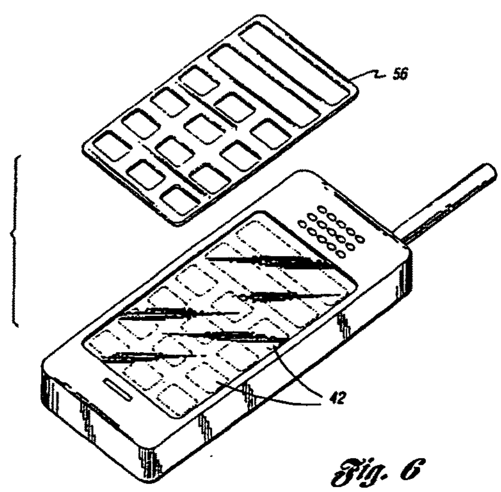

Fig. 6

EP 0 664 504 A2

Technical Field

The present invention relates to an improved user interface directed for use in interactive electronic devices which incorporate a physical overlay for precise disambiguation of touch screen input.

Background Art

Conventional Customer Premises Equipment (CPE) devices, including desktop telephones, mobile and portable telephones, facsimile machines, Personal Digital Assistants (PDA's) and computers and related electronic devices such as video cassette recorders, televisions, remote controls, calculators and the like, present all information entry keys for all functions. Such keys are generally adapted for use in cooperation with a single visual display -- regardless of whether the functions are relevant in the current context of the communication. Moreover, such visual displays which are generally liquid crystal displays (LCD's) do not present sufficient information to prevent users from entering an irrelevant or improper key. As a result, an erroneous key selection results in either an error message or similar indication that an invalid key has been entered -- neither of which is desirable from a user standpoint.

In an effort by system designers to implement additional functions, conventional keyboards have further incorporated additional keys which again correspond to functions which are neither relevant nor operable in all communication contexts. As a result, the size as well as the complexity of such keyboards has been correspondingly increased. While efforts have been made to reduce this inherent complexity, these efforts have heretofore proven unsuccessful.

In the mobile telephone communications industry, for example, efforts have been made to minimize the number of entry keys while increasing the number of available features. Such efforts have involved the incorporation of entry keys which may be used to initiate multiple functions. In other applications, such as calculators and other electronic devices, as well as the aforementioned mobile telephones, ⟨shift⟩ keys have also been utilized. These multi-function entry keys have been designed to provide specific functions which are tied to particular communication contexts. This correspondence, however, is still neither readily apparent nor logically referenced. For example, many wireless communications devices, and in particular cellular telephones, i.e. wireless telephones operable in the microwave band between approximately 1.8 GHZ and 2.2 GHZ, utilize an entry key labeled ⟨SEND⟩ for use in both answering an incoming call as well as to originate an outgoing call. Similarly, many vehicular cellular telephones utilize a ⟨CONTROL⟩ button or entry key which may be used to store selected telephone numbers, lock the hand-set, adjust the volume of the received communication and initiate other selected operations.

Consider, for example, the conventional vehicular mobile telephone handset shown in Figure 1 and designated generally by reference numeral 10. As shown, mobile telephone hand-set 10 includes a first class of fixed-label entry keys 12 disposed on the keypad for generating Dual-Tone Multi-Frequency (DTMF) signals (i.e. digits 0-9 plus the star and pound). Hand-set 10 further includes a single visual display 14 which, as referenced above, does not present detailed information sufficient to advise users from entering an irrelevant or incorrect key. Finally, hand-set 10 includes a second class of fixed label action keys 16, i.e. ⟨STO⟩, ⟨REC⟩, ⟨SEND⟩, etc., for initiating selected functions. As further referenced above, the ⟨SEND⟩ key 18 is ambiguously operative for answering both incoming calls and for originating an outgoing call. A ⟨CONTROL⟩ key 20 operative to initiate a plurality of other functions such as locking the locking the hand-set, increasing the volume, storing a desired telephone number and performing other selected operations is also provided. Vehicular mobile telephone hand-sets of this type provide ambiguous and imprecise functionality, are complicated to use and, as a result, are highly prone to user error.

As a further example, consider the prior art hand portable mobile telephone which is shown in Figure 2 and designated generally by reference numeral 22. Portable telephone 22 is known to those skilled in the art as the NEC Model T300 portable phone. Like the prior art vehicular mobile telephone of Figure 1, portable phone 22 includes a first class of fixed-label entry keys 24 for generating DTMF signals. Hand-set 22 further includes a second class of fixed-label action keys 26, i.e., ⟨SEND⟩, ⟨STO⟩, ⟨RCL⟩, ⟨FCN⟩, ⟨CLR⟩, ⟨END⟩, and ⟨PWR⟩ for initiating selected functions. Significantly, each of the fixed-label entry keys 24 and 26 are tied to a single visual display 28.

The most notable problem encountered in the operation of the above interactive electronic devices is that the required syntax is neither apparent nor consistent. In conventional mobile telephones, for example, storing a telephone number requires a three-step process, i.e. Initiation of a store sequence, identification of a telephone number sought to be stored, and selection of a storage location. Similar steps are also required when storing interim calculations or numeric sequences on conventional calculators, remote controls, VCRs, etc.. These steps and their store sequences vary widely from manufacturer to manufacturer and from device to device. Yet, in most cases, little if any "on-line" or "during operation" help -- other than an error message -- is provided to guide the user through the required syntax.

In a further effort to minimize the number of entry keys while increasing the number of available features, interface designers and, in particular, the assignee of the present invention, U.S. West Advanced Technologies, Inc., has contemplated the incorporation of dynamic visual display screens in mobile and desktop telephones and related electronic devices. These "dynamic" visual display screens are designed to present to the user a plurality of context sensitive function labels. In operation, these function labels are adapted to be accessed by depressing one or more soft-label signaling keys which are provided in electrical communication with the dynamic visual display. See, for example, copending U.S. patent application Serial No. 08/089,146 which is commonly owned by the assignee of the present invention.

As those skilled in the art will recognize, while the use of soft-label signaling keys presents a major advance over the prior art, this approach is nonetheless still limited in flexibility due to the inherent design requirement that items must be in specific places. In addition, the user is provided no direct manipulation or sensory feedback. In operation, the user must physically depress a button to access the corresponding desired function label, which subsequent testing has proven is less intuitive than direct manipulation of the label itself.

As the number of consumer electronic devices increases, interface designers have turned attention towards the employment of touch screens which, in contrast to the above devices, permit users to activate functions or to interact with information using direct manipulation. Such direct manipulation dramatically improves the ease-of-use of the interface, and thus increases the desirability of the device employing the interface. However, in contrast to the benefits derived from a direct manipulation interface via a touch screen, usability is simultaneously inhibited by the touch screen for the following reason. Due to the nature of the touch screen, users are apt to use their fingertips to activate/select items from the touch screen. Fingertips, however, are inexact pointing devices and thus generally unsuitable for such touch screens which require precise location of the finger press. Thus, the likelihood of activating the wrong function or selecting the wrong data is increased by the ambiguity of selections with the fingertip. This ambiguity actually inhibits the device's usability and thus its desirability.

Consequently, a need has therefore developed to provide an improved touch screen user interface which may be implemented in interactive electronic devices of the type referenced above. More specifically, a need has developed to provide such an improved interface wherein the function labels may be directly manipulated. Such an interface should also provide disambiguation means to guide the user to the appropriate function label while, at the same time, preventing the user from accessing an incorrect key.

Disclosure of the Invention

It is therefore a principal object of the present invention to provide an improved user interface for use in interactive electronic devices which eliminates the complexity and ambiguity problems encountered in conventional interfaces yet provides a plurality of user-friendly functions.

A more specific object of the present invention is the provision of a user interface for use in interactive electronic devices which incorporates a single class of touch screen entry keys which function as context-sensitive task and information display regions which may be accessed by direct user manipulation.

Yet another object of the present invention is the provision of such an improved touch screen user interface which, through the use of raised overlay means, delineates the touch screen or screens into a plurality of precisely defined and easily accessible context-sensitive task and information display regions which guide the user to the appropriate region for direct user manipulated activation.

In carrying out the above objects and other objects, features and advantages of the present invention, there is provided a user interface adapted for use in interactive electronic devices including land-based telephones, wireless telephones, Personal Digital Assistants (PDA's) and computers, and VCRs, televisions, remote controls and the like which comprises a touch screen or a plurality of touch screens. The user interface further incorporates raised overlay means for delineating the touch screen or screens into a like plurality of context-sensitive task and information display regions. This overlay means, which may comprise, for example, a raised plastic card or similarly substantially rigid cover having appropriate windows or voids stamped therein is operable to guide the user to the appropriate task/information display region for direct user manipulated activation. As disclosed herein, these context-sensitive task and information display regions function as both soft-label signaling keys and as dynamic visual displays. In operation, the soft-label signalling keys provide direct access the displayed function labels relevant to the current context of the user interface.

The above objects and other objects, features, and advantages of the present invention are readily apparent from the following detailed description of the best modes for carrying out the invention when taken in connection with the accompanying drawings wherein like reference numerals are used for like components.

Brief Description of the Drawings

FIGURE 1 is a front plan view of a prior art vehicular mobile telephone hand-set;
FIGURE 2 is a front plan view of a prior art hand portable mobile telephone;
FIGURE 3 is a perspective view of a prior art electronic device which incorporates touch screen entry keys;
FIGURES 4-6 are schematic diagrams of the improved user interface of the present invention and the component parts thereof;
FIGURE 7 is a schematic diagram of alternative embodiment of the improved user interface of the present invention;
FIGURES 8 and 9 are schematic diagrams illustrating the operation of the improved user interface of the present invention.

Best Modes For Carrying Out The Invention

Referring now to Figure 3 of the drawings, a plurality of prior art touch screens which have been provided, for example, in a hand-held calculator 30 are shown and designated generally by reference numeral 32. As seen, these touch screen interfaces incorporate a single visual display 34 which provides output responsive to user initiated activity on touch screens 32. The disadvantage of these touch screen interfaces is that they are highly prone to error since a user may easily hit the wrong touch screen. The lack of any physical feedback further maximizes the possibility of user error.

With reference now to Figures 4-6 of the drawings, the improved user interface incorporating the novel interactive touch screen interface of the present invention will be described in further detail. As shown, the interface of the present invention which is shown, by way of example, in a hand portable communications device such as a mobile telephone hand-set or Personal Digital Assistant (PDA) is designated generally by reference numeral 36. The interface necessarily incorporates physical overlay means such as substantially rigid plastic card 38. Card 38 is punched or stamped to define a plurality of voids or openings 40, which are of predetermined size, shape and location within card 38 and correspond to predetermined touch screen function labels.

As seen, by overlaying card 38 on touch screen or screens 42, a plurality of recessed information display and task regions 44 are defined which, in accordance with the invention described herein, are context sensitive and activated by direct user manipulation. Card 38 may be of any thickness sufficient to properly delineate the aforementioned task and information display regions 44 and guide the user to the desired region sought to be activated. As readily understood, however, the thinner the card 38 may be designed and implemented, the greater the reduction in corresponding material cost and vice-versa. Nonetheless, at both ends of the spectrum, a tradeoff exists with respect to the desired functionality of the overlay means. Thus, for example, if the card 38 is too thin, the user will be unable to properly physically distinguish the task and information display regions 44 and an erroneous region may be activated. Similarly, if the card 38 is too thick, the user will be inhibited from easily accessing the desired region.

Against this background, Applicants contemplate that a substantially rigid card having a thickness in the range of 0.5 mm to 2.5 mm should be sufficient for the involved user interfaces of most applications, including land-based telephones, mobile telephones, Personal Digital Assistants (PDAs) and computers, calculators and other electronic devices as referenced above. However, it is understood and contemplated by Applicants that the thickness as well as the size and flexibility of card 38 may, of course, vary depending upon the particular use of the same.

It is thus seen that the use of such an improved touch screen user interface provides maximum interface flexibility for use in a limited amount of real estate such as, for example, in the cellular telephone or PDA hand-set 36 which is shown. As readily seen, the improved user interface preserves flexibility of the touch screens 42 while adding the accuracy and physical feedback of soft-label signaling keys.

As shown in Figure 6 of the drawings, in an alternative embodiment, a contiguous touch screen need not be provided. Rather, a plurality of defined touch screens 42 may be used with their division made aesthetically more pleasing through the use of physical card overlay 38 referenced above. The physical card overlay 38 of the present invention may be used, in cooperation with any suitable interface including, for example, the personal computer as further shown in Figure 7 whether a contiguous touch screen or a plurality of defined touch screens are utilized.

As readily seen, the user interface of the present invention which incorporates a touch screen combined with a physical overlay serves to delineate regions of the touch screen that are both programmable, yet easily recognizable and simple to identify and activate. The raised overlay 38 guides the user's fingers to the appropriate soft key region, thus reducing ambiguity and error while preserving programmable flexibility.

Operation

Turning now to Figures 8-9 of the drawings, the operation of the improved user interface of the present invention will be described in further detail. Consider, for example, the user interface provided in a hand-held wireless telephone wherein a user desires to select from many stored telephone numbers provided in a "personal directory" and to dial a selected telephone number. As shown in Figure 8, the user may physically depress task region 46 (to personal directory) whereupon the display regions will dynamically accommodate the current context of the communication and prompt the user with a plurality of recipients and their corresponding telephone numbers which have been stored in the personal directory as shown in Figure 9. Should the user thereafter desire to send a communication to "Adam Marx," for example, the user need only physically depress task/display region 48 whereupon the corresponding telephone number will appear in display region 50 (541-6021).The user may then originate the telephone call by physically depressing display region 52 (dial number).

As readily seen, (up) and (down) keys may also be provided as shown in display regions 54 and 56 as well as a (back) key provided in display region 58. If any of regions 54, 56 or 58 are activated, the corresponding display of regions will change accordingly and prompt the user to select from additionally stored entries.

The improved user interface of the present invention which incorporates a touch screen or screens delineated by raised overlay means such as rigid plastic card 38 provides context-sensitive task and information display regions which may be used in a number of communication devices including hand-held telephones shown by way of example above as well as personal computers, PDAs, calculators and other suitable interactive electronic devices. The direct user manipulation provided for by the present invention greatly reduces user error by providing explicit instructions for the user and eliminating the aforementioned ambiguity problems encountered with shift keys, soft-label signaling keys and the like.

While the best modes for carrying out the invention have been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

Claims

1. A user interface, comprising:
   a touch screen;
   raised overlay means for delineating said touch screen into a plurality of context-sensitive task and information display regions and guiding the user to the appropriate region for direct user manipulated activation.

2. A user interface, comprising:
   a plurality of touch screens;
   raised overlay means for more precisely delineating said touch screens so as to define a like plurality of context-sensitive task and information display regions and guiding the user to the appropriate region for direct user manipulated activation.

3. A user interface as in claim 1 which is further adapted for use in a telephone.

4. A user interface as in claim 1 which is further adapted for use in a mobile telephone hand-set.

5. A user interface as in claim 1 which is further adapted for use in a calculator.

6. A user interface as in claim 1 which is further adapted for use in cooperation with a personal computer.

7. A user interface as in claim 1, which is further adapted for use in a Personal Digital Assistant.

8. A mobile telephone hand-set, comprising:
   an earpiece;
   a mouthpiece;
   a touch screens and
   raised overlay means for delineating said touch screen into a plurality of context-sensitive task and information display regions and guiding the user to the appropriate region for direct user manipulated activation.

9. An interactive electronic device, comprising:
   a touch screen; and
   raised overlay means for delineating said touch screen so as to define a plurality of context-sensitive task and information display regions and guiding the user to the appropriate region for direct user manipulated activation.

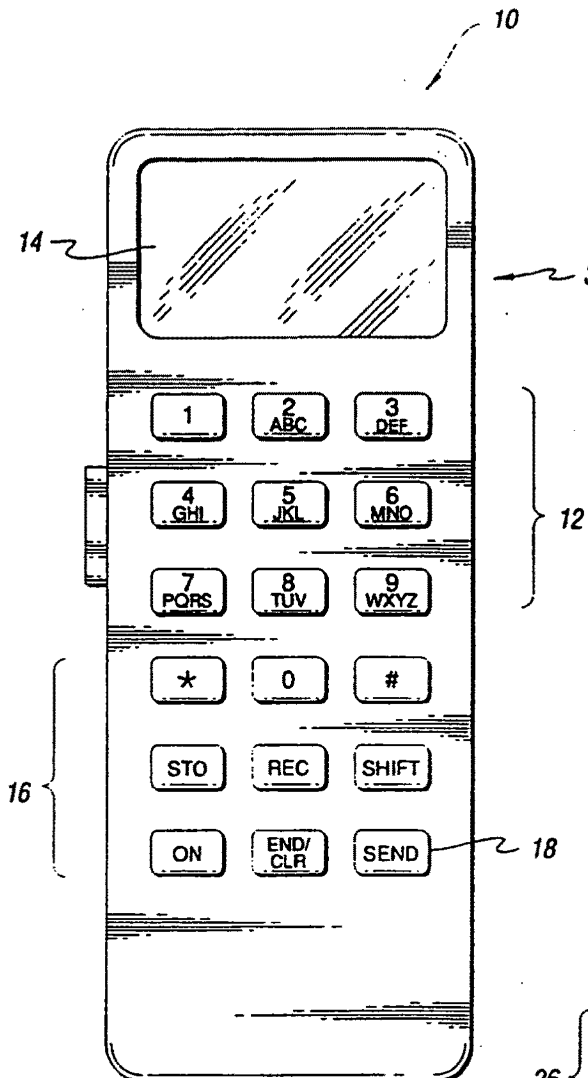

Fig. 1

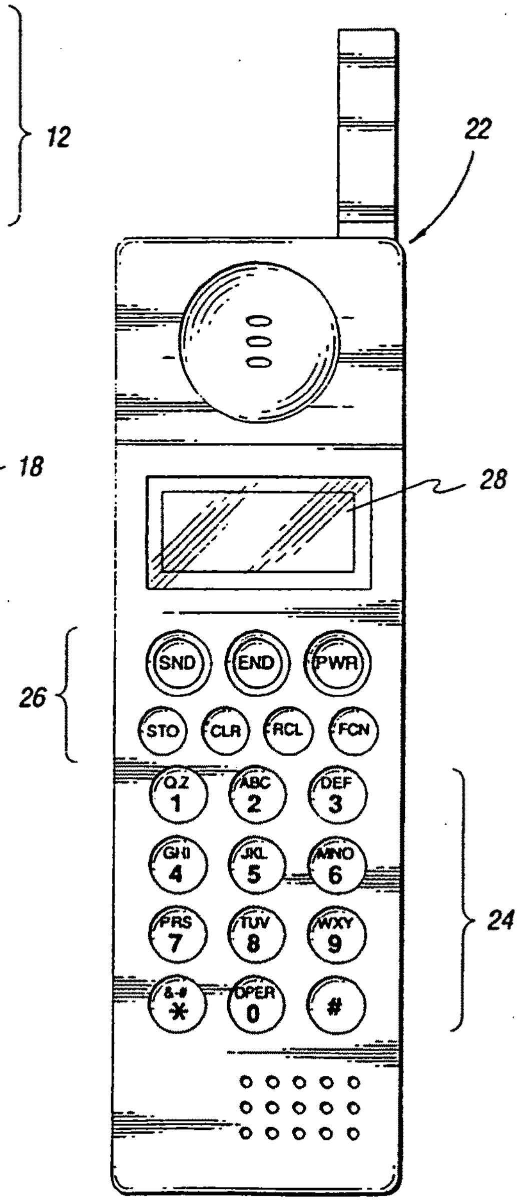

Fig. 2

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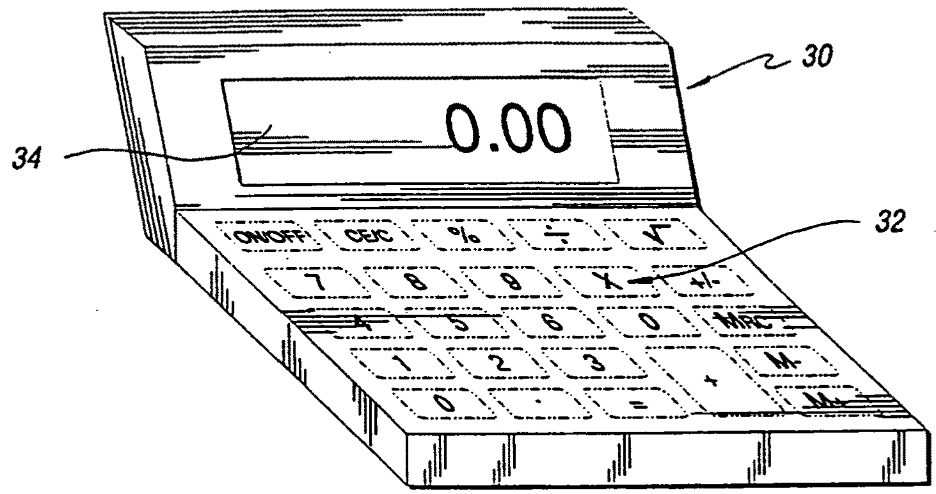


Fig. 3

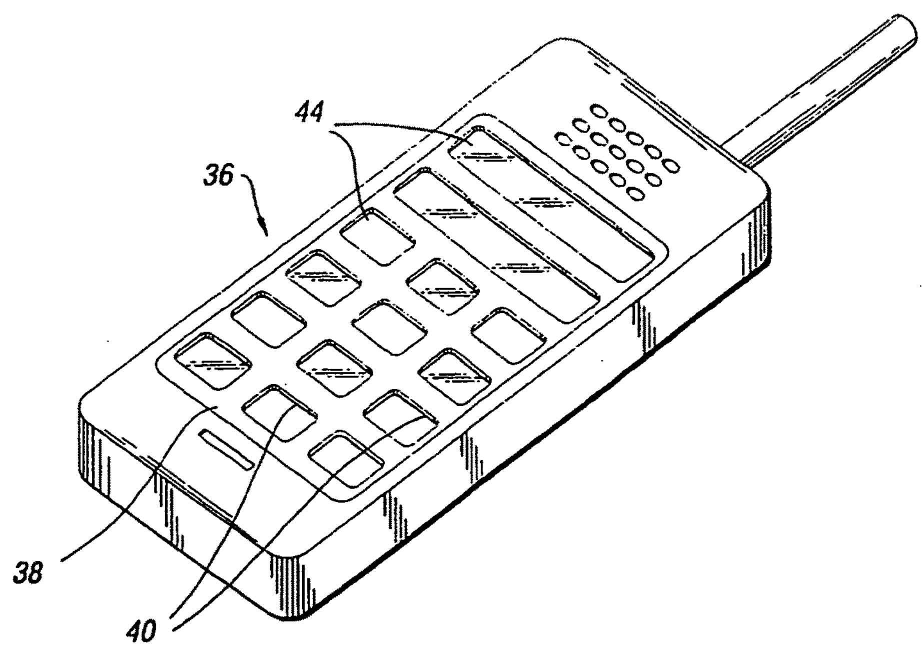


Fig. 4

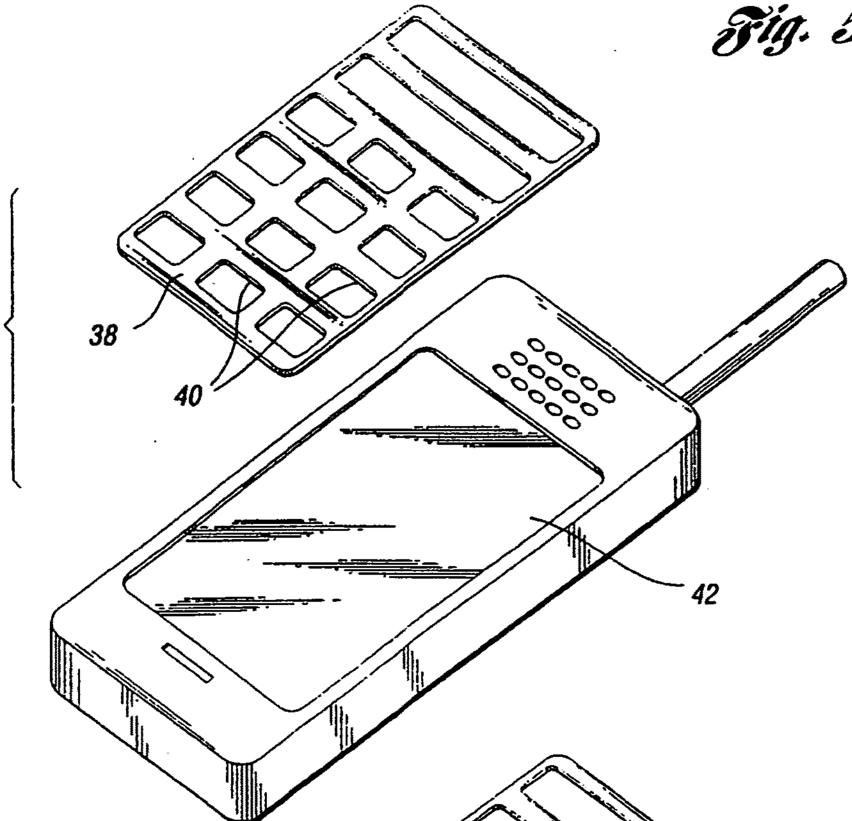


Fig. 5

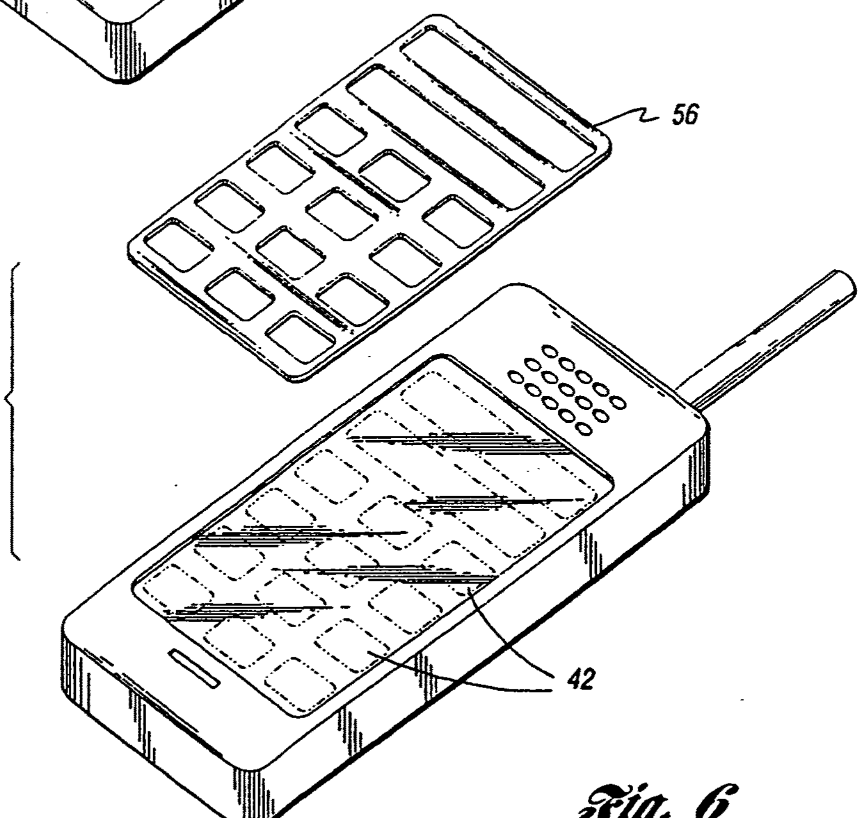


Fig. 6

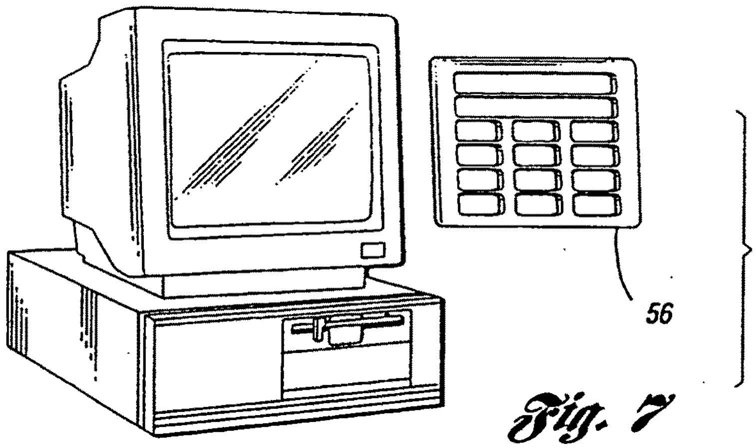


Fig. 7

Fig. 8

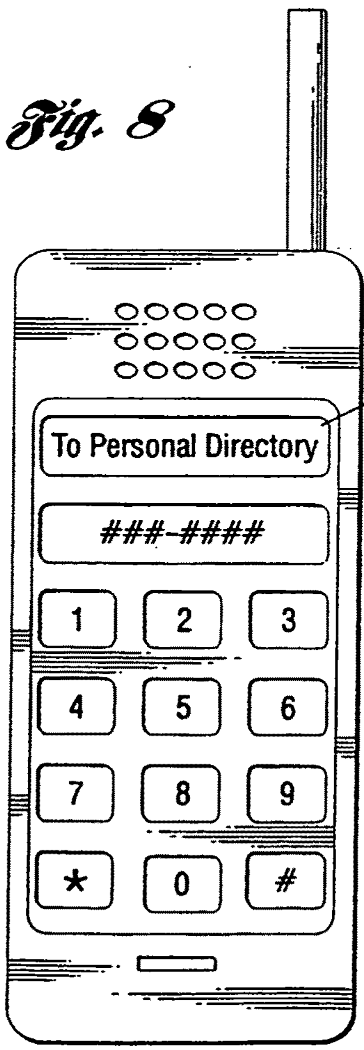
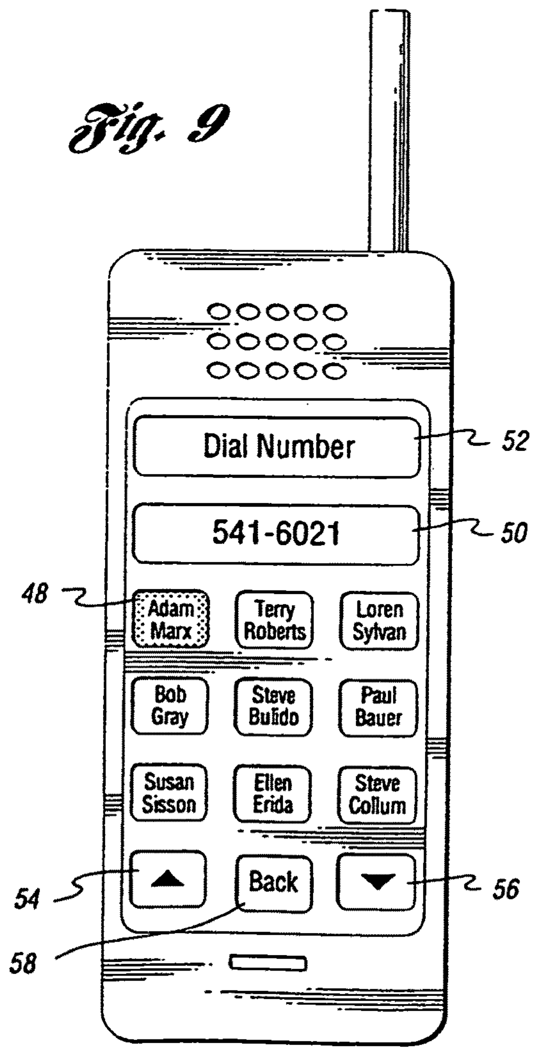


Fig. 9



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(54) **Touch sensor array systems and display systems**

System einer Berührungsmessfühlergruppe und Anzeigesystem

Système avec groupe de palpeurs à touches et système d'affichage

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(30) Priority: **29.06.1990 GB 9014529**

(43) Date of publication of application:
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US-A- 4 520 357
US-A- 4 839 634

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EP 0 464 908 B1

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Description

This invention relates to a touch sensor array system including an array of sensing elements arranged according to rows and columns and provided with addressing means on the basis of row and column conductors for selectively addressing a particular one of said sensing means at an intersection of a selected row conductor and a selected column conductor in accordance with the preamble of claim 1. Such a system is known from US-A-4 839 634. In general, these kinds of systems may be used as an overlay for the display screen of an liquid crystal or other display device to provide for example selected inputs to the device in accordance with touched positions in the sensor array. In another example, the system may be used as a stand-alone graphics tablet connected to a computer system.

Various other kinds of touch sensor array systems are known.

In a particular kind of touch sensor array system, capacitive effects are utilised. In an example, pairs of spaced conductive strips or pads are provided which can either be physically displaced with respect to one another in response to finger pressure so as to alter the capacitance therebetween or capacitively coupled together in response to proximity of a user's finger.

Such systems typically have only limited resolution capabilities.

Inter alia, it is an object of the present invention to provide an improved touch sensor array system, which offers the capability of high resolution.

According to one aspect of the present invention, each sensing element comprises a bistable circuit at the sensing element's location in the array, which bistable circuit is responsive to a presence or absence of a touch input at the location of the sensing element so as to adopt a first or a second stable state respectively that remains continuously addressable, and which upon addressing by addressing means provides an output in accordance with its actual state, said system having reset means for periodically resetting the bistable circuits of the sensing elements.

Touching of the sensing elements for example may be by means of a user's finger or by means of a stylus. Upon touching by such position designating objects the bistable circuit is caused to adopt a certain stable state which is different to the stable state adopted by the circuit in the absence of a touch input so that a clear, unambiguous indication of touching is obtained. Following the adoption of one or other state, the bistable circuit remains in that state until it is next called upon to sense touching and therefore acts in the manner of a memory element whose state is determined by touching, and which, by interrogation, can provide an indication of touching after the event, enabling the touched locations in the array to be ascertained. The addressing means, by periodically resetting the bistable circuits, and preferably at regular intervals, enables a series of successive touches, or absence of touches, to be detected.

Preferably, the sensing elements each include a respective switching device in a matrix of switching devices and are actively addressable though operation of the switching devices by the addressing means to connect the bistable circuits to a state detection circuit of the addressing means. Such active addressing of the sensing elements enables large numbers of sensing elements to be used in the array thereby providing a high element density or high resolution and without the kind of problems which could be expected when using a simple multiplexing technique for monitoring the sensing element states. The active addressing of the sensing elements, and hence the monitoring of their states, desirably is carried out at intervals related to the periodic resetting of the bistable circuits by the addressing means.

In a preferred embodiment the active matrix switching devices comprise transistors. Although other forms of switching devices such as two-terminal non-linear devices, e.g. diodes or MIMs, could be used it is felt that transistors provide the simpler approach for actively addressing the sensing elements.

Preferably, the bistable circuit of each sensing element is responsive to a capacitive effect produced by position designating means, e.g. a finger or stylus, in proximity to the sensing element. Each sensing element may include a sensing electrode which, in conjunction with the touch designating means adjacent thereto, provides a certain, characteristic, capacitance. The bistable circuit responds to the existence of this capacitance to adopt its first state. This can be achieved conveniently in practice using a bistable circuit comprising two cross-coupled inverters with the sensing electrode being connected to a respective one of the bistable nodes and a reference capacitance being connected to the other bistable node. If the two capacitances are not the same then an imbalance in voltages present at the nodes will exist and following resetting of the bistable circuit to a metastable state the bistable circuit adopts a state depending on which of the capacitances is greater. A layer of insulating material may conveniently be provided over the sensing electrodes of the sensing elements. The electrode and the position designating means either on, or in close proximity to, the exposed surface of the insulating layer constitute respective capacitor plates with the insulating layer serving as the capacitor dielectric. The physical dimensions of the electrode and overlying insulating layer are selected such that the value of the capacitance obtained upon the position designating means being presented in relation to the value of the reference capacitance causes the bistable circuit to switch appropriately. With this sensing electrode arrangement no direct external connection to the sensing electrode is required. The insulating layer can conveniently be of hard wearing material so that even with extensive use of a stylus damage does not occur to the sensing elements. The insulating layers of the sensing elements can comprise respective portions of a common layer extending continuously over the array of sensing elements. Consequently a continuous and protective sensing surface is provided.

Each bistable circuit comprising cross-coupled inverters may further include a switching transistor connected across the inputs of the two inverters and which is operable by the addressing means to set the bistable circuit in its metastable state.

Other types of bistable circuits could be used if desired. Also, it is considered that the sensing elements can be responsive to a touch input other than by using a capacitive approach. However, the latter is advantageous in that it avoids the need for direct electrical connections and allows the use of an insulating covering layer to provide a rugged sensing surface.

The bistable circuits of the sensing elements preferably comprise thin film transistors (TFTs). Similarly the active matrix transistors may also comprise TFTs. The processing of TFTs, particularly amorphous or polycrystalline silicon TFTs, on large area glass substrates is already well developed for active matrix liquid crystals display devices. Both the array of sensing elements and the active matrix switches can be fabricated using this technology. The sensor array shares many similarities with active matrix display devices, and fabrication of the sensor array by thin film deposition and patterning techniques used in active matrix switching technology is therefore particularly convenient. The additional components, such as addressing and monitoring conductors, capacitor elements, and insulated electrodes, are analogous to components often present in active matrix display devices, where picture elements comprise element electrodes, possibly with associated storage capacitors, connected via switching TFTs to row and column address conductors.

Using this technology, the sensor array can be fabricated with individual sensing elements of comparable size to picture elements in display devices. This has important implications in that high resolution is readily achievable.

According to another aspect of the present invention, there is provided a display system comprising a display device and a touch sensor array system according to the one aspect of the invention in which the sensing elements of the array are positioned over the display output of the display device. The display could, for example, be a liquid crystal display device comprising a matrix array of individually controllable pixels. The sensor system according to the invention offers an important advantage over known system when used with display devices, particularly of the aforementioned kind, in that a 1:1 pixel to sensing element relationship is obtainable especially, for example, when TFT active matrix technology is employed in the fabrication of the sensor array.

Various embodiments of touch sensor array systems in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a simplified schematic diagram of one embodiment of touch sensor array system in accordance with the invention showing an array of individual sensing elements together with associated circuits;
Figure 2 shows schematically the equivalent circuit of a typical sensing element of the array;
Figure 3 illustrates a particular implementation of the sensing element;
Figure 4 illustrates typical waveforms in operation of the sensing elements;
Figure 5 illustrates the circuit of a part of the sensor array comprising one complete sensing element and associated active matrix switching device;
Figure 6 illustrates typical waveforms present in the operation of the circuit part shown in Figure 5;
Figure 7 shows schematically part of a detection circuit of the system; and
Figures 8 and 9 illustrate respectively the circuit of a part of an alternative embodiment of sensor array device showing a typical sensing element together with its associated active matrix switching device, and typical waveforms appearing in operation of this embodiment.

The Figures are merely schematic and are not drawn to scale. In particular certain dimensions may have been exaggerated whilst others may have been reduced. The same reference numerals are used throughout to denote the same or similar parts.

Referring to Figure 1, the touch sensor system includes an array of sensing elements carried on a common substrate to form a sensing panel 10.

Each sensing element, referenced at 12, comprises a bistable circuit 14 connected to an insulated sensing electrode 15 which constitutes one side of a capacitor, the other side being the touching object, either a grounded stylus or, or example, a finger of a user. The state of the bistable circuits is dependent on touching. If the sensing electrode of a particular sensing element is touched the associated bistable circuit adopts a certain indicative state. The sensing elements are combined in an active matrix comprising switching devices 16, each sensing element including a respective switching device, with row and column addressing conductors to allow the state of each row of sensing elements to be read and the positions that have been touched to be determined.

The sensing elements 12 are in an X-Y array consisting of r rows (1 to r) with c elements (1 to c) in each row. Only a few sensing elements are illustrated in Figure 1 for simplicity. In practice there may be a several hundred columns and rows, the numbers chosen depending on the intended use. If used, for example, as a user interface for a computer graphics system, the number of sensing elements and the ratio of rows to columns would be dependent on the pixel count and aspect ratio of the system's display. If used as a display overlay, a 1:1 correspondence between pixels and sensing elements could be provided.

The circuit configuration of part of a typical sensing element 12 is shown in Figure 2. The element consists of a bistable circuit 14 comprising two cross-coupled inverters 17 and 18 and a switching transistor 19 connected between the two inverter inputs and whose control (gate) electrode is connected to a line 20 along which regular clocking, selection, signals are provided. One of the bistable nodes, referenced B, is connected to a sensing electrode 15, in the form of a rectangular pad of conductive material which is covered by an insulating layer, constituting the sensing element's input. The other node of the bistable circuit, referenced A, is connected to a reference capacitor 21 and also acts as the sensing element output, the output being provided along line 22.

An example implementation of this circuit configuration using NMOS transistors is illustrated in Figure 3. Two transistors 25, 26 connected in series are arranged in parallel with two other series-connected transistors 27 and 28 between positive and negative rails 23 and 24 with the gates of transistors 25 and 28 also being connected to the rail 23. The sensing electrode 15 is connected to the gate of transistor 27 as well as node B whereas node A is connected to one side of the reference capacitor 21 which is also connected to the gate of transistor 26, the other side of the capacitor 21 being connected to the rail 24. The power supply rails 23 and 24 are shared by the bistable circuits of all other sensing elements in the same row, other rows of sensing elements being similarly associated with respective pairs of supply rails as shown in Figure 1.

The bistable circuit 12 has two stable states, a first where A is high and B is low and a second where A is low and B is high, and a third state which is a metastable state where A and B are equal. When in this latter condition the bistable circuit is very sensitive to any imbalance introduced in the voltages at A and B and will readily revert to either the first or the second state depending on the sense of the imbalance.

In operation of the sensing element, the bistable circuit 12 is first set to its metastable state by taking the clock signal, Ck, on line 20 high to turn on the transistor 19. When turned on the transistor 19 connects nodes A and B and the voltages at these two nodes equalise at a voltage lying between the high and low logic levels. When the clocking signal Ck thereafter returns to a low level the negative going edge of the signal is coupled through onto nodes A and B by the parasitic gate/source and gate/drain capacitances Cs of transistor 19. These capacitances Cs, which are substantially equal, are shown in dotted outline in Figure 2. The capacitances Cs could instead be provided by two discrete capacitors. The magnitude of the voltage shift at nodes A and B caused by the presence of the respective capacitances Cs will depend on the value of the additional capacitance present at the associated node which for node A is the capacitance, Cr, of the reference capacitor 21 and for node B is the capacitance, Ce, of the input sensing electrode 15. If these capacitances are not the same then an imbalance in the circuit voltages is produced and since the nodes A and B are no longer interconnected by the transistor 19 the bistable circuit will flip into one or other of its two stable states depending on the relative values of the two capacitances. For example if the sensing electrode capacitance Ce is less than the reference capacitance Cr then the coupling of the signal Ck will cause the voltage at node A to be higher than that at node B and consequently the bistable circuit will flip into the state with A high and B low. Conversely, if the sensing electrode capacitance Ce is greater than the reference capacitance Cr the resulting voltage at node B will be greater than that at node A and the bistable circuit will switch to the opposite state in which node A is low and node B is high. The capacitance Ce of sensing electrode 15 can be of two distinct values according to whether or not a touch input is made to the sensing element, i.e. a higher capacitance is exhibited when a grounded finger or stylus is placed on, or closely adjacent, the surface of the dielectric layer covering the electrode 15. By selecting the value of Cr appropriately in relation to the capacitance at electrode 15 obtained by a touch input, which itself is dependent on the physical dimensions of the electrode 15 and the thickness of the insulating layer, the bistable circuit detects and responds to the increase in capacitance of the electrode 15 caused by touching the electrode with a finger or grounded stylus. Representative waveforms in operation of the sensing element are shown in Figure 4, in which Ck is the clocking pulse signal waveform applied to the transistor 19, and V_A and V_B are, respectively, the voltages appearing at nodes A and B. Figure 4a illustrates the case where Ce is less than Cr, i.e., for no touch input, and Figure 4b illustrates the case where Ce is greater than Cr, i.e., for a touch input.

The array of sensing elements 12 of the sensing panel 10 are combined with the active matrix switching devices 16 together with driving and addressing conductors in the manner depicted, by way of illustration, in Figure 5, which shows the circuit configuration of one complete, and representative, sensing element in the Nth row of Mth column of the array. The X-Y array of sensing elements 12 is driven and addressed via sets of row and column conductors with the sensing elements being located adjacent respective intersections of the column and row conductors. The clocking signals Ck for the transistor 19 (and the transistors 19 of other elements in the same row) are applied along a row conductor, 20, shared by all sensing elements 12 of the row. Similarly, the positive and negative (ground) supply lines 23 and 24 extend as row conductors and are shared by all other sensing elements in the same row. Referring also again to Figure 1, the row conductors 23 and 24 are connected at their ends adjacent the periphery of the panel respectively to supply rails 31 and 32 to which the outputs of a power supply circuit 33 are coupled. Each column of sensing elements is associated with a respective one of a set of column, detection, conductors 34 to which the active matrix switching devices 16, comprising FET transistors, are connected. Referring to Figure 5 particularly, the switching device 16 associated with each sensing element consists of two switching transistors 36 and 37 connected in series between the associated column conductor 34 and the supply conductor 24 with their gates connected respectively to the clock signal row conductor 20 associated immediately with the succeeding, (N+1)th, row of sensing elements and the node A of the bistable circuit of the sensing element.

The ends of the row conductors 20 and column conductors 34 are connected respectively to a row address circuit 40 which produces the clocking signals, and a column detection circuit 41 (Figure 1) whose operations are controlled and synchronised by a timing and control circuit 43. The row addressing driver circuit 40 scans the conductors 20 sequentially with a clock pulse so that each complete row of sensing elements is reset and operated in turn, the clock pulses serving also to enable the states of the preceding row of sensing elements to be read out, and detected, via the column conductors 34, by the circuit 41 which provides an output at 58 indicative of the states of each row of sensing elements in turn. The first and last rows of the array differ slightly in that one of the two row conductors 20 associate with each of these rows is dedicated solely to that row (as shown in Figure 1) so that there are r+1 conductors 20 in all. Scanning of the set of row conductors 20 by the circuit 40 is repeated in regular fashion in successive field periods.

In the version of the system shown in Figure 1, a grounded stylus 50 is manipulated by a user to touch an appropriate sensing element, although it will be appreciated that the stylus can be replaced by a user's finger.

Figure 6 illustrates typical waveforms present in operation of the system of Figures 1 and 5 for a particular sensing element. Ck(N) and Ck(N+1) are the clocking pulse signals applied by the circuit 40 to the Nth and (N+1)th row conductors 20. Upon receipt of the clocking pulse Ck(N) the bistable circuit of the sensing element (and all other elements in the Nth row) is reset and then immediately thereafter switches to one or the other of its two possible stable states according to whether or not the sensing element is being touched. V_A and V_B represent, as before, voltage levels appearing at nodes A and B of the sensing element and in this particular example are indicative that the sensing element concerned is not being touched. The dotted lines signify the other possible state would be adopted in the event of a touch input.

When a clocking pulse, Ck, is applied to the next, (N+1)th, row conductor 20 to reset the bistable circuits of the (N+1)th row of sensing elements, the active matrix switching device 16 of the sensing element (and all others in the Nth row) is operated to enable the state of the sensing element to be determined. The bistable output of the sensing element is connected to the gate of transistor 37 which, because the output (node A) is low in this example, is turned off. The Ck (N+1) clocking pulse turns on transistor 36 but connection between the column conductor 34 and supply (ground) conductor 24 is prevented because transistor 37 is off. On the other hand, if the bistable circuit was in its other stable state, with node A high indicating touching, transistor 37 is turned on and the series-connected transistors 36 and 37 then provide an interconnection between column conductor 34 and ground conductor 24.

The state of the bistable circuit of the sensing element is ascertained by detecting in the detection circuit 41 connected to the column conductor whether or not such an interconnection exists. This can be achieved in different ways. For example, the column conductor 34 can be pre-charged to a high voltage level before the (N+1)th row conductor 20 is addressed and then, upon switching of the matrix transistor 36 by the Ck (N+1)th clocking signal, detecting whether or not this voltage is discharged through operation of the transistor 37, depending on the state of the bistable circuit. The voltage waveform for the Mth column conductor for this mode of operation is shown at Vm in Figure 6, where t represents the precharging period and t1 the precharging period for the next row. Alternatively a current amplifier may be connected to the column conductor 34 to measure the current flow through the matrix transistors 36 and 37. The former technique allows logic level signals to be obtained directly from the column conductors of the matrix resulting in comparatively simple column drive circuitry. In this mode of operation the scanning rate of the rows of sensing elements may be limited as the active matrix transistors will require some time to discharge the capacitance of the column conductors. The latter technique requires a current or charge sensitive amplifier to be connected, in the detection circuit 41, to each column conductor 34 in order to convert the small signal from the active matrix transistors to the required logic levels.

By detecting the magnitude of the charging current with a respective sense amplifier connected to each column conductor, the system can determine which elements have been touched and their coordinates. Figure 7 illustrates part of one detection circuit suitable for such detection, the part shown comprising for simplification the circuit arrangement for just three consecutive columns of sensing elements. Each column conductor 34 of the panel 10 is connected to an input of an inverting amplifier 52 having a parallel feedback impedance 53. The detectors are rendered either charge or current sensitive by providing either a capacitive or a resistive feedback impedance 53. The outputs of the amplifiers 52 are fed to a signal processing circuit 54 comprising a parallel threshold circuit 55 responsive to the effect of large current spikes in the column conductor waveform indicative of a sensing element associated with that column having been touched to provide appropriate digital signal outputs and a parallel latching circuit 56 connected to the outputs of the threshold circuit which latches the digital signals into a series of flip flops forming a shift register 57 to give a serial output 58.

By associating the output of the processing circuit 54 with operation of the row conductor driver circuit 40 unique signals identifying the coordinates of sensing elements which have been touched can be generated in ways known per se in touch sensor systems.

Each row of sensing elements is addressed by the addressing circuit 40 in turn, so that, after one complete field, an indication, or picture, of all sensing elements which have been touched and their position is obtained. Addressing of the array of sensing elements in this fashion is carried out in a recurrent cycle with the condition of each sensing element being repeatedly monitored in subsequent field periods. The duration of each field period may be varied as desired taking into account the number of rows of sensing elements in the array, the duration of the clocking pulses applied by the drive circuit 40, and the manner of operation of the detection circuit 41. Obviously the field period is chosen to be sufficiently small to ensure that relatively brief touch inputs are sensed. By way of example each field period may be approximately 20msec., thus giving a very rapid response to user inputs and detection of rapidly changing touch inputs.

In the above described embodiment, a conducting stylus coupled to ground potential is used as a tool for entering input information. This enables small area sensing elements to be used and, in turn, allows a high resolution array to be achieved which is beneficial for use as an interface for a graphics display system for example.

The circuit configuration of another embodiment of touch sensor panel is illustrated in part in Figure 8, similar in respects to Figure 5, and showing the circuit of a typical sensing element together with its associated driving and address conductors and active matrix switching transistors. In this embodiment, the need for a separate ground supply conductor to each row is avoided, use being made instead of the fact that the row conductors 20 are at ground potential except when a clocking pulse is actually being applied therealong. Typical waveforms present in operation of this embodiment are shown in Figure 9 for comparison with those of Figure 6.

In this circuit arrangement, a positive supply line 23 is again provided for each row of sensing elements. However the ground supply lines 24 previously described are not used and instead each row of sensing elements is associated with three clocking signal row conductors 20, rather than two as previously. Comparing Figure 8 with Figure 5, it will be seen that a main electrode of the transistor 37 of the active matrix transistors, the side of the reference capacitor 21 remote from the node A and the interconnection between the transistors 26 and 27 of the bistable circuit are all connected via a line 60 to the (N-1)th row conductor 20. Operation of the sensing element, and likewise all other sensing elements in the same row, is generally similar to that of the previous embodiment. A clocking signal pulse applied to the Nth row conductor 20 resets the bistable circuit and, upon termination of this pulse, the bistable circuit adopts one of other of its two possible stable states according to whether or not a touching input is made to the sensing electrode 15. The necessary grounding of circuit components is achieved through the line 60. Figure 9 illustrates the clocking pulse sequence for the three consecutive, (N-1), N, and (N+1) row conductors 20 from which it will be seen that for the duration of the clocking pulses applied to the Nth and (N+1)th row conductors 20 the (N-1)th row conductor is held at ground potential. The state of the bistable circuit is read out, as previously, upon turning on of the active matrix transistor 36 by a clocking pulse applied to the (N+1)th row conductor 20. The elimination of the need to use ground supply conductors means that fewer sets of row conductors are required. However, it becomes necessary to provide an additional row conductor for the first row of sensing elements if these elements are to be fully operational.

With regard to both embodiments, fabrication of the array of sensing elements, the active matrix, and the address and driving conductors is based on technology used in active matrix addressed display devices, such as liquid crystal display devices. In active matrix display panels the picture elements each consist of a display element having first electrode carried on one substrate together with sets of row and column address conductors and with one or more associated matrix switching transistors. (A second display element electrode is carried on a second, spaced, substrate with electro-optical, for example liquid crystal material, therebetween.) It will be appreciated, therefore, that there are many similarities between the structure on the one substrate of these display panels and the above described touch sensing panels. Active matrix display device technology is now widely documented and well established as a means for producing large area active matrix arrays and as such it is considered unnecessary to describe here in detail methods by which the panel of the sensing array system of the invention can be fabricated. Typically, this involves the deposition and patterning of a number of superimposed layers on a substrate. The active addressing of the sensing elements also is accomplished in much the same fashion.

Although the sensing panel 10 is constructed in similar manner the processing is slightly more complex than standard display panels because of the necessity to incorporate additional sets of conductors and seven transistors for each sensing element.

As in active matrix display devices, a glass substrate is used with the transistors comprising thin film transistors (TFTs) using amorphous silicon or polycrystalline silicon technology. The address and driving conductors are formed by patterning metal layers, with appropriate insulation at cross-overs. The reference capacitors 21, and discrete supplementary capacitances Cs if required, are formed by defining metal pads from the deposited metal layers with insulative material therebetween. Similarly, the sensing electrode 15 is defined from a deposited opaque or transparent conductive layer, depending on how the system is to be used. The insulating layer covering the electrodes 15 is provided as a single layer extending over the whole area of the sensing element array to form a continuous sensing surface. The insulating layer serves also to provide a degree of electrical and mechanical protection for the sensing element array.

The physical dimensions of the sensing elements and particularly the sensing electrodes 15, may be varied to suit the particular requirements of the touch sensor array in use, for in accordance with the desired resolution characteristics. The sensing element dimensions may be of the same order as used for pixel elements in a display device, say around 100 micrometres square, or larger.

The above described embodiments of touch sensor systems may be used as a stand alone input interface. Alternatively they may be used as an overlay to a display device, for example a matrix liquid crystal display device or CRT. To this end, the sensing electrodes at least of the sensor elements should be transparent. The high resolution possible means that very precise position sensing can be achieved. When used as a display overlay, therefore, there can be a 1:1 relationship between the individual sensing elements and display pixels of the display device, for example an active matrix addressed liquid crystal display device. For a colour display one sensing element can be provided for each triplet of display elements. A typical liquid crystal display device comprises two spaced substrates carrying electrodes defining an array of pixels together with addressing conductors and with liquid crystal material therebetween. The sensing element array is mounted over the display device with each sensing element in registration with an individual display pixel.

It will be appreciated that various modifications to the described embodiments are possible. For example, the need for a dedicated reference capacitor 21 can be avoided by using instead parasitic capacitance of the TFT 37 as a reference capacitance. This parasitic capacitance can be increased by deliberately extending its gate contact over its source contact. Moreover, as will be understood by persons skilled in the art, alternative kinds of bistable circuit configurations, for example long tailed pair circuits, could be employed.

Although the described embodiments employ three-terminal transistor devices for the active addressing, it is envisaged that the sensing elements could be actively addressed by means of two-terminal non-linear switching devices, such as diodes or MIMs for example, following technology already known and used in active matrix addressing of display devices.

Also, it is envisaged that the sensing elements could be made to be responsive to touch inputs other than by the capacitive approach utilised in the specific embodiments described, for example by using a technique which relies on direct electrical contact between the position designating means and a component of the sensing element so that the state adopted by the bistable circuit of a sensing element is determined by the presence or absence of such electrical contact.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the field of touch sensor array systems and which may be used instead of or in addition to features already described herein.

Claims

1. A touch sensor array system including an array of sensing elements (12) arranged according to rows and columns and provided with addressing means (40, 41) on the basis of row (20) and colum (34) conductors for selectively addressing a particular one of said sensing elements at an intersection of a selected row conductor and a selected column conductor, characterised in that each sensing element (12) comprises a bistable circuit (14) at the sensing element's location in the array, which bistable circuit (14) is responsive to a presence or absence of a touch input at the location of the sensing element (12) so as to adopt a first or a second stable state respectively that remains continuously addressable, and which upon addressing by addressing means (40, 41) provides an output in accordance with its actual state, said system having reset means (19, 20, 40) for periodically resetting the bistable circuits (14) of the sensing elements (12).

2. A touch sensor array system according to Claim 1, characterised in that the sensing elements (12) each include a respective switching device (16) in an active matrix of switching devices and are actively addressable through operation of the switching devices (16) by the addressing means (40, 41) to enable a detection circuit (41) of the addressing means (40, 41) to detect the state of the bistable circuits (14).

3. A touch sensor array system according to Claim 2, characterised in that the addressing means (40, 41) actively addresses the sensing element (12) at intervals related to the periodic resetting of the bistable circuits (14).

4. A touch sensor array system according to Claim 2 or Claim 3, characterised in that the switching devices (16) comprise thin film transistors.

5. A touch sensor array system according to any one of Claims 2 to 4, characterised in that the sensing elements (12) are reset by the addressing means (40, 41) a row at a time in sequence.

6. A touch sensor array system according to Claim 5, characterised in that switching devices (16) of the sensing elements (12) are operated by the addressing means (40, 41) a row at a time in sequence.

7. A touch sensor array system according to Claim 6, characterised in that the sensing elements (12) are reset and the switching devices (16) are operated by selection signals (20) supplied via row address conductors (20) and in that the detection circuit (41) is connected to the switching devices via column detection conductors (34).

8. A touch sensor array system according to any one of Claims 1 to 7, chacterised in that the bistable circuit (14) of each sensing element (12) is responsive to a capacitive effect produced by a position designating means in proximity to the sensing element (12).

9. A touch sensor array system according to Claim 8, characterised in that each sensing element includes a sensing electrode (15) which, in conjunction with the position designating means, provides a certain capacitance.

10. A touch sensor array system according to Claim 9, characterised in that the bistable circuit (14) of each sensing element (12) comprises two cross-coupled inverters (17, 18), in that the sensing electrode (15) is connected to a respective one (B) of the bistable nodes (A, B), and in that a reference capacitance (21) is connected to the other bistable node (A), the bistable circuit (14) being periodically reset by the addressing means (40, 41) to a metastable state following which resetting the bistable circuit adopts its first or second state depending on the relative values of the sensing electrode (15) and the reference capacitance (21).

11. A touch sensor array system according to Claim 10, characterised in that the bistable circuit (14) further includes a switching transistor (19) connected across the inputs of the two inverters (17, 18) which is operable by the addressing circuit (40, 41) to set the bistable circuit (14) to its metastable state.

12. A touch sensor array system according to any one of Claims 9 to 11, characterised in that a layer of insulating material is provided over the sensing electrode (15) of each sensing element (12).

13. A touch sensor array system according to Claim 12, characterised in that the layers of insulating material comprise respective portions of a common and continuous layer of material extending over the array of sensing elements (12).

14. A touch sensor array system according to any one of Claims 10 to 13, characterised in that the bistable circuits comprise thin film transistors.

15. A touch sensor array system according to any of Claims 1 to 14 and comprising a display device having its display output area positioned in conjunction with the array so that the sensing elements are positioned over the display output.

Patentansprüche

1. System einer Berührungsmeßfühlergruppe, das eine Matrix aus Meßfühlern (12), die in Reihen und Spalten angeordnet sind, und Adressiermittel (40, 41) auf der Basis von Reihen- (20) und Spaltenleitungen (34) enthält, um ein bestimmtes der genannten Meßfühlermittel am Kreuzungspunkt einer ausgewählten Reihenleitung und einer ausgewählten Spaltenleitung zu adressieren, dadurch gekennzeichnet, daß jeder Meßfühler (12) eine bistabile Schaltung (14) an der Position innerhalb der Matrix umfaßt, in der sich der Meßfühler befindet, wobei die bistabile Schaltung (14) darauf reagiert, ob die genannte Position des Meßfühlers (12) berührt wird oder nicht, indem sie in einen ersten bzw. einen zweiten stabilen Zustand geht, der ständig adressiert werden kann, und die bei der Adressierung durch Adressiermittel (40, 41) ein Ausgangssignal in Übereinstimmung mit ihrem tatsächlichen Zustand liefert, wobei das genannte System Rückstellmittel (19, 20, 40) enthält, um die bistabilen Schaltungen (14) der Meßfühler (12) in regelmäßigen Abständen rückzustellen.

2. System einer Berührungsmeßfühlergruppe nach Anspruch 1, dadurch gekennzeichnet, daß jeder Meßfühler (12) jeweils ein Schaltelement (16) in einer aktiven Matrix von Schaltelementen enthält und aktiv adressiert werden kann, indem die Schaltelemente (16) durch die Adressiermittel (40, 41) so betätigt werden, daß eine Detektorschaltung (41) der Adressiermittel (40, 41) den Zustand der bistabilen Schaltungen (14) erfassen kann.

3. System einer Berührungsmeßfühlergruppe nach Anspruch 2, dadurch gekennzeichnet, daß die Adressiermittel (40, 41) die Meßfühler (12) in Ab-

ständen aktiv adressieren, die mit der regelmäßigen Rückstellung der bistabilen Schaltungen (14) in Beziehung stehen.

4. System einer Berührungsmeßfühlergruppe nach Anspruch 2 oder Anspruch 3, dadurch gekennzeichnet, daß die Schaltelemente (16) Dünnschicht-Transistoren enthalten.

5. System einer Berührungsmeßfühlergruppe nach einem der Ansprüche 2 bis 4, dadurch gekennzeichnet, daß eine Reihe mit Meßfühlern (12) nach der anderen durch die Adressiermittel (40, 41) rückgestellt wird.

6. System einer Berührungsmeßfühlergruppe nach Anspruch 5, dadurch gekennzeichnet, daß die Schaltelemente (16) einer Reihe mit Meßfühlern (12) nach der anderen von den Adressiermitteln (40, 41) aktiviert werden.

7. System einer Berührungsmeßfühlergruppe nach Anspruch 6, dadurch gekennzeichnet, daß die Meßfühler (12) rückgestellt und die Schaltelemente (16) aktiviert werden durch Auswahlsignale (20), die über die Reihenadressenleitungen (20) zugeführt werden, und daß die Detektorschaltung (41) mit den Schaltelementen über Spaltendetektorleitungen (34) verbunden ist.

8. System einer Berührungsmeßfühlergruppe nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die bistabile Schaltung (14) jedes Meßfühlers (12) auf eine von positionsbestimmenden Mitteln in der Nähe des Meßfühlers (12) erzeugte kapazitive Wirkung reagiert.

9. System einer Berührungsmeßfühlergruppe nach Anspruch 8, dadurch gekennzeichnet, daß jeder Meßfühler eine Fühlerelektrode (15) enthält, die zusammen mit den positionsbestimmenden Mitteln eine gewisse Kapazität erzeugt.

10. System einer Berührungsmeßfühlergruppe nach Anspruch 9, dadurch gekennzeichnet, daß die bistabile Schaltung (14) jedes Meßfühlers (12) zwei kreuzgekoppelte Inverter (17, 18) enthält, daß die Fühlerelektrode (15) mit einem entsprechenden (B) der bistabilen Knotenpunkte (A, B) verbunden ist und daß eine Referenzkapazität (21) mit dem anderen bistabilen Knotenpunkt (A) verbunden ist, wobei die bistabile Schaltung (14) regelmäßig von den Adressiermitteln (40, 41) in einen metastabilen Zustand rückgestellt wird, wonach die bistabile Schaltung in einen ersten oder zweiten Zustand geht in Abhängigkeit von den relativen Werten der Fühlerelektrode (15) und der Referenzkapazität (21).

11. System einer Berührungsmeßfühlergruppe nach Anspruch 10, dadurch gekennzeichnet, daß die bistabile Schaltung (14) außerdem einen Schalttransistor (19) enthält, der über die Eingänge der beiden Inverter (17, 18) angeschlossen ist und durch die Adressierschaltung (40, 41) so aktiviert wird, daß er die bistabile Schaltung (14) in ihren metastabilen Zustand bringt.

12. System einer Berührungsmeßfühlergruppe nach einem der Ansprüche 9 bis 11, dadurch gekennzeichnet, daß die Fühlerelektrode (15) jedes Meßfühlers (12) mit Isoliermaterial beschichtet ist.

13. System einer Berührungsmeßfühlergruppe nach Anspruch 12, dadurch gekennzeichnet, daß die Isolierschichten jeweils Anteile einer gemeinsamen durchgehenden Materialschicht enthalten, die sich über die Matrix der Meßfühler (12) erstreckt.

14. System einer Berührungsmeßfühlergruppe nach einem der Ansprüche 10 bis 13, dadurch gekennzeichnet, daß die bistabilen Schaltungen Dünnschicht-Transistoren enthalten.

15. System einer Berührungsmeßfühlergruppe nach einem der Ansprüche 1 bis 14, das ein Anzeigegerät enthält, dessen Anzeigeausgangsfläche so zusammen mit der Matrix angeordnet ist, daß sich die Meßfühler auf dem Anzeigeausgang befinden.

Revendications

1. Système à réseau de palpeurs à effleurement comprenant un réseau d'éléments de détection (12) agencés en rangées et en colonnes et pourvu de moyens d'adressage (40, 41) sur la base de conducteurs de rangées (20) et de colonnes (34) pour adresser sélectivement un élément particulier desdits éléments de détection à une intersection d'un conducteur de rangée sélectionné et d'un conducteur de colonne sélectionné, caractérisé en ce que chaque élément de détection (12) comprend un circuit bistable (14) à l'emplacement de l'élément de détection dans le réseau, ledit circuit bistable (14) étant sensible à la présence ou à l'absence d'une entrée d'effleurement à l'emplacement de l'élément de détection (12) de manière à adopter un premier ou un deuxième état stable, respectivement, qui reste adressable en permanence et qui, lors d'un adressage par les moyens d'adressage (40, 41), délivre une sortie en fonction de son état réel, ledit système comportant des moyens de remise à zéro (19, 20, 40) pour remettre à zéro périodiquement les circuits bistables (14) des éléments de détection (12).

2. Système à réseau de palpeurs à effleurement selon la revendication 1, caractérisé en ce que les éléments de détection (12) comprennent chacun un dispositif de commutation respectif (16) dans une matrice active de dispositifs de commutation et sont activement adressables par l'actionnement des dispositifs de commutation (16) par les moyens d'adressage (40, 41) pour permettre à un circuit de détection des moyens d'adressage (40, 41) de détecter l'état des circuits bistables (14).

3. Système à réseau de palpeurs à effleurement selon la revendication 2, caractérisé en ce que les moyens d'adressage (40, 41) adressent de manière active les éléments de détection (12) à des intervalles rapportés à la remise à zéro périodique des circuits bistables (14).

4. Système à réseau de palpeurs à effleurement selon la revendication 2 ou 3, caractérisé en ce que les dispositifs de commutation (16) comprennent des transistors à couches minces.

5. Système à réseau de palpeurs à effleurement selon l'une quelconque des revendications 2 à 4, caractérisé en ce que les éléments de détection (12) sont remis à zéro par les moyens d'adressage (40, 41) à raison d'une rangée à la fois en séquence.

6. Système à réseau de palpeurs à effleurement selon la revendication 5, caractérisé en ce que les dispositifs de commutation (16) des éléments de détection (12) sont activés par les moyens d'adressage (40, 41) à raison d'une rangée à la fois en séquence.

7. Système à réseau de palpeurs à effleurement selon la revendication 6, caractérisé en ce que les éléments de détection (12) sont remis à zéro et les dispositifs de commutation (16) sont activés par des signaux de sélection (20) délivrés via les conducteurs d'adressage de rangées (20) et en ce que le circuit de détection (41) est connecté aux dispositifs de commutation via des conducteurs de détection de colonnes (34).

8. Système à réseau de palpeurs à effleurement selon l'une quelconque des revendications 1 à 7, caractérisé en ce que le circuit bistable (14) de chaque élément de détection (12) est sensible à un effet capacitif produit par un moyen de désignation de position à proximité de l'élément de détection (12).

9. Système à réseau de palpeurs à effleurement selon la revendication 8, caractérisé en ce que chaque élément de détection comprend une électrode de détection (15) qui, conjointement avec le moyen de désignation de position, fournit une certaine capacité.

10. Système à réseau de palpeurs à effleurement selon la revendication 9, caractérisé en ce que le circuit bistable (14) de chaque élément de détection (12) comprend deux inverseurs à couplage croisé (17, 18), en ce que l'électrode de détection (15) est connectée à un noeud respectif (B) des noeuds bistables (A, B), et en ce qu'une capacité de référence (21) est connectée à l'autre noeud bistable (A), le circuit bistable (14) étant ramené périodiquement par les moyens d'adressage (40, 41) à un état métastable après quoi le circuit bistable adopte son premier ou son deuxième état en fonction des valeurs relatives de la capacité de l'électrode de détection (15) et de la capacité de référence (21).

11. Système à réseau de palpeurs à effleurement selon la revendication 10, caractérisé en ce que le circuit bistable (14) comprend par ailleurs un transistor de commutation (19) connecté aux bornes des entrées des deux inverseurs (17, 18), qui peut être activé par le circuit d'adressage (40, 41) pour amener le circuit bistable (14) à son état métastable.

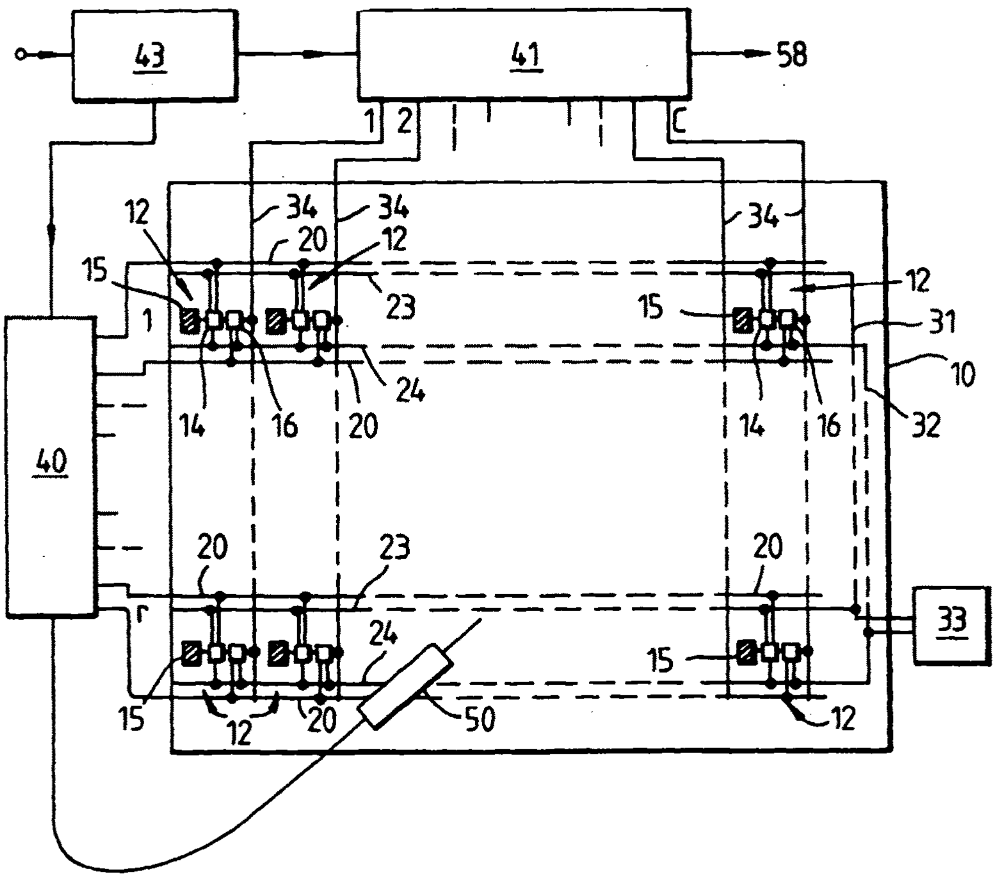
12. Système à réseau de palpeurs à effleurement selon l'une quelconque des revendications 9 à 11, caractérisé en ce qu'une couche de matière isolante est appliquée sur l'électrode de détection (15) de chaque élément de détection (12).

13. Système à réseau de palpeurs à effleurement selon la revendication 12, caractérisé en ce que les couches de matière isolante comprennent des parties respectives d'une couche commune et continue de matière s'étendant sur le réseau d'éléments de détection (12).

14. Système à réseau de palpeurs à effleurement selon l'une quelconque des revendications 10 à 13, caractérisé en ce que les circuits bistables comprennent des transistors à couches minces.

15. Système à réseau de palpeurs à effleurement selon l'une quelconque des revendications 1 à 14 et comprenant un dispositif d'affichage dont la zone de sortie d'affichage est mise en place conjointement avec le réseau de telle manière que les éléments de détection soient placés sur la sortie d'affichage.

Fig.1.


43
41
58
1
2
C
40
33
34
34
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12
20
12
12
15
15
23
1
31
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r
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12
20
50
12

Fig.2.

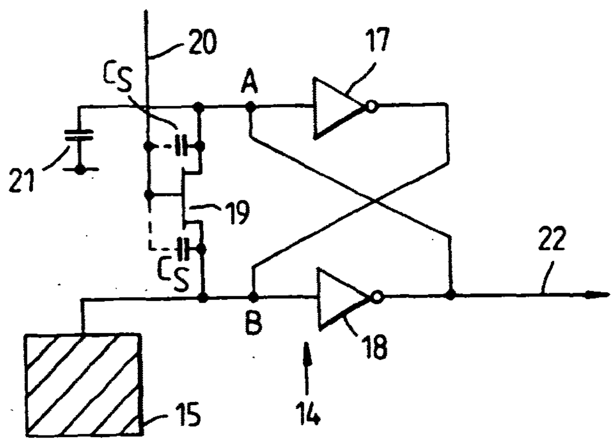


Fig.3.

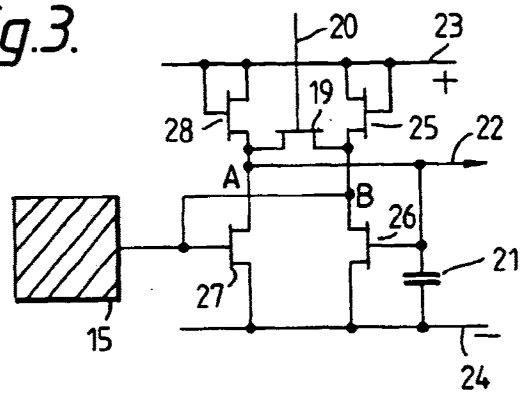


Fig.4.

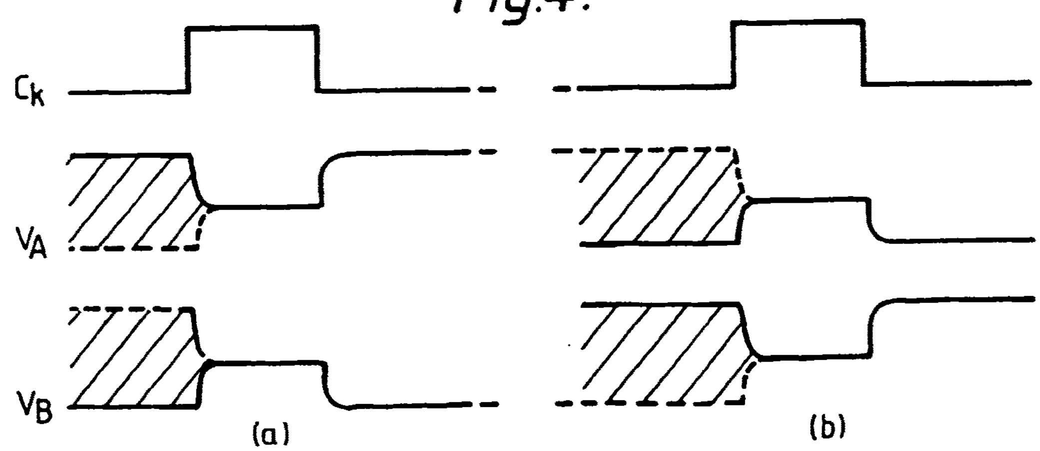
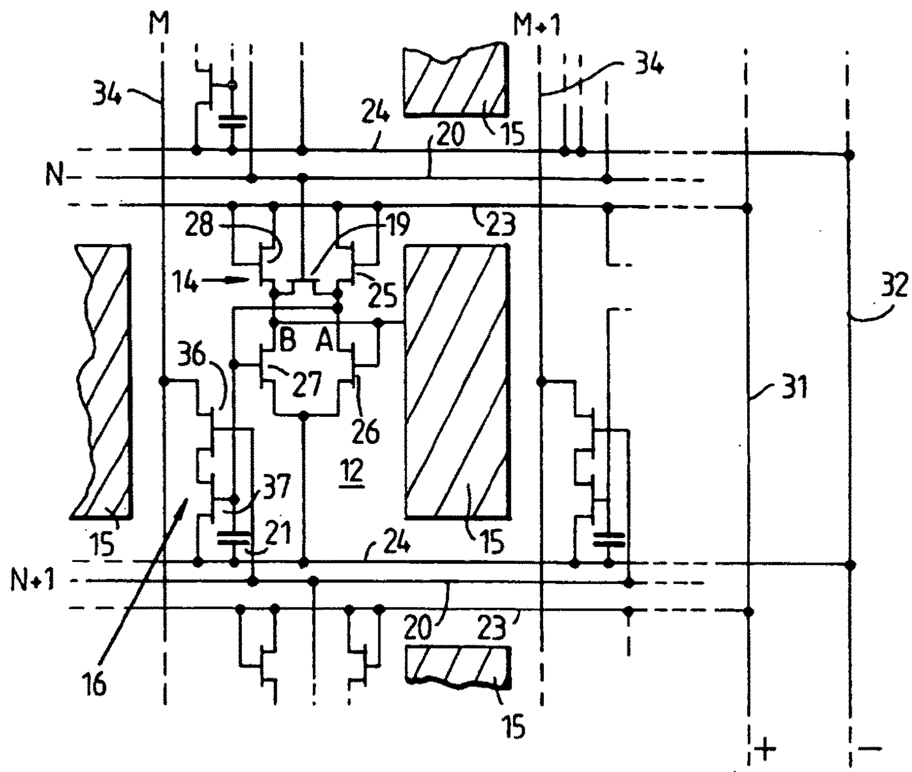


Fig.5.


M
M+1
34
34
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20
15
N
28
19
23
14
25
32
B
A
36
27
31
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12
37
21
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15
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16
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+
−

Fig.6.

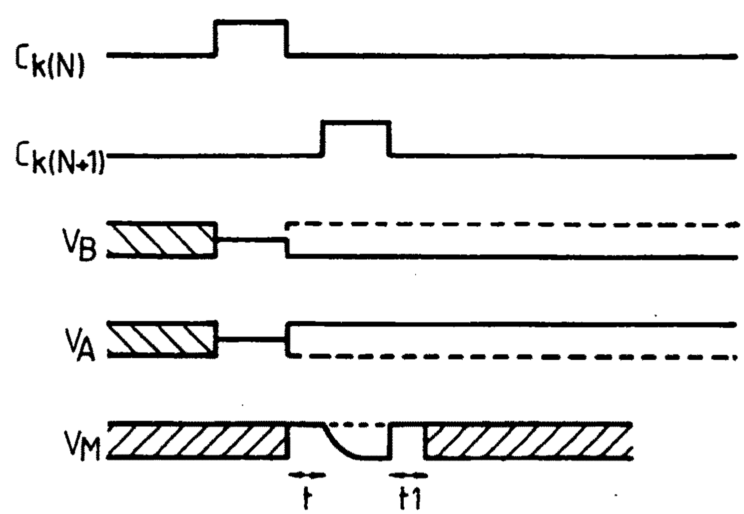

Ck(N)
Ck(N+1)
VB
VA
VM
t
t1

Fig.7.

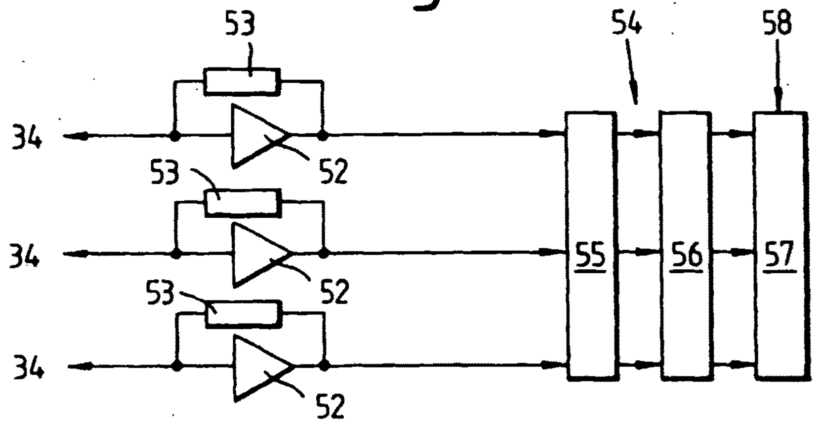


Fig.9.

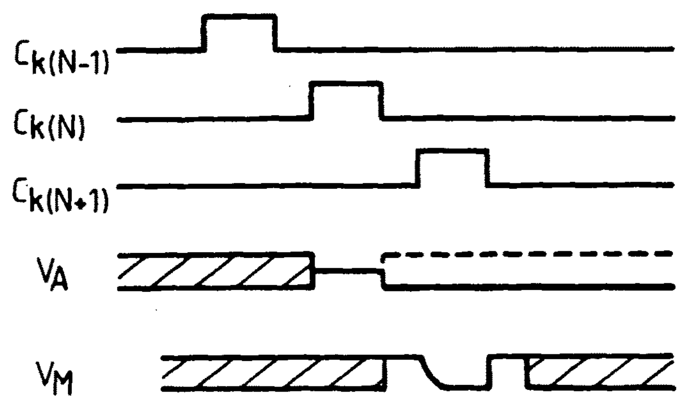
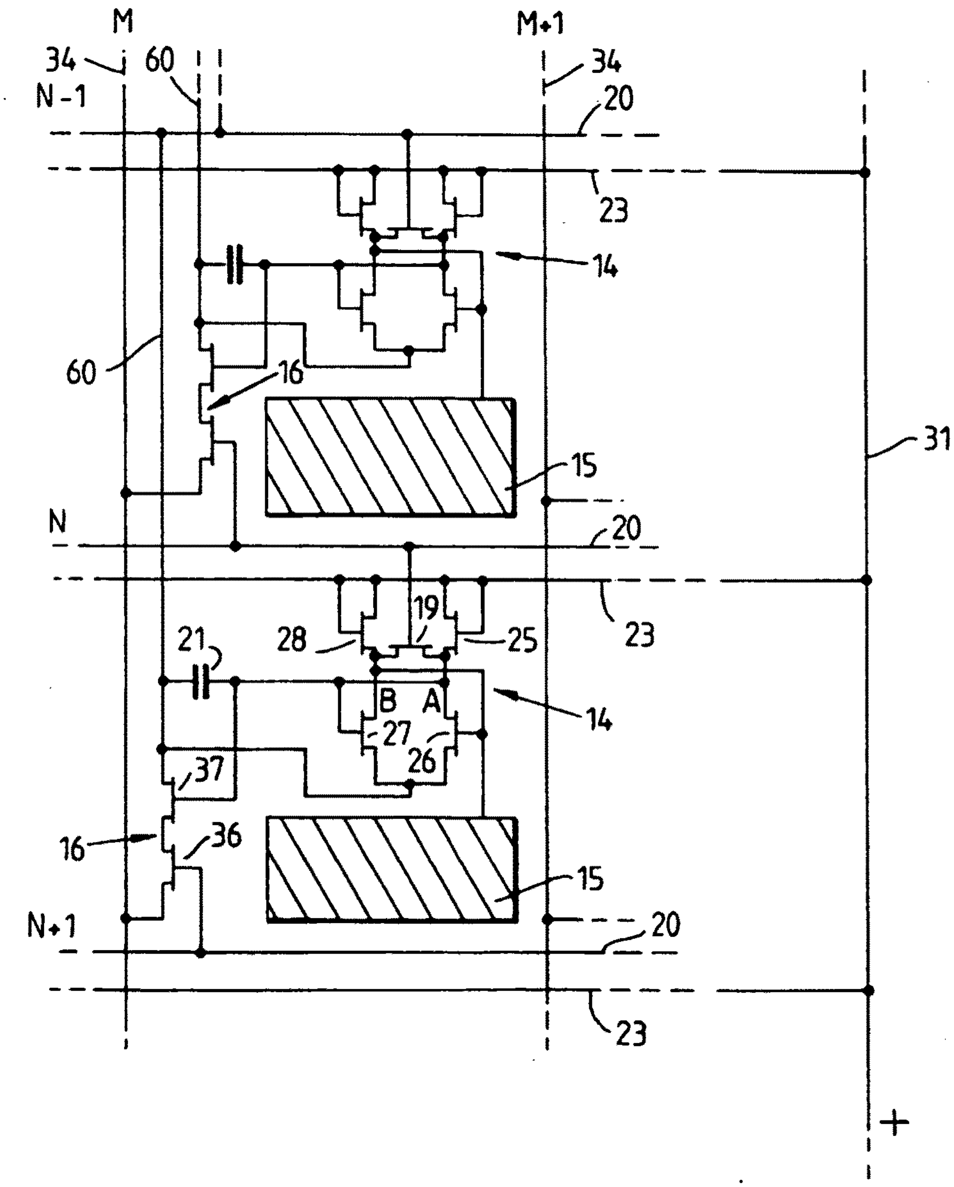


Fig.8.


M
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N-1
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A
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36
15
N+1
20
23
+

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derzeit kein Vertreter bestellt

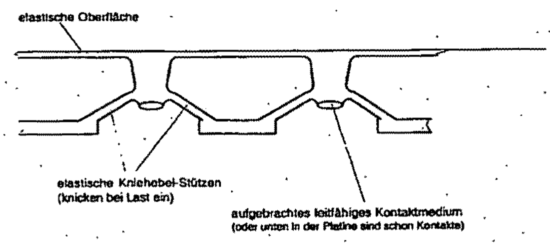
(72) Erfinder:
gleich Anmelder

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **flexibles Engabesystem / Mehrfinger-System**

(57) Zusammenfassung: Dieses "flexible Eingabe-System/Mehrfinger-System" ist dadurch gekennzeichnet, dass auf einer sensiblen Fläche Positionen und Druckauslösungen mehrerer Finger zugleich ausgewertet werden und dadurch Erleichterungen und flexible Anpassungen für den Nutzer möglich sind. Ein Zehnfinger-Tippen im Sinne der Patent-Anmeldung vom 21.12.2001 ist möglich, oder zwei gleichzeitig aufgesetzte Finger können z. B. Scroll- oder Zoom-Funktionen steuern.

Mehrere Lösungen für die Konstruktion einer solchen sensiblen Fläche werden genannt. Es wird z. B. ein (transluzentes) Strangpressprofil beschrieben, das eine dünne, elastisch eindrückbare Fläche bildet, das nach einem Kniehebelstützen-Prinzip wirkt und ein feinmotorisches Feedback leistet (Abb. 1). Mit dem Anschneiden der Unterseite in Querrichtung (Linienraster) wird diese Fläche weich und punktuell leicht verformbar. Es werden elektrisch wirksame Touchscreen-Varianten genannt. Es kann ein schnell umlaufender elektrischer Sensorfeldaufbau (sozusagen ein vom Flächenrand her nach innen gerichtetes "umlaufendes RADAR") Informationen über die Fingerpositionen bestimmen.



Beschreibung

Kurzdarstellung:

[0001] Dieses "flexible Eingabe-System/Mehrfinger-System" ist dadurch gekennzeichnet, dass auf einer sensiblen Fläche Positionen und Druckauslösungen mehrerer Finger zugleich ausgewertet werden und dadurch einige Erleichterungen und flexible Anpassungen für den Nutzer möglich werden.

[0002] Die hier benannte „flexible Tastatur" ist dadurch gekennzeichnet, dass sie die Position nicht nur eines Fingers, sondern mehrerer Finger (zugleich) bestimmt und aufgrund der Positionen, Bewegungen und Druckauslösungen von ein, zwei, drei oder bis zu zehn Fingern auf einer (relativ) glatten, sensitiven Fläche entsprechende Steuersignale erzeugt bzw. zugehörige Zeichen bestimmt. Die Handhabung kann speziellen Aufgaben angepasst sein und damit vereinfacht, ergonomisch sinnvoll und „intuitiv treffend" gestaltet sein. Das heisst, die für den Prozessor verfügbare und als Bezug dienende Topografie der Fingerspitzen ist (z.T. quasi selbstständig) allgemeinen bzw. individuellen Hand-Abmessungen und speziellen Aufgabenstellungen anpassbar.

[0003] Die sensitive Fläche kann optional auch als Trackpad genutzt werden, also eine Maus ersetzen.

[0004] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Eine in der Fläche materiell vorhandene (mehr oder weniger feine) Rasterung leitenden Materials erlaubt die Bestimmung der Fingerpositionen durch Messungen von Widerstand oder Kapazität.

[0005] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die Fläche ist im Sinne eines Rasters in materiell manifeste quasi punktförmige Leiter-Elemente aufgelöst. Sie kann im Sinne einer bestimmten Auflösung der (z.B. 70 × 150) punktähnlichen Elementen die durch Fingerberührungen veränderten Messdaten all dieser Elemente in einer kapazitiven Messung dem Prozessor verfügbar machen, um daraus bestenfalls die (von der Druckauslösung zu unterscheidende) Positionsbestimmung (PosB) und in jedem Falle die Druckauslösungsbestimmung (DruB) mehrerer Finger zu errechnen.

[0006] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die Fläche ist in materiell manifeste streifenförmige Leiter-Elemente aufgelöst. Sie kann im Sinne einer bestimmten Auflösung der (z.B. 150) streifenförmigen Elementen die durch Fingerberührungen veränderten Messdaten dieser Elemente in einer kapazitiven Messung dem Prozessor verfügbar machen, um daraus bestenfalls die (von der Druckauslösung zu unterscheidende) Positionsbestimmung (PosB) und in jedem Falle die Druckauslösungsbestimmung (DruB) mehrerer Finger zu errechnen.

[0007] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
In 5 oder 6 Richtungen verlaufende materiell manifeste Leiter (vergleiche auch bestehende 5-Fadentechnologie oder die vorgeschlagene 6-Fadentechnologie) liefern durch die Kombination der einlaufenden Signale eindeutige Positionen bzw. Druckauslösungsorte der Finger.

[0008] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die bestehenden (z.B. mit Widerständen, Kapazitäten, Feldeffekten arbeitenden) Methoden der Touch-Screens werden erweitert: Von den Rändern her wird die Fläche nicht nur in x- oder y-Richtung erschlossen, sondern z.B. in 3 verschiedenen Achsen (also aus 6 verschiedenen „Blickwinkeln") erschlossen. Eine klare Unterscheidbarkeit für die Auswertung könnte durch entsprechende (je nach Richtung) unterschiedlich aufmodulierte Frequenzen geleistet werden.

[0009] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die bestehenden (z.B. mit Widerständen, Kapazitäten, Feldeffekten arbeitenden) Methoden der Touch-Screens werden erweitert: Von den Rändern her wird die Fläche mit den Einflüssen durch die Finger nicht nur in x- oder y-Richtung messtechnisch erschlossen , sondern z.B. 10 mal pro Sekunde in z.B. in 6 verschiedenen Achsen, also aus 12 verschiedenen „Blickwinkeln" erschlossen (vergleichbar mit einem Uhrenblatt, von dem man 12 Blicke auf den Innenbereich einnimmt), um Daten über Fingerpositionen zu erhalten. Das ist ein umlaufender Sensorfeldaufbau, sozusagen ein nach innen gerichtetes, auf dem Flächenrand „umlaufendes Echolot" (Vergleiche **Abb. 4**). Aus diesen Daten können die Überdeckungen der jeweils gefundenen Punkte als Fingerspitzen gedeutet werden. (Vergleiche auch die Auswertungsmethoden seismologischer Untersuchungen). Es ergibt sich z.B. für zwei zugleich aufgesetzte Finger eine Richtung mit besonders starkem Ueberbrückungseffekt, das ist die Richtung, die beide Finger miteinander bilden. (Die dazu orthogonale Richtung zeigt einen minimalen Ueberbrückungseffekt).

[0010] (Die Unterscheidung von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) ist für einige Anwendungen (wie beim üblichen 10-Finger-Schreiben auf der QWERT-Tastatur) nötig. Diese Unterscheidung kann im Idealfall hochempfindlicher Feldeffektmessungen durch eine einzige Methode geleistet werden, aber sie erfordert ggf. doch den gleichzeitigen Einsatz zweier Messmethoden in der sensiblen Fläche. – Für zwei (oder drei) zugleich unterscheidbare Finger ist der Aufwand noch überschaubar, für alle 10 Finger muss die Technik entsprechend aufwendiger sein.)

[0011] Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:

Eine sensitive Fläche („Touch-Field") ist wie folgt aufgebaut: Die an der oberen Seite relativ glatte Fläche besteht aus einem elastischen und transparenten (oder transluzenten) Material und besitzt eine bestimmte Geometrie des Querschnitts, so dass sie durch die Finger mit einer bestimmten Kraft einzudrücken ist. Diese bestimmte Widerstandskraft ist durch Kniehebel-Effekte einer bestimmten Geometrie (vergleiche auch **Abb.** 1 oder 3) so zu gestalten, dass sie beim Eindrücken zunächst leicht ansteigt, dann ein Maximum erreicht und sich dann aber die Widerstandskraft wieder verringert, damit das auslösende Element die darunter liegende Fläche (insbesondere eine Leiterplatte) auch sicher und spürbar berührt. Es ergibt sich ein wünschenswertes feinmotorisches Feedback für die Fingerbewegungen.

[0012] Diese besagte sensitive Fläche ist insbesondere durch Strangpressverfahren herstellbar (z.B. würde eine Fläche von etwa 100 mm mal 250 mm durch ein Strangpresswerkzeug von 100 mm Breite zu erzeugen sein). Danach kann man (a) die in sich komplex aufgebaute Fläche so belassen, (b) dieses Produkt von der Unterseite her so weit aufschneiden, dass die oben durchlaufende Fläche erhalten bleibt oder (c) in diesem Produkt (z.B. durch Heissprofil-Schneiden oder LASER-Schneiden) von der Unterseite her soweit ein bestimmtes Profil ausschneiden (die oben durchlaufende Fläche bleibt erhalten), dass die Kniehebel-Stützchen in Querrichtung voneinander getrennt sind, sich also im Eindrückverhalten kaum noch gegenseitig beeinflussen (vergleiche **Abb.** 2). Im Fall von (c) entsteht zusätzliches Volumen unter der Fläche, in dem etwa LEDs untergebracht werden können. In einem weiteren Schritt können bestimmte Kontaktzonen an der Unterseite durch das Aufdrucken leitfähigen (und zugleich elastischen) Materials hergestellt werden. Im letzten Schritt kann dieses Produkt auf eine; Leiterplatte aufgeklebt werden. Diese Leiterplatte kann insbesondere Leiterbahnen quer zu den Strängen der Kniehebel-Stützchen tragen (um durch Messung von Widerstand oder Kapazität die Punkte der Druckauslösungen zu bestimmen und als Signal weiterzuleiten). Und die Leiterplatte kann insbesonder LED- (oder LCD-) Elemente tragen, die durch die transparente oder transluzente Fläche hindurch sichtbar sind.

[0013] Weitere Abmessungen eines solchen Produkte können z.B. folgende sein:

Dicke des stranggepressten Materials 3,5 mm
Hub der Kniehebel-Stützchen 1,5 mm
(usw. vergleiche **Abb.** 1 und 2)

[0014] Die „archaische Version" eines Kniehebel-stützen-Systems (vergleiche **Abb.** 3) ist etwas leichter eindrückbar und bietet mehr Volumen für z.B. LED-Elemente.

[0015] Mit diesem Repertoire sind zum Beispiel folgende Erleichterungen und Anwendungen möglich:

a) Zwei Finger zugleich (z.B. länger als 0,6 Sekunden) aufgesetzt und verschoben steuern die Scroll-Funktion der Screen-Darstellung. Durch diese streifende Bewegung wird quasi die Darstellung im direkten Griff beider Finger verschoben.

b) Zwei Finger zugleich aufdrücken (z.B. länger als 0,3 Sekunden und mit einem Mindestabstand von 6 mm) und gegeneinander bewegen steuert eine Zoomfunktion/Massstabsveränderung der Darstellung.

c) Drei Finger zugleich aufdrücken (z.B. länger als 0,3 Sekunden, bis zu 0,6 Sekunden) schaltet zum Beispiel die nächste Menü-Ebene ein.

[0016] Anwendungen können also z.B. sein:

– Tastaturen für Handies, Handheld-Computer oder andere Geräte mit nur relativ kleinen Displays bzw. Eingabefeldern (vom Nutzer selbst anzupassen, einzustellen und zu modifizieren) (Handies können dann statt Display + Tastenfeld einfach einen flexiblen Screen haben, der unterschiedliche Funktionen erlaubt, insbesondere den Mausklick-ähnlichen schnellen Zugriff auf die dargestellten Objekte. Durch die Scroll- und Zoom-Funktionen kann auch ein kleiner Screen gewisse Datenmengen schnell greifbar machen.)

– Eingabegeräte für Automaten und Kunden-Informations- und Führungssysteme

– Screens in Fahrzeugen (z.B. mit Kartendarstellungen), wo die Screenfläche zugleich als (assoziative, zeichenhaft eindeutige) Eingabefläche genutzt werden kann.

– CAD-Arbeitsplätze

[0017] Dieses System erleichtert Einhandbedienungen.

[0018] Weitere Anwendungen dieses „Mehrfinger-Repertoires" ergeben sich für den Einsatz im Sinne der flexiblen dynamisch anpassbaren Computer-Tastatur (siehe Patent-Anmeldung Ralf Trachte vom 21.12.2001. Zum Beispiel eine Justierung der individuellen „Hand-Topographie" kann dafür u.a. durch einmaliges Aufdrücken aller 10 Finger erfolgen). Dieses Produkt liefert zunächst Druckauslösungsbestimmungen (DruB) (auch mehrerer Finger). Eine für die verfeinerte Auswertung und Korrektur eventuell notwendige Positionsbestimmung (PosB) der 10 Finger kann ausgehend von der anfänglich justierten individuellen „Hand-Topographie" vom Prozessor mit protokolliert werden (Vergleiche auch Punkte 4. und 5. der Anmeldung vom 21.12.2002, Korrekturen und dynamische Anpassung).

Patentansprüche

1. Die hier benannte „flexible Tastatur" ist **dadurch gekennzeichnet**, dass sie die Position nicht nur eines Fingers, sondem mehrerer Finger (zugleich) bestimmt und aufgrund der Positionen, Bewegungen und Druckauslösungen von ein, zwei, drei oder bis zu zehn Fingem auf einer (relativ) glatten, sensitiven Fläche entsprechende Steuersignale erzeugt bzw. zugehörige Zeichen bestimmt. Die Handhabung kann speziellen Aufgaben angepasst sein und damit vereinfacht, ergonomisch sinnvoll und „intuitiv treffend" gestaltet sein. Das heisst, die für den Prozessor verfügbare und als Bezug dienende Topografie der Fingerspitzen ist (z.T. quasi selbstständig) allgemeinen bzw. individuellen Hand-Abmessungen und speziellen Aufgabenstellungen anpassbar.

2. Die sensitive Fläche kann optional auch als Trackpad genutzt werden, also eine Maus ersetzen.

3. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Eine in der Fläche materiell vorhandene (mehr oder weniger feine) Rasterung leitenden Materials erlaubt die Bestimmung der Fingerpositionen durch Messungen von Widerstand oder Kapazität.

4. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die Fläche ist im Sinne eines Rasters in materiell manifeste quasi punktförmige Leiter-Elemente aufgelöst. Sie kann im Sinne einer bestimmten Auflösung der (z.B. 70 × 150) punktähnlichen Elementen die durch Fingerberührungen veränderten Messdaten all dieser Elemente in einer kapazitiven Messung dem Prozessor verfügbar machen, um daraus bestenfalls die (von der Druckauslösung zu unterscheidende) Positionsbestimmung (PosB) und in jedem Falle die Druckauslösungsbestimmung (DruB) mehrerer Finger zu errechnen.

5. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die Fläche ist in materiell manifeste streifenförmige Leiter-Elemente aufgelöst. Sie kann im Sinne einer bestimmten Auflösung der (z.B. 150) streifenförmigen Elementen die durch Fingerberührungen veränderten Messdaten dieser Elemente in einer kapazitiven Messung dem Prozessor verfügbar machen, um daraus bestenfalls die (von der Druckauslösung zu unterscheidende) Positionsbestimmung (PosB) und in jedem Falle die Druckauslösungsbestimmung (DruB) mehrerer Finger zu errechnen.

6. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
In 5 oder 6 Richtungen verlaufende materiell manifeste Leiter (vergleiche auch bestehende 5-Fadentechnologie oder die vorgeschlagene 6-Fadentechnologie) liefem durch die Kombination der einlaufenden Signale eindeutige Positionen bzw. Druckauslösungsorte der Finger.

7. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die bestehenden (z.B. mit Widerständen, Kapazitäten, Feldeffekten arbeitenden) Methoden der Touch-Screens werden erweitert: Von den Rändem her wird die Fläche nicht nur in x- oder y-Richtung erschlossen, sondem z.B. in 3 verschiedenen Achsen (also aus 6 verschiedenen „Blickwinkeln") erschlossen. Eine klare Unterscheidbarkeit für die Auswertung könnte durch entsprechende (je nach Richtung) unterschiedlich aufmodulierte Frequenzen geleistet werden.

8. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Die bestehenden (z.B. mit Widerständen, Kapazitäten, Feldeffekten arbeitenden) Methoden der Touch-Screens werden erweitert: Von den Rändem her wird die Fläche mit den Einflüssen durch die Finger nicht nur in x- oder y-Richtung messtechnisch erschlossen , sondem z.B. 10 mal pro Sekunde in z.B. in 6 verschiedenen Achsen, also aus 12 verschiedenen „Blickwinkeln" erschlossen (vergleichbar mit einem Uhrenblatt, von dem man 12 Blicke auf den Innenbereich einnimmt), um Daten über Fingerpositionen zu erhalten. Das ist ein umlaufender Sensorfeldaufbau, sozusagen ein nach innen gerichtetes, auf dem Flächenrand „umlaufendes Echolot" (Vergleiche **Abb. 4**). Aus diesen Daten können die Überdeckungen der jeweils gefundenen Punkte als Fingerspitzen gedeutet werden. (Vergleiche auch die Auswertungsmethoden seismologischer Untersuchungen). Es ergibt sich z.B. für zwei zugleich aufgesetzte Finger eine Richtung mit besonders starkem Ueberbrückungseffekt, das ist die Richtung, die beide Finger miteinander bilden. (Die dazu orthogonale Richtung zeigt einen minimalen Ueberbrückungseffekt).

9. Die technische Machbarkeit von Positionsbestimmung (PosB) und Druckauslösungsbestimmung (DruB) mehrerer Finger besteht beispielsweise durch folgenden Vorschlag:
Eine sensitive Fläche („Touch-Field") ist wie folgt aufgebaut: Die an der oberen Seite relativ glatte Fläche besteht aus einem elastischen und transparenten

(oder transluzenten) Material und besitzt eine bestimmte Geometrie des Querschnitts, so dass sie durch die Finger mit einer bestimmten Kraft einzudrücken ist. Diese bestimmte Widerstandskraft ist durch Kniehebel-Effekte einer bestimmten Geometrie (vergleiche auch **Abb.** 1 oder 3) so zu gestalten, dass sie beim Eindrücken zunächst leicht ansteigt, dann ein Maximum erreicht und sich dann aber die Widerstandskraft wieder verringert, damit das auslösende Element die darunter liegende Fläche (insbesondere eine Leiterplatte) auch sicher und spürbar berührt. Es ergibt sich ein wünschenswertes feinmotorisches Feedback für die Fingerbewegungen.
Diese besagte sensitive Fläche ist insbesondere durch Strangpressverfahren herstellbar. Danach kann man (a) die in sich komplex aufgebaute Fläche so belassen, (b) dieses Produkt von der Unterseite her so weit aufschneiden, dass die oben durchlaufende Fläche erhalten bleibt oder (c) in diesem Produkt (z.B. durch Heissprofil-Schneiden oder LASER-Schneiden) von der Unterseite her soweit ein bestimmtes Profil ausschneiden (die oben durchlaufende Fläche bleibt erhalten), dass die Kniehebel-Stützchen in Querrichtung voneinander getrennt sind, sich also im Eindrückverhalten kaum noch gegenseitig beeinflussen (vergleiche **Abb.** 2). Im Fall von (c) entsteht zusätzliches Volumen unter der Fläche, in dem etwa LEDs untergebracht werden können. In einem weiteren Schritt können bestimmte Kontaktzonen an der Unterseite durch das Aufdrucken leitfähigen (und zugleich elastischen) Materials hergestellt werden. Im letzten Schritt kann dieses Produkt auf eine Leiterplatte aufgeklebt werden. Diese Leiterplatte kann insbesondere Leiterbahnen quer zu den Strängen der Kniehebel-Stützchen tragen (um durch Messung von Widerstand oder Kapazität die Punkte der Druckauslösungen zu bestimmen und als Signal weiterzuleiten). Und die Leiterplatte kann insbesonder LED- (oder LCD-) Elemente tragen, die durch die transparente oder transluzente Fläche hindurch sichtbar sind.
Die „archaische Version" eines Kniehebelstützen-Systems (vergleiche **Abb.** 3) ist etwas leichter eindrückbar und bietet mehr Volumen für z.B. LED-Elemente.

10. Mit diesem Repertoire sind zum Beispiel folgende Erleichterungen und Anwendungen möglich:
a) Zwei Finger zugleich (z.B. länger als 0,6 Sekunden) aufgesetzt und verschoben steuern die Scroll-Funktion der Screen-Darstellung. Durch diese streifende Bewegung wird quasi die Darstellung im direkten Griff beider Finger verschoben.
b) Zwei Finger zugleich aufdrücken (z.B. länger als 0,3 Sekunden und mit einem Mindestabstand von 6 mm) und gegeneinander bewegen steuert eine Zoomfunktion / Massstabsveränderung der Darstellung.
c) Drei Finger zugleich aufdrücken (z.B. länger als 0,3 Sekunden, bis zu 0,6 Sekunden) schaltet zum Beispiel die nächste Menü-Ebene ein.
Anwendungen können also z.B. sein:
– Tastaturen für Handies, Handheld-Computer oder andere Geräte mit nur relativ kleinen Displays bzw. Eingabefeldern (vom Nutzer selbst anzupassen, einzustellen und zu modifizieren) (Handies können dann statt Display + Tastenfeld einfach einen flexiblen Screen haben, der unterschiedliche Funktionen erlaubt, insbesondere den Mausklick-ähnlichen schnellen Zugriff auf die dargestellten Objekte. Durch die Scroll- und Zoom-Funktionen kann auch ein kleiner Screen gewisse Datenmengen schnell greifbar machen.)
– Eingabegeräte für Automaten und Kunden-Informations- und Führungssysteme
– Screens in Fahrzeugen (z.B. mit Kartendarstellungen), wo die Screenfläche zugleich als (assoziative, zeichenhaft eindeutige) Eingabefläche genutzt werden kann.
– CAD-Arbeitsplätze
Dieses System erleichtert Einhandbedienungen.

11. Weitere Anwendungen dieses „Mehrfinger-Repertoires" ergeben sich für den Einsatz im Sinne der flexiblen dynamisch anpassbaren Computer-Tastatur (siehe Patent-Anmeldung Ralf Trachte vom 21.12.2001. Zum Beispiel eine Justierung der individuellen „Hand-Topographie" kann dafür u.a. durch einmaliges Aufdrücken aller 10 Finger erfolgen). Dieses Produkt liefert zunächst Druckauslösungsbestimmungen (DruB) (auch mehrerer Finger). Eine für die verfeinerte Auswertung und Korrektur eventuell notwendige Positionsbestimmung (PosB) der 10 Finger kann ausgehend von der anfänglich justierten individuellen „Hand-Topographie" vom Prozessor mit protokolliert werden (Vergleiche auch Punkte 4. und 5. der Anmeldung vom 21.12.2002, Korrekturen und dynamische Anpassung).

Es folgen 3 Blatt Zeichnungen

Anhängende Zeichnungen

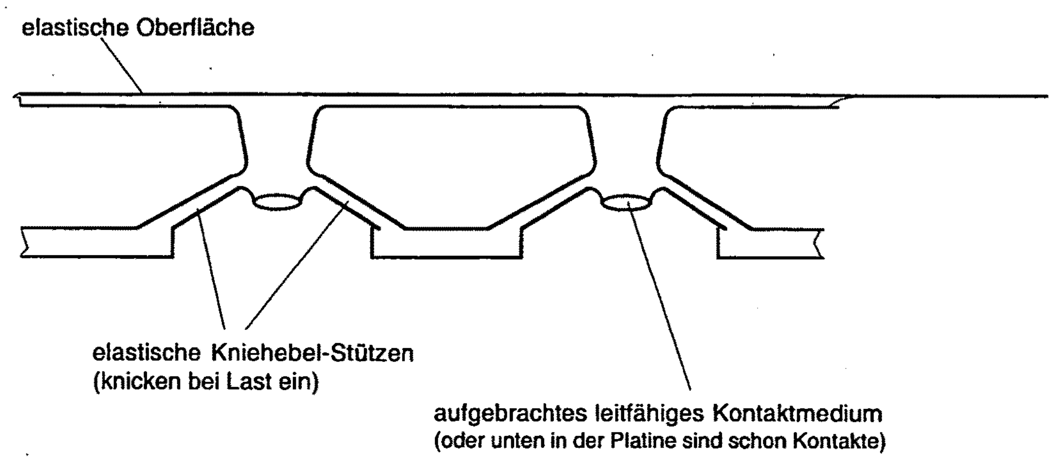


Abbildung 1: Querschnitt durch das Produkt
(z.B. im Sinne des Strangpressprofils, „von oben nach unten")

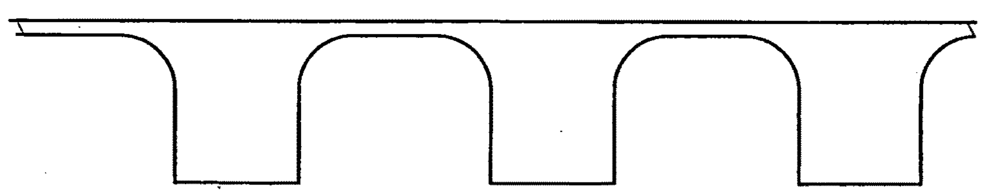


Abbildung 2: orthogonaler Querschnitt durch das Produkt
(Möglichkeit (c) im Sinne des geschnittenen Profils in Querrichtung, „von links nach rechts")

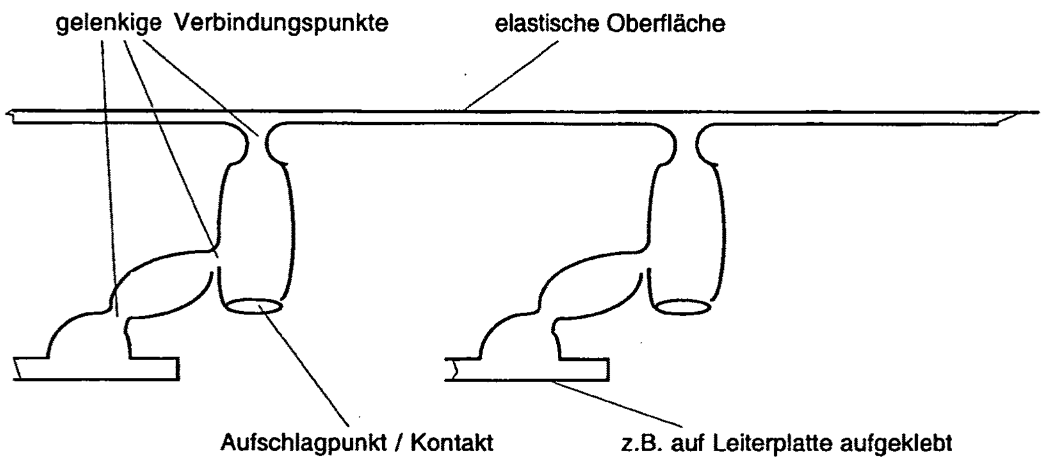


Abbildung 3: „archaische Version" von Kniehebelstützen

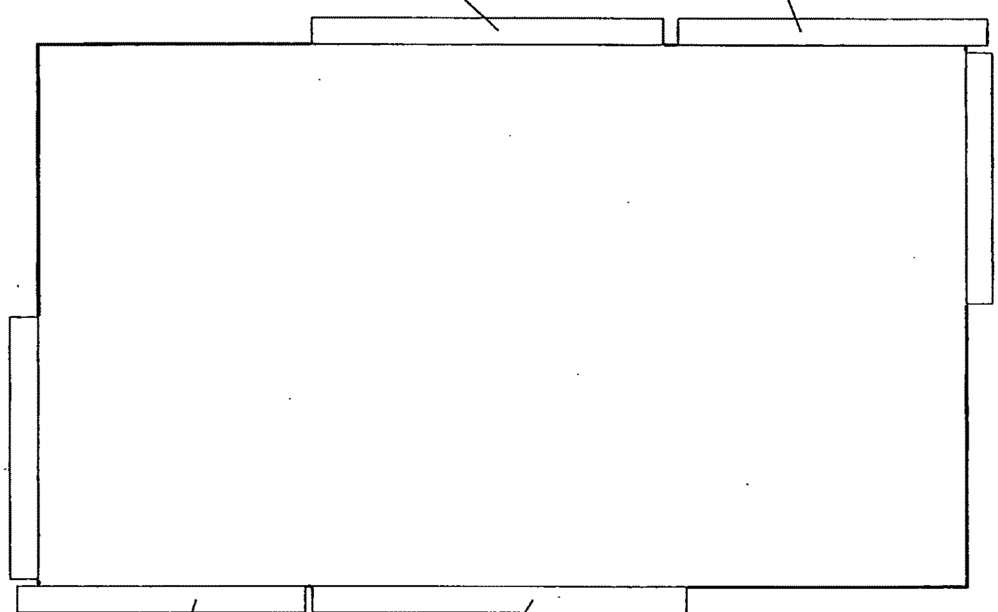


Abbildung 4: Prinzip des umlaufenden Feldaufbaus

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PATENT ABSTRACTS OF JAPAN, vol. 8, no. 38 (P-255)[1475], 18th February 1984;& JP-A-58 191 089

PATENT ABSTRACTS OF JAPAN, vol. 8, no. 202 (P-300)[1639], 14th September 1984;& JP-A-59 85 583

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Description

This invention relates to a graphics input tablet. The invention is particularly useful in the data processing field where it may be employed to input data of a graphical nature into a data processing machine.

Background Art

In the data processing field one of the major problems to users of a system is the rapid inputting of data. This has traditionally been achieved with a keyboard but when it is necessary to input graphical data, rather than character strings, a keyboard is grossly inefficient. There are various examples in the prior art of attempts to provide a more efficient and easier to use input means for graphical data.

One such example is disclosed in EP-A-5,996 (Quest Automation Ltd.) which shows an electrographic apparatus with two resistive layers, one overlying the other, held apart by a framework but arranged to be brought into contact by the pressure of a stylus or similar. Excitation voltages are applied to the resistive layer at 90 degrees to each other and two analogue voltages related to the position of the stylus are obtained in an unspecified manner.

Another example is disclosed in GB 2,088,063 (Robert Branton). This shows a conductive layer overlying a rectangular resistive layer with an insulating mesh between the two. The resistive layer has a contact at each corner and one opposed pair of contacts is energised at any one time. A stylus (ball-point pen or similar) is pressed onto the upper, conductive layer which then makes contact, through a gap in the insulating mesh, with the resistive layer. In consequence, the potential of the conductive layer equals that of the resistive layer at the point of contact; since this varies with the relative distances of the point from each of the polarised contacts, the potential of the conductive layer provides information to identify the position of the stylus. Once the position with respect to these polarised contacts is established they are de-energised and the other pair is polarised to give information regarding the position of the stylus along a different axis. Thus the position of the stylus in 2 dimensions may be identified.

EP-A-194,861 (Elographics Inc) discloses an electrographic touch sensor having z-axis capability. The x, y and z coordinates are calculated from voltage signals in a resistive layer of material. The voltage signals for each coordinate are generated during a separate time interval.

JP Abstract 58 191 089 describes a position detecting method in which an electrically insulated writing tool is used to sandwich a pressure conductive rubber sheet between a conductive film and a planar resistor. A voltage is applied to the conductive film.

The article titled 'A Pressure-sensitive Device for Input of Graphics' 8169 Systems-Computers-Control, Vol. 13 (1982) May - June, No 3, Silver Spring, Maryland, USA describes a pressure-sensitive device for input of graphics in which a resistive sheet is used to detect the x-coordinate and a separate resistive sheet is used to detect the y-coordinate.

Summary of the Invention

The ability to input 3 dimensional data using the tablet alone is very useful, for example a) to define the colour and/or intensity of a location on graphic terminal or b) for signature verification where the profile of the pressure applied across the signature would be a useful additional check, above and beyond a 2 dimensional check of the appearance of the signature. Pressure information could be useful, for example in the case of a one dimensional position-detecting tablet in the form of a strip. This would provide 2 dimensional input capability without occupying the large area taken up by a prior art 2-d input tablet.

Accordingly, the present invention provides a graphics input tablet comprising a layer of electrically resistive material supported coextensively with a layer of electrically conductive material to provide a flat tablet surface, first and second conductors connected respectively to first and second portions of the resistive layer, said portions being spaced apart on a notional x-axis across the tablet surface, third and fourth conductors connected respectively to third and fourth portions of the resistive layer, said portions being spaced apart on a notional y-axis, intersecting the notional x-axis; the arrangement being such that when an electrical potential is applied between the resistive layer and the conductive layer and localised pressure is applied to the tablet surface, currents flow from the conductors through the resistive layer to the conductive layer, the relative magnitudes of these currents being related to the respective distances of the region of applied pressure from the first and second portions and the third and fourth portions respectively, the resistive material has the property that the electrical resistance between the layers in the region of the localised pressure applied thereto changes monotonically with the applied pressure and when the localised pressure is applied, the total current flowing between the resistive sheet and the conductive sheet is related to the magnitude of the applied pressure and provides a measurement from which a z-axis value may be calculated; characterised in that electrical sensing means are arranged to measure individually at the same time, the current flowing in each of the conductors and to calculate subsequently a value representing an x, y and z-coordinate of the region of localised pressure.

This provides the facility to detect the position of a stylus in 3 dimensions, ie two linear dimensions and one pressure dimension.

The resistive layer may be in the form of a single sheet of material. Alternatively, the resistive layer may comprise two sheets, each of a resistive material, the conductors being connected to a first of said sheets and the second of said sheets having the property as aforesaid that the electrical resistance between the layers in the region of localised pressure applied thereto changes monotonically with the magnitude of the pressure applied to the layers.

Description of the Drawings

Fig. 1a shows schematically a cross-section through a graphics input tablet according to the present invention.

Fig. 1b shows schematically a cross-section through an alternative embodiment of a graphics input tablet according to the present invention.

Fig. 2 shows schematically a plan view of the tablet of Fig. 1a.

Fig. 3a shows schematically a circuit for processing signals representing positional and pressure information produced by the present invention.

Fig. 3b shows schematically a circuit for inputting the outputs of the circuit of Fig. 3a into a computer.

Fig. 4 shows schematically an alternative circuit for processing signals representing positional and pressure information produced by the present invention and inputting this into a computer.

Fig. 5 is a schematic graph showing variations in positional measurements versus actual position when employing the present invention.

Fig. 6 is a schematic graph showing variations in measured total current versus actual force applied to a small area using the present invention.

Detailed Description of the Invention

Fig. 1a shows a graphics input tablet according to the present invention. Layer 10 is a compressible resistive sheet known as Vermahide (Trade Mark). This material has the property that its localised electrical resistance reduces with increased pressure exerted on it as the electrically conducting fibres which make it up are forced into more intimate contact. Beneath layer 10 is layer 11 which is an electrically conducting coat applied to insulating substrate 13. Beneath insulating substrate 13 is conductive coat 50 which may be electrically grounded to give electrostatic screening. Layers 11, 13, 50 may conveniently be provided by double-sided unetched printed circuit board. Overlying layers 10, 11, 13, 50 is protective sheet 12 which is electrically insulating, physically hard-wearing and yet locally elastically deformable. Electrical connection is made to conductive layer 11 by conductor 30 and to opposed edges of resistive layer 10 by conductors 14, 15, 21, 22 (see Fig. 2).

Fig. 1b shows an alternative tablet comprising two resistive sheets, one compressible 10a and one rigid 10b. Conductive layer 11 overlies the resistive sheets and is locally elastically deformable.

Fig. 2 shows a plan view of the tablet in Fig. 1a. Contact pads 16, 17, 23, 24 are shown, attached to conductors 14, 15, 21, 22 respectively. Each contact pad makes electrical contact with a portion of the resistive layer: 16, 17, 23, 24 contacting 18, 19, 25, 26 respectively. This leaves the remainder 20 of layer 10 as the input region where a user applies localised pressure with a stylus, causing currents to flow in conductors 14, 15, 21, 22.

Fig. 3a shows one technique for producing signals x, y, z representing the position of pressure applied on region 20 (x, y) and the magnitude of pressure applied (z). Four current sense amplifiers (44) are provided for measuring the current flowing in the conductors 14, 15, 21, 22. The outputs of the currents sense amplifiers are fed into two analogue summing circuits 35, 37 one 35 for conductors 14, 15 covering the x dimension and the other 37 for conductors 21, 22 covering the y dimension. The outputs of these summers are fed into dividers 36 and 38 respectively, along with one of the current sense outputs in each case. The signal for x (and similarly for y) which this produces is not the simple ratio of currents in opposed conductors 14, 15 (or 21, 22); rather, if current in 14 = I1 and current in 15 = I2 then the value of x is:

$$x = \frac{I2}{I1+I2}$$

This function is selected since it provides a result which varies approximately rectilinearly between 0 and 1.

The signal for z, representing the pressure applied by the stylus is simply a sum of the individual currents in conductors 14, 15, 21, 22. This is obtained by summing in 39 the sums of x and y currents produced by 35 and 37 respectively.

Fig. 3b shows a circuit for inputting x, y and z to a computer. The multiplexer 40 selects each of x, y, z in turn to forward to the analogue to digital convertor 41. The results are fed to buffer 42 and thence to data bus 43 which is connected to the computer.

Fig. 4 shows an alternative arrangement to that of Figs. 3a, 3b. In this case there is an additional current sense amplifier 45 for directly measuring the current in conductor 30. This avoids the expense and inaccuracy of analogue summing circuit 39 (used in conjunction with 35 and 37). Further, the generation of the x and y functions is performed in the computer so the tablet does not need the local intelligence provided by circuits 35, 36, 37, 38. This approach has the disadvantage that more processing is necessary in the computer so the maximum sampling rate will be lower but it does not require circuits 35, 36, 37, 38, 39 so the hardware may well be cheaper to produce.

In use, the conductive layer 11 of the tablet is held at a voltage equal to -10 Volts. The conductors 14, 15, 21, 22 along the edges of resistive layer 10 are held at 0 Volts. When no pressure is applied to the upper surface of the tablet the physical contact between layers 10 and 11 is very slight and no significant current flows between them. However, when localised pressure is applied to the upper surface the layers 10 and 11 are pushed into physical and electrical contact so that a current flows from conductive layer 11 to the conductors 14, 15, 21, 22 connected to resistive layer 10. The current through each of these conductors is in inverse relation to the distance from the respective contact pad to the point where pressure is applied.

Another possibility is to have the arrangement as shown in Fig. 4 but without sense amplifier 45 (and its associated resistor). In this case the computer must sum all four conductor currents digitally. This is a processing overhead which reduces the maximum sampling rate but the hardware will be still cheaper to produce.

Fig. 5 shows the variation in the measured value of x versus the actual position at which pressure is applied. It can be seen that there are significant edge effects which mean that it may be necessary to process digitally the measurements once they are received by the computer in order to expand the measured x values to cover the entire range from 0 to 1 (0 is the left-hand edge of area 20 and 1 is the right-hand edge). It may also be necessary to take account of the y displacement when expanding the x readings since the x readings are compressed when taken near $y=0$ or $y=1$ compared to readings taken near $y=0.5$. This is shown by the two lines on Fig. 5, line A being taken at $y=0.5$ (ie across the centre of the tablet) and line B being taken at $y=0.9$ (ie near the upper edge of the tablet).

Fig. 6 shows the variation in measured total current (ie z) versus force applied to an area of tablet 1.5 millimetres square. It can be seen that this too would benefit from some digital processing, since the line produced is not as straight as ideally it should be. This would be straight forward to achieve if necessary, for example by employing a look-up table correlating measured current to applied pressure. It will be noted that below a certain non-zero value for the pressure the measured total current is zero. This is useful since it means that light pressure (eg from a person's hand) will not be detected by the tablet and will not interfere with the normal operation of the tablet.

The variation in current with applied pressure stems from 2 effects. The first of these is that the resistive material compresses locally, so reducing the electrical resistance in the region of applied pressure since the fibres in the material are in better electrical contact. The second and more significant effect is that the contact area between the conductive and resistive layers increases.

The increase in contact area with increased pressure can cause the measured position to be in error. This happens when the pressure is applied significantly closer to one contact pad than to the opposed contact pad (eg closer to 16 than to 17). The increase in contact area with pressure is uniform in all directions but since the contact area is closer to 16 than to 17, the distance from the contact area edge to 16 reduces by a greater percentage than the distance from the contact area edge to 17. This causes the measured position to appear further towards the near edge as more pressure is applied. If this effect is unacceptable then it would be necessary to compensate for it digitally in the computer by weighting the position measurement towards the centre, the level of weighting increasing with increasing pressure (ie increasing total current).

Another compensation which may be required is to allow for the fact that, at a constant pressure, the total current increases as the contact point approaches any edge of the tablet. This is because the overall resistance through the resistive sheet from the contact point to the contact pads 16, 17, 23, 24 decreases as the contact point moves further from the centre and closer to 1 or 2 of the contact pads. If this effect is too large to be ignored then a suitable weighting could be applied when the data is processed.

The rate at which the location and pressure of the stylus are sampled will depend on the requirements of the application and the circuitry and computer software employed. For graphics input to a terminal and for signature verification a sampling rate of around 10 kHz may be acceptable although a rate of around 20 kHz is preferable.

Claims

1. A graphics tablet comprising:
a layer of electrically resistive material (10) supported coextensively with a layer of electrically conductive material (11) to provide a flat tablet surface;
first and second conductors (14, 15) connected respectively to first and second portions of the resistive layer (18, 19), said portions being spaced apart on a notional x-axis across the tablet surface;
third and fourth conductors (21, 22) connected respectively to third and fourth portions of the resistive layer (25, 26), said portions being spaced apart on a notional y-axis, intersecting the notional x-axis;
the arrangement being such that when an electrical potential is applied between the resistive layer and the conductive layer and localised pressure is applied to the tablet surface, currents flow from the conductors through the resistive layer to the conductive layer, the relative magnitudes of these currents being related to the respective distances of the region of applied pressure from the first and second portions and the third and fourth portions respectively, the resistive material has the property that the electrical resistance between the layers in the region of the localised pressure applied thereto changes monotonically with the applied pressure and when the localised pressure is applied, the total current flowing between the resistive sheet and the conductive sheet is related to the magnitude of the applied pressure and provides a measurement from which a z-axis value may be calculated;
characterised in that electrical sensing means (35-44) are arranged to measure individually at the same time, the current flowing in each of the conductors and to calculate subsequently a value representing an x,y and z-coordinate of the region of localised pressure.

2. A graphics tablet as claimed in Claim 1 wherein the x-coordinate of the position of the localised pressure is calculated by dividing the current flowing in the first conductor (14) by the sum of the currents flowing in the first and second conductors (14, 15).

3. A graphics tablet as claimed in any of Claims 1 or 2 wherein the y-coordinate of the position of the localised pressure is calculated by dividing the current flowing in the third conductor (21) by the sum of the currents flowing in the third and fourth conductors (21, 22).

4. A graphics tablet as claimed in any of the preceding Claims wherein the z-coordinate is calculated from the sum of the individual currents measured in each of the conductors (14, 15, 21, 22).

5. A graphics tablet as claimed in any of Claims 1 to 3 further comprising:
a fifth conductor (30) connected to the conductive material (11); and
electrical sensing means (45) arranged to measure directly, at the first sample time, the total current flowing between the resistive layer and the conductive material, thereby providing a measurement from which the z-coordinate may be calculated.

Patentansprüche

1. Graphisches Eingabetablett, umfassend:
eine Schicht eines mit einem elektrischen Widerstand behafteten Materials (10), das flächengleich mit einer Schicht eines elektrisch leitenden Materials (11) gestützt wird, um eine ebene Tablettoberfläche zu bilden;
erste und zweite Leiter (14, 15), die an erste beziehungsweise zweite Bereiche der mit einem Widerstand behafteten Schicht (18, 19) angeschlossen sind, wobei die Bereiche durch eine über die Tablettoberfläche verlaufende fiktive x-Achse voneinander getrennt sind;
dritte und vierte Leiter (21, 22), die an dritte beziehungsweise vierte Bereiche der mit einem Widerstand behafteten Schicht (25, 26) angeschlossen sind, wobei die Bereiche durch eine über die Tablettoberfläche verlaufende fiktive y-Achse voneinander getrennt sind, die die fiktive x-Achse schneidet;
wobei die Anordnung derart gestaltet ist, daß beim Anlegen einer elektrischen Spannung zwischen der mit einem Widerstand behafteten Schicht und der leitenden Schicht und beim Ausüben eines örtlichen Drucks auf die Tablettoberfläche Ströme von den Leitern durch die mit einem Widerstand behaftete Schicht zur leitenden Schicht fließen, wobei die relative Größenordnung dieser Ströme mit dem jeweiligen Abstand der Region des ausgeübten Drucks zu den ersten und zweiten Bereichen beziehungsweise zu den dritten und vierten Bereichen in Beziehung steht, wobei das mit einem Widerstand behaftete Material über die Eigenschaft verfügt, daß der elektrische Widerstand zwischen den Schichten in der Region

des hierauf örtlich ausgeübten Drucks sich gleichförmig mit dem ausgeübten Druck verändert und daß bei ausgeübtem örtlichem Druck der Gesamtstrom, der zwischen der mit einem Widerstand behafteten Lage und der leitenden Lage fließt, mit der Größenordnung des ausgeübten Drucks in Beziehung steht und eine Messung ermöglicht, amhand derer ein z-Achsen-Wert berechnet werden kann; dadurch gekennzeichnet, daß elektrische Erfassungseinrichtungen (35-44) angebracht sind, um einzeln und zum gleichen Zeitpunkt den in jedem der Leiter fließenden Strom zu messen und nachfolgend einen Wert zu berechnen, der eine x-, y- und z-Koordinate der Region des örtlichen Drucks widerspiegelt.

2. Graphisches Tablett nach Anspruch 1, wobei die x-Koordinate der Position des örtlichen Drucks berechnet wird, indem der im ersten Leiter (14) fließende Strom durch die Summe der im ersten und zweiten Leiter (14, 15) fließenden Ströme dividiert wird.

3. Graphisches Tablett nach irgendeinem der Ansprüche 1 oder 2, wobei die y-Koordinate der Position des örtlichen Drucks berechnet wird, indem der im dritten Leiter (21) fließende Strom durch die Summe der im dritten und vierten Leiter (21, 22) fließenden Ströme dividiert wird.

4. Graphisches Tablett nach irgendeinem der vorausgehenden Ansprüche, wobei die z-Koordinate aus der Summe der einzelnen, in jedem der Leiter (14, 15, 21, 22) gemessenen Ströme berechnet wird.

5. Graphisches Tablett nach irgendeinem der Ansprüche 1 bis 3, desweiteren umfassend:
einen fünften Leiter (30), der an das leitende Material (11) angeschlossen ist; und
elektrische Erfassungseinrichtungen (45), die so angelegt sind, daß sie direkt, bei der ersten Abfragezeit, den gesamten Strom messen, der zwischen der mit einem Widerstand behafteten Schicht und dem leitenden Material fließt, wobei sie dabei eine Messung liefern, anhand derer die z-Koordinate berechnet werden kann.

Revendications

1. Tablette de données graphiques comprenant:
une couche de matériau électriquement résistant (10) portée dans la même direction qu'une couche de matériau électriquement conducteur (11) pour fournir une surface de tablette plate;
des premier et deuxième conducteurs (14, 15) connectés respectivement aux troisième et quatrième portions de la couche résistante (18, 19), lesdites portions étant séparées sur un axe théorique x traversant la surface de la tablette;
des troisième et quatrième conducteurs (21, 22) connectés respectivement aux troisième et quatrième portions de la couche résistante (25, 26), lesdites portions étant séparées sur un axe théorique y faisant intersection avec l'axe théorique x;
L'agencement étant tel que, lorsqu'un potentiel électrique est appliqué entre la couche résistante et la couche conductrice et qu'une pression localisée est appliquée sur la surface de la tablette, des courants circulent depuis les conducteurs en passant dans la couche résistante jusqu'à la couche conductrice, les valeurs relatives de ces courants étant en rapport avec les distances respectives de la région sur laquelle est appliquée la pression depuis respectivement les première et deuxième portions et les troisième et quatrième portions, le matériau résistant a comme propriété que la résistance électrique entre les couches dans la région sur laquelle est appliquée la pression, change monotoniquement avec la pression appliquée, et lorsque la pression localisée est appliquée, le courant total circulant entre la feuille résistante et la feuille conductrice est en rapport avec la valeur de la pression appliquée et fournit une mesure à partir de laquelle une valeur d'axe z peut être calculée;
caractérisée en ce que des moyens de détection électriques (35, 44) sont agencés pour mesurer séparément au même moment le courant circulant dans chacun des conducteurs, et pour calculer ensuite une valeur représentant une coordonnée x, y, et z de la région ayant la pression localisée.

2. Tablette de données graphiques selon la revendication 1, dans laquelle la coordonnée x de la position de la pression localisée est calculée en divisant le courant circulant dans le premier conducteur (14) par la somme des courants circulant dans les premier et deuxième conducteurs (14, 15).

3. Tablette de données graphiques selon l'une quelconque des revendications 1 ou 2, dans laquelle la coordonnée y de la position de la pression localisée est calculée en divisant le courant circulant dans le troisième conducteur (21) par la somme des courants circulant dans les troisième et quatrième conducteurs (21, 22).