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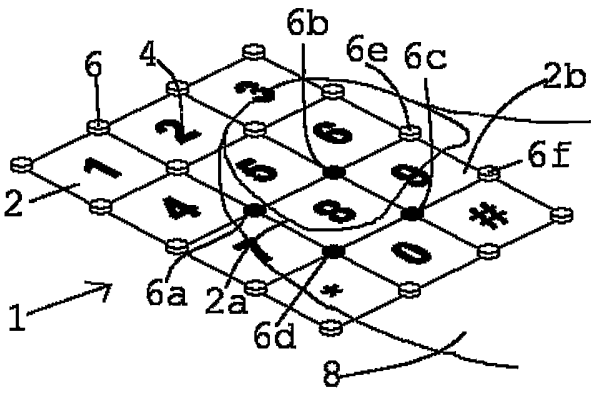

(57) Abstract: A compact data entry system comprises functional zones (2) uniformly divided over an input surface and switches (6) organized in functional groups. Each functional group of switches (6) is associated with a functional zone (2). A functional zone (2) is activated when at least one of its associated functional groups is activated. The system further comprises a processing device (3). The processing device (3) detects the activation of said switches (6) and further detects the activation of a functional group of switches (6) after the member switches (6) of said functional group are activated. When activation of a functional group of switches (6) is detected, the processing device (3) activates a function corresponding to the activated functional group.

Compact data entry system

The present invention relates to a data entry system, in particular to a compact data entry system for portable or hand-held electronic devices. Further, the present invention relates to the use of said data entry system.

The functionality of electronic hand-held devices, such as hand-held computers, cellular and smart telephones, electronic dictionaries and translators, personal information managers, labelers and smart watches, continues to increase, and electronic components become smaller and smaller. Most of such devices require alphanumeric input. Several solutions for data entry for such devices exist like compact keyboards, virtual keyboards, handwriting recognition, voice recognition, etc. Among them, a most convenient solution is a keyboard, because it is fast, very intuitive and reliable.

A problem of a keyboard for hand-held devices is the size of its keys in relation to the fingertips to be used for data entry. As human fingertips are relatively constant in size, they conventionally limit a key to a smallest possible size and therefore the size of a conventional keyboard is limited to a minimum.

Some keyboards have to be used in combination with a pointing device, since the keys on the keyboard are made too small in size to be activated with a finger. A pen-like pointing device has to be used to point at or push each key. This method demands accurate coordination of the pointing device, which can be very difficult e.g. when travelling.

Another known technique to minimize the size of a keyboard uses combinations of keys to address more functions with fewer keys, possibly in combination with smaller keys.

US Patents 4,400,593 and 4,994,992 disclose devices in which legend symbols corresponding to groups of keys are placed at intersections of key boundaries. By pressing at the intersection,

multiple keys are pressed and activated. The combination of these keys corresponds to an input function different from the function of the individual keys. Although the keys are still separately operable, the number of functions per unit area of the keyboard surface is increased.

A combination of key size reduction and key grouping is disclosed in US Patent 5,612,690. The publication shows a keypad with a two-leveled structure, one level for individual keys, and another level for groups of keys. The keys have dimensions about half the dimensions of a key of a usual computer keyboard. Each key has a function associated with it, and combinations of four keys, adjacent to each other, have other functions associated with them. The centers of the keys are elevated for ergonomic use, making it possible to activate only one key by pressing the center of a single key or to activate four adjacent keys by pressing at the lowered intersection of the boundaries of four keys situated between the elevated centers.

Legend symbols are situated in the center of each key and at the intersection of the boundaries of four adjacent keys. As a result, the legend symbols at the intersections are divided over the four corners of the four adjacent keys. Further, the legend symbols have different dimensions depending on their position, i.e. in the center of a key or at the intersection of four keys.

Input functions are divided over the input surface non-uniformly. Some functions are activated by pressing one key and other functions by pressing four keys.

A problem of the prior art is the complex structure of the keypad. Non-uniformity of division of input functions and variation in legend symbol sizes make use impractical and non-intuitive.

Another problem is the readability of the key legends. As the keys are already small, the legends are small and therefore difficult to read, and a division of the legend symbol in two or more parts makes reading of the legend symbol practically impossible.

It is an object of the present invention to provide a compact data entry system that is small, user-friendly and intuitive, especially for, but not limited to, hand-held devices.

It is another object of the present invention to provide a compact data entry system that is suitable for input using fingertips, in particular having all functions accessible by a single finger stroke.

It is a further object of the present invention to provide a compact data entry system with a large number of functions per unit area.

It is a still further object of the present invention to provide a compact data entry system having readable legend symbols.

It is an even further object of the present invention to provide a compact data entry system having input functions, which are uniformly divided over the input surface.

At least one of the above-mentioned objects is achieved by a data entry system according to the present invention comprising: an input surface, divided into a plurality of functional zones; a plurality of switches, organized in functional groups of switches, each functional group being associated with one of the functional zones; and a processing device for detecting activation of one or more of said switches and for activating a function after activation of a functional group of switches is detected, the data entry system being characterized in that at least one functional zone has an associated functional group of switches comprising at least two switches, which at least two switches are situated at or near the boundary of said functional zone.

The data entry system according to the present invention combines key size reduction and key grouping effectively. By defining functional zones that are not uniquely associated with one switch, it is possible to have a compact data entry system that is small enough to fit on a hand-held device, but is also intuitive and simple.

The input surface may be a flat plane or may be any arbitrary shaped surface; it may be hard or flexible. It is divided in functional zones. Activating a functional zone by activating the switches of the associated functional group of switches activates an input function of the data entry system.

The input surface may show legend symbols to the user, the legend symbols representing the associated input function. Preferably, the legend symbols are situated within the functional zones enabling the user to activate a function by pointing to, pressing at or touching the legend symbol. However, legend symbols do not need to be present. For example, when the data entry system is used for activation by a visually handicapped person, legend symbols are not needed.

Preferably, the input surface gives also tactile feedback to the user about the place of the functional zones. With tactile feedback, a user may feel the location of a functional zone. If the input surface is three-dimensionally curved at the location of each functional zone, the user may feel whether or not his fingertip is positioned correctly to activate a single functional zone. Such tactile feedback may be formed by molded key caps in an elastic material, or by grooves, bumps, dots or painted lines defining the boundaries or other parts of the functional zones. Additionally, there may be audible feedback, for example a sound when activating a functional zone or when an error occurs, or visual feedback, for example back lighting of the legend symbols, or both.

The switches are organized in functional groups. Each functional group may have any number of member switches, depending on the shape and size of the functional zones. A functional zone on the input surface is activated, when the member switches of a functional group associated with said functional zone are activated.

Each switch may be member of one or more functional groups. Thus, in combination with other switches, a switch may be associated with multiple functional zones. Further, each functional zone may have more than one associated functional

group of switches. For example, if a functional zone has four switches at its boundaries, but any combination of three of said four switches is unique for said functional zone, five functional groups may be associated with said functional zone: four functional groups of three switches and one functional group of four switches.

The switches may be any kind of switch. They may be electronic, electromechanical, mechanical or optical switches, for example. Any kind of activation of the switches such as touching, pressing or pointing is usable. Preferably, the switches are touch sensitive or force sensitive sensors, such as used in usual computer keyboards. Users are familiar with this kind of key activation. Further, a switch may have dimensions equal to the dimensions of a functional zone or smaller than the dimensions of a functional zone.

The data entry system comprises a processing device that detects the activation of the switches. Upon detection of the activation of the member switches of a functional group, the processing device activates a function corresponding to the activated functional group.

Advantageously the switches associated with a functional zone are situated at or near the boundary of said functional zone. When a switch is situated at the boundary, the center of said switch is situated at the boundary of at least one functional zone. The boundary may also be the boundary of two or more functional zones. In that case, a switch situated at the boundary is positioned between the centers of said two or more functional zones. Thus, said switch may be a member switch of one or more functional groups associated with each of said two or more functional zones.

Further, a switch may be situated just outside or partly inside a functional zone or in an area between two or more functional zones. Thus, said switch is situated near the boundary of at least one functional zone. If a switch is situated at the boundary, just outside a functional zone or between two or more functional zones, the dimensions of said switch are preferably

small relative to the dimensions of the functional zones, in particular having a maximum cap size as seen in any direction of approximately 1-3 mm.

Even further, a switch may be situated in a functional zone. The edge of said switch is near or on the boundary of said functional zone, and is preferably near or on the boundary of a functional zone in which no switch is situated. A functional zone, in which no switch is situated, may be activated by activation of at least two switches situated in other functional zones. Said switches need to be situated near the boundary of said functional zone in order to be activated when an attempt is made to activate said functional zone by a fingertip. Preferably the distance between the boundary of a functional zone, in which no switch is situated, and the edge of a switch, which is situated in another functional zone and is a member of a functional group of said functional zone, is smaller than half the dimension of said functional zone. In particular, said distance is smaller than a quarter of said dimension and more in particular, said distance is about zero. Advantageously, in case said distance is about zero and there is only one switch situated in a functional zone, said switch may approximately cover the area of said functional zone.

A functional zone is activated, when the associated switches, which form a functional group of switches, are activated. The processing device detects the activation of said switches. The processing device detects also the activation of said functional group of switches. As soon as the activation of the functional group of switches is detected, the processing device activates a function corresponding to the activated functional zone.

Advantageously the activation of a functional group is independent of any time constraint. A user action should trigger the processing device to detect the activation of a functional group of switches. Such a user action may be activating a switch or deactivating a previously activated switch. Thus, the processing device should be adapted for detecting activation of a

functional group of switches, when, after at least one switch is activated, at least one activated switch is deactivated.

When a switch is activated, the processing device checks whether or not the activated switch forms a functional group in combination with other activated switches, if there are any other activated switches, or else it checks whether or not the switch forms a functional group individually. If a group of activated switches forms a functional group associated with a functional zone, the processing device checks whether or not another functional group associated with another functional zone may be activated by activation of another switch. If such other functional group may be activated, the processing device waits for a user action. If a functional group is detected, which functional group determines a functional zone, the processing device activates the corresponding function. In any other case, the processing device activates an error function, e.g. a audible signal.

If one or more switches are activated and these switches form a functional group associated with a functional zone, but activation of another switch may activate another functional group, the processing device waits for a user action. If the user deactivates at that point at least one of the activated switches, the processing device checks whether or not the group of switches that were activated just before at least one of the activated switches was deactivated, form a functional group associated with a functional zone. If they do, the processing device activates the corresponding function or else it activates an error function.

After the processing device has activated a function corresponding to a functional zone or an error function it waits until all activated switches are deactivated. As soon as all switches are deactivated, it waits until a first switch is again activated and the detection of possible functional groups starts over again.

The above-described detection method is user-friendly, because a user action activates detection of a functional group

such as activation or deactivation of a switch. There are no time constraints. However, if a switch is activated for a predetermined time the processing device may check whether or not a functional group is activated to assist users who like the data entry system to respond to activation instead of deactivation of a switch.

In a preferred embodiment of the present invention, at least one of the functional zones comprises a switch situated in said at least one functional zone, and another at least one of the functional zones lacks a switch situated in said other at least one functional zone. The switches are situated within a functional zone, but contrary to usual keyboards, there is no switch situated in each functional zone. A functional zone that lacks a switch is activated by activation of at least two switches situated in at least two other functional zones, which functional zones are situated near or, preferably, adjacent to said functional zone that lacks a switch.

Advantageously, when the switches are situated inside a functional zone, each switch forms a functional group individually and also is a member of one or more other functional groups, associated with one or more other functional zones. Thus, a function may be associated with an individual switch and another function may be associated with a functional group of switches comprising two or more switches.

Preferably, the division of the input surface in functional zones is uniform and regular, i.e. the functional zones have the same size and shape and are positioned in a systematic way. A uniform division of the input surface enables uniform legend symbols. Uniformity of size and regularity of placement of functional zones and legend symbols improve the readability of the legend symbols and therefore the user-friendliness of the data entry system. Above that, uniformity and regularity make a selection and activation of the functional zones intuitive. For example, the functional zones may be round, oval, square, rectangular, triangular or hexagonal.

As the data entry system has preferably a functional zone for each function, the functional zones should be small to minimize the size of the keyboard. Advantageously, the functional zones are smaller than the adult human fingertip. This means that at activation of a functional zone by touching, the fingertip will probably touch not only the intended functional zone, but also adjacent functional zones. However, the adjacent functional zones, touched unintentionally, will not be activated, as the associated functional group of switches will not be activated.

Advantageously, the input surface is made of a single, continuous volume of elastic material, which may hide the switches. This is advantageous, because the switches are placed at locations that may disorientate the users. If the switches are covered by the input surface, users do not see the positions of the switches and therefore they will not be disorientated.

As the material is elastic, activation of a functional zone deforms the surface locally, activating the switches associated with said functional zone. After release of the functional zone, the elastic material returns to its former shape.

In electronic hand-held devices, the processing device comprises preferably an electronic circuit. This circuit may comprise logical circuitry suitable for detection of the activation of a functional group, when at least one switch is activated. Still, the detection may be done in any other way.

Further, the present invention relates to the use of a compact data entry system in a hand-held device, in particular in a hand-held computer, a cellular or smart phone, an electronic dictionary or translator, a personal information manager, a labeler or a smart watch.

Hereinafter the present invention will be illustrated in more detail with reference to the annexed drawings showing non-limiting exemplary embodiments.

Fig. 1a shows a perspective view of an embodiment of the present invention as a compact telephone keypad;

Fig. 1b shows a partly schematic top view of the embodiment according to Fig. 1a;

Fig. 2 shows a diagram illustrating the detection method of activated functional groups.

Figs. 3a and 3b show a perspective view of embodiments of the input surface.

Fig. 4 illustrates the size of an adult human fingertip according to ISO-standard 9241-4.

Figs. 5a-5c illustrate square, triangular and hexagonal placement of switches for minimum-sized functional zones;

Figs. 6a-6d illustrate possible layouts of functional zones and switches;

Figs. 7a and 7b show embodiments according to Figs. 1a and 1b with a minimum number of switches;

Figs. 8a-8e illustrate embodiments according to the present invention with switches situated within square functional zones;

Fig. 9 illustrates a minimum size and spacing of switches within functional zones in relation to the size of an adult human fingertip according to the ISO-standard 9241-4;

Figs. 10a-10d show possible layouts for embodiments of the present invention with switches situated at corners of functional zones;

Fig. 11a shows a perspective view of an embodiment according to the present invention with switches situated within functional zones;

Fig. 11b shows a possible layout for the embodiment according to Fig. 10a;

Fig. 11c shows another possible layout of an embodiment according to the present invention with switches situated within functional zones;

Fig. 12a illustrates a layout using hexagonal functional zones and having switches situated within functional zones;

Fig. 12b shows a pad according to the present invention for movement of a cursor in any direction;

Fig. 13a shows another preferred embodiment of the present invention having bar-shaped switches between functional zones; and

Fig. 13b shows an embodiment with a minimum number of bar-shaped switches between functional zones.

In the drawings, identical reference numerals indicate similar components or components with a similar function.

Figs. 1a and 1b show a perspective view of a numeric (telephone) keypad 1 having functional zones 2. Each functional zone 2 has a legend symbol 4 associated with it. At each corner of the functional zones 2 a switch 6 is located. Further, the contours of an adult human finger 8 are shown. The finger 8 is activating functional zone 2a provided with legend symbol '8'. Switches 6a, 6b, 6c and 6d are associated with functional zone 2a. For clarity, the switches 6a-6d are shown as black dots. However, their physical embodiment may be the same as the other switches 6.

Fig. 1b schematically shows a processing device 3 connected to the numeric keypad 1 through one or more lines 3a. The processing device 3 detects the activation of the switches 6 and the activation of functional groups of switches 6. Further, the processing device 3 activates a function through one or more lines 3b when the processing device 3 detects the activation of a functional group of switches 6. All data entry systems according to the present invention, parts of which are shown in the drawings, are provided with a processing device. However, the processing device is not explicitly shown in the other drawings.

The switches 6 are combined in functional groups. A functional group is associated with a functional zone 2. In Figs. 1a and 1b, for example, switches 6a-6d situated at the corners of the functional zone 2a may form a functional group associated with functional zone 2a. The members of said functional group, i.e. switches 6a-6d, may each also be member of other functional groups. Switches 6b and 6c situated at the corners of functional zone 2b together with switches 6e and 6f may form a functional group associated with the functional zone 2b.

Further, to activate functional zone 2a, it is not necessary that all four member switches 6a-6d of the functional group be activated. A combination of the switches 6a, 6b and 6c may also be a unique combination for functional zone 2a. Thus, in general, activation of a functional zone 2 may be detected upon activation of any unique combination of switches 6. In case of the embodiment of Figs. 1a and 1b, even two switches 6 may identify a functional zone 2: activation of two diagonally situated switches 6a and 6c (or 6b and 6d) is enough to identify the activation of functional zone 2a.

A functional zone 2 may have more than one associated switch 6. Thus, activation of said functional zone 2 needs activation of more than one switch 6. As activation of multiple switches 6 will almost never be simultaneous, the processing device has to wait until all switches 6 of a functional group are activated. In case activation of a functional group is unique for a functional zone 2, i.e. additional activation of other switches 6 cannot lead to activation of a functional group associated with another functional zone 2, there is no need for a time delay. The processing device may activate a corresponding function immediately.

On the other hand, there may be more than four switches 6 in a functional group associated with a functional zone 2. Any unique combination of switches 6 may be associated with a functional zone 2. In the embodiment of Figs. 1a and 1b, a usual number of switches 6 to form a functional group is four.

In Figs. 1a and 1b, the finger 8 is activating the functional zone 2a. As the finger 8 is larger than the functional zone 2a, it touches not only the functional zone 2a but also a part of at least a number of adjacent functional zones 2 with legend symbols '4', '5', '6', '7', '9', '*', '0' and '#'. Also, the switches 6a-6d situated at the boundaries of the functional zone 2a and the boundaries of adjacent functional zones 2 are touched. When activating functional zone 2a, the switches 6a-6d being members of the functional group associated with functional zone 2a are activated by the finger 8. Activation of the

functional group, and detection thereof, results in activation of a corresponding function, which in the present embodiment may be inputting the digit '8' into a terminal while dialing a telephone number.

In the embodiment of Figs. 1a and 1b, the functional zones 2 may have a height and width of about one third of the size of an adult human finger tip, i.e. about 6 mm. Thus, the keypad 1 has a width of about 18 mm and a height of about 24 mm. Realizing that a key on a common computer keyboard has a width and height of about 19 mm, the keypad 1 has nine functional zones 2 in an area having the size of a usual key.

Fig. 2 is a diagram demonstrating a detection method in case a functional group is also a subgroup of another functional group, i.e. if said functional group is activated, activation of another switch may activate another functional group of switches. The horizontal axis represents time T. On the vertical axis an active state S1 and non-active state S0 of three switches SW1, SW2 and SW3 are placed. The dashed lines represent five time points t1, t2, t3, t4 and t5. At t1 switches SW1 and SW3 are activated; switch SW2 is activated at t2. The switches SW1, SW2 and SW3 are deactivated at t5, t4 and t3, respectively.

At t1 the processing device detects the activation of two switches: SW1 and SW3. At that point it checks whether or not switches SW1 and SW3 form a functional group that is uniquely associated with a functional zone, which means that activation of another switch will not result in the activation of another functional group. If the switches SW1 and SW3 do form a uniquely associated functional group, the processing device activates the corresponding function. If the switches SW1 and SW3 do not form a uniquely associated functional group, the processing device waits until another switch is activated or at least one of the switches SW1 and SW3 is deactivated before the processing device again checks whether or not a functional group is activated.

At t2 another switch SW2 is activated. Again the processing device checks for a uniquely associated functional group. If the three activated switches SW1, SW2 and SW3 are not uniquely

associated with a functional group, the processing device waits again.

At t3 the switch SW3 is deactivated and returns to its non-active state S0. Now, the processing device checks whether or not the three switches SW1, SW2 and SW3 form a functional group at all. If they form a functional group, the processing device activates the corresponding function and waits until all switches are deactivated. If they do not form a functional group, the processing device assumes that the activation of switch SW3 was unintended and ignores its activation. The processing device checks whether or not SW1 and SW2 form a uniquely associated functional group and may activate the corresponding function or may wait for other events.

As soon as switch SW2 is deactivated at t4, the processing device checks whether or not SW1 and SW2 form a functional group and may activate the corresponding function or may wait for other events. If still no functional group is detected at t4, the processing device checks at t5 whether or not switch SW1 forms a functional group individually and may activate the corresponding function or it waits until another switch is activated.

Figs. 3a and 3b show embodiments of input surfaces with tactile feedback. The input surface in Fig. 3a has curved functional zones 2 like keys. The center of a functional zone 2 is elevated with respect to its boundaries. The switches 6 are situated at the lowered corners of the functional zones 2. In Fig. 3b, the center of a functional zone 2 is lowered with respect to its boundaries and the switches 6. In both embodiments, the surface may be hard like common computer keyboard keys, but the surface may also be flexible, for example made of an elastic material.

The functional zones 2 in Figs. 3a and 3b provide tactile feedback to the user. The user feels whether or not his fingertip is correctly placed on a functional zone 2. This tactile feedback minimizes the chance of unintentional activation of adjacent functional zones 2. The input surfaces of Figs. 3a and 3b are

particularly well suited to be handled by visually handicapped persons.

Fig. 4 illustrates the size of an adult human finger 8. ISO-standard 9241-4 defines a safe area 12. This safe area 12 is the area that is ergonomically needed by an adult human finger for activation of a key on a keyboard. The safe area 12 is a circle with a radius 14 of 9.5 mm (3/8 inch). Therefore, a square key 16 should have sides with a length 18 of at least 19 mm (3/4 inch). As above-mentioned, the size of keys on a common computer keyboard is about 19 mm.

In Figs. 5a, 5b and 5c, the square key 16 and the safe area 12 according to ISO-standard 9241-4, are shown, having dimensions as described above. A functional zone 2a lies in the center of the safe area 12. Switches 6 are situated at the boundaries of said functional zone 2a. Depending on the shape of the functional zone 2a, there are three (Fig. 5b: triangular placement), four (Fig. 5a: square placement) or six (Fig. 5c: hexagonal placement) switches 6a-6f at the corners of the functional zone 2a. Three, four or six of the switches 6a-6f form a functional group associated with the functional zone 2a. The switches 6a-6f lie also inside the safe area 12. No other switches 6 lie inside the safe area 12. The distance between center 20 of the functional zone 2a and the nearest switch 6g that lies outside the safe area 12 and is not a member of the associated functional group, is indicated by reference numeral 22. However, parts of adjacent functional zones 2 lie inside the safe area 12.

When activating the functional zone 2a, nearby located functional zones 2 should not be activated. The switches 6a-6f form the functional group associated with functional zone 2a. When these switches 6a-6f are activated, the detection device detects the activation of the functional zone 2a. If no other switches 6 lie inside the safe area 12, they will not be activated, when the functional zone 2a is activated. To prevent unintentional activation, other switches 6 than the member switches 6a-6f of the associated functional group should not lie inside the safe area 12. Thus, the size of safe area 12

determines the minimum distance 22 between the center 20 of the functional zone 2a and a nearest not-associated switch 6g. The distance 22 should be at least about 9.5 mm according to ISO-standard. Figs. 5a, 5b and 5c may be used to determine the minimal distance between adjacent switches 6 for square (Fig. 5a), triangular (Fig. 5b) and hexagonal (Fig. 5c) placement of the switches 6.

Figs. 6a, 6b, 6c and 6d show possible layouts for functional zones 2, using a triangular placement of switches 6. All four embodiments have the same triangular layout of switches 6. However, the layout of the functional zones 2 differs. In the layout of Fig. 6a, each functional zone 2 has three associated switches 6, although activation of a functional zone 2a may be detected by activation of at least two of three associated switches 6a, 6b and 6c.

In Fig. 6b, the number of functional zones 2 is more than twice the number of functional zones 2 in Fig. 6a, although the number and layout of the switches 6 is identical. However, as a result of the increased number of functional zones 2, an activation of a functional zone 2a may only be detected by the activation of at least three associated switches 6a, 6b and 6c.

The layout illustrated in Fig. 6c is essentially the same as the one illustrated in Fig. 6a, although the functional zones 2 are hexagonal. It has the same number of functional zones 2, each having three associated switches 6. A functional zone 2a may be identified by at least two of three associated switches 6a, 6b and 6c.

A layout with triangular functional zones 2 illustrated in Fig. 6d has more functional zones 2 per unit area than the layouts in Fig. 6a and 6c, but again a functional zone 2a may only be identified by at least three associated switches 6a, 6b and 6c.

In Fig. 7a, a layout with switches 6 and fake switches 24 around square functional zones 2 is shown. The layout approaches the one shown in Fig. 1a and 1b, only some switches 6 are replaced by fake switches 24. In this embodiment, a functional

zone 2a has only two associated switches 6a and 6b and two fake switches 24a and 24b, although the fake switches 24 may also be omitted.

Replacement or omission of the switches 6 is possible, because in the layout having switches 6 at each corner of a functional zone 2, activation of a functional zone 2 may be detected by activation of fewer than four associated switches 6.

In the embodiment illustrated in Fig. 7b, the number of switches 6 is also minimized. Switches 6 are located in the center of the keypad 1 and fake switches 24 replace the switches 6 at the edges of the keypad 1. As a result, the number of associated switches 6 is different for functional zones 2a, 2b and 2c. A corner functional zone 2b has one associated switch 6a, a side functional zone 2c has two associated switches 6a and 6b, and a center functional zone 2a has four associated switches 6a, 6b, 6c and 6d.

If different functional zones 2 have different numbers of associated switches 6, the processing device has to be adapted to detect the activation of the functional group, which the user intended to activate. A short, predetermined time delay may be used or preferably, the detection method demonstrated in Fig. 2 may be used. This method is less sensitive to erroneous input, because it only responds to user actions.

Figs. 8a-8b illustrate embodiments wherein a switch 6 is situated within a functional zone 2. There are also functional zones 2 without a switch 6. A functional zone 2a with a switch 6a may be activated by activation of this switch 6a only. However, the functional zone 2a in Fig. 8a may also be activated by a functional group of five switches 6a, 6b, 6d, 6e and 6f. A functional zone 2b may be activated by switches 6a, 6b, 6c and 6d situated in adjacent functional zones 2.

Figs. 8c, 8d and 8e show possible layouts when hexagonal or triangular functional zones 2 are used and switches 6 are situated in the functional zones 2. In Fig. 8c, the functional zone 2b is activated by activation of two adjacent switches 6a and 6b. In Fig. 8d, three adjacent switches 6a, 6b and 6c are

needed for activation of functional zone 2b. In Fig. 8e, the number of adjacent switches 6 needed for activation differs. The functional zone 2b is activated by activation of the switches 6a, 6b and 6c; the functional zone 2c is activated by activation of the switches 6c and 6d.

Fig. 9 illustrates the necessary spacing between adjacent functional zones 2a, 2c and 2e with switches and functional zones 2b and 2d without switches. According to ISO-standard 9241-4, the adult human fingertip 8 needs at least a width 38 of 19 mm (3/4 inch) to ergonomically push a key or button.

As seen in Figs. 8a and 8b, in a configuration with switches 6 situated within functional zones 2, the spacing between and the size of switches 6 should be equal in order to have uniform functional zones 2. In Fig. 9, when activating the functional zone 2c, the switches 2a and 2e should not be touched. The distance 38 between switches 2a and 2e should therefore be at least 19 mm. This allows the dimensions 36 of a key cap to be about one quarter of the size of an adult human fingertip 8, i.e. about 5 mm, as indicated in Fig. 9.

Figs. 10a-10e show keypads 1 according to the present invention. Switches 6 are situated at the corners of the functional zones 2. Fake switches 24 are situated at the edges of the keypad 1. The fake switches 24 at the edges may also be omitted.

Fig. 10a shows a keypad 1 with the layout of a usual telephone keypad. Fig. 10b shows a common keyboard layout ("QWERTY"). As modern hand-held computers have about the same width as this embodiment, this keypad 1 is very suitable for hand-held computers.

In Fig. 10c, the data entry system is divided over four parts 71, 72, 73 and 74. These parts are shifted slightly relative to each other. The embodiment is suitable for blind, four-finger typing. Each of the four fingers on one hand is placed on one of the keyboard parts 71, 72, 73 and 74. With only a small finger movement, each finger may activate one of nine

functional zones 2 and there is no need for any movement of the hand.

Fig. 10d shows an embodiment of a full Japanese Kana data entry system suitable for hand-held devices.

Fig. 10e shows another layout of a data entry system. The letters are arranged according to their frequency of use to minimize finger movement. Above that, the letters are arranged such that letters of frequently used letter combinations are situated next to each other, allowing a user to drag his finger over the input surface and not having to lift his finger from the input surface.

Fig. 11a shows a keypad 1 of a common cellular telephone. The keypad 1 comprises twelve switches 6: ten switches 6 for each digit and two switches 6 for '*' and '#'. The switches 6 are positioned with some space between them.

According to the present invention, the space between the switches 6 may be used as additional functional zones 2. Fig. 11b shows a layout for a keypad 1 according to the present invention with switches 6 situated inside functional zones 2. This embodiment comprises fifteen switches 6, offering enough functions to comprise ten numerals, twenty-six letters and a number of additional functions and punctuation marks. Compared to the telephone keypad 1 in Fig. 11a, only three switches 6 are added.

Fig. 11c illustrates a keypad 1 like the one shown in Fig. 11b. Only, four switches 6 are added compared to Fig. 11a, positioned at the right side.

Many cellular telephones have a keypad 1 like the keypad 1 shown in Fig. 11a. An alphanumeric keypad 1 may be implemented on cellular phones without many hardware changes. Addition of three or four switches 6 and additional software make the numeric keypad 1 also suitable for alphanumeric input.

Fig. 12a illustrates an embodiment using hexagonal functional zones 2 arranged in a circle. Functional zones 2 with switches 6 are indicated by fattened hexagons. The other functional zones 2 lack a switch 6.

Fig. 12b illustrates a pad 40 for cursor movement. The pad 40 having four switches 6 may direct a cursor in eight different directions 42.

Most software has a graphical user-interface nowadays. This interface uses a cursor or pointer, which is commonly controlled by a mouse. For hand-held computers, an external pointing device, such as a mouse, is not practical. With the use of a pad 40, a cursor or pointer may be directed in eight directions 42.

In the center of the circle of functional zones 2 shown in Fig. 12a, the pad 40 may be provided for movement of a cursor.

Fig. 13a illustrates an embodiment of the present invention having bar-shaped switches 6 between functional zones 2. A functional zone 2a has four associated switches 6a, 6b, 6c and 6d. Activation of at least two of the associated switches 6a-6d activates the functional zone 2a.

Fig. 13b illustrates an embodiment like the embodiment in Fig. 12a, but only ten switches 6 are used. A functional zone 2a on the side of the keypad has two associated switches 6a and 6d and a functional zone 2b in the middle has four associated switches 6a, 6b, 6c and 6d.

CLAIMS

1. Data entry system comprising:

an input surface, divided into a plurality of functional zones (2);

a plurality of switches (6), organized in functional groups of switches (6), each functional group being associated with one of the functional zones (2); and

a processing device (3) for detecting activation of one or more of said switches (6) and for activating a function after activation of a functional group of switches (6) is detected;

characterized in that at least one functional zone (2) has an associated functional group of switches (6) comprising at least two switches (6), which at least two switches (6) are situated at or near the boundary of said functional zone (2).

2. System according to claim 1, characterized in that said processing device (3) is adapted for detecting activation of a functional group of switches (6) when, after at least one switch (6) is activated, at least one activated switch (6) is deactivated.

3. System according to claim 1 or 2, characterized in that said processing device (3) is adapted for detecting activation of a functional group, when said at least one switch (6) is activated for a predetermined time.

4. System according to any of the preceding claims, characterized in that each functional zone (2) has an associated functional group of switches (6) comprising at least one switch (6).

5. System according to any of the preceding claims, characterized in that said switches (6) are pin switches having a cap size, which is smaller than the dimensions of the functional zones (2), in particular having a cap size of approximately 1-3 mm.

6. System according to claim 1 or 2, characterized in that at least one of the functional zones (2) comprises a switch (6) which is situated in said at least one functional zone (2), and

another at least one of the functional zones (2) lacks a switch (6) which is situated in said other at least one functional zone (2).

7. System according to claim 6, characterized in that said switches (6) approximately cover the area of a functional zone (2).

8. System according to claim 6 or 7, characterized in that each switch (6) is associated individually with a functional zone (2) and also is a member of one or more other functional groups, associated with one or more other functional zones (2).

9. System according to any of the preceding claims, characterized in that a functional zone (2) has more than one associated functional group of switches (6).

10. System according to any of the preceding claims, characterized in that a division of the input surface in functional zones (2) is uniform and regular.

11. System according to any of the preceding claims, characterized in that each of the functional zones (2) is round, oval, square, rectangular, triangular or hexagonal.

12. System according to any of the preceding claims, characterized in that each functional zone (2) has an associated legend symbol (4).

13. System according to any of the preceding claims, characterized in that the dimensions of each functional zone (2) are less than the dimensions of an adult human fingertip (8).

14. System according to any of the preceding claims, characterized in that said switches (6) are touch or force sensitive sensors.

15. System according to any of the preceding claims, characterized in that said input surface is a single, continuous volume of elastic material.

16. System according to any of the preceding claims, characterized in that the input surface is provided with molded key caps, grooves, bumps or dots defining the boundaries or other parts of the functional zones (2), or with back lighting of legend symbols to provide tactile or visual feedback.

17. System according to any of the preceding claims, characterized in that the processing device (3) is an electronic circuit.

18. Use of a compact data entry system according to any of the preceding claims in a portable electronic device, in particular in a hand-held computer, a telephone, a dictionary or translator, a personal information manager, a labeler or a watch.

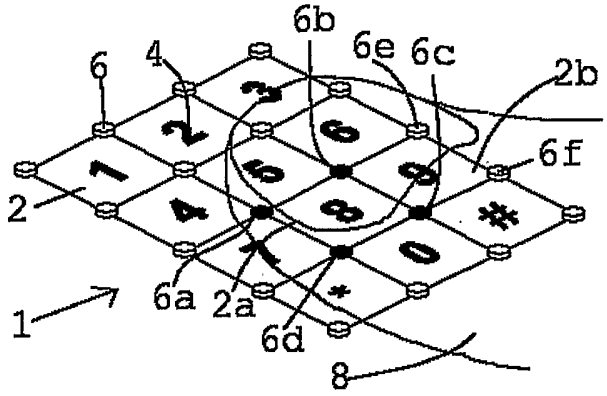

Fig. 1a

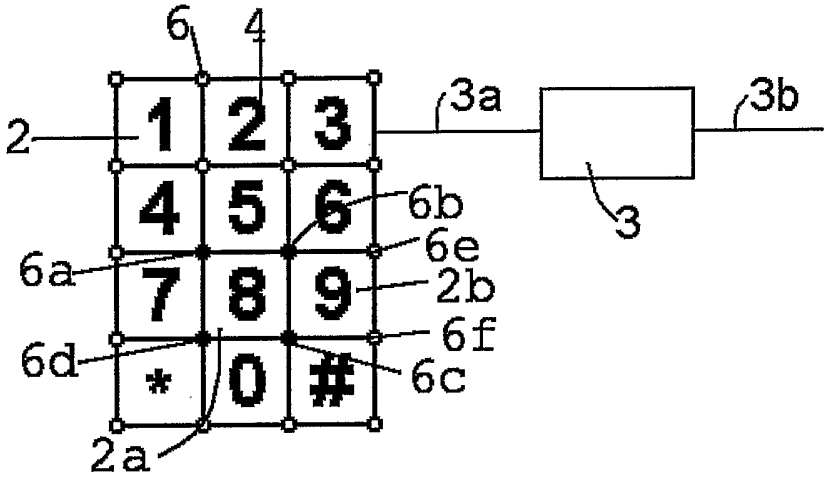

Fig. 1b

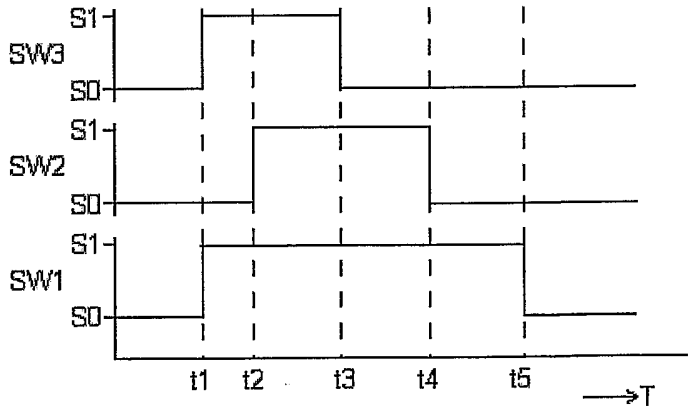

Fig. 2

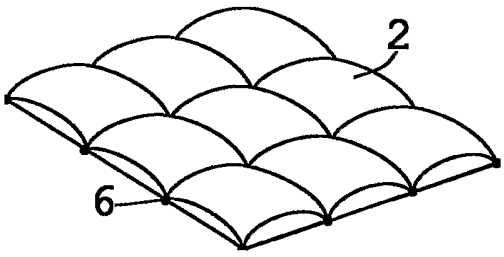

Fig. 3a

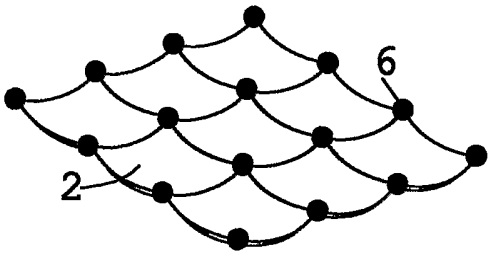

Fig. 3b

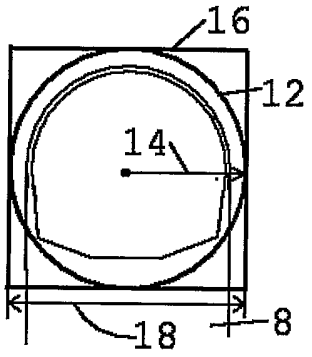

Fig. 4

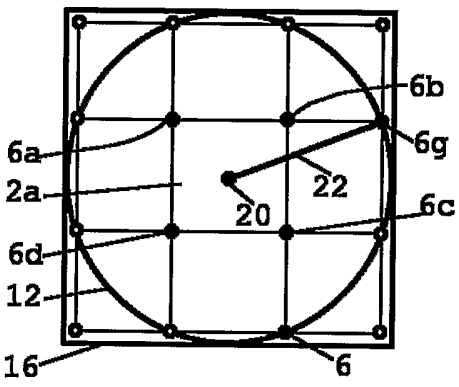

Fig. 5a

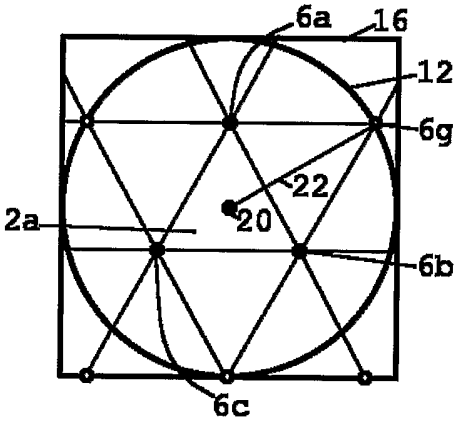

Fig. 5b

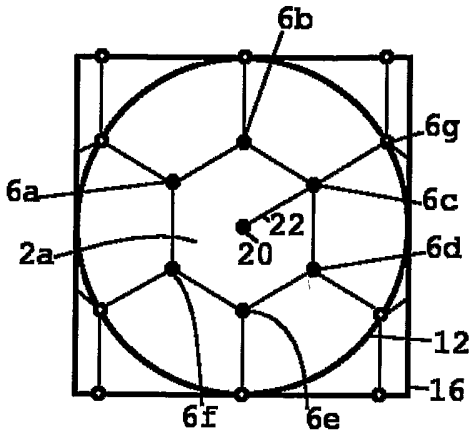

Fig. 5c

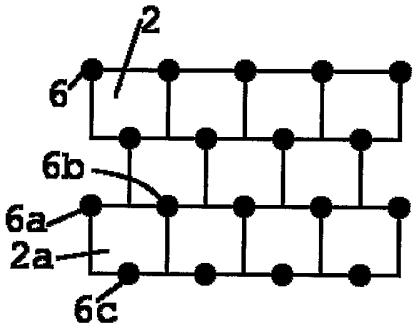

Fig. 6a

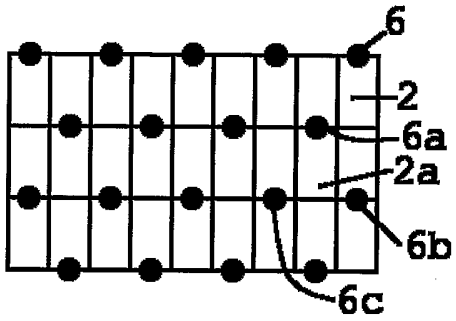

Fig. 6b

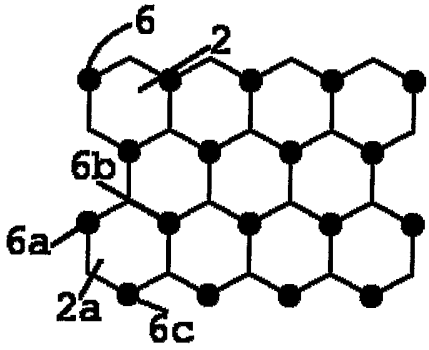

Fig. 6c

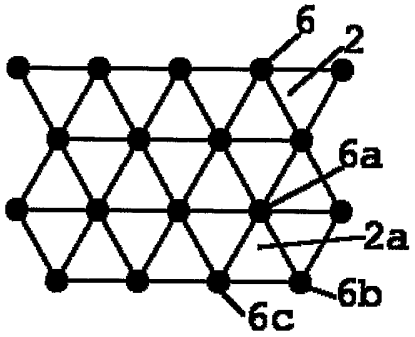

Fig. 6d

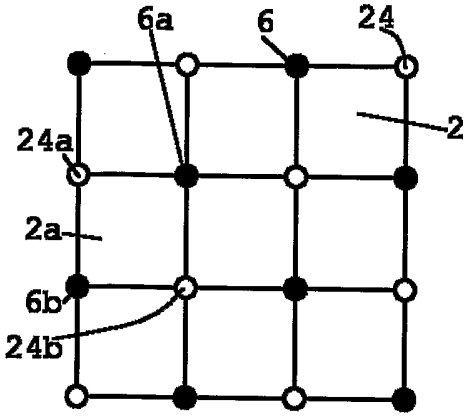

Fig. 7a

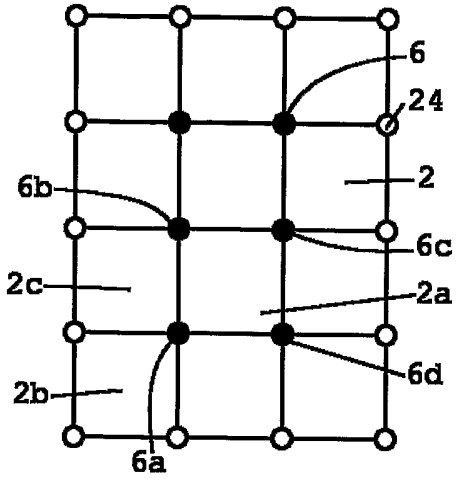

Fig. 7b

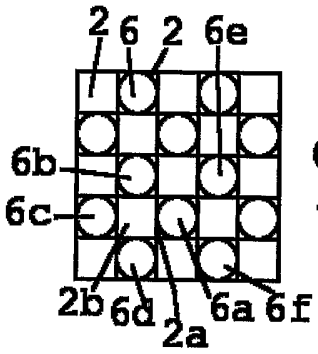

Fig. 8a

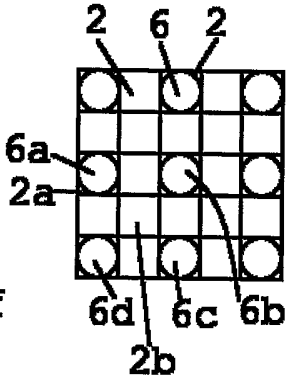

Fig. 8b

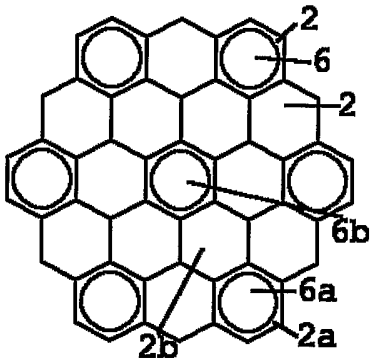

Fig. 8c

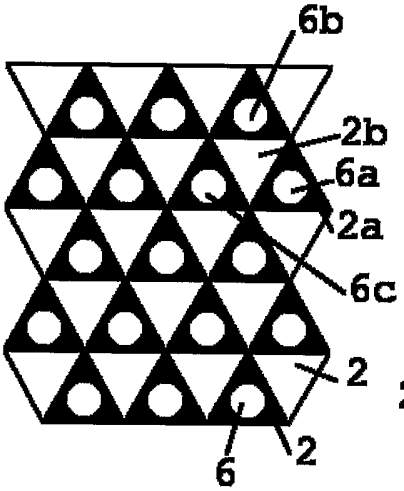

Fig. 8d

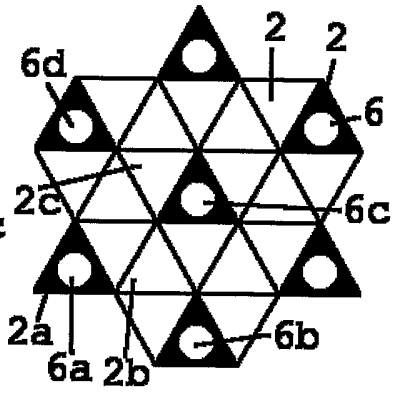

Fig. 8e

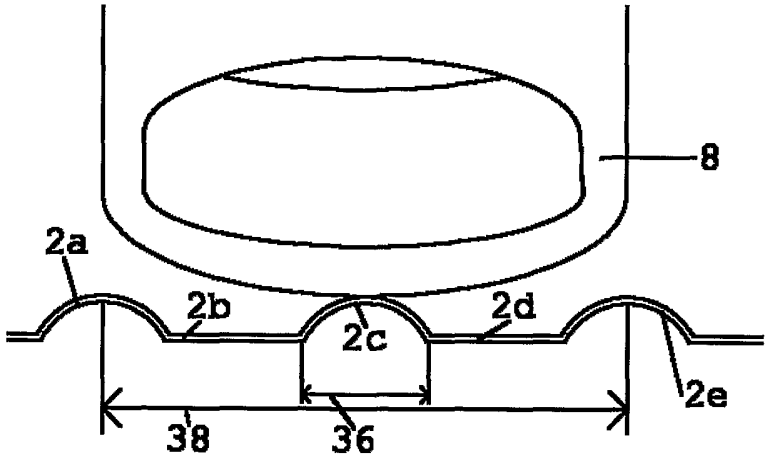

Fig. 9

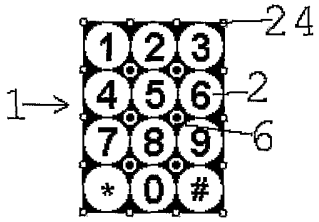

Fig. 10a

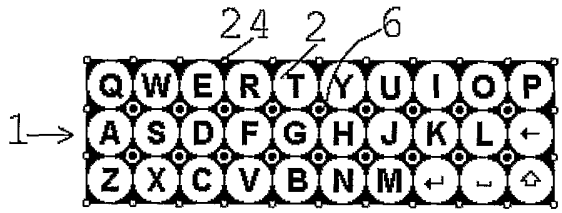

Fig. 10b

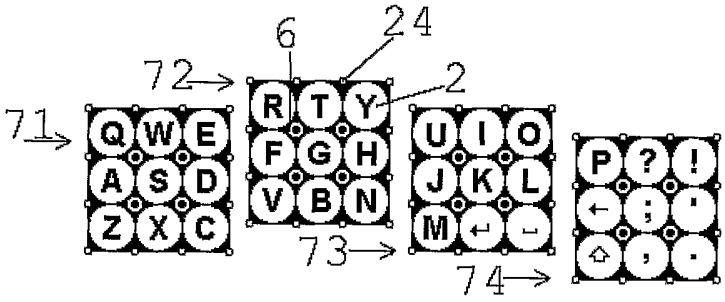

Fig. 10c

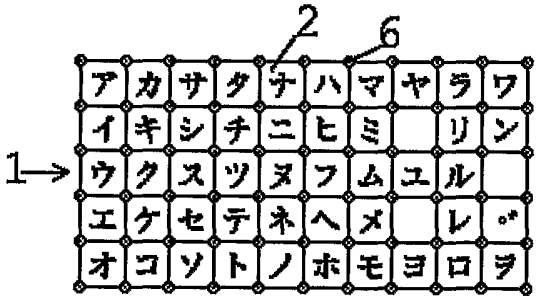

Fig. 10d

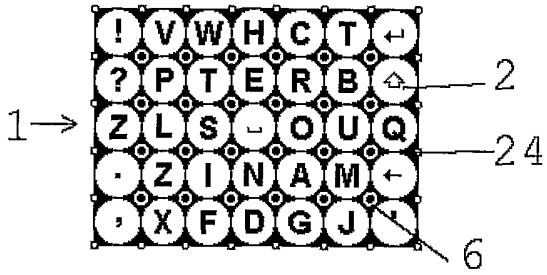

Fig. 10e

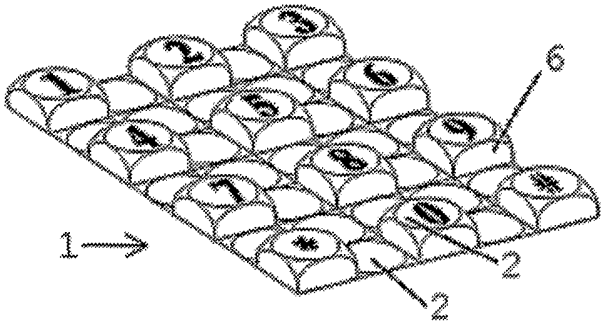

Fig. 11a

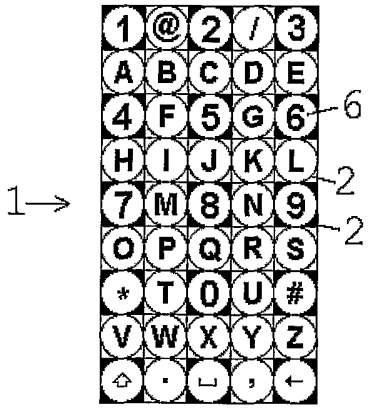

Fig. 11b

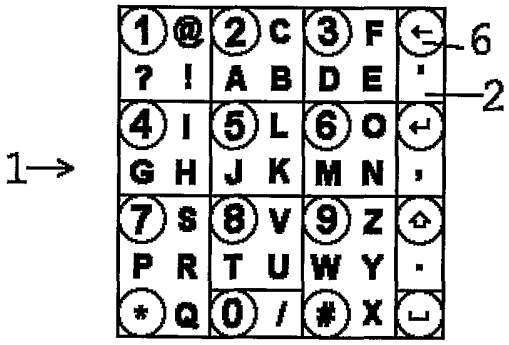

Fig. 11c

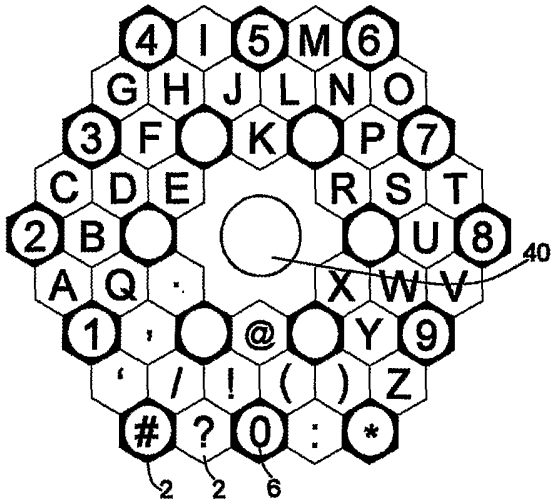

Fig. 12a

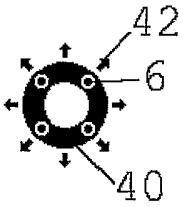

Fig. 12b

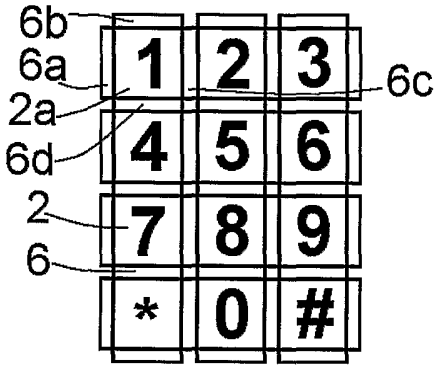

Fig. 13a

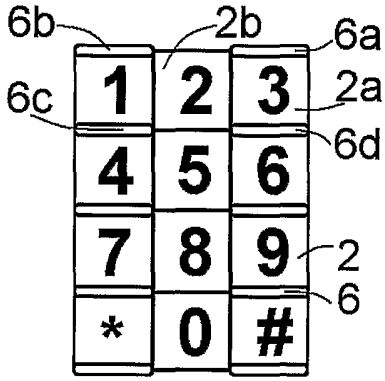

Fig. 13b

INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/NL 02/00871

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F3/02 G06F3/023 H01H13/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 88 11 954 U (MAN ROLAND DRUCKMASCHINEN AG) 3 November 1988 (1988-11-03) the whole document ---	1,4,6-8, 10-12, 16-18
X	DE 29 24 515 A (PRETZSCH SIEGFRIED) 15 January 1981 (1981-01-15) the whole document ---	1,4, 6-11,14, 17,18
A	WO 96 38776 A (HILLMERING CHRISTER ;MINEC SYSTEMS AB (SE)) 5 December 1996 (1996-12-05) page 3, line 28 -page 5, line 23; claims; figures --- -/--	1-4, 6-12,17, 18

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 August 2003	13/08/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Durand, J

INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/NL 02/00871

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 274 187 A (BIRKETT HAROLD) 13 July 1994 (1994-07-13) abstract; claims; figure 3	1,4,5, 9-13,17, 18
A	WO 01 95358 A (LEVY DAVID ;DIGIT WIRELESS LLC (US)) 13 December 2001 (2001-12-13) page 3, line 10 - line 23 page 26, line 15 -page 27, line 17 page 30, line 14 - line 19; figures 28-34,40	1-4, 6-12, 15-18

INTERNATIONAL SEARCH REPORT

Int ial Application No
PCT/NL 02/00871

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