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(54) **FAST TYPING SYSTEM AND METHOD**

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G06F 3/041 (2006.01)

(52) **U.S. Cl.** **434/167; 434/169; 434/362; 345/173**

(58) **Field of Classification Search** **434/156,**
434/169, 178; 345/168; 715/816
See application file for complete search history.

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(57) **ABSTRACT**

A method of interpreting keypad input includes identifying a first letter of a target word from activation of an initial key, identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key, identifying a last letter of the target word from activation of a final key following the non-activating traversal, and then determining the target word based upon the identified first, intermediate and last letters. The method is particularly useful in key input devices sensitive to non-activating finger position above the keys.

81 Claims, 2 Drawing Sheets

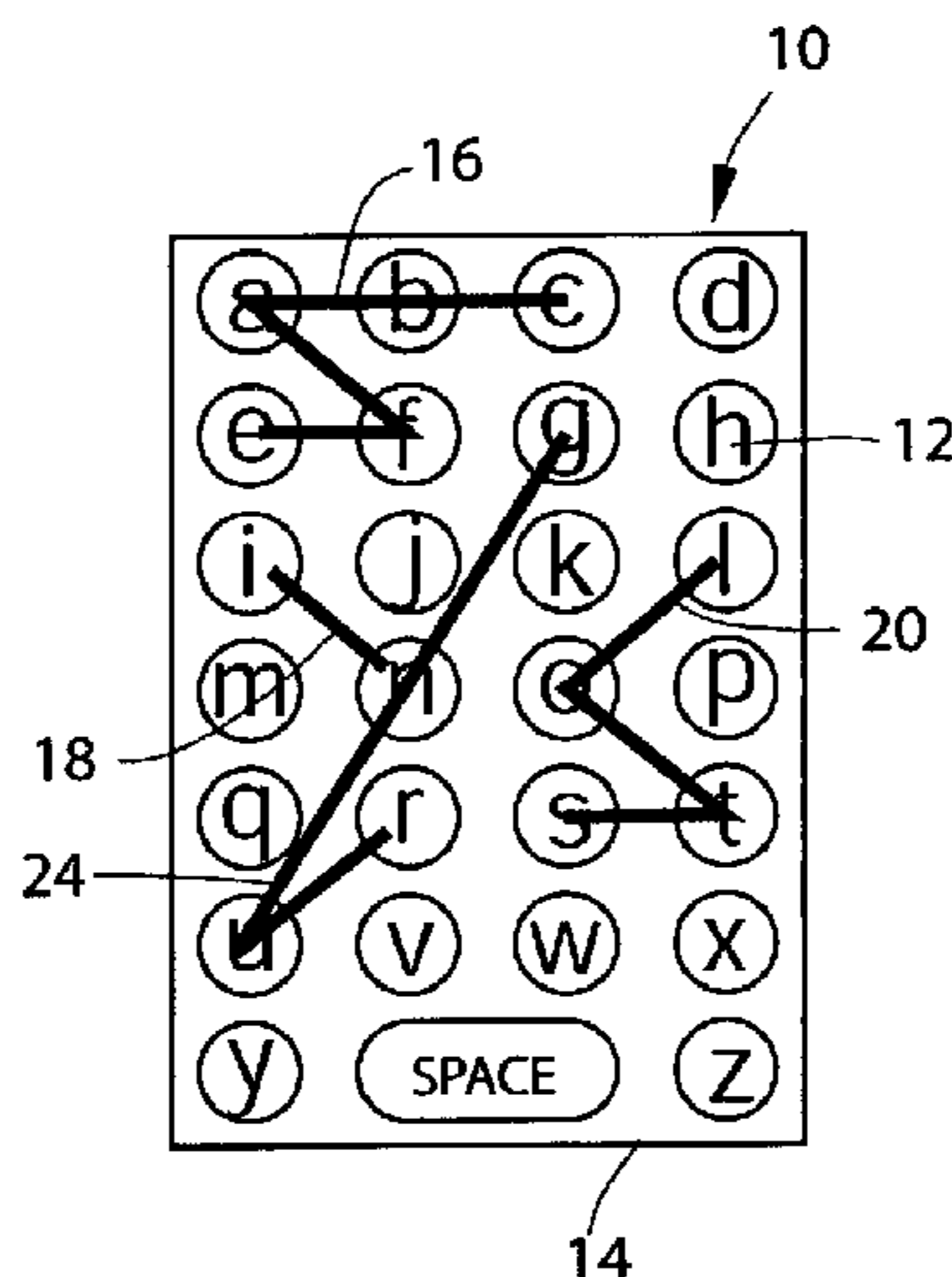


Figure 1

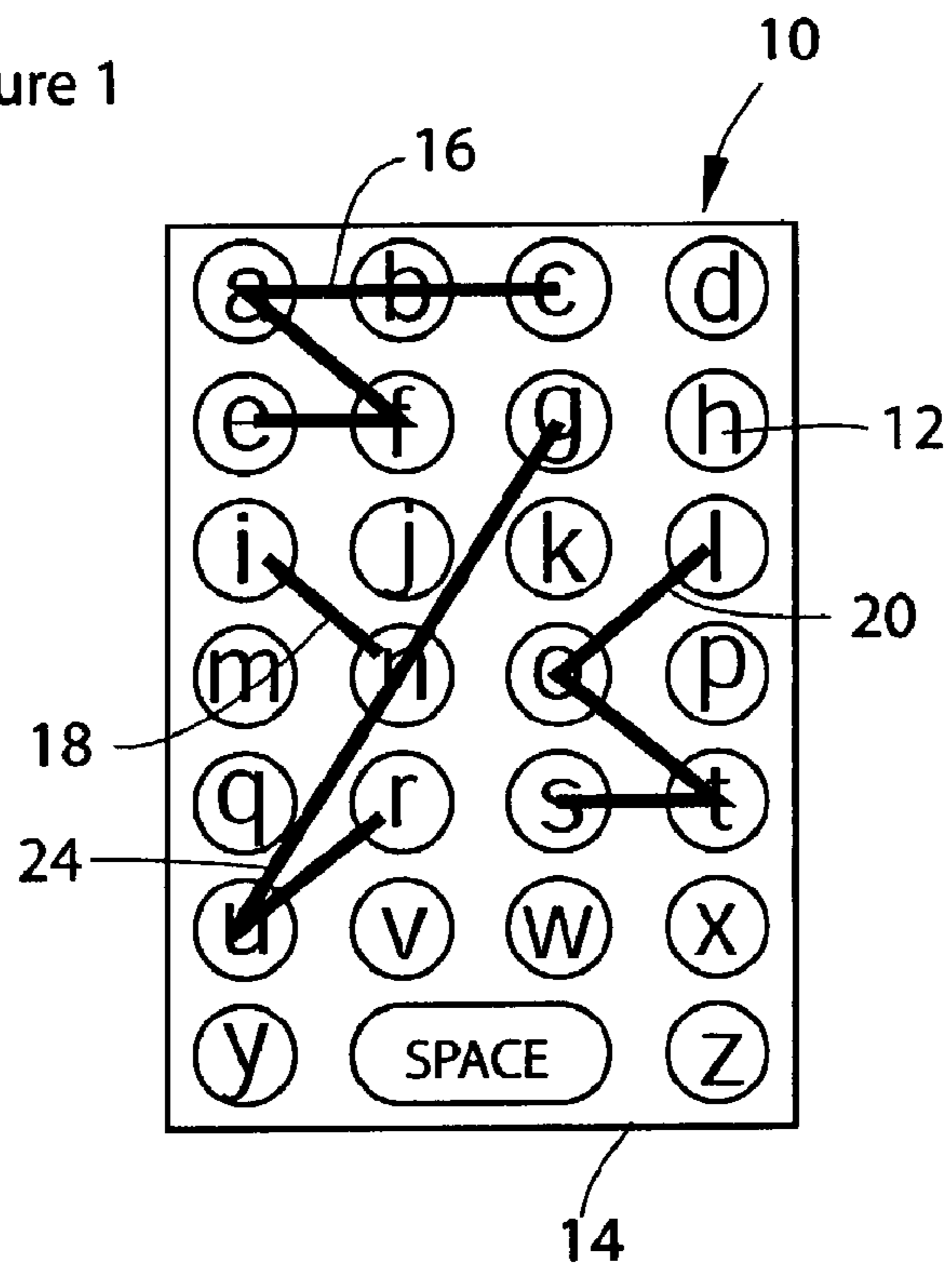


Figure 2

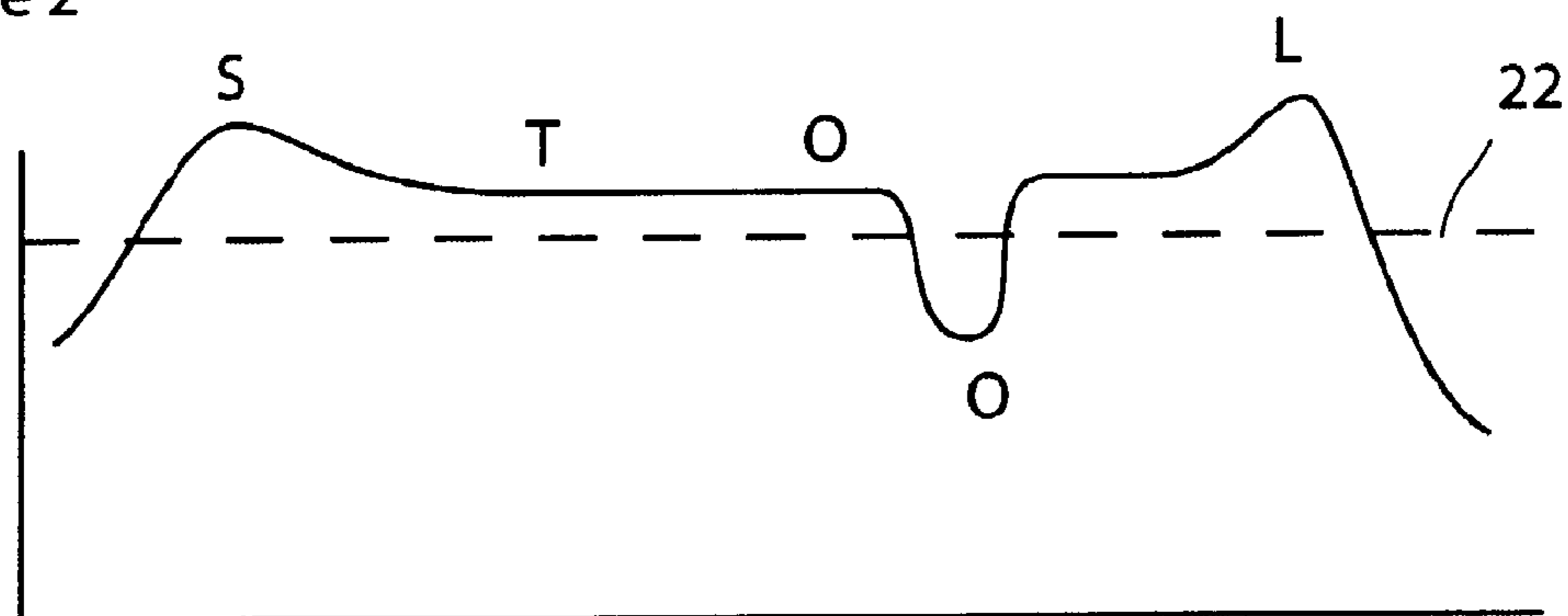
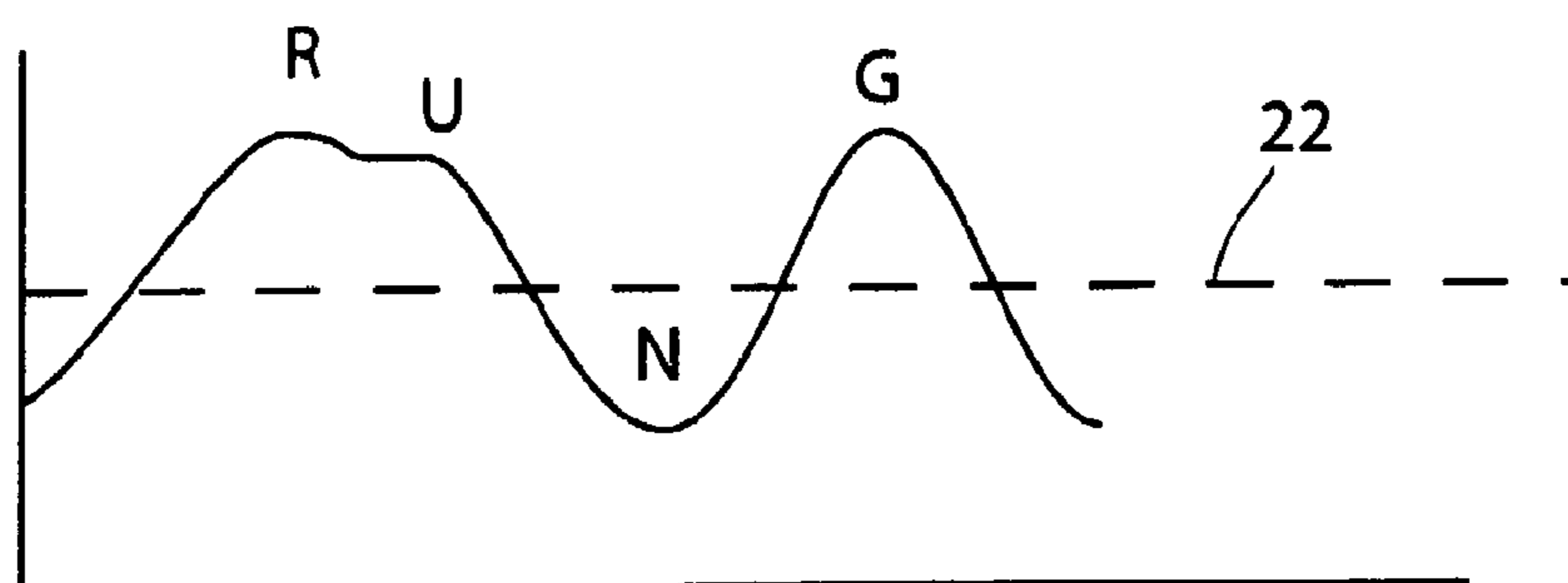
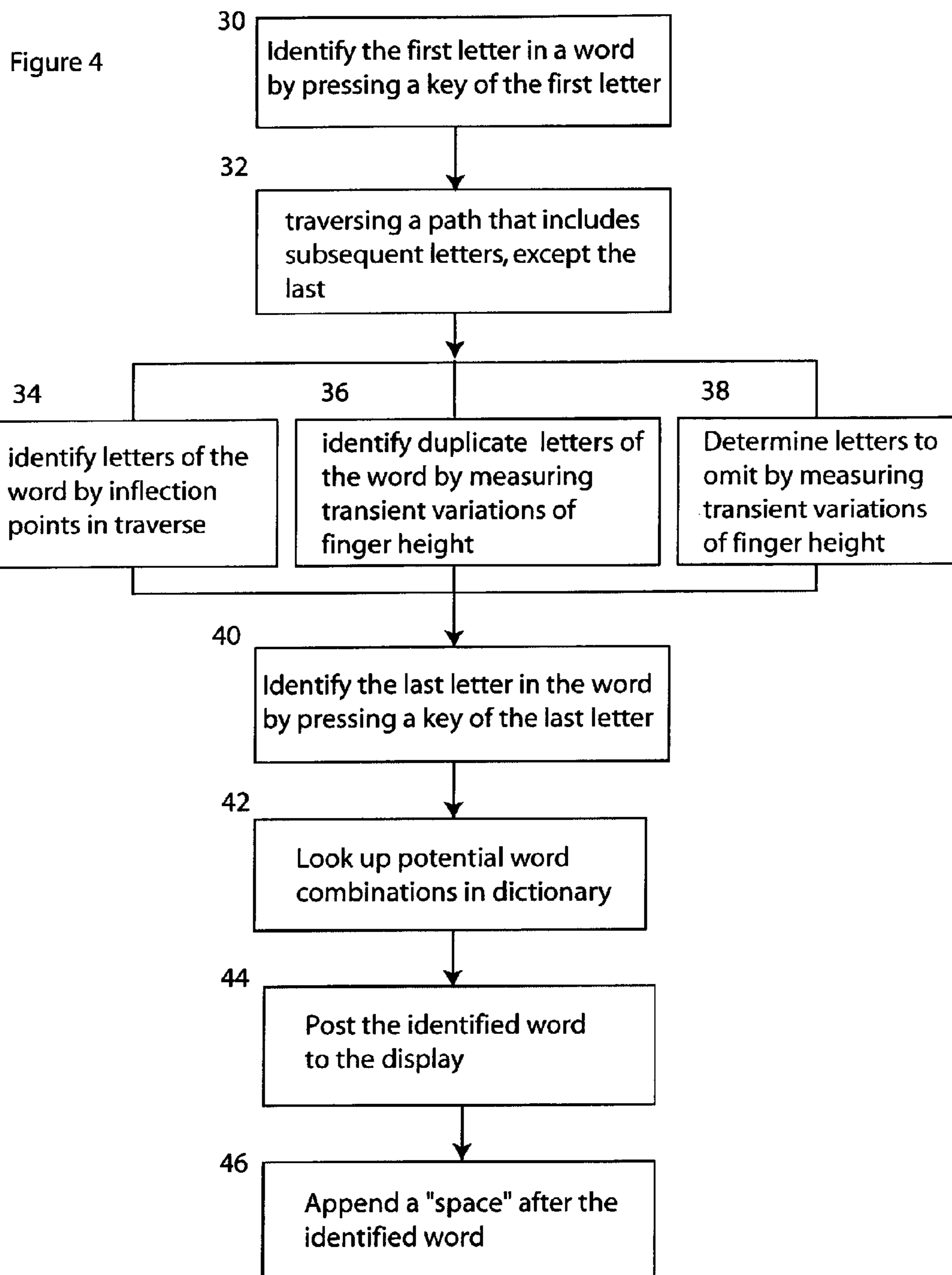


Figure 3





FAST TYPING SYSTEM AND METHOD

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CROSS-REFERENCE TO RELATED APPLICATIONS

[This application claims priority from U.S. Provisional Application Ser. No. 60/360,414, filed on Mar. 1, 2002. The entire contents of this provisional application are hereby incorporated by reference.]

Notice: More than one reissue application has been filed for the reissue of U.S. Pat. No. 7,175,438, which claims the benefit of priority under 35 U.S.C. 119(e) of U.S. Provisional Patent Application No. 60/360,414, filed on Mar. 1, 2002; the reissue applications are U.S. patent application Ser. No. 12/338,474 (the present application), which was filed on Dec. 18, 2008, and U.S. patent application Ser. No. 13/690,667, which was filed on Nov. 30, 2012, and claims priority to the present application as a continuation reissue application. The entire contents of U.S. Provisional Patent Application No. 60/360,414 are hereby incorporated by reference.

TECHNICAL FIELD

This invention relates to methods of typing, particularly on keyboards that are responsive to the position of a human finger above the keys.

BACKGROUND

The speed, accuracy and ease of written communication have always been important, but the advent of portable communications has increased the importance of these issues. Mobile telephones, as one example, provide the ability to write a text message, but the process is relatively slow, especially when compared with typing at a desktop. It would therefore be desirable to provide a system and method to increase the rate at which written information may be input to a device. It would therefore be desirable to provide a system that requires a minimum of training and retains the option of NOT using it, allowing users to try the new method, without committing to using it by buying the device.

SUMMARY

According to one aspect of the invention, a method of interpreting keypad input includes identifying a first letter of a target word from activation of an initial key, identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key, identifying a last letter of the target word from activation of a final key following the non-activating traversal, and determining the target word based upon the identified first, intermediate and last letters.

In some implementations, determining the target word includes generating a set of possible words from which the target word is to be selected, and in some cases selecting a most probable target word from the set of possible words. The set of possible words preferably contains only words starting with the identified first letter and ending with the identified last letter, and is selected from a list of words stored in

memory within a device connected to the keypad, such as a portable telephone or computer, for example.

In some cases, the method also includes displaying the target word on a display of a device connected to the keypad.

In some embodiments, a word-separation character is displayed immediately after displaying the target word. Preferably the word-separation character is deleted in response to activation of a key associated with a punctuation character.

In some implementations, the method includes editing identified letters to remove any of a predetermined set of non-occurring adjacent two letter combinations.

Preferably, in determining the target word, intermediate letters associated with finger traversal direction changes are preferentially considered. In some cases, only intermediate letters associated with finger traversal direction changes are identified as intermediate letters. In some applications, determining the target word includes selecting the target word from a list of words each starting with the identified first letter, containing all intermediate letters associated with finger traversal direction changes, and ending with the identified last letter.

In some embodiments, identifying any of the first, intermediate or last letters includes sensing an intensity of finger pressure upon an associated region of the keypad. Preferably, identifying either of the first and last letters includes sensing finger pressure intensity above a predetermined threshold. In some cases, keys traversed between activation of the initial and final keys during periods of finger pressure intensity below a predetermined threshold are omitted from the set of possible intermediate letters of the target word.

In some implementations, occurrences of duplicate sequential letters are identified in response to a transient change of finger position above an associated region of the keypad.

According to another aspect of the invention, an input device includes a keypad defining a set of keys associated with alphanumeric characters, and a processor adapted to perform the above method, such as through appropriately coded software.

In some embodiments, the keys are separably movable, spaced apart structures. In some other embodiments, the keys comprise adjacent regions of a contiguous keypad surface.

The input device may be structurally incorporated into a portable electronic device, such as a telephone or personal computer, or may be in the form of a stand-alone keyboard connected by cables or wireless communication link to another device, such as a desktop computing station.

The invention can provide an efficient means of text entry by cutting down on the number of keystrokes required to input text. Such advantages become particularly important in miniaturized keypads or keypads operated by one hand, or in portable devices frequently operated during multi-tasking.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIG. 1 shows four exemplary finger traces for entering desired text on an improved keypad device.

FIG. 2 shows a graph of signal intensity over time as the word STOOL is input.

FIG. 3 shows a graph of signal intensity over time as the word RUN is input.

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FIG. 4 shows a flowchart illustrating three alternate implementations of an improved word input interpretation algorithm.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

Referring first to FIG. 1, a keypad 10 has multiple keys identified by corresponding alphabetic characters 12, and a capacitive sensor or sense matrix 14 disposed beneath the surface of the keypad 10. The keypad may contain an array of discrete key switches, as is known in the art, in addition to the capacitive sense matrix, or the sense matrix may be fashioned to be responsive to key activation force or changes in capacitance related to intentional key activation by a user. Thus, the keypad includes means to determine finger location and whether or not a key has been pressed. The keys of the keypad may have independently movable, spaced-apart key caps, or the keys may comprise discrete regions of a single keypad surface, such as a flexible membrane. My pending U.S. patent application Ser. No. 09/862,948, filed May 22, 2001, describes some examples of at-a-distance sensors integrated into keypads of the latter type, and is incorporated by reference herein. Preferably the system retains all the hardware necessary to accomplish the typical input method of sequentially striking each key, such that the user does not need to commit to this new technique when purchasing the device.

The illustrated paths 16, 18, 20 and 24 are examples of finger traces effective to input words. In a preferred embodiment, the user first presses the first letter of a word, then traverse a path including at least certain intermediate letters of the word, and then presses the last letter of the word. As examples, word path 16 enters the word "cafe" by first pressing the letter "C," traversing the finger toward the letter "A," then the "F" before coming to rest on the letter "E" and pressing it. In response, the system compares the letters of the path traversed and compares it to the options available in an internal dictionary. The first and last letters are clearly defined by virtue of the user pressing the first and last keys. However, in this algorithm, the intermediate letters may consist of none or all of the letters "B", "A", and "F", in that order, potentially including CBAFE, CBAE, CAFE, CBFE, CBE, CAE, CFE and CE. However, the only word in the dictionary is CAFE. The system would therefore select, and display, "cafe" as the intended word. Preferably, the system automatically appends a "space" after the input word, later deleting the "space" if a punctuation mark is next entered by the user. Therefore, simply by pressing the letter "C," traversing the finger toward the letter "A," then the "F" before coming to rest on the letter "E" and pressing it, the system will enter the word CAFE, followed by a space.

In some cases, the system also identifies inflection points in the path traversed, preferentially including letters associated with these inflection points for consideration in word interpretation. For example, referring to word path 16, because the letters "A" and "F" are associated with inflection points (directional changes in the traverse of the finger), the system will include those letters in its analysis of the user's intent. According to this version of the algorithm, the options are significantly reduced from the list above, to CBAFE, and CAFE. Of course, the result is still CAFE, but the likelihood of eliminating potentially erroneous selections is vastly increased.

According to word path 18, the "T" is pressed, followed by the "N." The system follows the algorithms above to enter the word IN, followed by a space, into the display. In the case of

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single letter words, such as "T" or "A", the user will press the space bar to indicate the end of the word.

In some cases, two identical letters are entered in succession by raising the finger slightly to identify the repeated letter. For example, to write the word "stool," the user presses the letter "S", traverses the "T" and "O", raises and lowers her finger over the "O" and then completes the input by pressing the letter "L."

FIG. 2 shows a measurement of finger proximity to capacitive sensor 14 as the finger traces word path 20 of FIG. 1, particularly useful for keypads not having discrete key input switches. This graph (like FIG. 3) shows signal intensity as the system measures finger elevation above the surface of keypad 10 with respect to time. Threshold 22 identifies a signal intensity below which the system will declare the user's intent to signify a duplicate letter entry in the case where the finger returns to approximately the same location. The system may be calibrated to the user's finger size as a key is pressed, thereby providing a measurement of signal strength to finger distance. In some other cases, threshold 22 signifies a differential signal change, rather than an absolute signal value, to eliminate the calibration step. For example, the threshold value could be measured against the derivative of signal intensity. Signal intensity increases as the user presses the "S", remains relatively constant during a standard "traverse" (as the finger drags on or near the keypad surface, in this case the letters "T" and "O"), drops as the finger raises to signify a doubling of the "O", and then increases again as the user presses the "L." The length along the horizontal axis is arbitrary as it will be dictated by the speed the user moves her finger. Utilizing the algorithms described, the user has indicated that the word starts with the letter "S", next includes the letter "T" (due to the change of direction of finger motion while over it), next includes "OO", and ends with "L." All the letters have been identified for inclusion in the target word and there is only one possible solution in the dictionary: STOOL.

FIG. 3 shows a measurement of finger proximity to capacitive sensor 14 as the finger traces word path 24 of FIG. 1. In this example, the user raises her finger above the keypad during a traverse (i.e., before the final key is pressed). However, unlike the example of FIG. 2, the system measures a discontinuity in measurement of the finger position on the keypad (i.e., the finger returns to a different place), so a double letter is not entered. Furthermore, in this case, when signal intensity drops below threshold 22, and the system measures a discontinuity in measurement of the finger position, the system does not register intermediate locations as options for formation of the target word. With reference to word path 24, the user first presses "R." While this causes an increase of measured signal strength, this information is not critical if a key switch also monitors finger action. The finger traverses "U" and then leaves contact with the device, moving into the air and thereby reducing the signal to below threshold 22 until the user presses the letter "G." Note that while the letter "N" was traversed, it was not registered as a possible letter because the signal intensity was below threshold 22 at the moment the finger was over the letter "N." Also note that, while not indicated in the figure, imprecise use may have resulted in the following letters being registered: RUQG, RUG, RUJG, and RUKG of which only RUG would be a viable solution to post to the display.

FIG. 4 shows a flow chart of how the above algorithms may be implemented. In step 30, the user presses the first letter of the target word. This identification is made by pressing a key switch, key switch combination or by measuring transient variation of an at-a-distance-sensor, such as capacitive sensor

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14. In step 32 the user traverses the path with their finger held close to the surface of the keypad, so that a measured signal intensity is above a threshold. This threshold may be the same as threshold 22. It will be understood by one skilled in the art that the threshold 22 may have different values for the different functions presented herein. Because the at-a-distance-sensor is disposed in a fixed relationship with respect to keypad 10, the system may identify which letter the finger is above at any moment. As the finger traverses the surface of the keypad 10, the system captures each letter disposed within a prescribed tolerance of the finger's location, accumulating the list of possible letters which may be included in the target word. The list includes each letter of the target word in the order it will appear in the final word. In any particular example, all or none of these intermediate letters may be included in the target word. The system may also include a rule-based algorithm that eliminates letter combinations that do not exist, such as Q-X, B-Z, and V-K.

In a basic implementation, the system may go directly to step 40. However, other implementations may include one or all of steps 34, 36 and 38. In step 34, the system identifies letters to include in the target word analysis, by using the at-a-distance-sensor to identify inflection points in the traverse of the finger. Any significant change in direction is considered an inflection point. By determining one or more letters that must be included, or are at least preferentially included, in the target word in this manner, the system significantly decreases the number of possible word options that must be analyzed to determine the intended, or "target" word of the user. This both speeds the process and increases the likelihood of selecting the correct target word. In step 36, the system identifies if the user intends to use the same letter twice in succession in response to the user lifting their finger and lowering it again, thereby creating an associated signal (shown in FIG. 2) that may be read by the at-a-distance-sensor. In step 38, the system omits letters from consideration if the user's finger performs a traverse above them while the signal strength is below threshold 22, indicating that the finger was far from the keypad at the moment of traverse.

In step 40 the user presses the last letter in the target word, thereby also signaling to the system that all potential letters have been identified. The system then compares the list of potential words (such as that given in FIG. 1) to a dictionary, in order to identify the preferred target word. In the event that more than one word contains the identified letters, the system may select the first one at random, give the user an option to select from a list, or other algorithm known in the art. In step 44 the system displays the target word to the display. In some cases, the system automatically adds a "space" character when displaying the target word.

A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A method of interpreting keypad input, the method including identifying a first letter of a target word from activation of an initial key;
 identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;
 identifying a last letter of the target word from activation of a final key following the non-activating traversal; and

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determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters, the determining comprising preferentially considering intermediate letters associated with finger traversal direction changes.

2. [The method of claim 1] A method of interpreting keypad input, the method including

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal; and

determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters, wherein determining the target word comprises generating a set of possible words from which the target word is to be selected.

3. The method of claim 2 including selecting a most probable target word from the set of possible words.

4. The method of claim 2 wherein the set of possible words contains only words starting with the identified first letter and ending with the identified last letter.

5. The method of claim 2 wherein the set of possible words is selected from a list of words stored in memory within a device connected to the keypad.

6. The method of claim 1 further comprising displaying the target word on a display of a device connected to the keypad.

7. The method of claim 1 further comprising displaying a word-separation character immediately after displaying the target word.

8. [The method of claim 7 further comprising] A method of interpreting keypad input, the method including

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal;

determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters;

displaying a word-separation character immediately after displaying the target word;

deleting the word-separation character in response to activation of a key associated with a punctuation character.

9. [The method of claim 1 further comprising] A method of interpreting keypad input, the method including

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal;

determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters; and

editing identified letters to remove any of a predetermined set of non-occurring adjacent two letter combinations.

[10. The method of claim **1** wherein determining the target word includes preferentially considering intermediate letters associated with finger traversal direction changes.]

11. [The method of claim **10**] *A method of interpreting keypad input, the method including*

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal; and determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters, wherein determining the target word [includes] comprises selecting the target word from a list of words each starting with the identified first letter, containing all intermediate letters associated with finger traversal direction changes, and ending with the identified last letter.

12. The method of claim **1** wherein identifying any of the first, intermediate or last letters [includes] comprises sensing an intensity of finger pressure upon an associated region of the keypad.

13. The method of claim **12** wherein identifying either of the first and last letters [includes] comprises sensing finger pressure intensity above a predetermined threshold.

14. [The method of claim **12**] *A method of interpreting keypad input, the method including*

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal, wherein identifying any of the first, intermediate or last letters comprises sensing an intensity of finger pressure upon an associated region of the keypad; and

determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters, wherein keys traversed between activation of the initial and final keys during periods of finger pressure intensity below a predetermined threshold are omitted from the set of possible intermediate letters of the target word.

15. [The method of claim **1** further comprising] *A method of interpreting keypad input, the method including*

identifying a first letter of a target word from activation of an initial key;

identifying a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identifying a last letter of the target word from activation of a final key following the non-activating traversal;

determining, by a processor associated with the keypad, the target word based upon the identified first, intermediate and last letters; and

identifying occurrences of duplicate sequential letters in response to a transient change of finger position above an associated region of the keypad.

16. The method according to claim **1**, wherein the final key is associated with the last letter of the target word.

17. An input device comprising:

a keypad defining a set of keys associated with alphanumeric characters; and

a processor adapted to:

identify a first letter of a target word from activation of an initial key;

identify a set of possible intermediate letters of the target word in response to non-activating traversal of associated keys of the keypad following activation of the initial key;

identify a last letter of the target word from activation of a final key following the non-activating traversal; and

[to]

determine the target word based upon the identified first, intermediate and last letters *the determining comprising preferentially considering intermediate letters associated with finger traversal direction changes.*

18. The input device according to claim **17** wherein the keypad comprises a plurality of spaced apart key structures each associated with a corresponding one of the set of keys.

19. The input device according to claim **17** wherein the keypad comprises a continuous sheet defining a plurality of discrete key regions each associated with a corresponding one of the set of keys.

20. *The input device according to claim 17, wherein the input device is configured to allow a user to enter letters associated with non-adjacent ones of the keys without requiring the user to individually press each of the associated keys.*

21. *The input device according to claim 17, wherein the processor is further adapted to edit identified letters to remove letters that are unrelated to the target word.*

22. *A method of interpreting keypad input, the method comprising:*

identifying a first alphanumeric character of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad,

identifying a set of possible intermediate alphanumeric characters of the target word in response to non-activating traversal of the user's finger across other regions of the keypad following the sensed position of the user's finger within the first region;

identifying a last alphanumeric character of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad following the non-activating traversal; and

determining the target word based, at least in part, on the identified first, intermediate and last alphanumeric characters, the determining comprising preferentially considering intermediate alphanumeric characters associated with finger traversal direction changes;

wherein identifying the first, intermediate and last alphanumeric characters comprises sensing changes in measured capacitance levels at corresponding positions along the keypad.

23. *The method of claim 22, wherein each of the first, other, and final regions are each associated with a respective, single letter.*

24. *The method of claim 22, wherein each of the first, other, and final regions are defined by independently displaceable spaced apart key structures.*

25. *The method of claim 22, wherein the first, other, and final regions are adjacent regions of a contiguous keypad surface.*

26. *The method of claim 22, wherein determining the target word comprises generating a set of possible words from which the target word is to be selected.*

27. The method of claim 26 including selecting a most probable target word from the set of possible words.

28. The method of claim 26 wherein the set of possible words contains only words starting with the identified first alphanumeric character and ending with the identified last alphanumeric character, wherein the identified first alphanumeric character is a letter and wherein the identified last alphanumeric character is a letter.

29. The method of claim 26 wherein the set of possible words is selected from a list of words stored in memory within a device connected to the keypad.

30. The method of claim 22 further comprising displaying the target word on a display of a device connected to the keypad.

31. The method of claim 22 wherein determining the target word comprises selecting the target word from a list of words each starting with the identified first alphanumeric character, containing all intermediate alphanumeric characters associated with finger traversal direction changes, and ending with the identified last alphanumeric character, wherein the identified first alphanumeric character is a letter, wherein each of the identified intermediate alphanumeric characters is a letter, and wherein the identified last alphanumeric character is a letter.

32. The method of claim 22 wherein determining the target word comprises selecting the target word from a list of words each containing intermediate letters associated with finger traversal direction changes.

33. The method of claim 22, wherein identifying either of the first and last alphanumeric characters comprises sensing a change in measured capacitance levels above a predetermined threshold, and wherein the identified first alphanumeric character is a letter and wherein the identified last alphanumeric character is a letter.

34. The method of claim 22, wherein identifying one or more of the set of possible intermediate alphanumeric characters comprises sensing changes in measured capacitance levels within a predetermined threshold, wherein each alphanumeric character in the set of possible intermediate alphanumeric characters is a letter.

35. The method of claim 22 further comprising eliminating unlikely letter combinations.

36. The method of claim 35 wherein eliminating unlikely letter combinations comprises editing identified letters to remove any of a set of predetermined letter combinations that comprises non-occurring adjacent two letter combinations.

37. The method of claim 22 further comprising eliminating letter combinations that do not exist within a dictionary of a given language associated with the keypad.

38. The method of claim 22 further comprising identifying occurrences of duplicate sequential letters in response to a transient change of finger position above an associated region of the keypad.

39. The method of claim 22, wherein the final region is associated with the last alphanumeric character of the target word, and wherein the last alphanumeric character of the target word is a letter.

40. The method of claim 22, wherein identifying the first alphanumeric character of the target word comprises sensing activation of an initial key region of the keypad, and wherein the first alphanumeric character of the target word is a letter.

41. The method of claim 40, wherein sensing activation of the initial key region comprises sensing a change in a measured capacitance level above a predetermined threshold at a corresponding position along the keypad.

42. The method of claim 22, wherein identifying the final alphanumeric character of the target word comprises sensing activation of a final key region of the keypad, and wherein the final alphanumeric character of the target word is a letter.

43. The method of claim 42, wherein sensing activation of the final key region comprises sensing a change in a measured capacitance level above a predetermined threshold at a corresponding position along the keypad.

44. The method of claim 22, wherein the keypad is configured to allow a user to enter letters associated with non-adjacent regions of the keypad without requiring the user to individually press each of the non-adjacent regions.

45. An input device comprising a keypad defining a set of regions associated with alphabetic characters; and a processor adapted to:

identify a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of the keypad;

identify a set of possible intermediate letters of the target word in response to non-activating traversal of the user's finger across other regions of the keypad following the sensed position of the user's finger within the first region;

identify a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad following the non-activating traversal; and

determine the target word based, at least in part, upon the identified first, intermediate and last letters, the determining comprising preferentially considering intermediate letters associated with finger traversal direction changes;

wherein the processor is adapted to identify the first, intermediate and last letters based, at least in part, on sensed changes in measured capacitance levels at corresponding positions along the keypad.

46. The input device of claim 45 wherein the keypad comprises a plurality of spaced apart key structures each defining a corresponding one of the set of regions.

47. The input device of claim 45 wherein the first, other, and final regions are adjacent regions of a contiguous keypad surface.

48. The input device of claim 45, further comprising a capacitive sense matrix disposed beneath the keypad.

49. The input device according to claim 45, wherein the input device is configured to allow a user to enter letters associated with non-adjacent ones of the regions of the keypad without requiring the user to individually press each of the non-adjacent regions.

50. The input device according to claim 45, wherein each of the regions of the keypad is identified by an associated alphabetic character, and wherein the regions are arranged to form a standard keypad layout.

51. The input device according to claim 45, wherein the processor is further adapted to edit identified letters to remove letters that are unrelated to the target word.

52. The method of claim 1, wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions along a keypad.

53. The method of claim 52, wherein the keypad is configured to allow a user to enter letters associated with non-adjacent regions of the keypad without requiring the user to individually press each of the non-adjacent regions.

54. A method of interpreting keypad input, the method comprising:

identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad,

identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;

identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and determining the target word based, at least in part, on the identified first, intermediate and last letters;

wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad.

55. The method of claim 54, wherein the first, other, and final regions each is associated with a respective, single letter.

56. The method of claim 54, wherein each of the first, other, and final regions is defined by an independently displaceable spaced apart key structures.

57. The method of claim 54, wherein the first, other, and final regions are adjacent regions of a contiguous keypad surface.

58. The method of claim 54, wherein determining the target word comprises generating a set of possible words from which the target word is to be selected.

59. The method of claim 58 further comprising selecting a most probable target word from the set of possible words.

60. The method of claim 58 wherein the set of possible words contains only words starting with the identified first letter and ending with the identified last letter.

61. The method of claim 58 wherein the set of possible words is selected from a list of words stored in memory within a device comprising the keypad.

62. The method of claim 54 wherein determining the target word comprises selecting the target word from a list of words each starting with the identified first letter, containing all intermediate letters associated with finger traversal direction changes, and ending with the identified last letter.

63. The method of claim 54 wherein determining the target word comprises selecting the target word from a list of words each containing at least one intermediate letter associated with a finger traversal direction change.

64. The method of claim 54, wherein identifying either of the first and last letters comprises sensing a change in measured capacitance levels above a predetermined threshold.

65. The method of claim 54, wherein identifying one or more of the set of possible intermediate letters comprises sensing changes in measured capacitance levels below a predetermined threshold.

66. The method of claim 54 wherein determining the target word comprises eliminating unlikely letter combinations.

67. The method of claim 66 wherein eliminating unlikely letter combinations comprises editing identified letters to remove any of a set of predetermined letter combinations that comprises non-occurring adjacent two letter combinations.

68. The method of claim 54 wherein determining the target word comprises eliminating letter combinations that do not

exist within a dictionary of a given language associated with the keypad.

69. The method of claim 54 further comprising identifying occurrences of duplicate sequential letters in response to a transient change of finger position above an associated region of the keypad.

70. The method of claim 54, wherein the final region is associated with the last letter of the target word.

71. The method of claim 54, wherein identifying the first letter of the target word comprises sensing activation of an initial key region of the keypad.

72. The method of claim 71, wherein sensing activation of the initial key region comprises sensing a change in a measured capacitance level above a predetermined threshold at a corresponding position on the keypad.

73. The method of claim 54, wherein identifying the final letter of the target word comprises sensing activation of a final key region of the keypad.

74. The method of claim 73, wherein sensing activation of the final key region comprises sensing a change in a measured capacitance level above a predetermined threshold at a corresponding position on the keypad.

75. The method of claim 54, wherein the keypad is configured to allow a user to enter letters associated with non-adjacent regions of the keypad without requiring the user to individually press each of the non-adjacent regions.

76. An input device comprising a keypad defining a set of regions associated with alphabetic characters; and a processor adapted to:

identify a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of the keypad;

identify a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated; identify a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and

determine the target word based, at least in part, upon the identified first, intermediate and last letters; wherein the processor is adapted to identify the first, intermediate and last letters based, at least in part, on sensed changes in measured capacitance levels at corresponding positions along the keypad.

77. The input device of claim 76 wherein the keypad comprises a plurality of spaced apart key structures each defining a corresponding one of the set of regions.

78. The input device of claim 76 wherein the first, other, and final regions are adjacent regions of a contiguous keypad surface.

79. The input device of claim 76, further comprising a capacitive sense matrix.

80. The input device according to claim 76, wherein the input device is configured to allow a user to enter letters associated with non-adjacent ones of the regions of the keypad without requiring the user to individually press each of the non-adjacent regions.

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81. The input device according to claim 76, wherein each of the regions of the keypad is identified by an associated alphabetic character, and wherein the regions are arranged to form a standard keypad layout.

82. A processor for use with a keypad defining a set of regions associated with alphabetic characters, the processor being adapted to:

identify a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of the keypad;

identify a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that

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is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated; identify a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and determine the target word based, at least in part, upon the identified first, intermediate and last letters; wherein the processor is adapted to identify the first, intermediate and last letters based, at least in part, on sensed changes in measured capacitance levels at corresponding positions along the keypad; and wherein the processor is further adapted to edit identified letters to remove letters that are unrelated to the target word.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : RE43,977 E
APPLICATION NO. : 12/338474
DATED : February 5, 2013
INVENTOR(S) : David H. Levy

Page 1 of 6

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims:

At column 8, claim 22, line 35, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 22, line 38, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 22, line 43, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 22, line 48, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 22, line 50, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 22, line 52 through line 53, please replace “alphanumeric” with --alphabetic--.

At column 8, claim 23, line 57, please replace “are each” with --is--.

At column 8, claim 24, line 60, please replace “are” with --is--.

At column 8, claim 24, line 61, please replace “structures” with --structure--.

At column 9, claim 27, line 1, please replace “claim 26” with --claim 26,--.

At column 9, claim 27, line 1, please replace “including” with --further comprising --.

At column 9, claim 28, line 3, please replace “claim 26” with --claim 26,--.

At column 9, claim 28, line 5, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 28, line 6, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 28, line 6 through line 8, please delete “, wherein the identified first alphanumeric character is a letter and wherein the identified last alphanumeric character is a letter”.

Signed and Sealed this
Twenty-ninth Day of April, 2014



Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office

At column 9, claim 31, line 15, please replace “claim 22” with --claim 22,--.

At column 9, claim 31, line 17, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 31, line 18, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 31, line 21, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 31, line 21 through line 25, please delete “, wherein the identified first alphanumeric character is a letter, wherein each of the identified intermediate alphanumeric characters is a letter, and wherein the identified last alphanumeric character is a letter”.

At column 9, claim 33, line 31, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 33, line 33 through line 35, please delete “, and wherein the identified first alphanumeric character is a letter and wherein the identified last alphanumeric character is a letter”.

At column 9, claim 34, line 37, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 34, line 40 through line 42, please delete “, wherein each alphanumeric character in the set of possible intermediate alphanumeric characters is a letter”.

At column 9, claim 37, line 49, please replace “claim 22” with --claim 22,--.

At column 9, claim 37, line 50 through line 51, please delete “of a given language associated with the keypad”.

At column 9, claim 39, line 57, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 39, line 58 through line 59, please delete “, and wherein the last alphanumeric character of the target word is a letter”.

At column 9, claim 40, line 61, please replace “alphanumeric” with --alphabetic--.

At column 9, claim 40, line 62 through line 63, please delete “, and wherein the first alphanumeric character of the target word is a letter”.

At column 10, claim 42, line 2, please replace “alphanumeric” with --alphabetic--.

At column 10, claim 42, line 3 through line 4, please delete “, and wherein the final alphanumeric character of the target word is a letter”.

At column 11, claim 54, line 5, please replace “,” with --;--.

At column 11, claim 54, line 18, please delete “and”.

At column 11, claim 54, at the end of line 20, please insert --and displaying the target word on a display of a device comprising the keypad;--.

At column 11, claim 55, line 24, please replace “wherein the first,” with --wherein each of

the first.--.

At column 11, claim 55, line 25, please delete “each”.

At column 11, claim 56, line 26, cancel the text beginning with “56. The method of 54” to and ending with “spaced apart key structures.” in column 11, claim 56, line 28, and insert the following claim:

--56. A method of interpreting keypad input, the method comprising:
identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
determining the target word based, at least in part, on the identified first, intermediate and last letters;
wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad; and
wherein each of the first, other, and final regions is defined by an independently displaceable spaced apart key structure.--.

At column 11, claim 58, line 33, cancel the text beginning with “58. The method of 54” to and ending with “target word is to be selected.” in column 11, claim 58, line 35, and insert the following claim:

--58. A method of interpreting keypad input, the method comprising:
identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
determining the target word based, at least in part, on the identified first, intermediate and last letters;
wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad; and
wherein determining the target word comprises generating a set of possible words from which the target word is to be selected.--.

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At column 11, claim 62, line 44, cancel the text beginning with “62. The method of 54” to and ending with “with the identified last letter.” in column 11, claim 62, line 48, and insert the following claim:

--62. A method of interpreting keypad input, the method comprising:
identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
determining the target word based, at least in part, on the identified first, intermediate and last letters;
wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad; and
wherein determining the target word comprises selecting the target word from a list of words each starting with the identified first letter, containing all intermediate letters associated with finger traversal direction changes, and ending with the identified last letter.--.

At column 11, claim 63, line 49, cancel the text beginning with “63. The method of 54” to and ending with “finger traversal direction change.” in column 11, claim 63, line 52, and insert the following claim:

--63. A method of interpreting keypad input, the method comprising:
identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
determining the target word based, at least in part, on the identified first, intermediate and last letters;
wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad; and
wherein determining the target word comprises selecting the target word from a list of words each containing at least one intermediate letter associated with a finger traversal direction change.--.

At column 11, claim 66, line 60, cancel the text beginning with “66. The method of 54” to and ending with “unlikely letter combinations.” in column 11, claim 66, line 61, and insert the following claim:

--66. A method of interpreting keypad input, the method comprising:
 identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
 identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
 identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
 determining the target word based, at least in part, on the identified first, intermediate and last letters;
 wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad; and
 wherein determining the target word comprises eliminating unlikely letter combinations.--.

At column 11, claim 68, line 66, please replace "claim 54" with --claim 54,--.

At column 12, claim 68, line 1 through line 2, please delete "of a given language associated with the keypad".

At column 12, claim 69, line 3, cancel the text beginning with "69. The method of 54" to and ending with "region of the keypad." in column 12, claim 69, line 6, and insert the following claim:

--69. A method of interpreting keypad input, the method comprising:
 identifying a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of a keypad;
 identifying a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
 identifying occurrences of duplicate sequential letters in response to a transient change of finger position above an associated region of the keypad;
 identifying a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
 determining the target word based, at least in part, on the identified first, intermediate and last letters;
 wherein identifying the first, intermediate and last letters comprises sensing changes in measured capacitance levels at corresponding positions of the keypad.--.

At column 12, claim 76, line 28, please replace "comprising" with --comprising:--.

At column 12, claim 76, at the end of line 54, please replace "." with --; and
 wherein the processor is further adapted to edit identified letters to remove letters that are unrelated to the target word.--.

At column 12, claim 77, line 55, cancel the text beginning with “77. The input device of claim 76” to and ending with “one of the set of regions.” in column 12, claim 77, line 57, and insert the following claim:

--77. An input device comprising:
a keypad defining a set of regions associated with alphabetic characters; and
a processor adapted to:
identify a first letter of a target word based, at least in part, on a sensed position of a user's finger within a first region of the keypad;
identify a set of possible intermediate letters of the target word in response to traversal of the user's finger from the first region across other regions of the keypad, wherein the traversal of the user's finger across the other regions of the keypad comprises traversal of at least one key of the keypad corresponding to a letter that is not in the target word, and wherein the traversal causes a change in capacitance at the region of the keypad in which the at least one key is situated;
identify a last letter of the target word based, at least in part, on a sensed position of the user's finger within a final region of the keypad at the end of the traversal; and
determine the target word based, at least in part, upon the identified first, intermediate and last letters;
wherein the processor is adapted to identify the first, intermediate and last letters based, at least in part, on sensed changes in measured capacitance levels at corresponding positions along the keypad; and
wherein the keypad comprises a plurality of spaced apart key structures each defining a corresponding one of the set of regions.--.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : RE43,977 E
APPLICATION NO. : 12/338474
DATED : February 5, 2013
INVENTOR(S) : David H. Levy

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

At column 1, lines 16-27, please delete text starting at line 16 with “Notice: More than one reissue application has been filed” and ending at col. 1, line 27 with “No. 60/360,414 are hereby incorporated by reference,” and insert the following text:

--Notice: More than one reissue application has been filed for the reissue of U.S. Patent No. 7,175,438, which claims the benefit of priority under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 60/360,414, filed on March 1, 2002; the reissue applications are U.S. Patent Application No. 12/338,474 (which matured to U.S. Patent No. RE43,977), which was filed on December 18, 2008, U.S. Patent Application No. 13/690,667, which was filed on November 30, 2012, and claims priority to the U.S. Patent Application 12/338,474 as a continuation reissue application, and U.S. Patent Application No. 14/535,941, which was filed on November 7, 2014, and claims priority to U.S. Patent Application No. 13/690,667 as a continuation reissue application. The entire contents of U.S. Provisional Patent Application No. 60/360,414 are hereby incorporated by reference.--

Signed and Sealed this
Second Day of June, 2015



Michelle K. Lee
Director of the United States Patent and Trademark Office