

devices. Hand held computing devices often have only small keypad and display areas available, as well as limited memory capability. The inventive devices and methods provide for, inter alia, quick and easy entry of alphanumeric characters on a small keypad or keyboard, rapid check word calculation for data transfers, fast writing of data to the device display, and fast and efficient authentication of user identification character strings.

[0027] Referring more specifically to the drawings, for illustrative purposes the present invention is embodied in the apparatus and methods shown generally in FIG. 1 through FIG. 6. It will be appreciated that the apparatus may vary as to configuration and as to details of the parts, and that the method may vary as to detail and the order of the events or acts, without departing from the basic concepts as disclosed herein. The invention is disclosed primarily in terms of use in handheld data processors or computers. However, it will be readily apparent to those skilled in the art that the invention may be used with any type of data processor, including, for example, desktop and laptop computers. It should also be apparent to those skilled in the art that various functional components of the invention as described herein may share the same logic and be implemented within the same circuit, or in different circuit configurations.

[0028] Referring now to FIG. 1, a keyboard or keypad 10 in accordance with the invention is shown. Keypad 10 includes a plurality of first, "hard" or "fixed" keys 12, and a plurality of second, "soft" keys 14. Each of the first or fixed keys 12 on the keypad has at least one primary alphanumeric symbol 15. Additionally, one or more of the fixed keys may have a secondary alphanumeric symbol or symbols 16 associated therewith. As shown, a primary alphanumeric symbol 15 in the form of a single number or numeral is located on the central, lower portion of each of the first keys 12, while secondary alphanumeric symbols 16 in the form of three or four roman alphabet characters or text-related symbols are located in the upper portion of the first keys 12. The first keys 12 thus display alphanumeric characters in a manner similar to conventional telephone keypads. The first key 12 displaying the number "1" as a primary alphanumeric symbol includes, instead of alphabet letters, the symbols for "underscore", "period", "slash" and "dash" as secondary alphanumeric characters. The first key 12 displaying the number "0" as a primary alphanumeric symbol also displays non-letter secondary symbols corresponding to "blank space", "backslash", "colon" and "comma".

[0029] Primary and secondary alphanumeric symbols 15, 16 may be displayed elsewhere on first keys 12, or may be displayed adjacent to the first keys 12 or elsewhere in association with the first keys 12. A delete or backspace key 18 is included to allow deletion of alphanumeric character entries as described below, and an "enter" key 20 is provided that may be used to enter completed character strings, or as a reset key, or which may be programmable to carry out a selectable function upon actuation of the key 20.

[0030] The number of second, soft keys 14 as shown corresponds to the maximum number of secondary alphanumeric symbols 16 associated with each of the first keys 12. Upon selection and actuation of one of the first keys 12, the corresponding secondary alphanumeric symbols 16 associated with the actuated first key 12 are displayed in association with the second keys 14, with one secondary

alphanumeric symbol 16 displayed in association with a corresponding second key 14. The secondary alphanumeric symbols 16 may be displayed directly on the second keys 14 as shown, or displayed adjacent to the second keys 14, or displayed elsewhere in association with second keys 14.

[0031] In the embodiment shown in FIG. 1, keypad 10 is in the form of a touch screen that is overlaid on or superimposed with a display 22. Display 22 may comprise a liquid crystal, LED, CRT or other form of display. In handheld embodiments, display 22 will often be in the form of a liquid crystal display or LCD. Touch screen/display 22 includes a field 24 wherein are displayed alphanumeric characters selected according to selective actuation of the primary or first keys 12 and second keys 14 as described below.

[0032] By selective actuation of the appropriate first keys 12 and second keys 14, any string of alphanumeric characters may be entered on the keypad 10. The pressing or actuation of a selected first key 12 results in the displaying of the primary alphanumeric character 15 of the selected first key 12 on display field 24, and also results in the display of the corresponding secondary alphanumeric symbols 16 on the soft keys 14. If the primary alphanumeric symbol 15 displayed on display 24 is the symbol that the user wished to enter, the secondary keys 14 are not actuated. If, on the other hand, the user wishes to enter one of the secondary alphanumeric characters associated with the second keys 14, the user may actuate appropriate second key 14. This results in replacement of the displayed primary alphanumeric character (number) in field 24 with the selected secondary alphanumeric character (letter).

[0033] The operation of the keypad of FIG. 1 is illustrated in FIG. 2A through FIG. 2H. In FIG. 2A, a first fixed key 12, which displays the primary alphanumeric character "4" and the set of secondary alphanumeric characters "G", "H", and "I", is selected and pressed or actuated by a user. Actuation of the first key 12 results in display of the number "4" in display field 24, and results in the display of the letters "G", "H" and "I" on the second keys 14. If the user, at this point, merely wished enter the number "4", the enter button 20 may be selected. If the user instead wished to enter "G", "H" or "I", the appropriate second key 14 is selected and actuated.

[0034] Selection and actuation of the second key 14 displaying the letter "H" by a user, as shown in FIG. 2B, results in replacement of the number "4" with the letter "H" in the display field 24. The user may alternatively select "G" or "I" from this set of secondary alphanumeric characters. If the letter "H" as shown in FIG. 2B represents the entire character string that the user wishes to enter, the enter key 20 may be pressed.

[0035] The user may continue to expand the list of entered alphanumeric characters by selecting and actuating the appropriate first keys 12 and/or second keys 14. As shown in FIG. 2C, selection and actuation of a second fixed key 12 with a primary alphanumeric symbol "2" and a set of secondary alphanumeric symbols "A", "B" and "C", is shown, which results in display of the number "2" in field 24 next to the previously selected "H", and displays the letters "A", "B" and "C" on the soft keys 14. The user may at this point press the enter key 20 to enter the character string "H2". Or, as shown in FIG. 2D, selection and actuation of