

touch-screen while trying to enter text. There is also a need to facilitate simple and rapid recovery from misrecognition errors, where the intended word was identified by the system but a different word was actually output due to having a higher priority. Finally, to accommodate greater speed in the entry of gestures, there is a need to allow the user to be less precise in entering gestures without sacrificing the ability to consistently interpret the user's gestures in such a way that they are correctly matched with the intended word. This includes a need for the system to be able to frequently identify a correctly spelled word from an input path corresponding to an incorrect spelling of the word, as well as the need to accommodate a wide variety of path tracing errors including inadvertent gross errors in entering a path for an intended word.

[0011] It is also relevant to consider that, in contrast to the usual expectations for new hardware technology, handheld touch-screen devices are in some instances being developed with slower rather than faster processors. This is particularly true for touch-screen devices that are also cellular phones, as it is very important to create phone devices that extend the battery life as long as possible on a single charge, and slower processors help in that regard. Thus, it is very important to create a system that uses the most efficient means possible to identify the intended word as often as possible given these constrained resources. Furthermore, mass-market devices such as touch-screen cellular phones are designed to be able to be produced as cheaply as possible, which also tends to put a premium on the use of memory resources by applications which target these devices, so that minimizing the size of such applications (and in particular the databases required for such applications) is another critical goal.

[0012] The present invention solves all of the above problems. As described below, the various aspects of the present invention combine to yield an unexpected result—that visually guided gesturing with reference to a displayed virtual keyboard is far faster than tapping, and can be used to enter words from a vocabulary that is large enough (for example, over 60,000 words in one implementation of a system for the English language) that the user only needs to resort to tapping to enter an unusual name or word the first time that word is entered using the system. This initial entry of a new word can reasonably be viewed as a process that is outside the normal text entry method, since once such a word has been tapped in it is then known to the system and can thereafter be entered using gesturing. The present invention, however, also includes aspects with respect to the tapping of words that improve upon anything known in the prior art. And, as will be shown in the following description, the present system allows the user to easily enter distinct words that “collide” because they otherwise map to the same basic gesture, or input path. Also importantly, the method presented can be implemented such that the processing resources and memory required are within acceptable limits for virtually all of the handheld touch-screen devices being developed.

SUMMARY OF THE INVENTION

[0013] The method of the present invention is distinguished by a number of characteristics: 1) each word is input using one continuous motion in contacting a virtual keyboard on a screen, significantly reducing the number of controlled movements that must be executed to input each

word; 2) a the sequence of keys associated with the letters of a potential word candidate from a database is matched to the path of the contact action such that each such matched key need only be within a determined threshold distance from the matched path location; 3) the sequence of keys associated with the letters of a potential word candidate may be matched with points along the path of the contact action in an order other than the order in which the associated letters occur in the spelling of the word candidate; 4) one or more keys of the sequence of keys associated with the letters of a potential word candidate may be left unmatched with any point along the path of the contact action; and 5) candidate words associated with relatively higher levels of frequency of use may be entered with relatively higher levels of imprecision. This significantly increases text entry speed. The approach used allows the input path contact action to exhibit an overall “average” level of imprecision (that can be adjusted by varying the determined matching threshold distance) with respect to the intended candidate word, as well as to exhibit one or more instances of “extraordinary” imprecision. Since, in general, when input path contact actions are performed at higher and higher rates of speed they tend to be entered with less and less precision, this enables a user of the system to perform input path contact actions at significantly higher speeds.

[0014] The present invention uses word-level analysis to match the input path traced out on the keyboard with the most likely word or words in the system's database. The user is presented with a list of the identified matching words, and can either accept the default choice (the word identified by the system as being the most likely match), or select one of the alternate word choices or request the system to display further potentially matching words if the desired word does not appear in the list. When the system determines that the likelihood that the default choice is in fact the user's intended word is sufficiently greater than the likelihood of the second-most-likely word, then the default word is output without displaying a list of alternate word choices. Other aspects of the system provide feedback to the user in such a way as to minimize the necessity to distract the user from the task of composing and entering text.

[0015] A further advantage is obtained for the present invention through the insight that, due to the effect of practice, a user of the system will naturally tend to trace out paths more quickly for words with which the user is more familiar (which tend to be generally higher-frequency words). Conversely, when the user is entering a word that is unfamiliar, seldom used, or of whose spelling the user is unsure, the input path will tend to be traced out at a slower speed. This relationship can be used to change a number of the parameters used in carrying out the analysis of the input path itself and the subsequent comparison of the analyzed path with potentially matching words in the database.

[0016] The present invention provides a keyboard text entry system that is well-suited for devices with touch-sensitive input panels or touch-sensitive display screens. The user enters a word by tracing out a continuous path that starts near the first letter of the word, passes within a threshold distance of each letter of the word in sequence, and ends when the last letter of the word is reached. However, the system also accommodates a variety of path tracing errors, such that the user's intended word is still correctly recognized when the path does not pass within a threshold