VIRTUAL KEYBOARD SYSTEMS WITH AUTOMATIC CORRECTION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of copending U.S. patent application Ser. No. 10/775,483, filed Feb. 9, 2004; which is a continuation-in-part application of U.S. Pat. No. 6,801,190; and claims priority to U.S. Ser. No. 11/019,517, filed on Dec. 20, 2004, U.S. Ser. No. 10/621,864, filed on Jul. 16, 2003, and to U.S. Provisional Patent Application Ser. No. 60/532,131, filed on Dec. 22, 2003 each of which is incorporated herein in its entirety by this reference thereto.

TECHNICAL FIELD OF THE INVENTION

[0002] The invention relates to systems that auto-correct sloppy text input due to errors or imprecision in interacting with an input device. More specifically, the invention provides automatic correction for keyboards such as those implemented on a virtual keyboard, gesture-based keyboard, and the like, using word-level analysis to resolve inaccuracies, i.e. sloppy text entry.

BACKGROUND OF THE INVENTION

[0003] For many years, portable computers have been getting smaller and smaller. The principal size-limiting component in the effort to produce a smaller portable computer has been the keyboard. If standard typewriter-size keys are used, the portable computer must be at least as large as the keyboard. Miniature keyboards have been used on portable computers, but the miniature keyboard keys have been found to be too small to be easily or quickly manipulated with sufficient accuracy by a user.

[0004] Incorporating a full-size keyboard in a portable computer also hinders true portable use of the computer. Most portable computers cannot be operated without placing the computer on a flat work surface to allow the user to type with both hands. A user cannot easily use a portable computer while standing or moving. In the latest generation of small portable computers, called Personal Digital Assistants (PDAs), companies have attempted to address this problem by incorporating handwriting recognition software in the PDA. A user may directly enter text by writing on a touch-sensitive panel or display screen. This handwritten text is then converted into digital data by the recognition software. Unfortunately, in addition to the fact that printing or writing with a pen is in general slower than typing, the accuracy and speed of the handwriting recognition software has to date been less than satisfactory. To make matters worse, today's handheld computing devices which require text input are becoming smaller still. Recent advances in two-way paging cellular telephones, and other portable wireless technologies has led to a demand for small and portable two-way messaging systems, and especially for systems which can both send and receive electronic mail (e-mail).

[0005] It would therefore be advantageous to develop a much smaller keyboard for entry of text into a computer. As the size of the keyboard is reduced the user encounters greater difficulty selecting the character of interest. In general there are two different types of keyboards used in such portable devices. One is the familiar mechanical keyboard consisting of a set of mechanical keys that are activated by depressing them with a finger or thumb. However, these mechanical keyboards tend to be significantly smaller than the standard sized keyboards associated with typewriters, desktop computers, and even laptop computers. As a result of the smaller physical size of the keyboard, each key is smaller and in closer proximity to neighboring keys. This increases the likelihood that the user depresses an unintended key, and the likelihood of keystroke errors tends to increase the faster the user attempts to type.

[0006] Another commonly used type of keyboard consists of a touch-sensitive panel on which some type of keyboard overlay has been printed, or a touch-sensitive display screen on which a keyboard overlay can be displayed. Depending on the size and nature of the specific keyboard, either a finger or a stylus can be used to interaction the panel or display screen within the area associated with the key that the user intends to activate. Due to the reduced size of many portable devices, a stylus is often used to attain sufficient accuracy in interactioning the keyboard to activate each intended key. Here again, the small overall size of such keyboards results in a small area being associated with each key so that it becomes quite difficult for the average user to type quickly with sufficient accuracy.

[0007] One area of prior development in mechanical keyboards has considered the use of keys that are much smaller than those found on common keyboards. With smaller keys: the user must take great care in controlling each key press. One approach (U.S. Pat. No. 5,612,690) proposes a system that uses up to four miniature keys in unison to define primary characters, e.g. the alphabet, and nests secondary character rows, e.g. numbers, between primary character rows. Selecting a secondary character involves depressing the miniature key from each of the surrounding primary characters. Grouping the smaller keys in this fashion creates a larger apparent virtual key composed of four adjacent smaller keys, such that the virtual key is large enough to be depressed using a finger. However, the finger must interaction the keys more or less precisely on the cross-hairs of the boundaries between the four adjacent keys to depress them in unison. This makes it still difficult to type quickly with sufficient accuracy.

[0008] Another area of prior development in both touch screen and mechanical keyboards has considered the use of a much smaller quantity of full-size keys. With fewer keys, each single key press must be associated with a plurality of letters, such that each key activation is ambiguous as to which letter is intended. As suggested by the keypad layout of a touch-tone telephone, many of the reduced keyboards have used a 3-by-4 array of keys, where each key is associated with three or four characters (U.S. Pat. No. 5,818,437). Several approaches have been suggested for resolving the ambiguity of a keystroke sequence on such a keyboard. While this approach has merit for such keyboards with a limited number of keys, it is not applicable to reduced size keyboards with a full complement of keys.

[0009] Another approach in touch screen keyboards has considered analyzing the immediately preceding few characters to determine which character should be generated for a keystroke that is not close to the center of the display location of a particular character (U.S. Pat. No. 5,748,512).