KITTY: Keyboard Independent Touch Typing in VR

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Abstract

A new hand- and finger-mounted data input device is presented, using traditional touch-typing skills as method of alphanumeric data input to provide an ultra-portable solution for “quiet” data input into portable computer systems. The presented keyboard independent touch-typing device (KITTY) offers high data input rates and minimal training requirements for new users.

1 Introduction

With recent advances in portable computing and in particular the design of pocket PCs and eye-glass displays, the development of new augmented reality (AR) environments has been made possible. However, one of the current shortcomings in these AR systems is the lack of intuitive input devices that provide users with complete control over their workspace in combination with high data input rates. In particular in environments where voice input is undesirable due to privacy concerns or infeasible as a result of background noise, touch-typing capabilities have to be available to allow for intuitive access to possibly complex data.

2 KITTY Interface

The presented KITTY interface overcomes common device limitations by providing a portable device with intuitive access to touch-typing skills. To accomplish this, the device utilizes a glove with multiple contacts on each finger that are only activated when the appropriate finger and thumb contacts are combined. The layout of these contacts follows the traditional QWERTY keyboard layout, allowing anyone with previous touch-typing experience to immediately use the device. A significant advantage of KITTY is that arbitrary finger motion is allowed without data input, as long as finger contacts and thumb contacts on a single hand do not meet. In other words, KITTY allows the user complete freedom for hand movements while only generating input when finger-and thumb-contacts are combined.

Figure 1. KITTY glove prototype and contact placement.

Finger-Thumb Touch-Typing - Figure 2 illustrates a standard QWERTY keyboard, which was used as the reference for the design of the KITTY keyboard mapping. Even though the QWERTY layout was chosen, other key mappings such as Dvorak or the half-keyboard can be easily supported.

Figure 2. Standard US-keyboard with division of alphabetical characters into ‘base’ row (solid), top row (dashed) and bottom row (dash-dot) characters.

While using the standard QWERTY keyboard, a user’s fingers are normally in a home position that includes placing the left pinky on the A-key, the ring finger on the S-key, the middle finger on the D-key and the left index finger on the F-key. The home position for the right hand includes placement of the right index finger on the J-key, the right middle finger on the K-key, the index finger on the L-key and the right pinky on the ;-)key. The base row, top row and bottom row, of the standard keyboard were used to define the reference rows in a row-column layout that could subsequently be mapped onto a glove-based design.

Key-Map - Figure 2 illustrates the matching enumeration of
left-hand fingers (1-4), right-hand fingers (5-8) and thumbs with thumb contacts (A,A0), (B,B0), (C,C0), (D,D0), (E,E0), (F,F0), employed for the key-map. Figure 3 shows the location of electrical contacts on the user’s hands. Both finger- and thumb-contacts are utilized allowing a broad range of key definitions.

![Figure 3. Wired prototype: Location of a) fingertip contacts (1-8) (dashed lines indicate location on the inside of each hand), b) thumb contacts (A(0) - D(0)) and c) 'side-finger' contacts for ‘special’ character input.](image)

As shown in Figure 3 by dashed lines, finger contacts 1-8 are located on the palm-side of the user’s hand near the top of the fingers or the fingertips. There is one finger contact on the pinky, ring, middle and index finger of each hand (1-8). Also, there are six contacts A-F, A0-F0 on each thumb, three contacts on each inner thumb and three contacts on each outer thumb. Signals for letters A-Z are generated by pressing one of the finger contacts 1-8 against one of the six thumb contacts A-F, A0-F0 on the same hand.

The middle thumb contacts B, E are used for characters in the base row. The top thumb contacts A, D are used for characters in the top row and the bottom thumb contacts C, F are used for characters in the bottom row. For example, on a QWERTY keyboard the character “a” is the character that would be typed using the fifth finger of the left hand in the home (base row) position. With the present method, the signal representing the character “a” is generated when the finger contact 1 on the pinky finger of the left hand (see Figure 3) is closed with the thumb contact B (representing the base row). Since the left pinky finger is used to press the “q” character located on the upper row of a keyboard, the signal representing the character “q” is generated by closing the contact between the pinky finger contact 1 and the top thumb contact A. Since the index finger is used to reach two characters on a given row, an additional thumb contact for each row is located on the back or outside of the user’s thumbs. For example, to generate the signal representing the character “f”, the finger-thumb-contact combination 4-B is used. The contact combination used to generate the character “g” is 4-B0 which implies contacting the left index finger 4 with the center contact on the outside of the user’s left thumb B0. Note that, due to ergonomic reasons, finger-thumb contact 1-C is not used to generate “z” but rather 8-E. Accordingly, “;”, “:” and “ .” are generated by one of the supplemental contacts located on the sides of the fingers as shown in Figure 3.

Supplemental finger contacts are located along the sides of the user’s fingers nearest to the user’s thumbs. Any given finger may have up to three supplemental contacts located on the first, second and third segment of the user’s finger. These supplemental contacts are used to generate signals representing special characters such as arrow keys. A signal is then generated by contacting a particular supplemental contact with the thumb contact A or D located on the inside tip of the thumb of the same hand. In other words, “Thumb-coding” is used for these special characters due to the infrequent use of these characters.

Additional contacts may also be located on the fingernails for input of digits 0-9. Upon using the “Shift” contacts, several special characters can be generated using these additional contacts. Using these contacts for input of digits 0-9 still uses fingering or finger movement analogous to the fingering on a standard keyboard. However, now signal input is achieved by combining a contact on the outside or nail-side of the finger tips with the thumb contact located on the palm-side tip of the thumb of the same hand.

3 Hardware Implementation

The prototype utilizes the encoder of a commercially available keyboard to demonstrate the key mapping approach for alphanumeric data-input input as well as selected control keys. The “Virtually Indestructible” foldable keyboard from GrandTec™ (Figure 4) was used since it provided 100% correspondence between the circuit layout on the two membranes of the keyboard and the KITTY key-mapping. Wires were attached to the corresponding locations on the keyboard membrane circuitry using self-adhesive copper tape. Wirewrap was subsequently used to keep the design sleek. The wire ends were then collected and attached to two gloves according to the layout shown in Figure 3. The resulting KITTY device is lightweight, portable and low cost.

![Figure 4. Prototype system utilizing a traditional roll-up keyboard as the keyboard encoder.](image)