

Gestyboard: A 10-finger-system and gesture based text input system for multi-touchscreens with no need for tactile feedback

Tayfur Coskun, Eva Artinger, Lorenzo Pirritano, Daniela Korhammer,
Amal Benzina, Claudia Grill, Andreas Dippon, Gudrun Klinker
Technische Universität München

ABSTRACT

This paper presents a new text-entry approach for multi-touch devices based on both the 10-finger-system and a unique gesture-to-key mapping to overcome the lack of tactile feedback on touchscreens. We use unique gestures for all 10 fingers based on the QWERTY layout. There are two classes of gestures: Taps and Slidings. Taps activate the keyboards central home keys while slidings are used for the remaining neighboring letters. The idea behind this is to perform the gestures without looking at the “virtual keyboard” and without tactile feedback. By coupling the gestures to the highly efficient 10-finger-system the performance of the text entry can also be improved. We developed a first prototype, called Gestyboard, and conducted an evaluation with 41 pupils who were familiar with the 10-finger-system. Through this evaluation, we are aiming to investigate the potential usability of the first Gestyboard prototype. The results revealed that despite the complexity of the finger gestures, the users were able to perform the text entry with our prototype, and the results also highlighted additional improvements to increase the performance of our concept. The Gestyboard prototype showed a large acceptance and enthusiasm among the users. This concept has been developed within the scope of the SpeedUp project.¹

Author Keywords

Virtual Keyboard, Touch typing, 10-finger-system, Multi-touch Device, Gestures, No tactile feedback

ACM Classification Keywords

H.5.2 User Interfaces: Multi-touchscreen keyboards

General Terms

¹The project SpeedUp is funded by the German Federal Ministry of Education and Research (BMBF) within the program “Research for Civil Security” (May 1st, 2009 - April 30th, 2012, FKZ: 13N10175). Website: <http://www.speedup-projekt.de>

Algorithms, Experimentations, Human Factors, Performance, Usability

REQUIREMENTS

The Gestyboard concept is based on the requirements listed below. The common reason among all these requirements is that the classical keyboard in fact do fulfill all these requirements. We believe, that a touchscreen keyboard has to fulfill the same core features to be able to replace the classical keyboard.

- (R1) No additional hardware, just the multi-touchscreen
- (R2) No dictionary / No word prediction / No database
- (R3) Enable fast typing - comparable to the classical hardware keyboard
- (R4) Enable typing without missing the keys
- (R5) Enable blind typing

GESTYBOARD CONCEPT AND FIRST PROTOTYPE

Activation of the Gestyboard

To start the text entry process, an activation state is needed initially for the Gestyboard. When the user touches the multitouch surface with all 10 fingers the keyboard is activated and a visual feedback is displayed on the touchscreen. The home keys are placed at the position of the user’s fingers with a QWERTY layout and are activated by tapping them. By sliding a finger horizontally, vertically or diagonally, the user is able to select and activate the direct neighboring keys of the central ones. Hence, a group of keys is assigned to each finger. Therefore, each finger gesture has to be uniquely mapped to a keystroke, which is the main feature inherited from the 10-finger-system.

Keystroke Activation Gestures

Each finger can activate one and only one key group assigned to it, based on the 10-finger-system. Figure 1 shows the gesture overview. When the keyboard is activated, the keys ‘a’ ‘s’ ‘d’ ‘f’ are assigned to finger 1 to 4 and the keys ‘j’ ‘k’ ‘l’ ‘;’ to fingers 7 to 10, respectively. A space key is assigned to fingers 5 and 6 (thumbs) and appears at their position in the visualization. It is important to mention that all these keys are not virtual buttons, in a sense that they are not activated by a finger touch. In fact, their only purpose is to visualize the QWERTY layout to guide the users while typing if they do not master the 10-finger-system.

The fingers' gestures for the horizontal central keys

Tapping with a finger always activates the central key assigned to that finger, whether or not the tap occurs within the corresponding square of the visual representation, e.g. a tap of finger 1 always activates the key 'a'. Even if the users tap on key 'q' with finger 1, key 'a' will still be activated because the tap represents a unique gesture for this finger. The same holds true for key 's' and finger 2, key 'd' and finger 3, and so forth.

The fingers' gestures for the neighboring keys : upper and lower keys

The upper buttons ('q' 'w' 'e' 'r' and 'u' 'i' 'o' 'p') are activated by performing a sliding-up gesture with the corresponding finger. For example, to activate the key 'q', the corresponding finger, finger 1 in this case, has to be slid upwards the screen. If the finger displacement exceeds a predefined threshold in the upper direction, the letter 'q' will be activated and hence typed. The same procedure is used for the activation of the lower keys ('y' 'x' 'c' 'v' and 'n' 'm' ';' ':'). Again, there is no need to physically hit the corresponding visual representation of the desired keys, the sliding gesture upwards or downwards with the associated finger defines a unique keystroke activation.

The fingers' gestures for the vertical central keys

The keys 't', 'g', 'b', and 'z', 'h', 'n' are a special case, since they add an extra gesture overhead to fingers 4 and 7. Finger 4 has to be slid to the right and finger 7 has to be slid to the left to activate the key 'g' and 'h' respectively. To activate the keys which are positioned diagonally, a diagonal finger sliding to the corresponding direction has to be performed.

The fingers' gestures for Space, Enter, Backspace and Shift

Performing a tap gesture with finger 5 or 6 (thumbs) activates the space key. The 'Enter' key is activated by a sliding gesture to the right with finger 10, while the 'Backspace' key is activated by sliding the same finger diagonally to the upper right. Lastly, the 'Shift' key can be activated with either finger 1 (diagonal sliding to the lower left) or finger 10 (diagonal sliding to the lower right). An overview and a sketch of all the gestures is given in Figure 1.

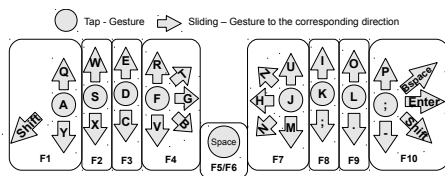


Figure 1. The overview of the gestures. Fx : Finger x.

Qualitative Feedback

We asked the participants to express their suggestions for improvement, further usage, difficulties, preference, physical and mental demand as well as whether their knowledge of the 10-finger-system has some benefit or not. This interview was conducted after the evaluation with every participant individually.

Improvements and difficulties

Several different categories were mentioned for improving the Gestyboard.

Movement The sliding gesture for the upper and the lower row as well as performing two different gestures, sliding and tapping, were mentioned frequently as being problematic. The movements were uncommon and therefore not that much liked. Especially sliding had the disadvantage that it is not always possible to move all fingers individually without moving other fingers too. This resulted in mistyping. Some of the pupils would therefore prefer tap movements instead of the combination of both movements. Some subjects described that they had less problems with the movement after practicing it for a while. The pupils reported, that their motivation increased during the test to get even better after some more training. Interestingly, we got also some sporadic answers saying that the movement was not a problem at all. During our test we had also the chance to speak to a teacher, who teaches the pupils typing. We got very valuable feedback concerning the two different movements. She explained that besides the standard process of typing with a classic keyboard, Gestyboard requires, that the typist has to differentiate for each letter if a sliding or tapping movement has to be performed. This adds additional mental load for typing with Gestyboard.

Automatic reset to initial position Furthermore, the pupils mentioned that it is cumbersome to push the sliders of Gestyboard upwards to type any key in the upper row or downwards to type any key in the lower row and then drag it back again to the initial position in the middle row. An automatic reset is preferred, which sets the slider automatically back to its initial position if it is released somewhere else than there.

Difficult keys It was also mentioned that some keys were more difficult than others. Especially the movement of the little finger caused problems. This finger is also used for the Enter key. Furthermore, also the space key was mentioned as being problematic. Both keys appear very frequently in a text and we are investigating other specific gestures or placement in order to type them more easier.

Further usage and preference

The majority of the participants would like to use the Gestyboard in future. A lot of them would like to train to get better in typing with it. There were only very few people who did not want to use Gestyboard any further and prefer a touch keyboard, because it was too slow or unfamiliar. The preference for the Gestyboard is visible in the answers as we got almost 150% more positive answers about the familiarization than negative.

Several typical statements from the pupils that show their opinion: "If I would use it more, than I could write very quick." - "It is funny to use and interesting." - "There is a difference to the classic keyboard, but if I type longer I would get used to it." - "Gestyboard makes more fun. I prefer it, if I had to chose."