Swipe&Switch: Text Entry Using Gaze Paths and Context Switching

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OVERVIEW

Swipe-based methods for text entry by gaze allow users to swipe through the letters of a word by gaze, analogous to how they can swipe on a touchscreen keyboard.

There are two challenges for these methods:
- Gaze paths do not possess clear start and end positions.
- It is difficult to design text editing features.

Swipe&Switch uses swiping and switching to improve gaze-based interaction. The interface contains three context regions, and detects the start/end of a gesture and emits text editing commands when a user switches focus between these regions. A user study showed that Swipe&Switch provides a better user experience and higher text entry rate over a baseline, EyeSwipe.

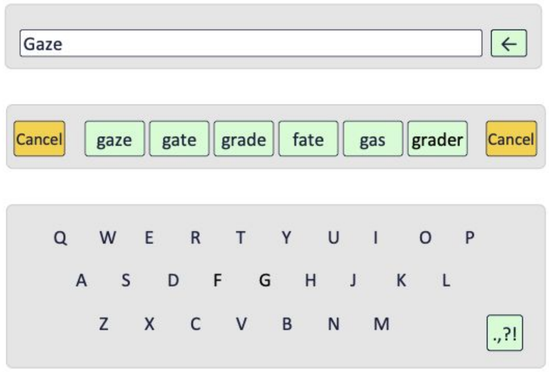
INTERACTION DESIGN

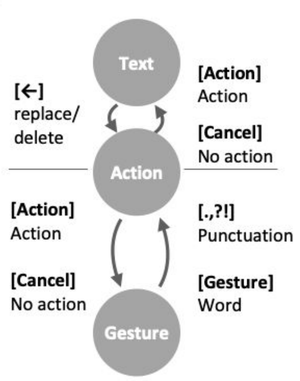
Explicit Selection
Swipe&Switch provides two ways to confirm the beginning of a gaze gesture:
- The first fixation in the gesture region
- Any other fixation longer than a hidden dwell-time

The letters near the initial fixations are used as candidates of the first letter. The last letter is determined based on the distance to the last fixation on the gesture region.

Text Entry and Editing
The user emits commands to the interface by switching focus from one region to another.
- From the gesture region to the action region: the interface shows either candidate words
- From the text region to the action region after focusing on the backspace key: the action buttons show candidates to replace the last word and the option to delete it.
- From the action region to any other region: the interface performs the selected action.

INTERFACE





The text region contains the entered text and a backspace key.
The action region is used for command selection and confirmation, which changes dynamically based on where the user previously focused her gaze.
The gesture region is where the gaze gesture is performed and contains all the characters.

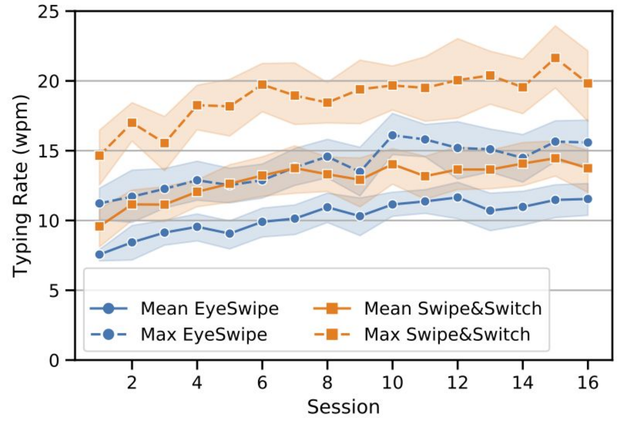
Swipe&Switch utilizes switching between different regions to allow explicit starting and ending a gesture, and text-editing commands in a swipe-based interface. The design of the three regions can decouple tasks that primarily require *gaze control* (e.g. glancing through the letters in the gesture region) from those that primarily require *gaze perception* (e.g. checking input text in the text region), and reduce the switching between gaze control and gaze perception.

Word prediction: The gaze path is segmented based on the start and end positions indicated by the user. Similarly to EyeSwipe, Swipe&Switch computes probabilities of words in a lexicon based on the gazepath and a language model.

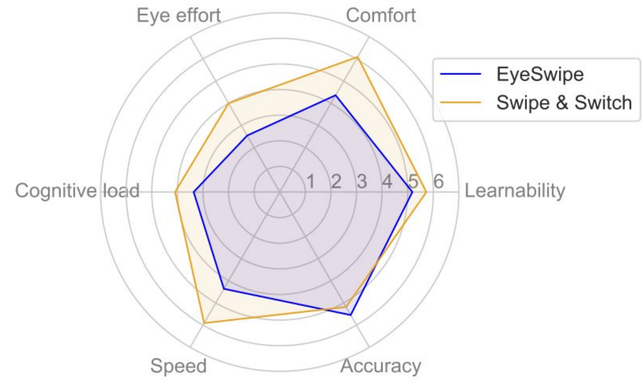
USER STUDY

- 12 participants (4 females and 8 males, ages 19-28), within-subject design.
- Sixteen 5-minute text entry sessions for each interface (Swipe&Switch and EyeSwipe) spanning two days.
- Tobii EyeX eye tracker was used to collect gaze data.
- Participants memorized and typed as fast and accurately as possible as many phrases as they could.
- At the end of the experiment participants completed a questionnaire about their subjective feedback on the two typing methods and their basic demographic information.

RESULTS



Text Entry Rate



Subjective Feedback

DISCUSSION

- Users were able to enter words about 20% faster using Swipe&Switch (13.74 wpm) compared to EyeSwipe (11.54 wpm), on average.
- Regarding peak velocity, a participant was able to enter a sentence at 33 wpm with Swipe&Switch, compared to 21 wpm with EyeSwipe
- Participants rated Swipe&Switch higher than EyeSwipe in 5 out of 6 dimensions: Learnability, Comfort, Eye effort, Cognitive load and Speed.
- Overall, participants considered Swipe&Switch to be a more "fluid" text entry method.