



# Haptic Feedback of Gaze Gestures with Glasses: Localization Accuracy and Effectiveness

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# Gaze interaction in smartglasses

- Smartglasses are growing in popularity.
- Conventional interaction techniques like touch may not be suitable for the eye-glass form factor.
- Gaze interaction is feasible and beneficial in such devices.
- Gaze gestures are a promising interaction technique in the mobile context.




# Feedback for gaze gestures

- Appropriate feedback helps to perform gestures.
- Visual feedback maybe distracting and difficult to perceive.
- Auditory feedback may not be practical always due to social conventions, environmental noise *etc.*
- Eye-glasses provides several natural contact points with the skin and haptics is a promising feedback modality for gaze interaction.



## Related work

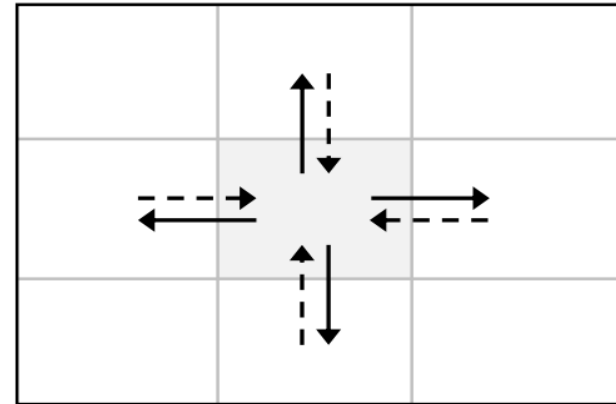
- Rantala et al.<sup>1</sup> designed a wearable haptic feedback prototype for use with gaze gestures.
  - 3 vibrotactile actuators attached to the frame of the glasses.
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- The diagram shows a pair of black-rimmed glasses. Three dashed circles highlight the locations of haptic actuators: one on the bridge of the nose and two on the lower part of the temples.
- 20ms sine wave at 150Hz used to drive the actuators. The actuation resembled a tap.
  - **Result:** Stimuli from one actuator easier to recognize than simultaneous actuation of multiple points.

<sup>1</sup> Rantala, J., Kangas, J., Akkil, D., Isokoski, P., & Raisamo, R. (2014, April). Glasses with haptic feedback of gaze gestures. In *CHI'14 Extended Abstracts* .



## Related work (contd..)

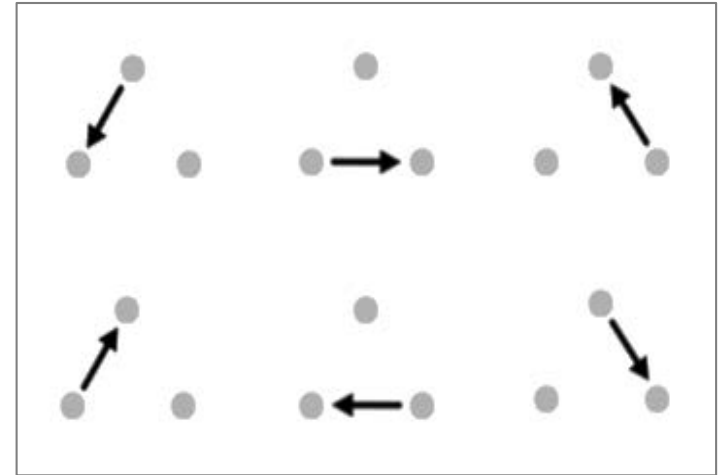
- Same study investigated how participants associate haptic feedback with gaze gestures.
- Participants tried 2-stroke gaze gestures in all 4-cardinal directions and selected haptic feedback separately for each stroke if helpful.
- **Result:** Users prefer feedback only at the end of first stroke. Chosen feedback spatially congruent with the gaze movement.





# Study 1: Localizing Haptic Stimulation

- **Aim:** Improve haptic feedback design by adding a short delay between stimulation from two actuators.
- Six moving haptic stimuli with a 400ms delay between two actuators.



- **Participants:** 16 participants (age: 19-41, median 23) took part in the study
- **Task:** Sense the haptic stimulation, select the corresponding stimuli in the computer screen. 24 trails.



## Study 1: Results

- 15 out of 16 participants localized all sequences perfectly, and the mean localization accuracy was 99%.
- Front actuator was rated significantly more unpleasant than left ( $p < 0.01$ ) and right ( $p < 0.01$ ) [Pairwise Wilcoxon signed rank test for bipolar rating scale -4 to +4].



## Study 2: Effect of Haptic Feedback on Performing Gaze Gestures

**Aim:** To understand effect of haptic feedback on gaze gestures.

**Participants:** 12 participants (age: 19-27, median 22)

**Apparatus:** Tobii EyeX connected to a 24" computer display.  
Glasses and stimuli same as used by Rantala et al. 2014.

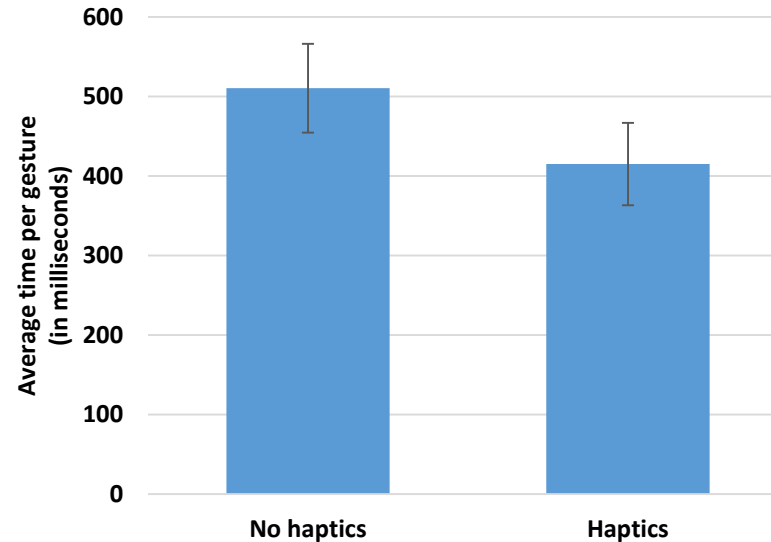
**Procedure:** Gesture to be performed shown on middle of computer screen (< or >). Two groups of participants and two blocks of 25 trials. One group received haptic feedback (for both strokes) and other did not.







## Study 2: Results



- Participants performed gestures faster with the haptic feedback (510ms without feedback, 415ms with feedback)
- However, difference not statistically significant.



## Discussion

- Temporally separated haptic stimuli better than simultaneous actuation. In terms of subjective preference, haptics behind ears better than in front.
- Small effect of haptic feedback on time to perform a gesture. The effect might be bigger for more complicated gestures or in tasks requiring repetition of gestures.
- Haptics has large and untapped potential as a feedback modality in glasses, for gaze interaction.
- General goal of our research is to study the combination of gaze-input and haptic feedback in smartglasses for everyday interactions.



Thank You!

Try our demo 😊!