Leveraging Distal Vibrotactile Feedback for Target Acquisition

【Summary】:

In this paper, we consider distal feedback, through vibrotactile stimulation on a smart-watch placed on the user’s non-dominant wrist, as an alternative feedback mechanism to interaction location vibrotactile feed-back, under the user’s finger. We compare the effectiveness of interaction location feedback vs. distal feedback through a Fitts’s Law task completed on a smartphone.

【4 forms of feedback in the article】:

(1) fill feedback, (2) center feedback, (3) line leading edge feedback, (4) no feedback (blue colouring denotes feedback area).

【Apparatus】:

Sony Smartwatch 3+Nexus 7P

【Experiments】:

The final experimental design included four haptic feedback conditions.

•Interaction location feedback with no delay (C01): when the user correctly enters the target region, the phones vibration motor immediately activates and remains active until the user either lifts their finger or removes their finger from the region. This is typically the way that vibration-based feedback works in modern interactive touchscreens.

•Interaction location feedback with delay (C02): when the user correctly enters the target region, the phones vibra-tion motor activates after the calculated delay time (39ms) and remains active until the user either lifts their finger or removes their finger from the target plus the delay time.

•Distal feedback (C03): when the user correctly enters the target region a message is sent from the phone to the smartwatch to activate the watch vibration motor. This remains active until the user either lifts their finger or removes their finger from the region, at which time a message is sent to deactivate the vibration motor of the watch.

•No feedback (C04): no vibration feedback occurs upon cor-rect target acquisition.

Hypotheses:

[H1] Feedback improves targeting time compared to no feedback.

[H2] Feedback lowers error rate compared to no feedback.

[H3] Participants prefer feedback conditions over no feed-back, and prefer phone feedback over watch feedback.

Discuss:

•H1 posited that feedback would reduce targeting time. However, we find that targeting time increases in two feedback conditions (Phone with delay and watch) versus the no feedback condition. Despite the fact that this ap-pears due to Bluetooth delay, because feedback conditions are never statistically faster than no feedback, H1 is not supported.

•H2 posited that feedback would reduce errors. We find that feedback does reduce errors; therefore H2 is supported.

•H3 posited that participants would prefer feedback over no feedback and phone feedback over watch feedback. Given our user preferences, we find that H3 is supported.