The Influence of Hand Size on Touch Accuracy

【Summary】:

Touch accuracy depends not only on the performance of the touch sensor itself. Instead, it is shown that aspects such as phone holding or screen occlusion also affect accuracy. To better understand touch input, we investigated how 11 hand features affect accuracy.

【Important】Several factors influencing touch accuracy have been previously explored. For example, Holz and Baudisch have proposed that visual features on top of the touching finger determine the desired touch location [13]. Whether a target is in easy reach of the thumb [3], whether the thumb is curled or straight [22], as well as whether a user is multitasking [20] have all been shown to impact touch performance.

【Improving Touch Input】【The Thumb’ s Influence on Touch Performance】

【DATA COLLECTION】:

Data collection is divided into two phases. Phase 1 consists of clicking on 1,000 crosshair targets, which then appear at random locations throughout the screen. Phase 2 includes five interactive tasks, each with 10 repetitions: swipe, scroll, pan, type, and select.

Attributes:

A set of gesture measurements were collected in each participant (see Figure 2). Measures include: (1) the width of the thumb pad (which may affect the touch size [13]), (2) the length of the index finger from the base of the thumb (this affects the extension of the thumb), (3) the span of the fingers between the thumbs And forefinger (this also affects the reach of the thumb [3] and the aiming angle of the thumb), (4) the span of the finger between the thumb and the little finger, and (5) the width of the palm (both affect the width of the grip). May affect the vertical stability of the phone); (6) the length of the palm (this affects the length of the handle, which may affect the horizontal stability); and (7-11) the length of each of the five fingers.

Device:

iPhone 6 and Nexus 6P

The former measures 13.8 × 6.7 × 0.7 cm smaller (screen diagonal 5.7), while the latter measures 15.9 × 7.8 × 0.7 cm (screen diagonal 4.7). In the current device environment, the Nexus 6P is medium in size, while the iPhone 6 represents a smaller class of phones.

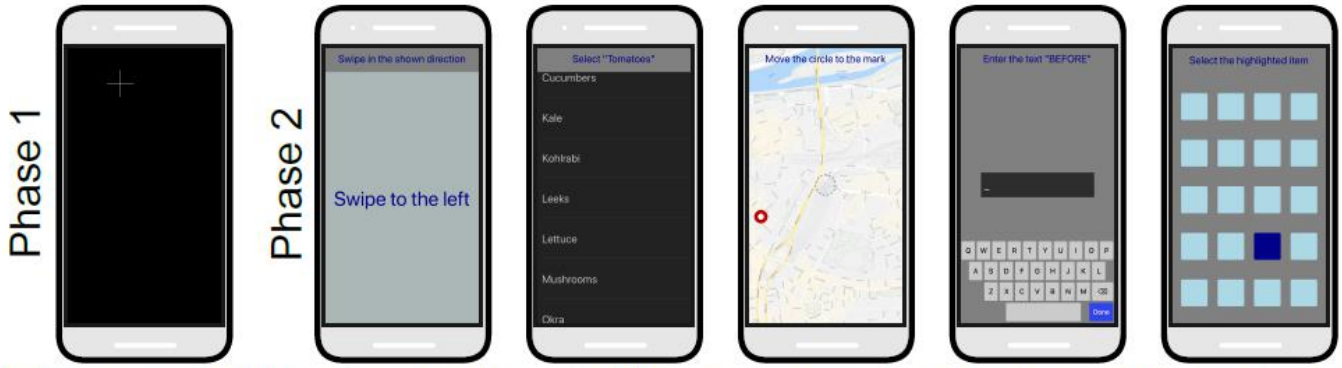

Figure 4: Screenshots of the Android study interface. The leftmost screen shows phase 1’s touch accuracy task. The other five show screens from phase 2’s: swiping task, scrolling task, panning task, typing task, and selection task.

【Experiments】:

E1-Touch Accuracy:

In Phase 1, we collected speed and accuracy data to determine how anthropometric hand characteristics affect touch accuracy across the entire screen area. The task is to use your thumb to hit the 1 cm large crosshair target that appears on the screen (see Figure 4).

E2-Recording Touch Patterns:

In Phase 2, we collected touch pattern data to explore the potential relationship between anthropometrics and higher-level interactions. We collected data from five types of tasks that represent common interactions with mobile phones (see Figure 4). In addition to touch data, we also record device movement data (such as accelerometer readings).

Swiping Scrolling Panning Typing Selection

Results: (Detail in Paper)

(1) **Overall Touch Performance**

(2) **Hand Features' Impact on Touch Error**

(3) **HIGHER-LEVEL TOUCH INTERACTIONS**

Discuss:

Our analysis shows that the size of the hand and the length of the thumb can especially have a measurable effect on touch input. . . (See the discussion section of the paper for details)

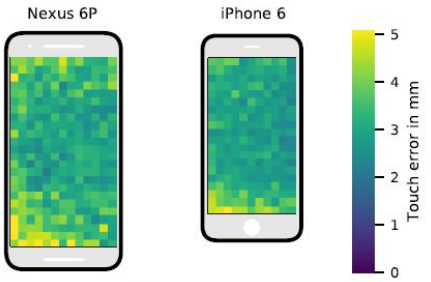

Figure 5: Magnitude of touch error after normalizing for handedness. The error varied over each phone's screen with the largest errors occurring away from the center. Error was larger along the edge opposite the one where the phone was held. This effect is more pronounced in the larger Nexus 6P.

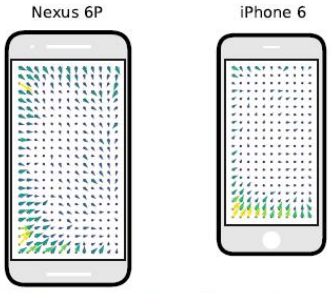

Figure 6: Plotting the direction of the touch error shows that participants tended to touch more inwards than the target's location when the target was close to the screens' extremes. This hints that the reaching motion often required for those targets introduced an additional source of error.

【Conclusion】:

We investigated the effect of hand size on touch input. The length of the thumb especially affects touch accuracy, explaining about a 12% difference. In addition, we have shown that metrics for higher-level touch interactions (such as swiping) are also related to thumb length.

【Important Reference】:

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