Ergonomics of multi-touch surfaces

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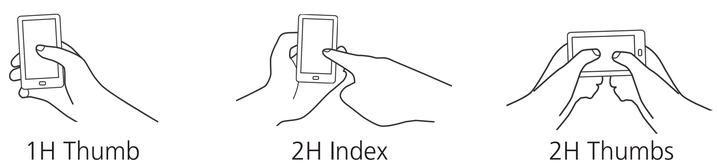
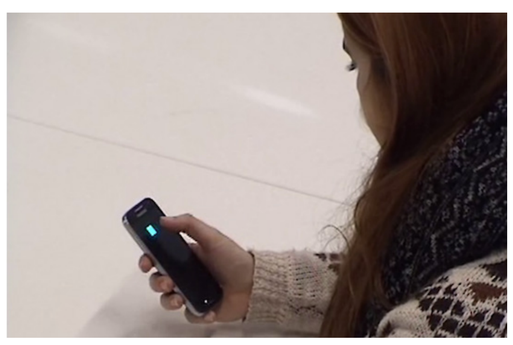
Abstract

In a public study we investigated the taps on multi-touch surfaces. We differentiated between three conditions and analyzed how efficiently and accurately people can tap on visual targets. We also explored ways to increase performance on multi-touch devices.





Findings

- Touch offsets can be corrected by 2.39% applying a correction algorithm
- Performance is high in center regions
- It's most accurate to tap with the index finger
- 2H Index usage reduces error rate by 10%

Experiment

The main focus of this study is to analyze and to understand touch input on smartphones, as well as delivering comprehensible insights for user interface designers and developers.

Therefore, we conducted an experiment where the participants had the task to tap on randomly appearing squares under three conditions. For each condition a participant had to accomplish 1140 trials. We analyzed the touch events in terms of performance, error rates, orientation and touch offsets. In total we collected 25,080 touch events per condition.

In parallel to the public study, we ran a laboratory study where the participants took part at the same experiment, but under a controlled environment.

Data was collected from 22 participants (10f, 12m), aged 23.86 years and were all right handed. The participants had a mean experience with smartphones of 3.59 years.

The study was implemented within an Android app that guided the participants through the single steps of the experiment. The collected data was sent as logfiles to a Node.js Server. For the analysis we implemented an tool based on the Processing library which outputs visualizations.

In a follow-up project we used the findings of this study to develop and analyze an algorithm for touch offset correction, utilizing the linear combination of touch offset vectors.

Future Work

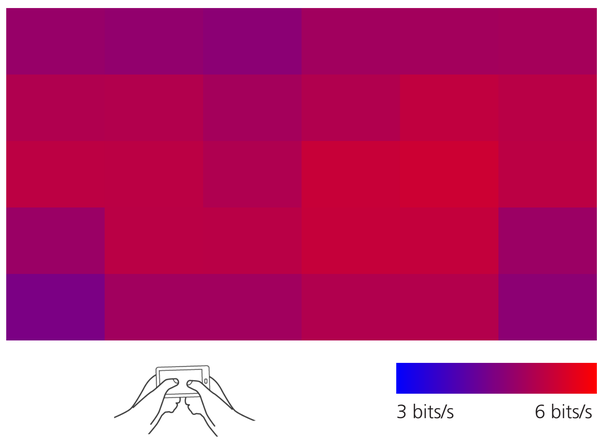
It's planned to submit parts of this work as an paper to the 2016 ACM International Conference on Interactive Surfaces and Spaces.

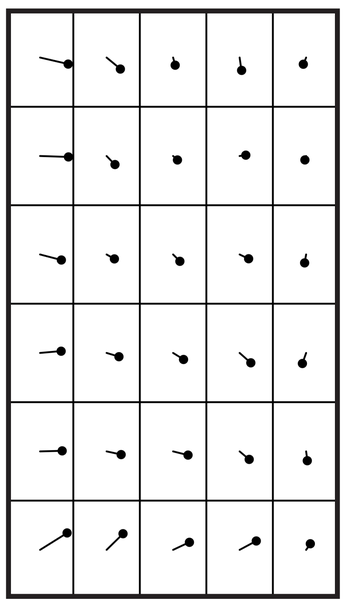
We also plan to open-source parts of the source code and to utilize gamification to conduct a large scale public study, investigating different types of touch input on multi-touch surfaces of smartphones.

Performance

Measures how quickly a person taps on a target

- Performance is high near the assumed fingertips of the thumbs
- The right half shows a higher performance than the left
- The corners show a lower performance in general





Lengths: 0.13mm - 0.94mm

Touch Offsets

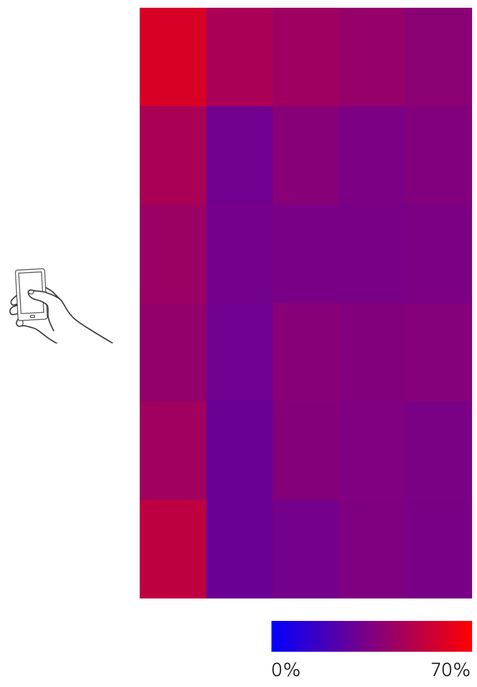
Offsets between the taps and targets, interpreted as vectors

- In the left border region, people tap more to the right of a target
- Touch offset vector fields shows a systematic skew of touch events
- Touch offset vector fields can be used for algorithms to correct touch input and make it more accurate

Error Rates

Number of times a person missed the target

- The top and left border regions are more error prone than those on the right and bottom border
- The top left corner shows extreme error rates which is correlating to a low accuracy
- Central regions show a lower error rate, as they are easier to reach with the thumb



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