A reachability feature for one-handed interaction with smartphones

TAXY

GIVES YOUR THUMB A LIFT.

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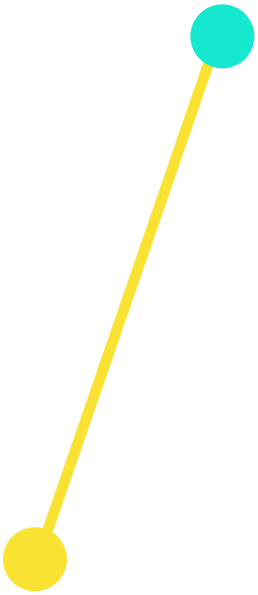
INHALT



INHALT

ABSTRACT

Display sizes of smartphones have increased enormously in the past years. Statista estimates that in 2019 around 75% of all smartphone unit shipments will include a 5.5“ screen or larger[1]. This leads us to a servere reachability problem when it comes to one-handed interaction with smartphones as most elements on the screen are far out of the thumb‘s reach.

TAXY is a feature offering a solution to this problem. Once activated by a flick gesture, TAXY generates a new virtual cursor, determined by the user’s thumb position and the current values of the accelerometer. Distant elements can easily be reached and moved - even on a large screen.

This feature was developed using a 5.5“ smartphone (Android), a notebook (MacOs), Android for Processing and the ke:tai library.

[1] Statista. (2018, August). Smartphone unit shipments worldwide by screen size from 2018 to 2022 (in millions). In Statista - The Statistics Portal. Retrieved from https://www.statista.com/statistics/684294/global-smartphone-shipments-by-screen-size/ [Accessed Feb. 7, 2019]

MOTIVATION

The mentioned problem of reachability should be given attention as it is not only a challenge of the present but also of the future. Bad reachability means bad usability. If screen elements can not be reached at ease, the users are forced to shift their grips and employ a shaky handling of their phones. As a consequence, many phone displays break and users end up frustrated. Finding a solution to this problem would mean a huge competitive advantage among smartphone producers.

So far there have only been some very basic attempts to confront this issue. Apple has released “Reachability”, a software option that lets users temporarily move the iPhone user interface down towards the bottom of the screen.

But still, this is not an all-in-one solution: Many elements, especially the ones close to the screen borders, are not easily reachable. In addition, the lower half of the screen disappears. Which means that interaction between the two halfs of the screen is hardly possible.

Huwai released an UI adaptation called “Mini Screen View”. By swiping up diagonally from either bottom-left or bottom-right the screen will scale down into the corner.

“Mini Screen View” has an obvious problem:
The advantages of a big screen get lost. Information will be displayed in a smaller size and the “fat-finger-problem” revives a comeback.

CONCEPT

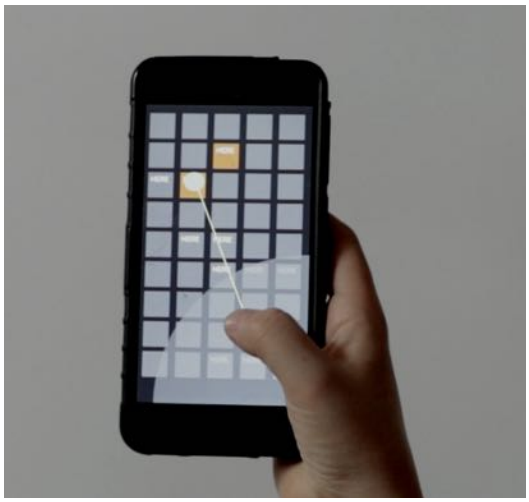
The innovation in TAXY lies within the new interaction techniques. While previous attempts are mainly based on simple touch gestures, TAXY employs the following gestures: Two-Axis-Tilt, Flick, Tap.

The title explains the technical background:

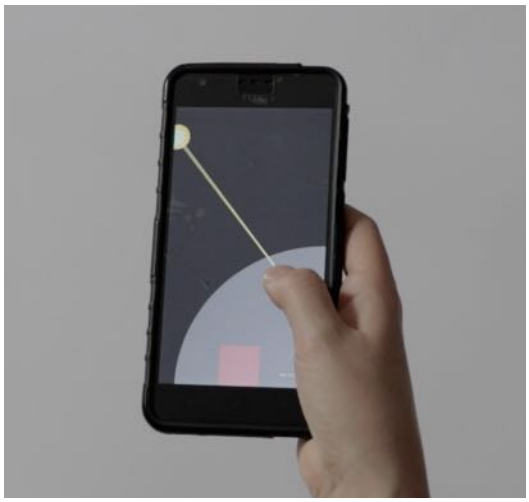
By T ilting the smartphone
the values of the A ccelerometer
on the X – Axis
and the Y- Axis will change.

These values in combination with the thumb position can then be used to generate an extension of the thumb. The feature can be enabled and disabled by a flick gesture (similar to swipe).

Two tasks were designed to test essential ways of interaction: Selection and Drag and Drop.

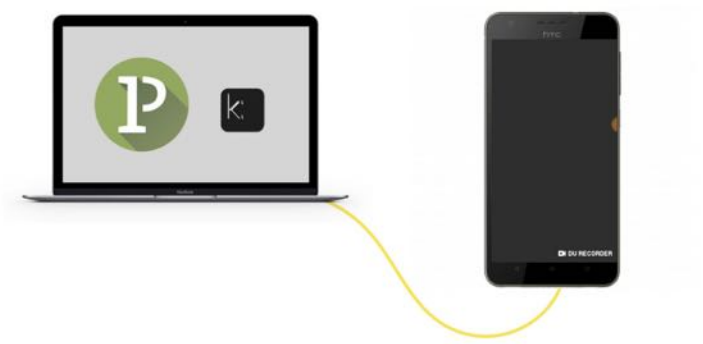


1. Selection. For selection the user has to tap. The x- and y- coordinates of the selection are determined by the virtual cursor instead of the thumb.



2. Drag and Drop. Again, an element can be selected by moving the cursor over it and then make a tap. To transport an element, the user has to keep touching and tilt the phone towards the desired direction. Once it has reached the new location, the user can release the touch and the element will drop.

IMPLEMENTATION



For the implementation of the prototype I used:

Hardware
HTC Desire 10 Lifestyle, 5.5" display, running Android 6.0.1
MacBook Pro (Mid 2014) running macOS Mojave
USB cable

Software
Processing 3.4
Imported libraries:
Android Mode 4.0.3 by The Processing Foundation
Ketai v14 by Daniel Sauter and j.duran

I programmed my sketches in Java language and switched the Processing IDE to Android Mode. In the beginning I ran sketches in the emulator. Later I transferred them to a smartphone using a USB cable.

In order to put the right limits for the tilt gesture I had to find the ideal tilt values first. I followed a tutorial on Processing for Android[2] which helped me to receive sensor measurements. I ran a sketch that responded to changes in acceleration and displayed the current values on the screen. By holding and tilting the smartphone in my right hand I could get a guess of ideal values.

For the activation of my feature I wanted to find a rarely used gesture to prevent accidental activation. The best I could find was the "Flick" gesture of the Ketai library. Unfortunately, it is similar to a swipe and in the user tests it caused an increase of the error rate.

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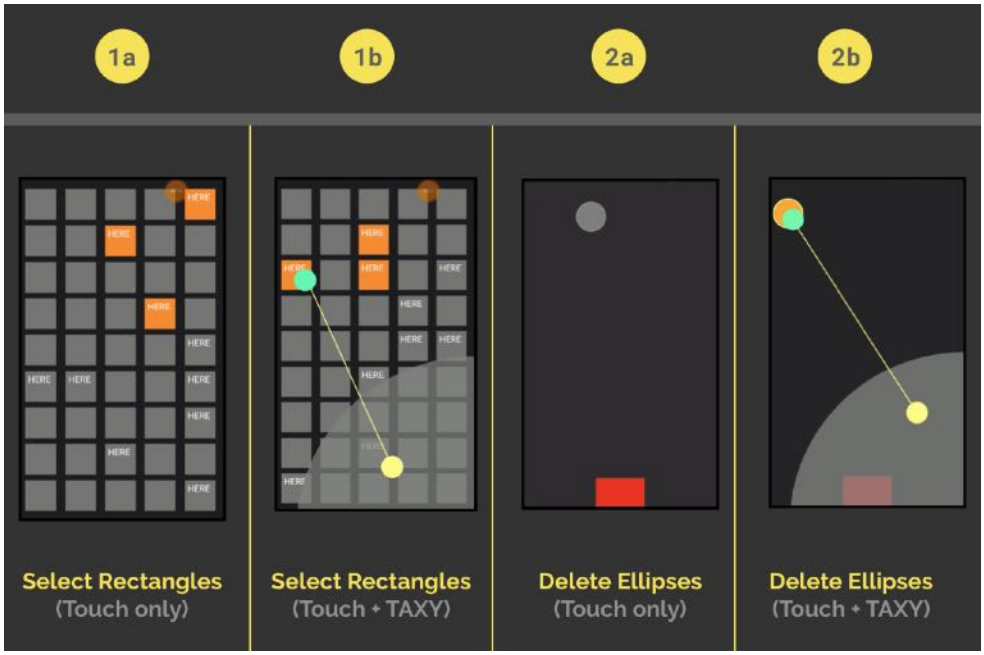
[2] The Processing Foundation. Processing for Android - Using the sensors. Retrieved from https://android.processing.org/tutorials/sensors/index.html [Accessed Feb. 7, 2019]

EVALUATION

6 people aged between 20 - 30 participated in the user study. Every test subject had to complete 4 Tasks (s. below). They were given a training phase in order to get used to TAXY. They decided when they were ready. They were asked to think aloud. The sessions were video taped. After the task completion they answered a SUS questionnaire which scored 80/100.



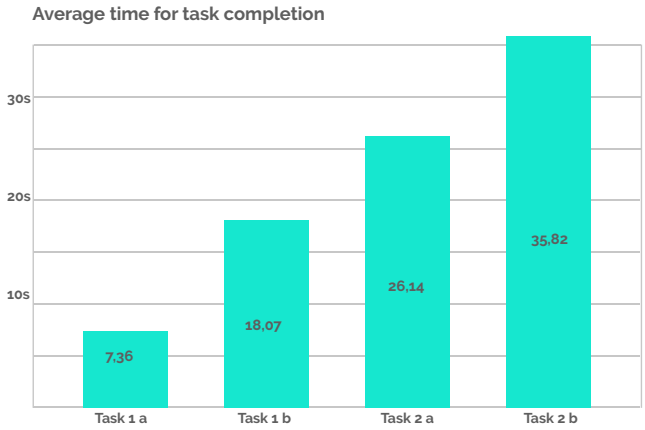
Observations

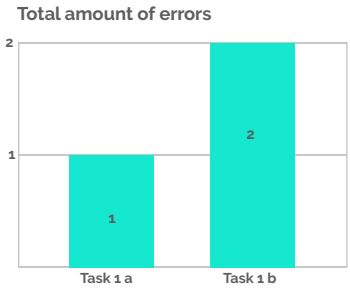
1. Test subject 3 and 4: the ones with the longest training phase achieved the best results. A longer training seems to make an impact.

2. Users barely used the combination of the two techniques, although I emphasized several times this possibility. Maybe the training phase was too short or the combination demands too much effort.

3. Especially in Task 2 a (Drag and Drop - Touch only) the users had to shift their grip a lot. The hand was very unsteady and the phone could easily slip out of their hands. TAXY allowed a steady handling of the phone.

4. Subjects with bigger hands and longer finger were faster. So there is probably a correlation between ratio of hand to display and the operation speed.





CONCLUSION

The prototype does not speed up one-handed interaction with smartphones, but makes it more secure and comfortable. The overall goal of reachability could be met.

Still, there are many possible improvements that can be realized in future work:

Prototype

Functional
Magnet
New activation gesture (Zigzag)
Detect posture
(standing vs. laying on back)
Automatic deactivation after usage

Design
Remove ellipse at the thumb position
Remove connection line
Remove overlay
Transparent cursor

User Tests

Longer training phase and same duration for everybody
More open questions
No table (many test subjects supported their arm on it)
Automatic timer, error counter, screen recorder
Different display sizes