Modeling Human Behavior during Touchscreen Interaction in Mobile Situations

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Abstract
As mobile devices are becoming more ubiquitous, it is common for users to interact with them in many different situations. In our research, we focus on modeling human behavior during touchscreen interaction in mobile situations. Resulting models do not only increase our understanding of human behavior but also predict or infer intended user interaction. This enables us to design interfaces suited for one-handed interaction and to derive new interaction possibilities. In our work, we will collect data in lab studies as well as on a large scale to create models with high external validity.

Author Keywords
Touchscreen; human behavior; mobile device; research in the large

ACM Classification Keywords
H.5.2 [User Interfaces]: Input devices and strategies

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Research goals and approach
Models do not only help to explain human behavior but can also be used to predict or infer intended user interaction. Famous examples include Fitts's law to predict the required time to reach targets, or probabilistic text entry models to enable gestural text input on mobile devices. In recent years, touch interaction has emerged especially on mobile devices. Prior work presented models to predict the thumb's reachable areas on touchscreens [1], describe touch error rates [2], or model touch scrolling transfer functions [5].

As mobile devices are becoming more ubiquitous nowadays, interaction takes place in many different situations. This includes mobile or encumbered situations which lead to less precise input or constrained input due to one-handed interaction. Our research project focuses on modeling human behavior during touchscreen interaction in mobile situations. As gestural input can increase input performance using models to infer intended user input, we will also investigate models of touch gestures.

Resulting models of this project will help to design more efficient and ergonomic touch interfaces in mobile situations. Specifically, these models will help to avoid grip changes which can be detrimental for mobile interaction, or enhance touch input performance during one-handed use by understanding the constraints. Additionally, touch and

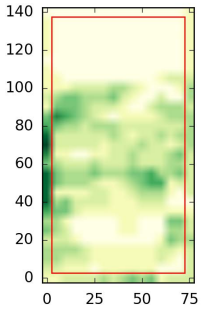

Figure 1: Finger placement during text input using an on-screen keyboard.

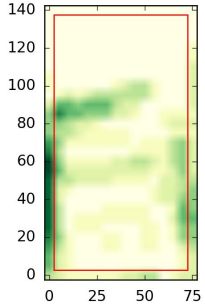

Figure 2: Finger placement while reading a text.

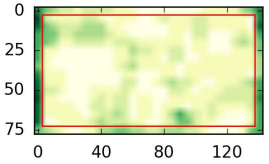

Figure 3: Finger placement while watching a video.

hand grasp models of mobile device interaction help to derive new interaction possibilities from an ergonomic perspective, or help manufacturers to find appropriate placements for sensors such as cameras, microphones or additional touch panels.

Using data collected in a series of lab studies will enable us to create models with a high internal validity. As the participants' background and contextual factors in different situations can have a large influence on their usage behavior, we will also develop apps (e.g. games) to publish them in app stores to collect data in a large scale. These apps will be designed to answer specific research questions and are therefore freely available to over hundred thousands of users.

Research conducted so far

We investigated finger placement and hand grasp during smartphone interaction in a lab setting [3]. This enables us to understand which fingers of the user's hand are free to interact with the phone and where novel interaction elements could be placed on the back or on the edges of the device (see Figure 1 – 3). With this model in mind, we built a smartphone prototype with a back-of-device (BoD) touch panel to evaluate different BoD interaction methods. These methods aim to ease one-handed interaction with large smartphones during mobile situations [4].

Remaining efforts and expected results

Next steps involves expanding our results published in [3] in different ways: Firstly, we will investigate natural finger placement and hand grasp during mobile and encumbered situations. Secondly, we will look deeper into modeling reachable areas of all fingers to inform the placement of sensors or additional touch panels on mobile devices. Further, mobile applications will be developed and published in App stores to collect data about touch interaction in a real life context.

We expect to build models that help to improve touchscreen interaction in mobile situations. Our models will predict the quality of mobile interfaces already in the design stage and support the derivation of new interaction possibilities. Data collected on a large scale will enable us to generalize the findings to realistic contexts.

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REFERENCES

1. Joanna Bergstrom-Lehtovirta et al. Modeling the Functional Area of the Thumb on Mobile Touchscreen Surfaces. In *Proc. CHI '14*. ACM Press (2014). DOI: http://dx.doi.org/10.1145/2556288.2557354
2. Niels Henze et al. Observational and Experimental Investigation of Typing Behaviour Using Virtual Keyboards for Mobile Devices. In *Proc. CHI '12*. ACM Press (2012). DOI: http://dx.doi.org/10.1145/2207676.2208658
3. Huy Viet Le et al. Finger Placement and Hand Grasp During Smartphone Interaction. In *Proc. CHI EA '16*. ACM Press (2016). DOI: http://dx.doi.org/10.1145/2851581.2892462
4. Huy Viet Le et al. Investigating Screen Shifting Techniques to Improve One-Handed Smartphone Usage. In *Proc. NordiCHI '16*. ACM (2016, in press).
5. Philip Quinn et al. Touch Scrolling Transfer Functions. In *Proc. UIST '13*. ACM Press (2013). DOI: http://dx.doi.org/10.1145/2501988.2501995