

# Modelling human behavior during text entry

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## ABSTRACT

Mobile text entry, used in several contexts and done in a variety of ways, has been a topic of ongoing research. Research in mobile text entry has largely depended on empirical evaluations with human participants, where users are asked to complete specific tasks to measure their performance. Until recently, metrics used for study results were based on solely users' touch input, while ignoring other factors involved in the process of text entry. We aim to develop novel metrics and models of behavior during text entry, which will incorporate aspects of human motor and cognitive processes, by adopting new technologies, to enhance current text entry research and meliorate our understanding of users' text entry behaviors.

## CCS CONCEPTS

• **Human-centered computing** → **Text input; Keyboards; Touch screens.**

## KEYWORDS

Text entry; Mobile text entry; User behavior

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## 1 INTRODUCTION

Mobile text entry is used in several contexts and systems, and is done in a variety of ways, where the ability to input text quickly and accurately is key to the usability of such systems. Text input on mobile devices, such as smartphones, tablets and smartwatches, and the behaviour of their users has been a perennial subject of research, also recently including text input in systems utilizing Augmented or Virtual Reality or systems based on the Internet of Things [2].

Research in mobile text entry has largely depended on empirical evaluations with human participants, which are time-intensive and costly to organise. In-lab evaluations with users performing transcription tasks are the actual study method, used in the majority of published studies. Evaluation protocols using these tasks, have

participants copying short phrases as quickly and accurately as possible. These short phrases are selected from standard English phrase sets [12, 14], that have been tested for memorability and representativeness of text generated on mobile devices. Until recently, metrics used for study results were based on solely users' touch input [1], while ignoring cognitive, motoric and sensory aspects that are involved in the process of text entry.

Although affording high internal validity to studies, the generalisability of the findings is hindered by several factors [15]. During laboratory experiments, participants tend to change their text entry behaviour, compared to real-world contexts [5, 13]. Moreover, recent work has demonstrated that the use of standard English phrase sets introduces unintended effects in studies with participants whose English is not their native language [4, 11].

## 2 PROPOSED METHODS

In this proposed research, we aim to develop new metrics and behavioral models during text entry, which will incorporate aspects of human motor and cognitive processes, by adopting new technologies, such as low-cost wearable eye-tracking and myoskeletal activity detection, to enhance current text entry research, while contributing to our theories and understanding of human behaviour in text entry tasks, both in laboratory and real-world contexts.

In controlled, i.e. in-lab, conditions, various aspects of users' behavior during text entry can be examined, such as typing speed and error rates. Users are asked to perform specific tasks, allowing the close observation and measurement of these aspects during text entry. However, this can not fully capture the complexities of real-life text entry scenarios. Thus, the need for conducting in-the-wild studies emerges, during which users engage in text entry tasks in their everyday environments, using their own devices. As a result, a broader range of factors that influence user behavior during text entry can be captured.

The pursuit of deriving new behavioral models, which will simulate the behavior of users during text entry (Fig. 1), also stems from the need to find economical and non-time-consuming ways to evaluate the efficiency of new typing techniques, without the requirement of conducting extensive experiments with real participants.

The necessary data will be collected via appropriately defined experiments, both in laboratories and simulating "in-the-wild" conditions. Specifically, following the General Regulation of Personal Data Protection, we shall collect:

- Typing data, which may come from mobile devices, desktop keyboards and/or virtual or augmented reality applications.
- Eye movement data, collected from wearable and on-device gaze trackers (Fig. 2).

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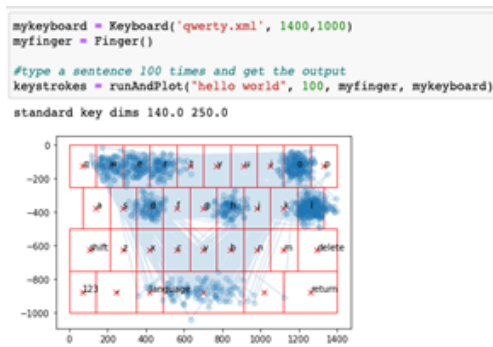


Figure 1: Simulating a text input task.



Figure 2: Eye-tracker used in text entry experiment.

- Hand and finger movement data, collected using appropriate body tracking equipment.
- Brain activity data, collected with multi-channel wearable EEG devices.
- Qualitative data, collected using closed-ended questionnaires.
- Other types of data, the need for which will potentially emerge during the research period.

### 3 EXPECTED OUTCOMES

The expected outcomes of the proposed research are:

- The study of user behavior during text entry, both in controlled conditions (i.e. within laboratories) and in real world conditions ("in-the-wild"). As outlined, to be able to fully

understand users' behavior, both modalities need to be taken into account.

- The derivation of new metrics and behavioral models, which will have incorporated aspects of human motor and cognitive processes. This will potentially contribute to cost reduction by allowing the simulation of text entry processes without the need for actual user involvement, and facilitate the evaluation of newly proposed typing techniques through computational design and synthetic evaluation.
- Attaining a comprehensive understanding of users' behavior during text entry, will therefore result in the strengthening existing research in the field of Text Entry.

### 4 CURRENT STATUS

I have been interested in Mobile Text Entry research since my undergraduate years. My first degree dissertation was titled "Analysis of mobile text entry data using machine learning techniques", while my M.Sc. dissertation was titled "Evaluation of user behaviour during mobile text entry using open data". From this experience, as well as collaboration with other students in the department, I have already co-authored two scientific publications [6, 7]. Further, from my experience working in other research projects at the Computer Technology Institute and Press "Diophantus" (CTI) and our department, I have a further four publications [3, 8–10].

My Ph.D. topic follows my interest in mobile text entry and builds upon my work in the area carried out during my undergraduate and postgraduate dissertations. Regarding the current status of my research, it is important to consider the unique circumstances of pursuing a part-time Ph.D., while maintaining professional commitments. Given the limited availability inherent in a part-time Ph.D., I am currently at the very early stages of my research, and thus, concrete results are yet to be obtained. However, I am fully committed to the Ph.D. process, balancing my work responsibilities while pursuing knowledge and striving for academic excellence.

During this preliminary phase, I have been diligently allocating time towards establishing a comprehensive theoretical framework and conducting relevant literature review. Recognizing the importance of time management and prioritization, I am committed to optimizing the allocation of time to progress towards achieving significant research outcomes. Throughout this journey, I am grateful for the understanding, guidance, and support I receive from my advisor.

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