Incremental Learning Technique for Optimized Keyboards

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***Abstract*—This paper sets out to conclude whether touch keyboard users will find it easier to learn a new, optimized keyboard layout by using a procedural learning technique. Using this method, multiple keys on the keyboard will be switched at certain checkpoints throughout the research process until the user adjusts to the placement of the new keys. There are multiple touch keyboard layouts that need to be analyzed ranging over a wide variety of philosophies and methodologies. This paper lays the foundation for a protocol to analyze the viability of incremental learning in a field study. While the paper does overview the previous works and methods, not all layouts can be fully implemented and tested in the desired conditions.**

I. Introduction

The search for better efficiency has taken researchers on large research quests throughout many areas of design and experimentation. An important area of study comes on how users interface with the keyboard and inputting text. The most common layout is known as the QWERTY keyboard which has proliferated to the point of near ubiquitous use. However, with the advent of the mobile phone researchers have been experimenting with different layouts in order to create a layout with a more efficient layout and spacing as compared to the more common QWERTY layout.

Switching to a new layout entirely from scratch is a daunting task, even for the most experienced mobile phone users. It presents a steep learning curve that needs to be overcome, and for many reasons, can be insurmountable. It is for this reason that we attempted to alleviate the steepness of such a learning curve by breaking the process down into steps. In order to do this, we attempted to compile and run the standard Android Open Source Project (AOSP) keyboard [1]. This large pre-built keyboard is one of the most commonly used keyboards on the Android platform and served as the base for which the system can be built. It is a rather dense project and the full implementation needs more work in order to fully realize the potential that this study can bring.

The key contributions of this paper are as follows:

- Analysis of previous works in an attempt to best understand the best practices of designing, building and testing a new keyboard layout.
- Outline a protocol detailing the experimentation throughout each stage of the testing process. This protocol will also include a summary of potential changes to the methods that can be made to test for other notable variables.
- Discuss implementation and explain the methods used in creating the keyboard. Key positives and negatives about the design choice will also be laid out.
- Conclude what can be further down in order to continue research in this area and how to best approach the problem in future experiments.

There is still plenty of experimentation that needs to be done but the time to run such experiments is not infinite and there are always more ideas that can be tested and shared. This paper will end by discussing potential areas to explore in regards to incremental layout learning techniques. This is done in the hopes that more work can be done at a later date to gain more insight into the power of an incremental learning system for touch typing, that may have applications in other areas.

Throughout this paper, the discussion will only revolve around soft programmable keyboards found on modern day touchscreen devices. The layouts and situations all revolve around these soft keyboards and do not directly relate to common hard keyboards typical of a desktop or laptop.

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II. Previous Works

The creation of new keyboard layouts is a highly-discussed topic in the world of Human Computer Interaction. Multiple papers have been dedicated solely to the discussion of the creation of a new layout, with each including initial philosophies, methodologies for creation and testing in both lab and field environments.

In discussing previous works, it is imperative that we look at the layouts that fall under consideration for applying an incremental learning technique towards. There are layouts that appear drastically different to that of the typical QWERTY layout, where the keyboard is formed to fit the constraints of the typical mobile device [2]. Some layouts take the approach and drastically change not only the relative layout of the keys, but they also aim to make typing on a phone a new experience. Whether it lies in position on the screen, use of other typing vectors such as sight, or even resizing the keys based on the probability of a key being typed [2,3,4]. These papers serve as an extreme side to what it means to alter the layout of the keyboard. While they certainly carry merit for their work, this paper will focus more so on papers that do not aim for a change in the tying experience. Rather this paper will focus on layouts that can be learned without changing the method of text input.

When formulating the reason for creating a new keyboard layout, there is often a discussion of how similar is the new keyboard to the QWERTY keyboard. Papers that discuss this component in the design process are of important note as the design and efficiency can be heavily determined by how willing researchers are to step outside of the QWERTY mindset. Some have taken to stay as true as possible to the most common keyboard layout, opting to only change a few keys and their orientation in return for a smaller learning curve [5]. The ATOMIK keyboard stands as one of the more drastic layout changes, with a squarer dimension and tuned to have a tendency to descend through the alphabet as one goes from the top left corner to the bottom right corner.

On the opposite extreme are the layouts that hope to closely emulate the structure of the QWERTY layout [6]. The IJQWERTY layout makes a simple swap of two keys, I and J, in order to boost the efficiency of typing on a soft keyboard without sacrificing much in the way of creating a steep learning curve. Such a philosophy has brought upon the creation of this layout, and the data suggest there is improvement in efficiency and error rate using such a configuration. However, for the purposes of this paper we will not be focusing on layouts which take an extreme approach to either, eliminating parity to the QWERTY layout, or clinging tightly to it.

The layouts that are the most interesting or this paper are those that take the middle approach and have a new layout structure without entirely separating itself from the QWERTY style. These down the middle layouts have the advantage of being able to be taught in increments, without drastically altering perceptions on how to input text. Most notable of these layouts is the Quasi-QWERTY layout which aims to be the quintessential middle of the road layout [5].

Through all of the previous works on these subjects we determined that the Quasi-QWERTY layout presents the most opportunity now for implementation. However in the future it would be best to come back to the works that have been discussed and attempt to find out if an incremental learning process could even be applied to them.

III. Protocol

After taking into account previous works, we determined that most other papers did not take into account the possibilities that incremented learning can play. Papers would often focus on their own keyboards similarities to the QWERTY and did not attempt to study using an incremented process. The protocol described in this section aims to outline a series of steps, metrics, and analysis techniques to best implement a system that can fulfill the needs of this paper.

The main instrumentation we are using in this study is the keyboard application that we are downloading onto our subjects phones. The application is built on top of the already wildly popular Android Open Source Project keyboard and serves as a common keyboard for many users. We wanted to minimize the learning curve due to external factors such as new color, design, settings, etc. and only focus on the layout of the actual keys. Using a commonly used keyboard as a base eliminated most of these external factors.

A. Research Design

We hypothesized that a procedural learning technique result in users who will find it easier to learn an unfamiliar optimized keyboard layout and be more willing to use the new keyboard layout on a daily basis. Our idea is to begin the study with a Qwerty keyboard and over time switch a few keys until the user gets used to it. That process will continue until all of the keys are in their fully optimized position.

B. Test User Sample

Recruiting can consist of an initially small sample of around 5 people who are 18 years or older. This small sample size will allow for real time analysis of the data that we receive from these users without overloading. We are also looking to run this experiment on individuals who are familiar with using an Android soft keyboard. For this reason, it is best to have the ages of the subject skew young.

C. Metrics

The main instrumentation we are using in this study is the keyboard application that we are downloading onto our subjects phones. The most important metrics that nearly all similar previous works use include:

1) Words per minute (WPM) Can be determined by either considering the use of the space bar, or even estimated by considering every 5 characters to be a word. [8]
2) Accuracy - This measurement includes correct characters (C), incorrect and not fixed characters (INF), incorrect and fixed characters (IF) and finally all backspaces used to fix errors (F). Using these variables, you can calculate three different error rates; corrected, uncorrected, and total.
3) Error rate Can be analyzed Cumulatively or in Chunks [8]. This method would disallow error correction all together and treated any character out of place as an error. The use of this measurement would require the users to be copying a display text that is presented to them.

D. Study Location

Students will be recruited from various parts of the Rutgers University community and may be asked to come to the lab for introduction and initial sampling. However, the rest of the study will be done in the field.

E. Detailed study procedures

Once the sample is put together, we will set up times to meet with them to explain the study and application. Before starting with the study, we want assess their familiarity with the Qwerty keyboard before we switch it around. This serves as a baseline and will give us an idea of how they improve or decline throughout the course of the study. The participants will be asked to use our keyboard as their native keyboard during the study, and they will periodically receive alerts to test their progress with the keyboard. In order to test their progress, they will need to go into the application and copy a line of text that is displayed. The application will store the measurements taken and relay back to a central database.

IV. CONCLUSION

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