Alternative Keyboard Layouts for Improved Password Entry and Creation on Mobile Devices

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ABSTRACT

With the rise of mobile computing, users are using their phones and tablets for more and more applications that require password entry, both recalling and creating passwords. The soft keyboards for these devices are not well designed for password entry as they require users to switch between alternate views to gain access to less common keys and symbols. Inevitably, this leads to password entry being inefficient and inconvenient, and it could also subtly force users to create weak passwords to further ease the entry procedure. To address this issue, we explored two soft keyboard designs that are specific for password entry on compact screens of mobile devices. The primary goal of these keyboards is to make special characters and numbers more available to the user without having to switch screen layouts while also maintaining similar access to the alphabetic keys. Additional, as these are "soft" keyboards being displayed on the screen, information about password choices can be displayed to aid users selection, much like Telepathwords [2]. Following the creation of the two layouts we ran a pilot study to test one of our designs. Our layout show promise through the preliminary testing, and we intend to expand our initial pilot study with more participants.

1. INTRODUCTION

Current software based keyboards (or "soft keyboards") on mobile devices are often inefficient and cumbersome for users to create and enter a strong, secure password on a compact touchscreen. The special characters and numbers that are required for most "strong" passwords are often not directly accessible on the primary keyboard and thus using them slow the speed of password entry. For example, the standard Android keyboard requires three different alternate displays of all alphanumeric characters and special characters to realize the full set of symbols that are suggested for strong passwords. The inconvenience that this presents leads to users utilizing weak passwords on their mobile devices [3].

In this poster abstract, we describe a potential solution to this problem. We designed and prototyped two alternate keyboard layouts that are specifically designed to aid password entry. Both layouts are designed for the Android operating system and are installed as a standard keyboard application. When activated, if the user is within a password text field, the password-specific keyboard is displayed; all other times, the standard keyboard is used.

During our design phase, we concluded that the primary limiting factor for efficient entry of a password is switching screen layouts though alternate keyboards to reach special characters and numbers. In both designs, we set the requirement that the keyboard should enable access to the broadest set of symbols/numbers with the least amount of alternating views. This led to two designs:

- **Cycle Keyboard**: The cycle keyboard expands the standard QWERTY keyboard screen vertically to add a fixed row of numbers and a *cycle bar* that cycles through the special characters without alternating the primary keyboard. (See Figure 1)
- **Scroll Keyboard**: The scroll view keyboard abandons the QWERTY layout in favor of three vertical scroll bars (like a slot-machine) that display upper case, numbers and symbols, and lower case numbers. (See Figure 3)

Both designs differ than other proposed custom keyboards, such as [1] which kept alternate layout but with two added rows of numbers/symbols not incorporated into the main keyboard. Additionally, as these are soft keyboards dislayed on the touchscreen, this provides an opportunity to implement techniques to help guide users in password selection, such as Telpathwords [2] where stronger "next characters" are suggested to users. We implemented such a system on the cycle keyboard.

Finally, we conducted a small pilot study with 10 participates to measure the efficiency of entering and strength of creating passwords with the cycle keyboard. We find that password entry speeds greatly increase with the cycle keyboard, but the results for password creation are inconclusive. Advancing these results is an area of continuing research.

2. ALTERNATE KEYBOARD DESIGNS

Cycle Keyboard. The main motivation for the cycle keyboard design was to make special characters and numbers more accessible to the user. This led to adding a row of numbers directly over the QWERTY style keyboard, and also adding a *cycle-row* of special symbols that alternates between special symbols. We utilized the RockYou password dataset to determine which special symbols are used most frequently. The four most common were placed near the space bar at the bottom of the keyboard and the remaining ones were placed in the cycle bar. The user controls the cycling of that bar with a "Cycle" key located in the upper right of the keyboard. The remainder of the keyboard kept the QWERTY layout with the shift key for upper-case letters.

The cycle keyboard also featured Telepathwords [2] trained on the RockYou dataset. This feature is activated via the triangle shaped key on the lower left of the keyboard. When activated this feature provides next character suggestions to the user by illuminating different color dots on the upper left corner of each character key (see Figure 2). This is accomplished by setting up a bigram model of passwords trained from the RockYou dataset, and suggestion are made to nudge users towards choosing an uncommon next key (green is a good/uncommon key to select next, red is a bad/common key to select next).

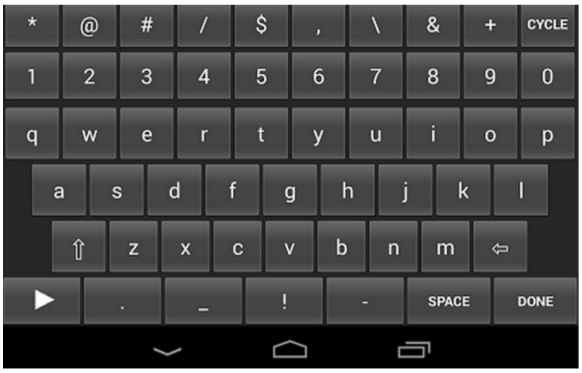

Figure 1: Cycle Keyboard Layout

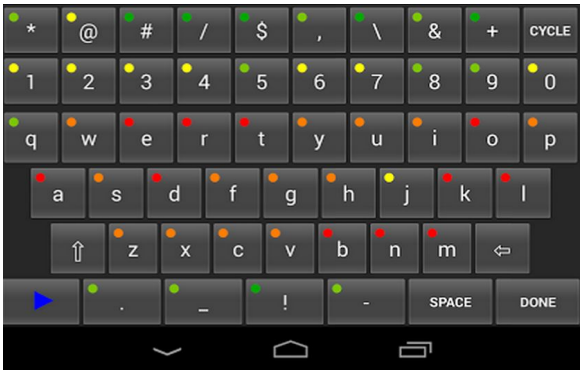

Figure 2: Cycle Keyboard with Telepathwords

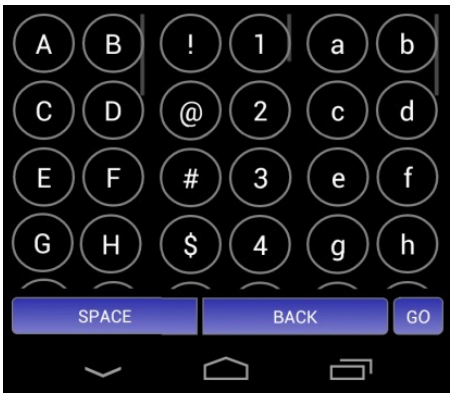

Figure 3: Scroll View Alternate Keyboard Layout

Scroll Keyboard. The scroll keyboard design feature choose to remove alternate keyboards entirely by making all characters accessible at the same time. To accomplish this task, vertical scroll bars are used such that the user can scroll through three categories of characters at once, much like a slot machine display. In this design, the upper-case characters, lower-case characters, and numeric/symbols each have a seperate scroll view. We did not implement telepathwords on this keyboard layout.

3. PILOT STUDY

We conducted an IRB approved pilot study of the cycle keyboard (we leave testing the scroll keyboard for future work). We were able to recruit 10 participates: all undergraduates ages between 18-22; 8 males and 2 females; all familiar with mobile device soft keyboards.

Methodology. The study comprised of two parts: an efficiency portion, testing how fast/accurately can users enter passwords; and a strength portion, testing the strength of created passwords. In the first part, efficiency, users were familiarized with the keyboard and then prompted to enter a predetermined "strong" (special characters, numbers, upper/lower case letters) password. They did so twice, first on the Android a standard QWERTY keyboard that ships with most devices, and then using the cycle keyboard. Once finished, in task two, the users were asked to create a password, first on a standard QWERTY keyboard and then again on the cycle keyboard with telepathwords optionally turned on.

Results. Comparing the cycle keyboard efficiency to that of the standard keyboard, the cycle keyboard was on average three time faster for password entry. We feel that these results would further improve if the user had more time to acclimate to the alternate keyboard layout. Unfortunately, the strength portion was largely inconclusive because users were not clear on how to use Telepathwords and also did not understand "strong password" semantics. Furthering this experiment is a focus of our continuing research.

4. CONCLUSIONS AND FUTURE WORK

While the overall results of our prototype for cycle keyboards were both positive and negative, we do find that changing the layout of the keyboard for password entry can substantially effect the user experience, particularly the speed of password entry. The exact layout that will produce the fastest password typing speeds may vary from user to user, but in the majority of cases the standard Android keyboard are not the most efficient keyboard for password entry.

In the future, we would like to conduct an expanded study on both of our keyboard design layouts. In these tests, we will allow users to first become proficient on both keyboards before analysis. The instructions for how to utilize all features of both layouts will be explained in depth before any testing begins as well as using a "warm up" round to better familiarize users with the placement of keys on the alternate layout.

Additionally, we wish to connect the results of these experiments into furthering the design space. For example, we will expand our experimentation to account for the form factor of the device. The varied screen size of tablets vice smartphones may allow for more variations in the design space that can take advantage of more (or less) screen real-estate.

5. ACKNOWLEDGMENTS

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