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BrailleÉcran: A Braille Approach to Text Entry on Smartphones

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***Abstract*—Nowadays, due to touchscreen, mobile devices have become much more dynamic than in the past. However, due the same reason, those devices are less accessible for blind people who depend on physical keyboards to type. In order to allow blind people performing text entry more easily, this research have as goal the development of a method, called BrailleÉcran, for smartphones with no physical keyboard. The method combines an Android application and a kind of screen protector with points and Braille symbols. This paper presents a proposal, results, discussion and future works.**

***Index Terms*—Braille, Blind People, Smartphone, Tangible Interface, Text Entry.**

I. Introduction

Around the world there are about 285 millions impaired visual people and about 39 millions are blind [1]. To those people, the technology can expand communication and personal autonomy, minimize or compensate the restrictions related to the lack of vision [2].

Researches show that over half of global mobile phone users will have a smartphone in 2018 [3]. Used as a personal computer, it offers sufficient processing and memory for doing many tasks. However, the touchscreen brought difficulty usability for blind people, that need to use a smooth screen, without tactile sensation, so important for their spatial recognition.

One approach frequently used by blind people for text reading and writing is the Braille System. Accepted in several countries, is used to literacy visually impaired and consists of 63 symbols represented by six points combination (3x2), where each set of points forms a character (Figure 1) [4].

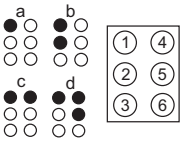

Figure 1: Braille alphabet, letters a, b, c and d.

Considering that message is a dominant way for communication between people [5], besides the fact, Braille is a method frequently used, in the last years braille text entry researches has been developed. Presents are some work related: BrailleKey [6], the app screen is splitted in two lines (2x2), first is reserved for text entry, in the left, one touch selects the point 1, two touches, the point 2, and long touch, the point 3. The same applies to right, for points 4, 5 and 6. BrailleTouch [5], accepts simultaneously six finger on screen, with two hands support, yet requires the screen in the opposite direction to the user. In the EdgeBraille [7] the letters can be input with arbitrary points sequence and offers a cell cover to guide the user on the screen limits. HoliBraille [8] offers vibrotactile feedback for text entry with six vibrating motors supports and the firsts results the BrailleÉcran [9].

This paper present the BrailleÉcran evolution, compound of a Android App and a tactile interface, so important for blind people spatial location. Others researchers developed a app or a tactile interface, separately. BrailleÉcran joins both solutions.

Moreover, this paper is structured as follow: section II, Methodology, presents the materials and methods used, in III, Results, show the app and tactile interfaces layout, in IV, Discussion, presents the main functions the interfaces and for last, in section V, the conclusion and future works.

II. Methodology

These experiments were splitted into two parts: predictive and experimental evaluation. This paper is a result of predictive evaluation, accomplished for a voluntary, 36 years old of age, congenital blindness, braille literate, graduated and computer and cell phones experienced. The BrailleÉcran prototype is a set of a Android application and a tangible interface, printed in a 3D Printer. The application prototype is being developed with Android Studio 1.3.2. The screen shield is being built in a 3D Printer, Prusa Mendel i3 like, and printed in white transparent PLA (Polylactic Acid). The experiments are being accomplished on Motorola, Moto G, 2ª generation, with 5" screen and dimension 70,7mm x. 141,5mm, with operating system Android™ 5.0 (Lollipop).

III. Results

The next figure shows the app screen and tactile interface. The Figura 2A: **1)** Text box. **2)** Confirm. **3)** Braille cells. **4)**

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Send message. **5)** Delete. **6)** Left and Right. **7)** Display. **8)** Exit; and the Figura 2B: **1)** Checkpoint. **2)** Path.

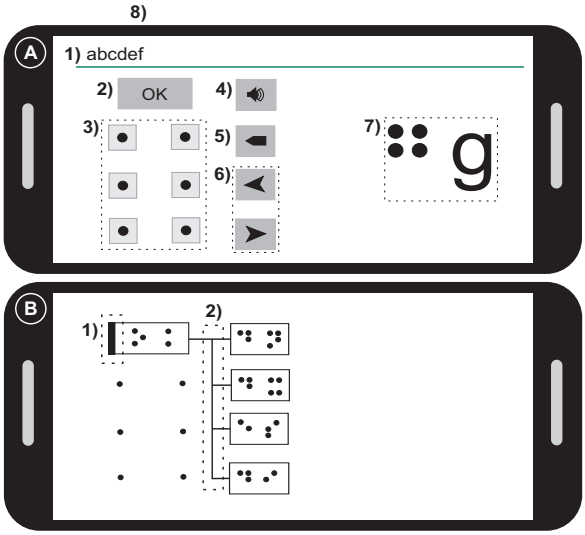

Figure 2: A. App Interface and B. Tactile Interface.

IV. Discussion

Below presents the apps main functions and its Tactile Interfaces:

A. The application

The app is divided into three columns, in order to allow fingers sliding in vertical, without needing to slide horizontally to write. So that the user is aware of his actions there are two types of feedbacks: vibrotactile and audio.

The ”Text box” (A.1) shows typed message and have a principal function become easier to the user be assisted by sighted people. To a more compact interface, the buttons ”Confirm”, ”Send message” and ”Delete” have more than one function. ”Confirm” (A.2): they are always activated by a simple touches, confirm letter typed in "braille cells"(A.3); insert space when none braille button activated and deactivate the Keypad. ”Send message” (A.4), activated with a simple touch, offer two functions: a long touch sends the message and a single touch cancels the sending and returns for typing mode. ”Delete” (5) also have two functions: deletes letters with a single touch, and with a long touch, clears the display (A.7).

Each point of ”Braille cells” (A.3) is also activated by single touch. More than one point can be activated simultaneously and it is not necessary follow the numeric sequence of braille, for instance, 12 and 21 will result in the same letter, ”b”. As in Braille, to activate the keypad, the user should type 3456 symbol; for caps lock, type 46 and capital letter, type 46 twice. To deactivate the keypad and caps lock insert space. The capital letter is automatically deactivated after the confirm letter.

The ”Left” and ”Right” (A.6) are used for navigation, moving the cursor by a simple touch. The ”Display” (A.7) shows the braille points typed and the letter being formed. Finally, for closing the app, the "Exit"(A.8), the user should press the buttons for volume control on the smartphone.

B. The Tactile interface

The apps layout is fixed, so the screen shield can be used by different screens sizes. The ”Confirm” (A.2), ”Send message” (A.4), ”Delete” (A.5), ”Left” and ”Right” (A.6) buttons are represented with two firsts braille letter and have border for to delimit each touch. The dots are printed just above the Apps buttons, because then the user can locate and press the exact location without any interference. The goal of ”Checkpoint” (B.1) is a localization mark to the interface elements. The ”Path” (b.2) guides the user for the buttons, like a tactile floor, used for direct people in environments.

V. Conclusion and Future Works

Although BrailleÉcran is still a prototype and there are some issues to be solved, it already shows promising results. In order to evaluate users usability and experiences, we are planning experiments with volunteers. We also plan to create customization options for users adapting your app and to produce the tactile interface as a removable cover.

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