

The Prototypes of Braille to Speech Application as a Self-Learning Support Media for Visually Impaired Person

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Abstract : Visually Impaired Person (VIP) is a person who has a reduction of eyesight. VIP uses Braille as a written communication tool. This application is developed to let VIP learn Braille by themselves so that they could master the beginner braille faster. By Prototyping method, two mains mechanism has been developed, they are the braille translation mechanism and the scanning mechanism. The translation mechanism could translate braille to words from the taken braille picture. Since taking the braille picture manually is impossible for VIP, the braille scanning mechanism is developed. By scanning and letting the square pattern in frame the camera, the prototype will take the picture automatically which the braille is located inside that square pattern.

Key words : Visually Impaired Person (VIP), Braille, Mobile App, OpenCV, Speech

1. Introduction

According to World Health Organization (WHO), around 1.3 billion people around the world are Visual Impaired Person (VIP)⁽¹⁾. In general, visual impairment is defined as the reduction of the eyesight that cannot be corrected by standard glasses or contact lens and it reduces a person's ability to perform some daily tasks⁽²⁾. Braille is tactile format of written communication for people with low vision and blindness worldwide, since its inception by Louis Braille in 1829⁽³⁾. Braille was a system of embossed or raised signs which used 6 dots to represent different characters, which were arranged in 3 rows and 2 columns⁽⁴⁾ as shown in Figure 1. Unique combinations of raised dots would represent different characters⁽⁵⁾.



Figure 1. The braille written on paper

Blind Braille readers were better than sighted controls at tactile recognition of dot patterns (with similar dot diameter and spacing to Braille). It was thought that the Braille-reading experience of the blind subjects accounted for these findings. Performance of the late-blind subjects was somewhat worse than the early-blind subjects but substantially better than that of the sighted subjects⁽⁶⁾.

There are two types of VIP: by born (study braille at school) and by adult (study braille at private teaching and seminars)⁽⁷⁾. VIP learn Braille by practice and assisted by instructor whether to know they are correct or not in reading⁽⁸⁾ because the shape memorizing (1st step in learning braille) is the most difficult step⁽⁷⁾. These past years, VIP are using smartphone as well like normal people by the help of screen reader application which describe what are in the screen so that VIP could navigate the smartphone well. The survey says that the percentage of VIP who are using smartphone in Japan in 2007 is 78 % and in Malang city Indonesia is 60% in 2017⁽⁸⁾. The smartphone-based for supporting VIP was also developed⁽⁹⁾ in Japan. That system was designed to

help VIP in discovering the meaning of Braille written in the public facilities by phone with embedded camera.

Based on the problem and the potential solution, a smartphone application to help VIP in learning Braille is needed to develop. The main idea is the system will convert the Braille to speech to help learners in understanding and practicing Braille reading by themselves instead of the help from instructor just by capture to the Braille written on their book by their own smart phone.

2. System Overview

To help VIP in learning braille by themselves, the application will translate the scanned braille picture to speech sound produced by the application. By that speech, it checks the content of the braille so that the VIP will be able to know whether they are correct or wrong in learning braille. The mechanism of the application is shown as the Figure 2.

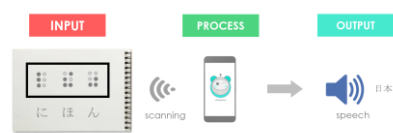


Figure 2. The Application Overviews

Based on Figure 2, there are three main steps:

1. Input

The input of the application is a braille picture. Because VIP are not able to take the braille picture manually, this application captures the braille automatically by detecting the square mark on the book. The input of the application is based on the beginner braille book for VIP by adult in Japan. The main material of the beginner braille is the shape memorizing which is the most difficult step⁽⁷⁾ and takes a long time to learn as shown in Figure 3.

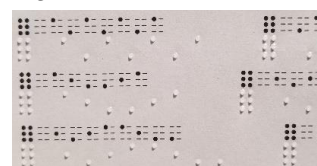


Figure 3. The shape memorizing braille

In the implementation, the book will be made which the concept is based on the beginner braille book ⁽¹⁰⁾ with some custom designs, like the rectangle mark for having communication with the application.

2. Process

In processing step, application translates the input braille picture into corresponded characters. This mechanism uses OpenCV (Open Source Computer Vision Library).

3. Output

The output of the application is a speech. The speech will be produced in the upcoming developing by using Android to Speech Engine or Google Speech based on the character translation in the previous step.

The developing process uses Android Studio with prototyping method since the project's requirement are not known. By prototyping method, two mains mechanism has been developed, they are the braille translation mechanism and the scanning mechanism.

The braille translation mechanism prototype has been developed and it translates braille to corresponded characters from the taken braille picture. The translation prototype is shown as Figure 4.

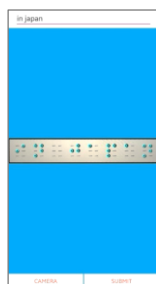


Figure 4. The braille translation mechanism prototype

The translation mechanism has many steps to translate the taken picture to corresponded characters. The first step is detecting the template of braille which is the black rectangle. It has fixed 5 rows and 25 columns for mapping 8 braille characters ⁽¹⁰⁾. The app crops the picture by the rectangle and processes it to the next image processing steps.

The image processing steps use the OpenCV. The steps are gray scaling image, erosion, dilation, Gaussian (to remove noises), and for the last is applying thresholding (to get the black and white result) ⁽¹¹⁾. The black and white image is used to check the presence of dots by using Find Contours algorithm from OpenCV. By the fixed cell mapping of the template, the presence of dots in each braille can be detected and converted to array data. The array then translated to corresponded character based on the braille translation ⁽¹⁰⁾.

Since taking the braille picture manually is impossible for VIP, the prototype of braille scanning mechanism is developed as well. By scanning and letting the square pattern in frame the camera, the prototype will take the picture automatically which the braille is located inside that square pattern. As we can see in Figure 5, the prototype detects the presence of a rectangle by showing cross sign in the rectangle. This prototype works with frame. The app checks the presence of the rectangle in a

frame by using OpenCV. If there is no rectangle in the frame, the application will skip that frame and process with the next frame until the rectangle is detected and then put the cross sign.



Figure 5. The rectangle scanning mechanism prototype

3. Conclusion

There are two prototypes developed in this research, the braille translation prototype and the rectangle scanning prototype. The next developing is combining those two prototypes, adding speech engine and creating custom beginner braille book. By those all mechanisms, the application is expected to support VIP in learning beginner braille by themselves.

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