2021 43rd Annual International Conference of the
IEEE Engineering in Medicine & Biology Society (EMBC)
Oct 31 - Nov 4, 2021. Virtual Conference

Examination of Reading Aloud Method for Braille Learning Materials

K. Doi, T. Nishimura, and H. Fujimoto, *Member, IEEE*

Abstract— **This study aimed to examine an effective reading aloud method for Braille learning materials with a reading aloud function. We have developed a prototype system that can identify the position of Braille and finger using a tablet computer, and obtain audio information when the user touches Braille with a finger. One simple check of the speechreading accuracy of the prototype system was conducted. As a result, it was confirmed that Braille could be read aloud using the prototype system.**

I. Introduction

Braille is generally known as a special character that allows visually impaired children to read and write at their own pace. In addition to Japanese syllabary Braille, there are many other types of Braille, such as mathematical symbols and English abbreviations and acronyms, which need to be learned according to the stage of learning. Under this background, teachers at schools for the blind and staff members who teach Braille at social welfare corporations have been calling for Braille learning materials that are easier to learn. The number of acquired visually impaired people due to various diseases is increasing year by year. It is not easy for acquired visually impaired people to learn Braille by relying on tactile information. Therefore, a multimodal information guarantee that utilizes not only the sense of touch but also the sense of hearing is effective. This study aimed to examine an effective reading aloud method for Braille learning materials with a reading aloud function.

II. Methods

In our previous research [1], the authors developed a prototype of Braille learning material that enables Braille learners to confirm information corresponding to Braille characters with voice by touching the area around the Braille characters with a pen-type device with reading aloud function (hereinafter referred to as a "pen-type device"). The previous Braille learning material used an optical identification method that reads a two-dimensional code consisting of tiny dots with an image sensor mounted on the pen-type device and outputs audio information associated with the two-dimensional code. However, there was a problem that the hand movement for Braille tactile reading was restricted because the pen-type device had to be grasped. Therefore, it was necessary to investigate a method of acquiring speech information other than grasping the device by hand. In this study, we developed a system to identify the position of a finger using a tablet computer equipped with three cameras, and to read out the voice when a finger touches the Braille. Braille and finger positions are identified using three cameras mounted on a tablet computer, and audio information corresponding to the Braille is output when a finger touches the Braille (Figure 1). As a target for speechreading, we developed a prototype Braille learning material for Braille mathematical symbols used in arithmetic and mathematics. Specifically, the Braille mathematical symbols ">" and "<" were used as the stimuli. One simple check of the speechreading accuracy of the prototype system was conducted. We checked the accuracy of reading aloud when two braille beginners touched each braille 20 times.

K. Doi is with the National Institute of Special Needs Education, 5-1-1 Nobi, Yokosuka, Kanagawa 239-8585, Japan (corresponding author to provide; e-mail: doi@nise.go.jp).

T. Nishimura is with the National Institute of Special Needs Education, 5-1-1 Nobi, Yokosuka, Kanagawa 239-8585, Japan.

H. Fujimoto is with the Faculty of Human Sciences, Waseda University, 2-579-15 Mikajima, Tokorozawa, Saitama, 359-1192, Japan.

III. Results and Discussion

We conducted one simple check test to investigate the accuracy of reading aloud by use of the prototype system. As a result, it was confirmed that the prototype system could read out both Braille mathematical symbols correctly with a probability of more than 95%. In the future, it will be necessary to further improve the accuracy of reading aloud.

IV. Conclusion

In this study, we developed a prototype system that can identify the position of Braille and finger using a tablet computer, and obtain audio information when the user touches Braille with a finger. One simple check of the speechreading accuracy of the prototype system was conducted. As a result, it was confirmed that Braille could be read aloud using the prototype system.

References

[1] K. Doi, T. Nishimura, M. Takei, S. Sakaguchi, and H. Fujimoto, "Braille learning materials for braille reading novices: Experimental determination of dot code printing area for a pen-type interface read aloud function," *Universal Access in the Information Society*, vol. 20, no. 1, 45-56, 2020. https://doi.org/10.1007/s10209-020-00709-8

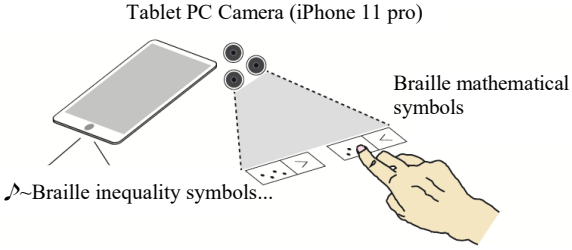

Figure 1. A prototype system that can identify the position of Braille and finger using a tablet computer, and obtain audio information when the user touches Braille with a finger.