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An Auditory Writing Support System for Japanese EFL Braille Users

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Abstract: This study investigates the problems faced by blind braille learners in English writing, identifies needs for a support system, and constructs and evaluates a new auditory writing support system for Japanese EFL blind learners. Two blind Japanese university students participated in this study. The study stars with a semi-structured interview about the use of ICT. The general requests for the system include functions such as noticing spelling mistakes clearly and determining the number of words with the help of sound. Based on the results of the interviews, this study constructed a system that had the following features: (i) Web application; (ii) Screen reader software; (iii) Speech synthesis; (iv) Sentence/passage reader, (v) Natural language processing; (vi) Retry function; and (vii) Short-cut keys. Lastly, as a user experiment, the participants were asked to use the system for English writing tasks. Their feedback on the system was positive.

Keywords: blind users, auditory feedbacks, English writing with keyboard, ICT

1. Introduction

In recent years, there has been an increase in the number of special needs students with disabilities such as intellectual disabilities, autism, visual impairment, and hearing. Within the framework of an "Inclusive Education System", the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been emphasizing the importance of support for such students so that they can be provided with a learning environment that reduces the gap between them and non-disabled students (MEXT, 2011).

2. Features of Blind Learners

2.1 Features of Blindness

The term visual impairment refers to disabilities with eyesight and field of vision (Shibata, 2015) and it includes the concepts of "blindness" and "low-vision". "Blindness" is that people cannot go about their daily lives with visual, and "low vision" is that people can go about their daily lives with visual but with many difficulties (Miyamoto & Takeda, 2010).

Since blind people cannot use their vision, they have to depend on auditory sensations and/or the sense of touch; in other words, they receive information through auditor support tools and braille.

2.2 Features of Braille

"Braille" is composed of two rows of three points in a longitudinal direction and two points in a transvers direction. We can read it from left to right. Braille can represent alphabets, numbers, marks, and musical notes, except for kana characters (Shibata, 2015).

There are two patterns of using braille in English, namely "Grade 1" and "Grade 2". "Grade 1" braille employs uncontracted forms, while "Grade 2" braille includes a combination of uncontracted and contracted forms.

In "Grade 2", there is a special convention, generally called "contractions", which can reduce the numbers of squares and is more suitable for tactile reading by contracting a part of words or common words (Nagaoka et al., 2009). Thus, it can be difficult for braille learners to memorize the spelling of English words in their entirety, since most of them use contracted braille words.

In addition to the difficulties in learning, the use of braille presents further challenges. For example, in comparison with ink character documents, braille documents can become too cumbersome to carry when printed, due to the size of the document. Another difficulty is the need for a "special" braille printer (Shibata, 2015).

Therefore, it seems necessary not to depend on braille documents alone. In an educational setting, this presents a need to devise other forms of learning support.

2.3 Support for Blind Learners with ICT tools

Although some ICT tools are available for blind learners, the range of options is limited. For example, blind learners cannot get the same access to spelling feedback as sighted people with existing CAVL (Computer-Assisted Vocabulary Learning) applications, and therefore, alternative hardware is necessary for blind learners to get access to a spellchecker.

There are two practical tools to aid the vocabulary learning of blind students, "Braille Line" and "Screen Reader." The former translates spelling into braille; however, it is too slow to provide instant feedback. The latter is a popular application. However, "Screen Reader" does not provide "visual" feedback. Therefore, blind learners have to choose either of the two applications, even though they are not sufficient to support blind learners' language learning.

The solution to this problem is to use auditory feedback, namely, TTS (Text-to-Speech). Compared to the use of braille translation, the processing speed of TTS is the same as or faster than the systems available for sighted people. Therefore, the use of TTS is a promising candidate for blind learners' writing support (Verena, Robert, & Jan, 2010).

2.4 Problems for Blind Learners in Language Learning

Since blind learners cannot use visual information, which accounts for a large amount of information for cognitive processes, they encounter various difficulties in language learning, especially regarding English writing, due to the difficulty in surmising a word's spelling from its pronunciation (Verena, Robert, & Jan, 2010), and the large number of exceptions in spelling rules (Arter & Mason, 1994). Blind learners have to learn braille symbols and contractions. Additionally, to write English words an ink characters, they have to learn the full spelling of new words. Consequently, learning spelling is a challenging task for blind learners.

Recently, blind learners have been expected to write complete essays in English in academic or business contexts. However, there are some problems in the current voice support system will correct the wrong input automatically and read the correct version. That is, blind learners do not know if they have made spelling mistakes, and therefore, they miss opportunities for prompt attention to and correction of such mistakes.

Therefore, it is necessary for blind learners to know the correct spelling of words so that they can detect spelling mistakes through auditory help.

3. System

3.1.1 System description

At present, we are constructing an auditory system for blind users, with the following considerations.

Firstly, the system employs a "web application." Everyone can use the application at any place with an Internet connection.

Secondly, the system is compatible with "screen reader applications." One of the most common applications is the "PC-Talker." The application reads all the information on the screen. Most visually impaired people, especially blind users, operate the PC with this application. Without this system, it is practically impossible for blind users to operate the PC and receive information, including visual information. Therefore, we constructed a system that works while PC-Talker is activated.

Thirdly, as was suggested above, "speech synthesis" or a so-called "TTS" is employed. We use speech synthesis to read all the information on the screen during system operation.

The fourth characteristic is that the system is also equipped with a "Sentence/passage reader." We created two tools, namely "sentence reader" and "passage reader" reads all inputted sentences at a time. Both tools provide reading in a regular manner when the words are correct, and letter by letter when the words are incorrect.

The fifth is the use of "natural language processing." We use a natural language process to identify words with spelling mistakes.

The sixth is the "retry function." If there are some spelling errors in inputted sentences, braille users can choose the incorrect word they want to correct and can retype the word.

Lastly, the system utilized "short-cut key" commands. Most braille users encounter many difficulties in operating PCs with visual information. Therefore, this system allows all the functions to be operated without any visual information, but with auditory support. To realize this, all operational functions can be used with short-cut keys. The short-cut keys are listed below.

Table 1
Short-cut Keys for System Operation

Full sentence read	shift+control+enter
One sentence read	shift+control+s
Stop reading sentences	shift+control+x
Count the number of words	shift+control+c
Select sentence to read	shift+→/←
Read the sentence/Modify words	shift+↑/↓

3.1.2 Configuration of User Terminal

To construct this system, we employed javascript and php, and set up a browser environment with Google Chrome.

This system is operated as follows: ① Users input sentences in English (Input). ② The sentences inputted are collated with Google NLP. Through this process, proper nouns and derivative words are identified (Dictionary Verification). ③ Words with spelling errors are extracted and listed. Then, the processing of sound output for incorrect words changes the output into a different output with correct words (Feedback). ④ The output is a sound for Users (Output).

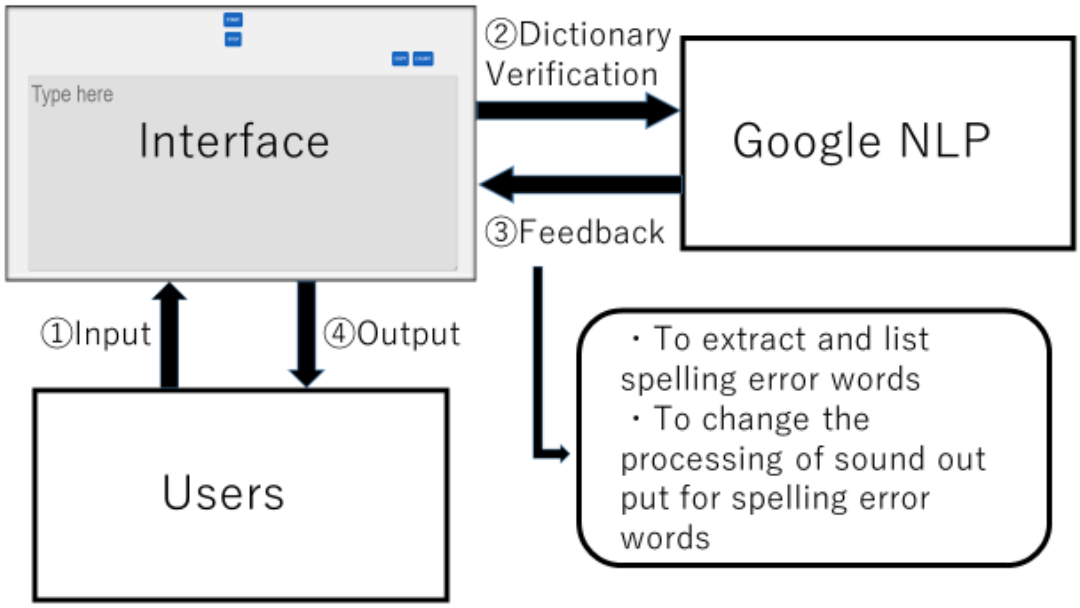

Figure 1. Terminal settings

4. Preliminary Evaluation

The pilot study was conducted to evaluate this writing support system from the following perspectives: operability or interface, usability of the system, effectiveness of this system for English writing.

The participants included two blind EFL braille users. The materials were selected from the Grade 2 and 4 EIKEN tests in practical English proficiency.

The procedure of this evaluation was as follows: i) Participants practiced operating this system. ii) We conducted evaluation twice. Participants used the system for 10 minutes, with 150-word example sentences. During the evaluation tests, when participants asked for help, we told them how to use the short-cut key orally. The results are shown in the tables below.

Table 2
Results of the Interview to Participant A

Usability	It is easy to use.
Points to improve	・When I push the backspace key, I felt inconvenient because it doesn't read alphabets, so I lost my cursor location. ・Change the signaling sound in "full sentence read". ・Simplification of short-cut key (Easy one to remember is preferable). ・Improve the system conflict with PC-Talker in word correction. ・Visually impaired people rarely use Google chrome, so it would be more useful that this system is implemented on Internet Explorer.

Table 3
Results of the Interview to Participant B

Usability	・If users can use this system well, it would be so useful tools for supporting English writing. ・It is unique that this system make it possible to focus on spelling error words only. ・It is so good to tell "no errors" when all of inputted sentences are correct.
Points to improve	・It is good to tell users with signal sound at the time they input spelling error words. ・Simplification of short-cut key →but there is nothing that users can't remember the key, because the number of it isn't so much. ・To add the function to correct spelling error words in "one sentence read". ・Visually impaired people rarely use Google chrome, so it would be more useful that this system is implemented on Internet Explorer.

5. Implication for Future Research

From the results of the evaluation experiment, we obtained positive feedback on utilizing this system in support for English writing. However, there are some points to improve the system, relating to "audio output," "short-cut keys," and "conflict with PC-Talker."

On the basis of these results, we would like to upgrade the system to implement the above improvement points and conduct an evaluation experiment again in the near future.

References

Arter, C. & Mason, H. (1994) Spelling for the visually impaired child. *The British Journal of Visual Impairment, 12*(1), 18-21.

Miyamoto & Takeda. (2010). *Dai4kan Syougai Rikai notameno Igaku/seirigaku*. (Medicine or Physiology for Understanding Disabilities, 4th Edition), Tokyo: Akashi Syoten.

Nagaoka, E., Ishii, K., Kobayashi, M., Ono, A., Aoki, K., Tatsumi, K., … Osada, K. (2009). Tenyakusya notameno Eigotenjihyouki Kaisetusyo "Eigotenyaku Gaido" no Kannkou (Reference Book of English Braille Description, "Guidance of English Braille Transcription" for Braille Translators), *Tsukuba University of Technology, Techno Report, 16,* 135-138.

Nakamura, A. (2015). *Construction and Evaluation of a Reading Support Tool for Partially-Sighted EFL Learners*. Graduation Thesis. University of Tsukuba.

Shibata, Y. (2015). *Shikaku Syougaiji/sya no Rikai to Shien* (Understanding Visually-Impaired People and Support for them), Kyoto: Kitaooji Syobou.

Verena, S., Robert, N., & Jan, A. (2010). Improving spelling skills for blind language learners − orthographic feedback in an auditory vocabulary trainer. *International Conference on Computer Supported Education*, 501-506.