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Advances in Usability and User Experience

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Study of Voice-Based Crowdsourcing Platform for the Enhancement of Self-support for the Visually Impaired

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Abstract. This research suggested a voice-based crowdsourcing platform that can increase the independence of visually impaired people. This study used a qualitative analysis; one group interview and one in-depth interview. As a result, they expressed needs to know information that are directly related to health such as medicines, clothing, and food. This research suggested a platform construction based on the information most needed by the visually impaired.

This platform allows both people with visual disabilities and the public to freely share and utilize information. The application's QR code and voice search functions provide immediate access to the various product information available from the platform. Users' voluntary participation will provide an opportunity to register and modify product information needed. In addition, public institutions and companies will be able to use this voice-based crowdsourcing platform to promote independent living of visually impaired people.

Keywords: Crowdsourcing platform · Visually impaired people · QR code · UX design

1 Introduction

1.1 Necessity and Purpose of This Study

According to a study conducted by the Korea Food and Drug Administration (KFDA), 71 cases (44.10%) of disability grade 1 and 8 cases (4.97%) of grade 2 abused drug. It also appeared to be difficult to distinguish between medications for breakfast, lunch, and dinner, which posed the risk of side effects [6].

As the study shows, visually impaired people have great difficulty in classifying products or obtaining information on their own. So, it is important to make a way to easily obtain the necessary information for the view of the visually impaired. In conclusion, this study investigated a crowdsourcing platform which can improve the self-support by allowing the visually impaired to easily obtain the necessary information for everyday life through voice recognition.

1.2 Precedent Research Review

Minji Yang (2016) emphasizes the need for a UI/UX design for the socially disadvantaged who are isolated by the development of smart technology. Therefore, the research suggested the design of a mobile app that helps visually impaired people find shops with the GPS function and helps them identify clothing information through the QR code and barcode recognition for the visually impaired people who have difficulties in independent living. Although the preceding research is limited to clothing, this study proposed building a voice-based crowdsourcing platform based on product lines that can be expanded not only to clothing but also daily life.

1.3 Method

This study investigated a way to improve accessibility of information by using qualitative research to improve the experience of the visually impaired. Specifically, the first group interview was established to construct a voice-based crowdsourcing platform. the research hypothesis was tested on four visually impaired people in the in-depth survey.

2 Terminology and Concept

2.1 Definition of Visual Impairment

The definition of "visual impairment" is a functional limitation of the eye(s) or visual system due to a disorder or illness that can lead to a visual disability or a visual handicap. A visual disability is a limitation of individual ability(ies), and a visual handicap is a limitation of personal and socioeconomic independence. It is estimated that there are between 1.5 and 3.4 million visually impaired adults in the United States. This study ultimately made it possible to use not only visually impairment but also people who are socially weak [2].

3 Research and Analysis of User's Living Environment

3.1 First Group Interview

3.1.1 Objective of First Group Interview

The first group interview was conducted to collect essential basic data prior to the development of services that would allow visually impaired people to live independently. Based on this interview, the blind people's self-reliance and practical needs for the development of services were identified and therefore provided the justification for this study.

3.1.2 Subjects and Methods of Group Interview

This first interview was done on 3rd of October in 2018, with 3 blind people who are living alone by visiting Gyeongsangbuk-do Province's blind welfare center (Table 1).

Table 1. First group interview subjects

	Gender	Age	Degree of disability	Disability determination
P1	Female	30 s	1st	Innate
P2	Male	20 s	1st	Innate
P3	Male	30 s	2nd	Acquired

3.1.3   Contents of Group Interview

The interview consisted of a total of 40 questions. In the first part, inconvenience of daily lives when living alone in the house, and difficulties when distinguishing objects or acquiring information were asked. In addition, the questions also consisted of inquiry of hardships when getting to a specific place by oneself, using public transportation, using public institutions and educational facilities, and whether blind people need the independent daily lives. The second part consisted of questions about closeness and proficiency of blind people's use of smart devices along with preferred method of input and output system of information.

3.1.4   Analysis of Group Interview

(a) *Analysis on inconvenience of purblind people's daily life*

According to the group interview, blind people have relatively less or no limitation of their activities because they normally do not go outside without their assistants. However, there's difficulty of acquiring visual information within house without the assistants' help. Because they have to rely on their sense of touch or memories, there's huge limitations in gathering information.

Therefore, there was a need for basic objects distinctions as well as when gaining new specific information on objects in their daily lives without the assistants. Especially in situations where they need to solve the problem by themselves, it is hoped they could solve the problem by themselves since it is realistically hard to seek for assistance from others.

(b) *Utilization of information delivery via smart devices*

It was said that if there was a service that could provide information on products in a voice using smart devices, it would be better and easier to live alone without assistant and service would be highly like to be used willingly.

3.2   Second Individual In-Depth Interview

3.2.1   Objective of Individual In-Depth Interview

Individual in-dept interview was conducted in order to identify and analyze specific products that are actually difficult to obtain information from touch alone, therefore selecting the vital information to be presented on the platform.

3.2.2 Subjects and Method of Individual In-Depth Interview

This interview was done in a one-to-one format with pre-prepared specific 50 Q&As. They survey period was October and November of 2018, and four people were selected for the survey considering the ratio of gender, disability diagnosis time, total blindness and non-blindness (Table 2).

Table 2. Individual in-depth interview subjects

	Gender	Age	Degree of disability	Disability determination
P1	Male	30 s	1st	Innate
P2	Female	20 s	1st	Innate
P3	Male	30 s	2nd	Acquired
P4	Female	40 s	2nd	Acquired

3.2.3 Content of Individual In-Depth Interview

Prior to the interview, product lines that have high visual dependency in daily lives were pre-selected. The questions asked to select the most needed information from the product lines. Moreover, the preferred way to provide voice-based information, and the need for such information platform were asked.

3.2.4 Analysis of Individual In-Depth Interview

(a) *The most needed information for the visually impaired people*

After going through various product lines, it was requested to identify the most needed ones. As a result, it was possible to come up with the drugs, clothing and food products that were the most needed. Because such products directly relate to health of blind people, it was highly crucial that correct information was provided.

Nevertheless, because such products hugely rely on visual information, it was big problem for blind people to identify and distinguish the products by themselves.

(b) *Preferred method of information delivery by the visually impaired people*

It was found that blind people have inclination toward voice-based information delivery due to easy accessibility. However, the downside was that it required good amount of patience in order to listen all information. Therefore, it was preferred to separate information into main and sub according to importance of information and receive afterwards.

More specifically, it was opinionated that after receiving the most important information first, if they wanted to listen to less importance information, they could press a button in order to do so.

(c) *Need of crowdsourcing platform for self-supporting of the visually impaired people*

It was discovered that because blind people hope to get information independently without limitations of time and space, there was a necessity of space to contain data of wanted information, and service to share such knowledge and information.

Therefore, it was concluded that crowdsourcing platform could provide variety of utilization, and would be used highly.

4 Proposal of Voice-Based Crowdsourcing Platform

4.1 Definition of Crowdsourcing Platform

Crowdsourcing is mix of two words 'Crowd' which means general people and 'Outsourcing' meaning utilization of source from outside. It means to outsource solution a problem from general people [5].

In the age of Web 2.0, due to the influence of many positive attitudes, collective intelligence was able to realize ideas rather than just presenting ideas [9].

4.2 The Need for a Crowdsourcing Platform

For, if information about an ever-increasing number of products is written together by the visually impaired and the sighted, input of information can be made faster, the crowdsourcing platform is used. For example, the platform "Malaria Spot" is a crowdsourcing website that teaches people around the world how to find malaria parasites in blood sample images in a game format. There are 600,000 cases of malaria per day, but the public collects the right samples through games to diagnose them quickly and reliably [4].

Interviews also found that people who are visually impaired are more aware of inconveniences and information about products that people who are sighted are unaware of, and have clear and simple solutions for those. Thus, when sharing the know-how or solutions of individuals who are visually impaired among the other visually impaired, virtuous cycle platform is completed. Then, the crowdsourcing platform will be found to be effective.

4.3 Concepts and Objectives of Voice-Based Crowdsourcing Platform

Visually impaired people who are unable to acquire visual information need other daily information than the sighted, but a platform that provides information for them is not readily available. Since most of the information is designed on a display basis, there are many limitations for the visually impaired to use. Therefore, the visually impaired depends on assistants even for indoor daily activities, which makes it difficult for them to live independently.

This study suggests the establishment of a 'crowdsourcing platform' in which the visually impaired and the public share information and use collected information together. It also seeks to establish guidelines for voice-based platforms that provide voice-based conversion of display-based information for people with visual impairments.

When it becomes possible to provide daily information through voice, it can be expected to enhance the independent lives of people who are blind. In addition, the

main objective of this study is the creation of a virtuous and well0intentioned platform for the public, including those who are visually impaired.

4.3.1   Increase Self-help of the Visually Impaired by Providing Voice-Based Information

This service can replace text-based web platforms such as Wikipedia, which are difficult to use for people with visual impairments. Once a platform is established to add and modify information that the visually impaired themselves want, it is possible to deploy information in a faster time as it does not go through the assistance of sighted. In addition, the information needed by people who are visually impaired is directly available.

Furthermore, voice-based platform is a visually impaired person centered interaction that provides easy access to information only by auditory elements without visual elements. Also, voice-based information delivery helps visually impaired people to lead independent daily lives.

4.3.2   Building a Virtuous Cycle Platform

A virtuous cycle platform opens data reproduced by users to the platform and allows other users to reuse it to share the added data. Thus, the platform is conducted in such a way that information generated by the visually impaired and the public is used by people who are visually impaired and that information or knowledge is shared on the platform. Companies can promote their products by providing voice-based information about their products while the visually impaired can obtain information more easily.

4.4   Proposal of Voice-Based Crowdsourcing Platform Prototype

4.4.1   Input Storage Method

To eliminate the limitations of accessibility and acceptability of current services for the visually impaired people, the crowdsourcing platform in this study has recently developed an application type platform that makes it easy to enter information anytime with mobile devices. Google has also created a platform to share information using crowdsourcing, but since it is not a voice-based platform suitable for people who are visually impaired, there are limitations to accessibility. Therefore, despite having useful information, utilization is very poor in terms of user experience (UX) for the visually impaired.

Thus, this study proposes a voice-based platform to address issues in terms of accessibility, acceptability, and availability for people with greatly reduced vision. The platform of this study uses voice over function TTS, text to speech technology, which can provide button text and screen text on a mobile screen in speech.

The proposed use of the platform is as follows. Select the product category for which you want to enter information first. The information regarding the product is then written in text and shared in accordance with the input guidelines provided by the platform. At this point, voice-over function provides the keys of the keyboard in speech, making it easier for the purblind to write information in text. In addition, when content is written and shared, it is uploaded and stored on the platform.

As for the platform's design, a research result has been reflected; "by emphasizing simplicity has a positive effect on the convergent thinking of crowdsourcing participants by enhancing perceived ease of use" [1]. Also used 'alternative text', 'focus shift', and 'high contrast' based on the in-depth interview results and research on a Korea nationwide messenger service Kakao Talk. Therefore, the accessibility of the purblind has been greatly enhanced through its simplicity and attentive design for the purblind.

Additionally, this study considered how voice-based AI technologies can be used to recognize and write the spoken sentences. However, we have discovered that it is technically difficult to recognize and interpret sentences with a large amount of information. Thus, this study used TTS based writing methods. We suggest using voice AI information writing method when the language recognition technology for long sentences is fully developed.

4.4.2 Information Printing Method

The use of the platform proposed above is designed to help users quickly and easily obtain information about registered products online through mobile applications. The main way to search for registered products in mobile applications is to search through QR code and voice recognition, users can choose a method that suits the user's convenience.
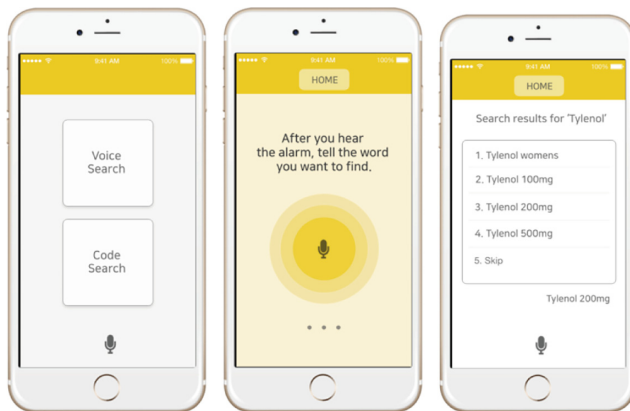

Fig. 1. Voice search flow

As shown in Fig. 1, voice search helps you find the correct products through automatic additional verification without saying product name. For example, if you search for "Tylenol," the screen will display a list of Tylenols such as Tylenol Women, Tylenol 100 mg and so on and read it by voice so that users can choose the specific product they want to know. If you do not know a particular product, you can use 'skip' function and then it automatically connects it to the most commonly sold Tylenol product.
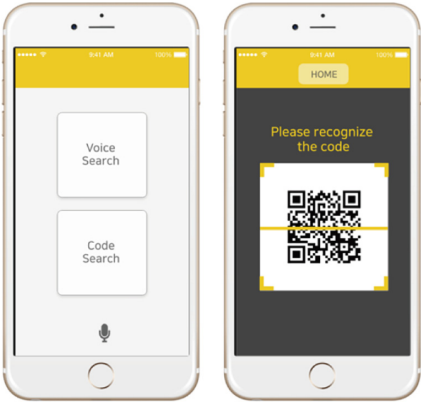
Fig. 2. Code recognition flow

The QR code search shown in Fig. 2 can be skipped by repeating additional steps such as pressing a button or listening to voice information. It is able to get the necessary information easily and quickly only by a simple process of recognizing QR codes printed on a product by the camera.

In fact, in an in-depth interview, participants said that it would be more accessible to search information through a simple process rather than through several steps. Therefore, QR code search function is added for easy accessibility and high usability.

In addition, since QR code uses three location symbols, it can recognize without being influenced by the environment in any direction and restores data up to about 30% of code words by 'error recovery function'. Even if a part of the code is dirty or damages, it still can be used as a barcode. In fact, Nongshim introduced the QR code for one of their products for the first time in the noodle and used the QR code to help users look up information on brand story, TV CF video, radio CM shipment information and product manufacturing know-how (QR code.com).

Figure 3 shows the screens that are displayed when the product is searched and recognized. The data were listed in order of importance of the details derived from the

Fig. 3. Search and recognition result flow

in-depth interviews. The user can selectively receive the specific contents by swiping the contents organized in the card format.

5 Prototype Usability Testing

In this study, usability testing is conducted with 11 participants. The purpose of it is to verify usability as a new information delivery method. In order to improve the usability of users, it is necessary to evaluate the usability of applications that utilize cloud platform data. As a result of this research, we will diagnose the current usability situation of the application and suggest some improvements.

Usability assessment assigned 11 participants to search for particular information about products using the application.

Then an experiment (a) is conducted to measure conducted an experiment measuring the time it took to complete the task and the number of errors that occurred to analyze the usability and (b) asked questions about learnability, preference for search methods, and satisfaction with how information was provided.

(a) The result demonstrated, (i) visually impaired individuals were able to find information on their own with our platform and (ii) the time taken to complete given task has decreased by an average of 10 s and the number of errors reduced to less than two times on average which emphasized high level learnability after repeating task several times. (b) According to the interview result, (i) more than 90% of respondents said that the information divided into main and detailed parts was highly efficient. (ii) all participants felt the process to receive information using a platform and application to receive information is fast and easy.

Furthermore, this usability assessment suggests the 'importance of QR code location'. In this usability testing, the QR code was placed in the lower right corner so as not to interfere with the usability testing. However, diverse location of barcodes and QR codes can make it difficult for visually impaired people to scan the codes. Therefore, we recommend placing the QR code in the bottom right corner of the product or marking it with a tactile element, the time to actually retrieve the information can be shortened.

The platform may assist visually impaired person to increase independence and self-esteem. Consequently, the platform would fulfill the visually impaired individuals' right to know. More importantly, this platform will bring a fundamental change that reduces the information gap between the sighted and the visually impaired.

6 Conclusion

The purpose of this study is to analyze the difficulties experienced by the visually impaired people in the residential space and to find a solution by using user-centered design methodology. As a solution, we proposed a speech-based crowdsourcing platform that can receive accurate information easily by using QR code and speech recognition. In addition to text-based interaction, speech-based interaction can be expected to encourage the use of a virtually circular platform to directly input necessary information.

Furthermore, public institutions and corporations can participate in providing information about their products and services in the platform so that they can promote them to the visually impaired, as well as contribute to social development.

The platform may assist visually impaired person to increase independence and self-esteem. Consequently, the platform would fulfill the visually impaired individuals' right to know. More importantly, this platform will bring a fundamental change that reduces the information gap between the sighted and the visually impaired.

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