Investigating the demand for barrier-free information by visually impaired people for the design of a social platform facilitating the sharing of this information

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Abstract: Assistive instruments such as slopes and textured paving blocks are installed in order to help the elderly, visually impaired, and physically impaired, who face many inconveniences in moving around outside. Though these precipitous situations affect disabled people's migration pathways in getting to their destinations, it is difficult to quickly gain new knowledge on barrier-free pathways because of limited local information disclosure. It is necessary to develop a comprehensive system that appropriately acquires and arranges scattered barrier-free information and presents that information intuitively. Our study aims at developing a social platform that can obtain and present information depending on users' situations, including users' disabilities and locations, and can share barrier-free information provided by users. This report outlines the concept design, the implementation progress of the platform, and the results of a needs survey of visually impaired people.

Keywords: Barrier-free information, Social information sharing platform, Visually impaired people

1. Introduction

Some developed countries, such as Japan, are faced with a rapidly aging society, and they must cope effectively with the increasing numbers of sensory and physically disabled people. Because it can be predicted that the numbers of visually and physically impaired people will gradually increase, effective support schemes and systems will become necessary. Accordingly, medical technologies and welfare systems will mature, and barrier-free locations will gradually increase in number. Japan is in this same situation, particularly after the enactment of the Act on Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc. in 2006 [1].

On the other hand, visually and physically impaired people have difficulty obtaining information regarding barrier-free or non-barrier-free places because of limited local disclosure of this information. This inconvenient situation harms the quality of life of the disabled because decreased opportunities to go outside causes reduced social participation and limited recreation opportunities. In addition to senior disabled people, young disabled people also suffer from the same circumstances. It is necessary to develop a system that enables these groups to get this information easily. In Japan, for the purpose of helping these people, there has been an increasing number of websites that share barrier-free information. The Eco-mo Foundation provides information related to public transportation, especially the insides of stations through the Station & Terminal Information Search (namely, *rakuraku odekakenet*) [2]. Other public administration offices have also developed websites offering barrier-free information. Network data on walking space were experimentally released by the Ministry of Land, Infrastructure, and Transportation [3]. The Cabinet Office also provides a collection of links to barrier-free maps in the prefectural capitals [4]. However, these websites involve only downtown areas. In addition, it is occasionally impossible for mobile phone users to read barrier-free maps because they are provided in pdf format. On the other hand, some volunteers have also performed data collection and sharing. Maps of multipurpose toilets can be mentioned as a successful case [5]. However, disabled people have difficulty providing barrier-free information because there are no interfaces for disabled people to post barrier-free information. If a more effective information collection system can be developed, then not only public administration offices and volunteers but also disabled people themselves can provide information.

In this study, we propose and develop a social platform with the purpose of providing information to visually and physically impaired people on getting around outside. The platform aims to acquire and present needed information according to users' disability and to share information posted by users. For this report in particular, we aimed at deciding on the implementation requirements for visually impaired people. First, the concept of the platform and its system design are described in Section 2. Second, in Section 3, needed information on how visually impaired people move around is investigated for the purpose of deciding on the design guideline of an interface for them.

2. Conceptual design and prototype system

We propose a conceptual system that will address the aforementioned problems. This system helps users to use and share information on whether or not locations are barrier-free. Fig. 1 illustrates the conceptual system summary. This system is composed of three information units: accumulation, acquisition, and presentation. The accumulation information unit allows users to store, post, and share information. The acquisition information unit manages obtaining users' conditions, such as their current positions, the directions they are heading, and their circumstances. The presentation unit presents users with the relevant information using methods appropriate to the user's disability.

2.1. Ecosystem

For the continuous smooth operation of the system, it is necessary that users constantly post up-to-date barrier-free information. The ideal ecosystem for this smooth operation is illustrated in Fig. 2. This figure presents the following:

1) A user posts barrier-free information to the system.
2) A different user checks and takes advantage of the information.
3) Many users also check the information. Use of the system increases.
4) Additional users provide barrier-free information, leading back to 2).

For the smooth operation of this ecosystem, the benefits of continuous use should be expressly presented to the users. In particular, the authors added a function that allows users to evaluate and express their appreciation of the barrier-free information. This kind of function can allow not only disabled users but also unimpaired people to post information.

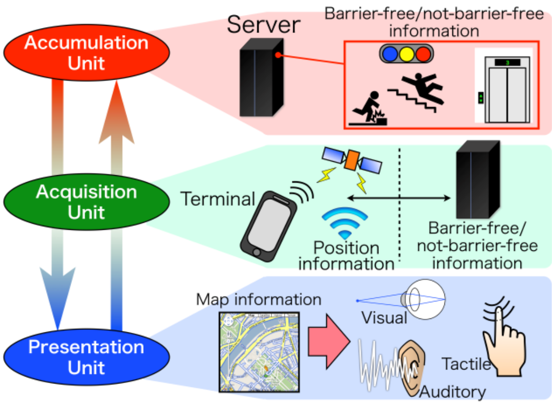


Fig. 1. Conceptual system summary of the social platform sharing barrier-free information

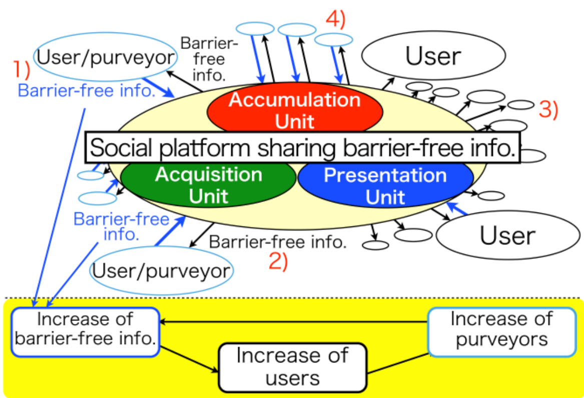


Fig. 2. Ecosystem of the social platform

2.2. Prototype system

The current interface of the prototype system is shown in Fig. 3. Only the visual presentation interface is implemented: Interfaces for auditory and tactile senses, such as for visually impaired people, are a part of our future work. The system can be used through web browsers because of the availability of many terminals. Figures 3(a) and 3(b) show examples of developing user interfaces, displayed in Google Chrome on Windows Vista and in a standard web browser on Android 2.3, respectively. The view of the system includes map and post UIs regardless of the web browser.

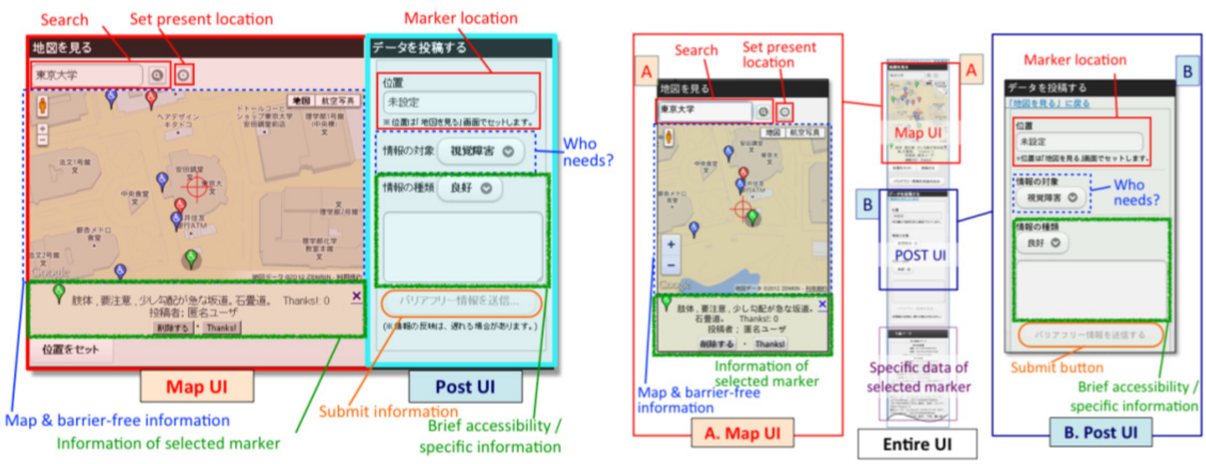
The map UI manages information presentation. This UI includes a search area, a button for obtaining the user's current location, a map view comprising map and markers, and a view of comments on selected markers. The search area enables users to see maps and barrier-free information on an indicated location by inputting the particular location name in text form. When the button for obtaining users' current location is clicked or pressed, the user's current position can be acquired through the specific and coarse locations identified by GPS and Wi-fi. The map view displays a map, current positions, and hovered markers representing barrier-free information. These markers summarize barrier-free information using three colors, specifically, red: dangerous/impassable, green: caution needed, and blue: safe/passable. These markers also note the targets of barrier-free information using icons representing persons with visual, hearing, and physical impairments. The comment view placed at the bottom of the map UI displays detail information on selected markers.

The post UI enables users to submit barrier-free information. This UI comprises a box indicating a marker location, a pull-down menu regarding the targets for the information, a pull-down menu of brief information on accessibility, and a text box for inputting specific information. When a user inputs and posts any barrier-free information from a location, the corresponding coordinate on the map is input to the marker location indicator box. The target information pull-down menu lists the targets for the information being provided, with tags for people with no impairment and for vision, hearing, and physical impairments. Brief information on accessibility, including whether or not an area is passable and whether it is dangerous or safe, can be selected from the pull-down menu of brief accessibility information. The text box for inputting specific information accepts specific situations.

In a preliminary brief usability test of the interface, some users with physical impairments input the opening hours of gates and shops, the steepness of slopes, alternate routes for better accessibility, etc.

3. A design for visually impaired people

In this section, a survey on interface design for users with visual impairment is described. The survey was carried out for the purpose of establishing a design guideline for interfaces for users with visual impairment.



(a) On Google Chrome (rendered by WebKit) on Windows Vista

(b) On a standard browser (rendered by WebKit) on Android 2.3

Fig. 3. Examples of developing a user interface displayed by web browsers

3.1. Participant

Twenty-six visually impaired people (22 males and 4 females) participated in the survey. Participants consisted of 13 totally visually impaired people, including people who could only perceive light stimuli, and 13 low-vision people. All of them usually went outside with or without a support person.

3.2. Questionnaire outline

First, a preliminary interview survey was conducted in a small participant group to objectify questionnaire items. Then, a survey based on the questionnaire was carried out. In the interview survey, three totally blind (two males and one female) and eight low-vision (four males and four females) participants participated. The interview items were, for instance, about the kinds of difficulty the subjects faced in getting around and the kinds of information they needed. In accord with the results of the interview, survey items were specified and then the survey was conducted. The questionnaire was composed mainly of the following seven sections.

1) Individual characteristics of the participants: age, gender, disability, history of training in daily living activities, et al.
2) Usage of information and communication technology (ICT): personal computers, cell and smart phones, the Internet, current models, locations and circumstances of use, in-use application and accessibility functions, et al.
3) Travel conditions: frequency, use of a support person, use of public transportation, et al.
4) Information on what they need to get around, outside, inside, in the daytime and nighttime, et al.
5) What kinds of objects it is difficult to locate when moving around inside buildings and outside in both good and bad weather.
6) Presentation method: what kinds of information participants want to acquire in real time or in advance, accessible ICT devices, et al.
7) Other opinions or reflections.

Questionnaire items were determined by referring to those of MHLW [6] and Nakamura-Funaba [7] and from our previous study [8]. The questionnaire was distributed in computer-based electronic text file format (for university students) or in paper-based format (for students at the school for the visually impaired). The electronic file was distributed by means of e-mail, and then participants inputted with their own computer and replied to the authors. Paper-based questionnaires were filled in by the participants' support persons and then were submitted to the authors.

3.3. Result and discussion

In this report, we present information needed for getting around outside in the daytime and at night and our presentation method.

Fig. 4 illustrates the information that totally and partially vision-impaired participants reported needing regarding outdoor objects in the daytime and nighttime. In the daytime, totally visually impaired people generally requested information on more objects except for the locations of guide maps and streetlights. In particular, the number of people with total visual impairment requested information on more of the following items than did those with low vision: locations of equipment for going up and down, such as stairways, elevators, and escalators and locations of equipment for crossing roads such as traffic lights and crosswalks.

The information that people with total visual impairment need in the daytime and the nighttime does not differ. On the other hand, people with low vision requested the number of streetlights more for the nighttime than the daytime. However, they needed more information on maps and obstacles in roads in the daytime than in the nighttime. This result may be because some low-vision participants also had night blindness. Although they could perceive blurred visual images during the day, it is difficult to acquire visual information on dark places at night. It can be assumed that they needed to know the number of streetlights in order to find bright areas at night.

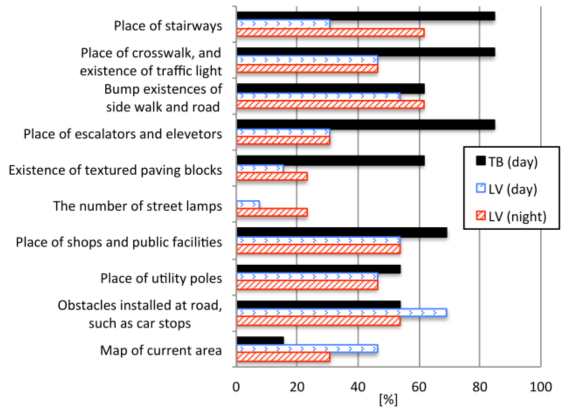


Fig. 4. Necessary information of outdoor objects in the daytime and nighttime in totally or partially visually impaired people. TB and LV represent people with totally blind and low vision, respectively. Horizontal axis means percentage of answers.

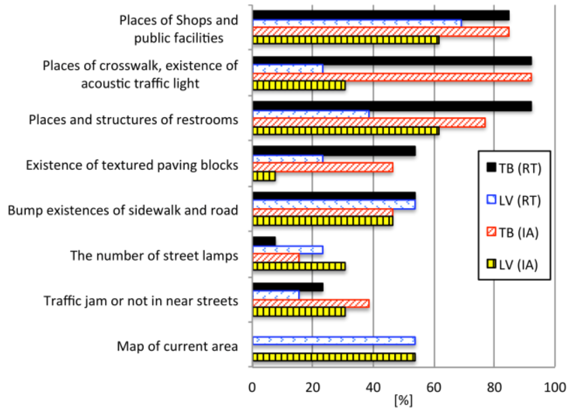


Fig. 5. Desirable presentation method such as in real-time or in advance of necessary information in totally or partially visually impaired people. TB and LV represent people with totally blind and low vision, respectively. RT and IA represent real-time presentation and presentation in advance, respectively.

As shown in Fig. 5, desirable presentation methods varied with disability and type of barrier-free information. In regard to real-time presentation, over 80% of totally visually impaired people needed the locations of shops, public facilities, and places with restrooms, in terms of getting around outside. Approximately 50% of them selected places with textured paving blocks and bumpy roads. Among those with low vision, approximately 70% and 50% needed real-time information on, respectively, locations of shops and public facilities, and information on maps and the existence of bumpy roads. With respect to the information that subjects preferred to receive in advance, responses from totally and partially visually impaired participants followed a similar trend to that of the responses regarding real-time presentation. However, participants with total visual impairment tended to need real-time presentation more than presentation in advance, according to the comparison of the TB (RT) and TB (IA) items shown in Fig. 6. On the other hand, in low-vision participants, the opposite trend was observed: presentation in advance was preferred to real-time presentation.

These results indicate that a desirable interface should include real-time presentation, particularly for people with total visual impairment, and in-advance presentation for people with low vision. Because totally visually impaired people have difficulty relying on visual sense, they may need to acquire information such as the direction of their bodies relative to their surroundings continuously and instantaneously. As a result, they preferred real-time presentation to in-advance presentation. On the other hand, low-vision people can broadly and in the moment figure out environmental information from visual information. In many cases, map information is understood in advance through visual sense. Low-vision people usually move to destinations following their memories based on visual information acquired in advance. Thus, it can be assumed that their need for in-advance information was greater than that for real-time information.

3.4. Implementation guideline

Based on Section 4 and the literature [7-10], the following brief implementation guideline was established for the social sharing of barrier-free information for the visually impaired.

- Needed information:
  - For the totally visually impaired: location of equipment for changing floors and crossing roads
  - For those with low vision: surrounding information that can help people see clearly, especially at night
- Presentation methods:
  - For the totally vision-impaired: real-time presentation
  - For those with low vision: presentation in advance

The authors are implementing an interface for visually impaired people following this guideline. With respect to the accumulation of barrier-free information, semiautomatic or automatic post interfaces should be developed. According to our other report [11], there were some visually impaired smartphone owners, and their numbers are expected to increase. If life-log technology based on sensors embedded in smartphones were implemented, barrier-free information would increase effectively. In this case, the presentation method should be discussed.

4. Conclusion and future work

The authors stated the concept and the development progress of a social platform with the purpose of providing barrier-free information to visually and physically impaired people. Then, the implementation requirements for visually impaired people were decided based on the results of a questionnaire survey. Achievements of this paper are summarized as following:

1) Concept of the platform was specified and prototype system interface was developed. The conceptual and prototype systems are comprised of information units of accumulation, acquisition, and presentation. At present, the system is improving through brief user tests.
2) A questionnaire survey was carried out in order to decide the implementation requirements of the interface for visually impaired people. The results indicated that totally visually impaired users needed to be presented barrier-free information including place information of equipment for changing floors and crossing roads in real-time. On the other hand, people with low vision mainly need surrounding information especially at night in advance.

Future work will involve the development and evaluation of an interface accessing the platform for visually impaired people.

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