The Evaluation of Visually Impaired People's Ability of Defining the Object Location on Touch-screen

Keijiro Uusi
Sophia University
7-1 Kioicho, Chiyodaku
Tokyo, Japan
k-usui@sophia.ac.jp

Masamitsu Takano
Sophia University
7-1 Kioicho, Chiyodaku
Tokyo, Japan
takanyo@gmail.com

Yusuke Fukushima
Sophia University
7-1 Kioicho, Chiyodaku
Tokyo, Japan
yfukushima@sophia.ac.jp

Ikuko Eguchi Yairi
Sophia University
7-1 Kioicho, Chiyodaku
Tokyo, Japan
i.e.yairi@sophia.ac.jp

ABSTRACT

Touch-screen has been used not only on home appliances but also on so many kinds of machines in public facilities at the present time. However the fact is that most of visually impaired people have a problem with the difficult usability of a touch-screen. We come up with an idea of Presentation Methods of Sound Information, which is thought to enable visually impaired people to define the object location on the touch-screen. We also make a proposal of the Concentration game content that is possible in improving the Sound localization's ability and evaluating the visually impaired people's characteristics of touch-screen's operation method. In this paper, we introduce the results of the experiment that we conducted with 5 visually impaired people. These are evaluated through the way of the finger moving on the touch-screen panel while using this content, and the ability of defining the object location.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: Haptic I/O; H.5.2 [User Interfaces]: Auditory (non-speech) feedback

General Terms

Design, Human Factors

Keywords

visually impaired, touch-screen, recognition, blind, sound- localization

1. INTRODUCTION

Touch-screen has been used not only on home appliances but also on so many kinds of machines in public facilities (e.g., ATM Bank Machine, Automatic Ticket Machines) at the present time. But the fact is that most of visually impaired individuals have a problem with the difficult usability of a touch-screen display. The reason for this problem is there is no uneven display on it so the visually impaired people can not define the location of GUI parts, such as buttons, links to other pages and menu lists. The solution for this problem is that instead of tactility, just by using the method of auditory feedback, we can help the visually impaired users to be able to access to these kinds of equipments.

Now there are many existing studies focusing on using the touch screen devices by applying the method of auditory feedback. For example, the studying of developing video games for visually impaired people with auditory and haptic displays [1], the evaluation of musical navigation of fingers [2]. Beside these studies, there are also games such as 'space invader for blinds' [3], the car racing games [4] and so on. Anyway, these are not the studies that can make the best use of visually impaired people's ability which is called 'Sound Localization' [5], that is described as a method using the sound information to catch the surrounding environment. Therefore, we come up with an idea of Presentation Methods of Sound Information, which is thought to be able to exploit the visually impaired people's characteristics. Much more than that, we also propose a content that is possible in improving the Sound localization's ability. By using this method, the visually impaired people may easily define the object location on the touch-screen. Moreover, it can be considered to make a big effect on education for visually impaired, auditory training of sound localization for the patients who are on rehabilitation process, or assistance training program, also. In this paper, we describe the idea of Presentation methods of using sound Information and the content that we referred above, and we mention the results of the experiments that we conducted with the visually impaired people in section 2. These are evaluated through the way of the finger moving on the touch-screen panel while using the content, and the ability of defining the object location.

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2. THE CONTENT USING THE SOUND LOCALIZATION'S ABILITY

2.1 The Outline of Our Concentration Game Content

The content that we develop is a Concentration game using sound information. This sound information may help players to recognize the position of cards on the display screen. Adobe Flash CS4 is used as development software. The rule of the game is the same as the Concentration game, which is played with the deck of cards. Even number of cards is shown in a grid on the display screen. The right answer is when the examinees can choose the pairs of matching cards continuously. Anytime it is the right choice, the chosen matching cards will disappear from the screen. With the purpose to let everybody can enjoy the Concentration games regardless of age or sex, we use normal animal's cry instead of numbers. Anytime when a card is chosen, the interactive animal's cry is reproduced. Sound information is set on each on the cards that are arranged in a grid. By touching the card on the screen with a finger, the players can hear and catch the sound information. With this method, they can assume the location of cards on the screen.

In this Concentration game, we formulate 5 types of sound information, and conducted an experiment on 4 undergraduate students and 5 visually impaired people. In this experiment, the valuation indexes were the total time it took to clear the game, the number of times to turn over the cards, and the number of times the examinees touched the cards. We also asked the examinees to give opinions [6]. Based on the results of the experiment and the participants' opinions, we chose 2 types of sound information: the

octave scale and stereo effect. The octave scale is a kind of sound caused by frequency veering using the musical scale of do, re, mi, fa. The stereo effect is made by changing the output level of left and right speakers of the touch-screen, and it's depicted for the sound source movement between the left side and the right side of that 2 speakers. We suggest the sound presentation method using 2 sound information, also called the octave + pan. With this method, the stereo effect is applied on the row of cards that are located in a grid, and the octave scale is applied on the column. Stereo effect has a sound effect on driving the visually impaired people's sound localization ability out, and enables them to imagine the card's location intuitively. Therefore, if they can get the picture of the location of cards, and then all they have to do is to just distinguish the top and bottom position of the card using the octave scale. This helps them to reduce more one task. Also, since the octave scale has the regularity in frequency veering, it is easier to distinguish the sound comparing to that of mere frequency veering. The figure relating to the card's position and the sound presentation method is shown in figure 1.

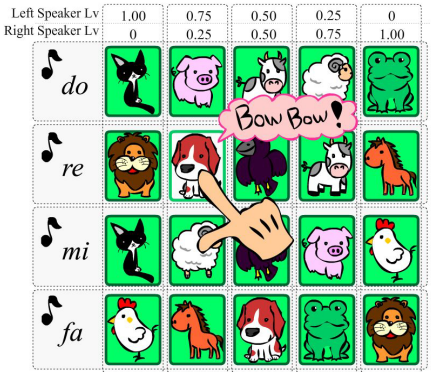

Figure 1. A combination of the octave scale and stereo effect.

2.2 The Evaluation

This content, in addition to measuring the actual total time it took to clear the game, the number of times to turn over the cards, the number of times the players could touch the cards while moving their fingers, we also collected the data of the fingers' coordinates every 0.1 seconds. These results are considered as the evaluation indexes. This data may make it possible to evaluate the differences in the way they operated the touch panel, caused by levels of handicap, age, and their circumstances, and also evaluate the level of their sound localization by judging how well they can define the cards' location. We have been conducting some experiments on 5 visually impaired individuals using this content. Here, we show the finger's coordinates of one of the examinees as an example of our obtained experiment results in figure 2.

This examinee is 27 years old with congenital total blindness. From figure 2, it can be seen that there are not many dots on the y-axis, and on the opposite side, there are many dots on the original coordinates. Based on this result, it can be observed that the movement of examinee's finger seems to have a tendency to move sideways, and that the examinee regarded the card on the left bottom of the touch-screen as the base position and the starting point. Furthermore, since the dots showing the finger's coordinate is right on the card, we can see that the finger's movement is quite accurate, and is in straight-lined. Also, since the result of the total time it took to clear the game, the number of times the player touched the cards, the number of times he turned over the cards had a better result than the other examinees, it can be thought that this examinee has quite a good memory, the ability of identifying the cards' location, that is to say the ability of sound localization, also the way of his touch-screen operation is significantly superior. As for the other examinees, regardless of their level of handicap, most of them who answered yes to the questionnaire that they usually go out by themselves had a better game results, and their finger tends to move accurately. Also, many of these examinees gave us their opinions that they would like to play our Concentration game at their homes or when they go out in their daily life.

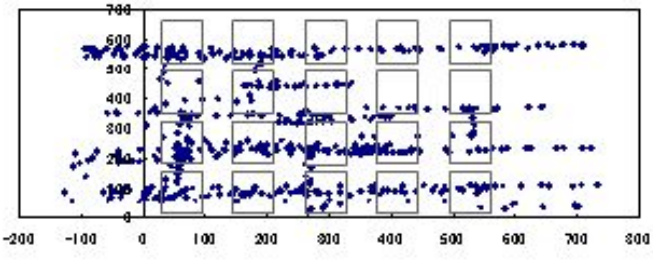

Figure 2. Dots of the finger's coordinate every 0.1 seconds on the touch-screen.

3. CONCLUSIONS

In this paper, we introduced the sound information presentation method using stereo effects and octave scale, and a Concentration game content mounted with sound information. Through this actual experiment, we found out that it may be possible to evaluate the visually impaired individuals' characteristics of touch-screen's operation method caused by the differences of their age and the level of handicap, the circumstance, and also the sound localization capability. In the near future, we intend to conduct more experiments on visually impaired people such as children attending schools for the blind, and the numerous of the other ones. And based on the experiment results that we can obtain evaluating the touch-screen's operation method of the visually impaired people, and to verify the effects of training the sound localization capability.

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