Development of a Tracking Sound Game for Exercise Support of Visually Impaired

Yoshikazu Ikegami, Keita Ito, Hironaga Ishii, and Michiko Ohkura

Shibaura Institute of Technology, 3-7-5
Toyosu Koto-ku, Tokyo, Japan
{m110007,m108017,m105005,ohkura}@sic.shibaura-it.ac.jp

Abstract. We developed an exercise support system that the visually impaired can use alone at home. Our system used the entertainment characteristics of games to encourage users to continue exercising. We focused on continuity, fun, and system usability and performed and improved our system by conducting experiments repeatedly.

Keywords: visually impaired, system, sports.

1 Introduction

Many visually impaired people have the desire to exercise [1]. However, they often cannot exercise for reasons that include no time and no facilities available for visually impaired. Based on this background, we developed an exercise support system that the visually impaired can use alone at home.

Exercising must be continued to be effective. Therefore we developed an exercise support game that utilizes fun to motivate continued exercise. After development, we improved the fun of our system based on the results of evaluation experiments. In addition, we focused on its usability, and improved it so that the visually impaired can use it even when they are alone.

2 Development

2.1 Outline

Figure 1 is an overview of the system. We employed a bicycle-type device for the use at home because it needs relatively small space. The system was controlled by a PC. The device sends such data as the degrees of leaning of the steering wheel and the numbers of pedal rotations to a PC, which sends sound data to the headphones.

2.2 Outline

Because our previously developed system for the visually impaired that employed sound localization got favorable comments [2], we also employed sound localization for our new system. Fig. 2 shows an image of the game.
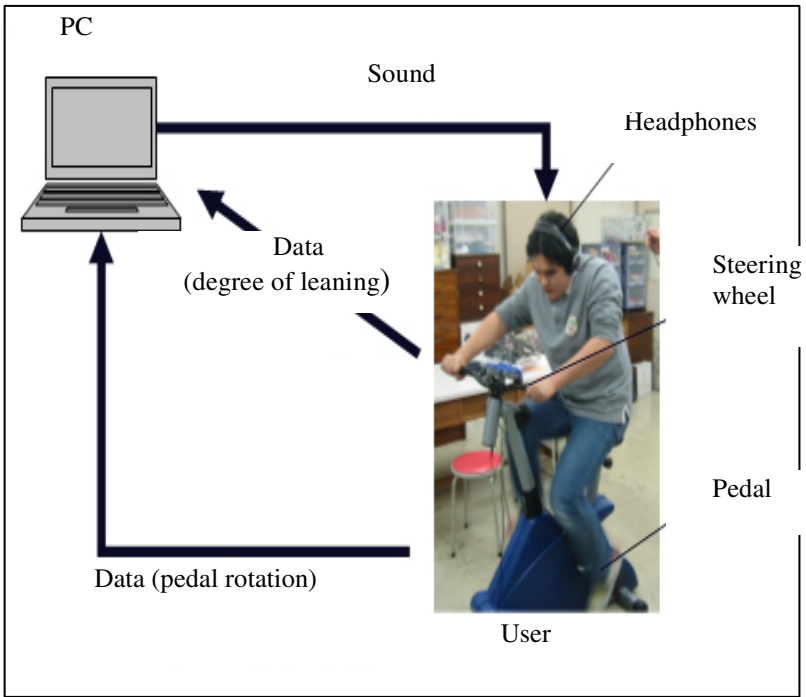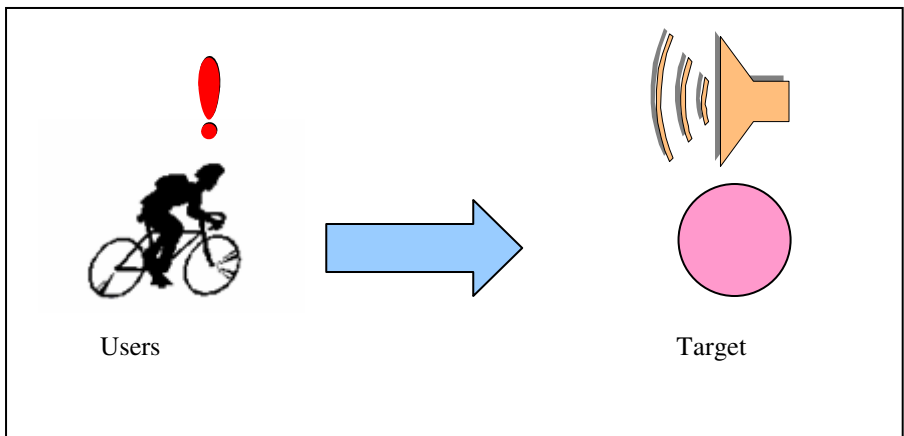
Fig. 1. Overview

Fig. 2. Image of game

The game flow is as follows:

1. Users wear the headphone and ride the bicycle-type device.
2. The PC outputs a target sound that is assumed to be located around the users.

3. Users pedal the bicycle to catch the target to which they get closer to the target by handling the steering wheel and pedaling.
4. When users reach the target, it disappears, and a score is given. Then, a new target appears.
5. After a certain number of targets have appeared, one stage is finished, and the next stage begins.
6. When three stages have finished, the users receive by voice their total score, ranking, and mileage.

We employed a lion's roar and the sound of maracas as the target sounds.

3 Evaluation

3.1 Experiment

We experimentally evaluated our prototype system with 20 subjects: seven were totally blind, five had amblyopia, and eight were unimpaired. We recorded the log data of the system and performed five-point scale questionnaires.

The questionnaire results that focused on fun are shown in Fig. 3. The game was evaluated as enjoyable by both the visually impaired and unimpaired.
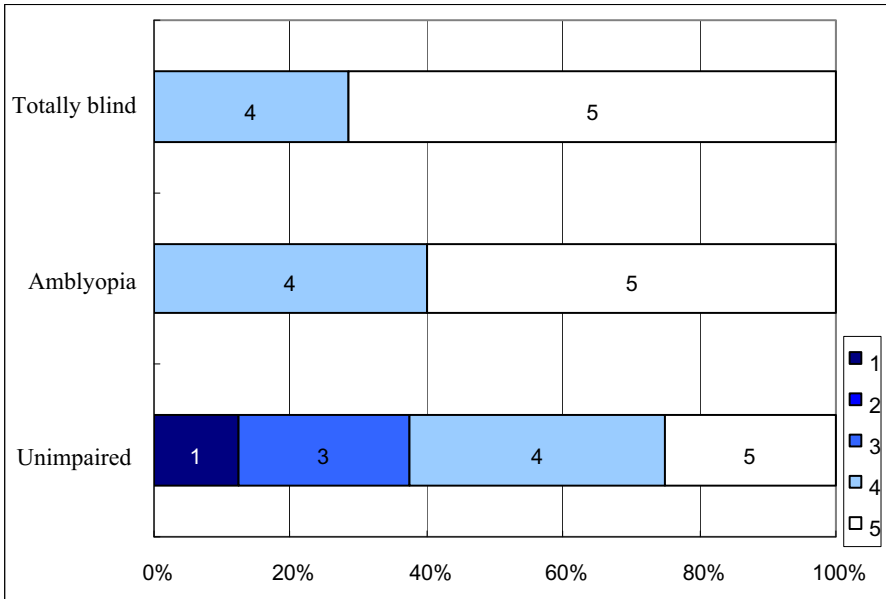

Fig. 3. Questionnaire results about system's fun

3.2   Improvement of System

Based on the questionnaire results, we made the following improvements.

- Added a ranking function.
- Added a function to raise the degree of difficulty when a user plays well.
- Added a function for pedaling backward.
- Added various game modes and target sounds.
- Simplified the game's start.

For raising the difficulty, targets appeared at the positions that are difficult to localize and the time limit was shortened. We also added a new game mode with new target sounds such as sheep bleats and dog barks.

3.3   Evaluation Experiment of Improved System

We re-evaluated our system after the above improvements.
    We set it up in a school for visually impaired students, and 17 students freely used it for two months.
    As in previous experiment, we recorded log data and performed questionnaires whose main items were the following.

- Which parts of the system should be improved?
- Which elements of the system were enjoyable?

Figure 4 shows how many times each student used the system. Although some used it more than ten times, many students only used it a few times. This indicates that our current system needs more improvement to increase continuity.
    Figure 5 shows the questionnaire result that focused on the enjoyable system elements. Riding a bicycle-type device and getting scores were considered fun.
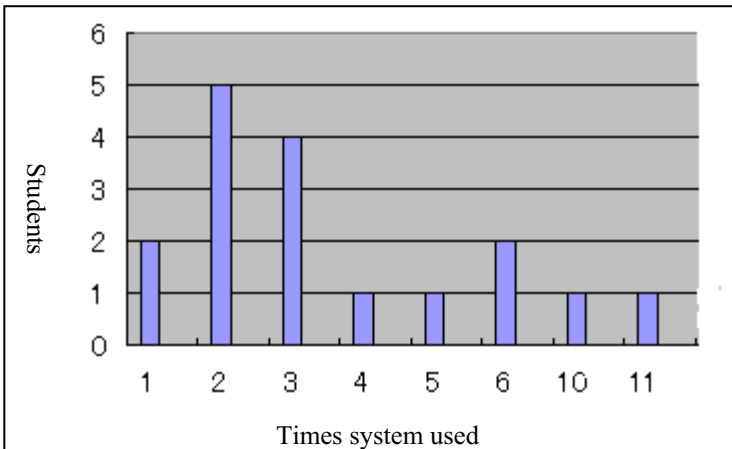

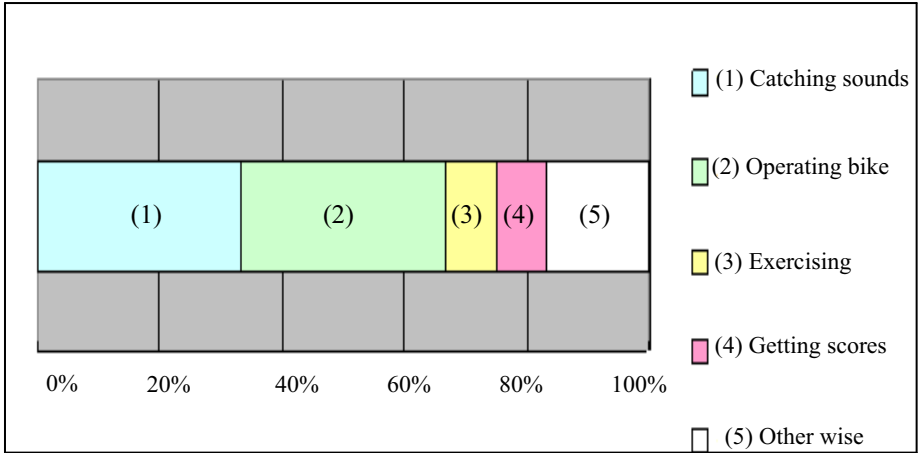**Fig. 4.** Frequency that system was used

Fig. 5. Questionnaire results: enjoyable elements

4   Conclusions

In this study, we developed a system that encourages the visually impaired to continue exercising at home.

The evaluation experiment results suggest that our system provided enjoyable support for continued exercise for the visually impaired.

Data from an evaluation experiment of our improved system, showed advancements of continuity and fun and what elements were considered fun.

We will implement a competition function because of such a strong demand from the young visually impaired students.

References

1. National rehabilitation center for persons with disabilities: A report of survey about exercise and sports for graduates of national rehabilitation support center for visually impaired (in Japanese),
   `http://www.rehab.go.jp/achievements/japanese/19th/paper20.html`
2. Ishii, H., Inde, M., Ohkura, M.: Development of a game for the visually impaired. In: 16th World Congress on Ergonomics, IEA2006, CD-ROM, Maastricht (July 2006)