Development of a Game that Visually-Impaired People Can Actively Enjoy

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Abstract. Recreational activities have an effect of improving the quality of life, but the recreational activities that visually-impaired people can enjoy are quite limited. "Passive" recreational activities that one can enjoy by reading, watching, or hearing (in particular those that visually-impaired people can enjoy) have increased through the development of synthesized voices. However, there are still only a few recreational activities such as sports and games that they can proactively participate in and enjoy. Videogames are one of such "active" recreational activities popular among visually-impaired people, however, interviews revealed that it requires a huge amount of effort for them to enjoy videogames. In the present study we developed a game that visually-impaired people could also actively enjoy.

Keywords: Dance game · Visually-impaired people · Kinect

1 Introduction

Recreational activities can reduce various stresses caused in our daily life, serving as an enhancer of QOL (Quality of Life). However, most types of recreational activities such as watching TV, movies, or plays, enjoying sports, reading books, and playing games require eyesight. Therefore, visually-impaired people can only enjoy limited types of recreational activities. The number of passive types of recreational activities that visually-impaired people can enjoy with content encompassing reading, watching, or listening has been increasing. However, there are still few active types of recreational activities such as sports, computer games, and board games that they can voluntarily participate in, analyze, and enjoy.

In this study, we developed a game that visually-impaired people could enjoy with the following aims: "The game shall not rely on the player's vision," "the game shall be enjoyable to both sighted and visually-impaired people," "the game shall not require complicated explanations on how to play," and "the game shall motivate players to continue to play it".

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2 Background

In Japan, playing videogames is a form of recreation familiar to visually-impaired people. The Pokémon game and "Taiko no Tatsujin" game are particularly popular [1, 2]. Also, fighting games are popular among serious visually-impaired "gamers" [3, 4]. Interviews with visually-impaired people indicated that they needed to memorize many things and devise their own ways of playing the games in order for them to enjoy them. In contrast, a survey result showed that most visually-impaired people were eager to play sports [5].

These games are popular because players can understand the situation by sound. In Pokémon, for example, the voices made by the characters, the sound effects of actions, and the sound effects of striking an obstacle change depending on the power gauge of the characters. Visually-impaired people enjoy the game by making an effort to memorize these sounds and creating a map in their brain by virtually walking all over the game world. They can also enjoy other games since the games contain a lot of sound information that can compensate for visual information. Of course, a great deal of work is necessary for them to enjoy the games just like sighted people.

In foreign countries, there are game-specific forums for visually-impaired people [6]. The games for visually-impaired people in these forums are mostly adventure games, arcade games, and board games, with only a few action games, sports games, and racing games (Fig. 1). Namely there are many games that allow players to enjoy the game stories and/or require them to take time analyzing, along with a few games that require the players' quick response. However, the fact that sports and fighting games are popular indicates that visually-impaired people would want to play action games and sports games. In this study we developed a dance game that people can play by actually moving their bodies.

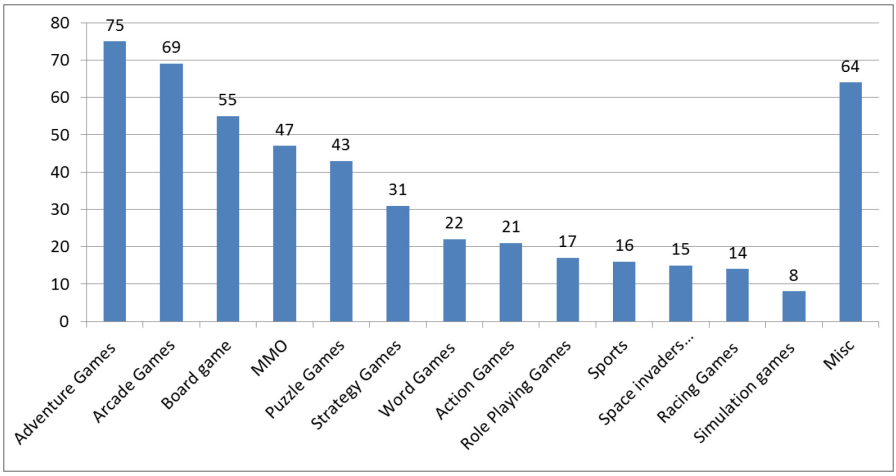

Fig. 1. The number of audiogames

3 Overview

In this study we developed a dance game that people can actively enjoy. The game is used in the following manner.

1. Music for dancing is registered.
2. A tutor dances as a model to record model data.
3. A player learns the dance according to the model data.
4. After learning the dance, the player actually dances and is rated on how accurately he/she dances.

If the player is not satisfied with the score, he/she can return to Step 3, learn the dance again, and try the game in Step 4 again. By doing this repeatedly, the player can pursue the improvement of his/her dancing.

Our developed dance game consists of two systems: Acquiring model data system, and dance scoring system. The present game incorporated the system of acquiring model data and the dance scoring system. Kinect was used to capture the player's body motion. The player plays the game by dancing to music in front of Kinect. A space of 1.8 m × 1.8 m would be necessary for Kinect to capture the entire body of the player (Fig. 2).

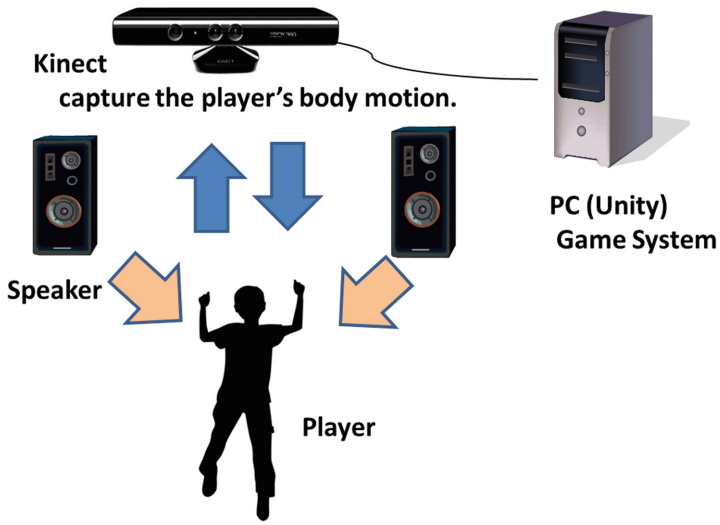

Fig. 2. System overview

3.1 Model Data Acquisition System

Model data are acquired to compare the player's dance with the model. The acquired data are used in dance scoring system. Also, when acquiring the data of the model, one can specify breaks at which the model dance stops for the choreography. For example,

when a player makes a downward swinging motion of his/her arm, the start time of the motion when the player raises their arm up and the ending time when the player finishes swinging it down are recorded and the system recognizes the motion from the start time to the ending time as a single motion. The start and ending times of the motion are saved in a text file in the form of flags and time stamps.

3.2 Dance Scoring System

This system scores the dance that the player learned. It compares the player's dance with the model and informs the player if the difference is large. The score is based on how accurately the player could follow the dance model.

For rating, the three dimensional coordinates of five points of the player's body are compared with those of the model data. If the player's body coordinates deviate from the model by an amount larger than, for example, one third of the length from the player's elbow to the wrist, the system determines the deviation of the motion.

The motion measurement is performed three times a second. For example, for 3-min. music, the dance is compared with a model 540 times (180 [sec] × 3 [times] = 540) and the number of deviating motions from the model is counted to reduce the score. If 54 motions are judged as deviating, 90 % of the motions of the player were correct and thus the score is 90.

A sound is created to indicate which of the five points deviated most. The sound differs from point to point. For example, when the right hand of the player makes a wrong motion, the sound of a bell ringing is made, and when the right leg makes a wrong motion, the sound of a dog barking is made. With such sounds, the player can know which part of the body moved in the wrong way at the ending time of each motion.

4 Evaluation

Two sighted examinees in their twenties were selected to use the dance scoring system. In the experiment, a character danced for a minute according to the model data and the examinees learned the dance by watching the character's motion (Fig. 3). The instruction of the game, including the operation procedure and rules, was given verbally. The examinees were asked to repeat the dance until they felt moderately tired or they were satisfied with the score. As a result, one examinee played 11 times and the scores were from 60 to 72. The other played 8 times and the highest score was 92.

In the experiment, the examinees could easily understand the operation procedure and rules to play the game. To increase the score they tried to dance accurately and repeated the game actively while conscious of the score. The examinees gave the following comments: "Dancing gave me an appropriate amount of exercise," "I tried to dance accurately while keeping the score in mind," and "I wanted to play the game repeatedly to increase the score". Also they said, "Learning the dance itself was difficult". and "It would be better if we could choose the difficulty level of the dance".

Fig. 3 Screenshot of the character's dancing motion

5 Conclusions

A future work will be to incorporate the tutorial system so that a player who does not know a dance motion can learn it by himself/herself. The future work will also include making all the systems verbally-controllable without eyesight. Also, not only the motion of hands and feet but also other body parts need to be measured for more accurate dance evaluation by adding more coordinate measurement points, such as fingertips and head, to the five points for which the coordinates are measured

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