

An Interactive Game Using Wii Remote for Visually Impaired People

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Abstract— Number of visually impaired people around the world is increasing year by year. However, companies that develop the games for visually impaired people are very few. For the visually impaired people, we have to create a fair environment, and enhance their entertainment. In recent years, somatosensory device has been introduced. Through the body to control the game is more attractive than the traditional joystick. In this paper, we design an interactive game for the visually impaired people, through somatosensory device and infrared-gun, and combined with Text-to-Speech technology to implement a flash game for the visually impaired people's to enhance entertainment quality of daily life. We invited five subjects to play this game, and complete a questionnaire and interview after the experiment. Our questionnaire divided into three parts: interested, audio guide and novelty of the game. The results showed that most subjects were very interested in interactive games. Through Text-to-Speech technology, most of the subjects were able to smoothly play the game with audio guide. A lot of subjects feel the game is very useful and innovative.

Keywords - Visual Impairment People; Somatosensory Device; Interactive Game; Text-to-Speech.

I. INTRODUCTION

Vision is the most important and the natural way for humans to receive the message from the environment. We rely on vision to handle most things in daily life. Not only are the assistive devices, the amount of the games for the visually impaired people, are very few, too. Currently, most entertainment activities for the blind people are static, such as e-book. Moreover, most are have inconvenience user interface. For these reasons, considering the demands of visually impaired people, and design an interactive game for the visually impaired people is very important.

The "Wii" has been introduced by the Nintendo company in 2006 [1, 2]. Different to the traditional games, Wii uses the wireless controller to control it. In this way, it is providing a new way to play the games. Moreover, the wireless controller has a friendly user interface; the player is able to control instinctively. For these properties, the Wii's controller can be used in other domains, such as education and physical therapy.

In this paper, we are going to develop an interactive game for visually impaired people. The game can assist them to play the game by wireless controller, audio and text-to-speech technology (TTS). In addition, this game

will improve and be more interesting for the visually impaired people. For the game testing, we invite five persons to provide us assistance, such as play this game and give some suggestion. Finally, we got some data which about game testing from these people. So far, it is perceived that this game "very interesting", "have a good voice and sound guidance", and "has novelty" The paper is going to introduce related work about our game and how we implement this game.

II. BACKGROUND AND RELATED WORK

We should to know some sensors and development kit before implement the game. First, the Wii's controller that named "Wii Remote [3, 4]." In the shape of Wii Remote is look like a bar, it is a small and light handset. It can be divided into three modules: the G sensor [5, 6], CMOS [7] IR receiver and Bluetooth module [8]. The G sensor can calculate X, Y and Z axis acceleration. Next, determine the player's actions on real time. The CMOS IR receiver can receive the infrared from the sensor bar. Then, we find the different position of infrared point to determine controller's movement. After, Wii or computer handles these data which receive from Bluetooth.

Secondly, if we to drive the components which on the Wii Remote, and communicate with computer, it should use the Wiiflash [9] API to do that. The Wiiflash API is an open source development kit; it is good for designer to write the flash program which linked the computer and Wii Remote. About this development, the kit includes: (1) Wiiflash API library, (2) Wiiflash Server: providing a way and the computer is able to communicate with Flash, (3) examples, and (4) documents.

III. STATE OF ART

Today, the studies for the Wii Remote are more than before. Some people have used the Flash to develop many fun games, and control by Wii Remote [10]. Yi-nung Lin designs a pantomime games for children with cerebral palsy. They wear the simply IR transmitter on their wrist, and lead those children to do rehabilitation with the interactive teaching materials. Children were felt interesting in these teaching materials. So they learn how to play this game really hard.

About the research of the infrared sensor on the Wii Remote, Johnny Lee's Wiimote whiteboard [11] is the first study. Since the Wii Remote can track the sources of

infrared light, Johnny Lee make a pens that have an IR led in the pen's tip. Wii Remote can combine with IR pens, rear-projected, and notebook, it will become a low-cost interactive whiteboards.

Chien-Yu Lin et al. [12] wore a simple infrared emitter for children who is a cerebral palsy usually. It is very interest for her to use interactive teaching materials, so she works hard to raise her hand and do some exercise. The most current study on the Wii Remote is research in education and rehabilitation. In this paper, we design set of interactive games for the visually impaired people and our purpose is to increase the quality of entertainment for the visually impaired. We combine the Wii Remote with Flash, and designed a game like "Whac-A-Mole". We redesign the mode of operation of the game. We consult the concept of infrared pen, to design an infrared gun, so that the visually impaired people have more immersive in play his game. To allow for the visually impaired can play game alone. Interactive game system that we purpose also has the following function and characteristics:

- Easy to use, visually impaired people can operate independently without others help.
- Use speech in the game to identify the location of hamster through audio.
- Everyone can adjust the scope of the game to increase the applicability of system fitness.

IV. SYSTEM DESIGN

We develop an interactive game for visually impaired people that use the Wii Remote and infrared-gun. For the visually impaired people to have interest in the game, we add the audio and speech.

A. Experimental Equipment

1) *Wii Remote*: Unlike most operate method of Wii Remote general; we use the CMOS sensor camera and Bluetooth to receive the location data from infrared-gun. Then CMOS sensor camera can send the data to the computer.

- 2) *Infrared-gun*: The process of making infrared-gun:
- a) Soldering the wire with the infrared LED's positive pin and negative pin.
 - b) Add a button in the middle of the negative wire to control the flow of the circuit.
 - c) Connect the power with wire.
 - d) Complete. The infrared-gun image is presented in Figure 1.



Figure 1. The infrared-gun.

B. System Architecture

In this paper, the computer is our data server. When visually impaired people move the infrared-gun, Wii remote will send the location value to data server through Bluetooth technology. Then Wii Flash server can interpret a position value and transmit the value into flash. Flash can process the data and display in computer screen. The position value can determine whether the gun hit the mouse. The system architecture is presented in Figure 2.

C. Game Flowchart

We designed a game like "Whac-A-Mole" and use Flash CS3 as our development environment tool. Therefore the code written is ActionScript3.0 [13, 14]. Because of this game is design for visually impaired people, we use audio and speech in game as the main navigation tool to help the visually impaired people to operate the game. The game flow chart is presented in Figure 3.

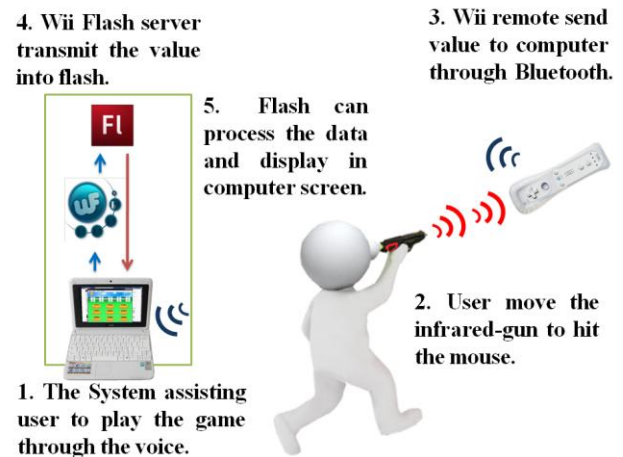


Figure 2. The system architecture.

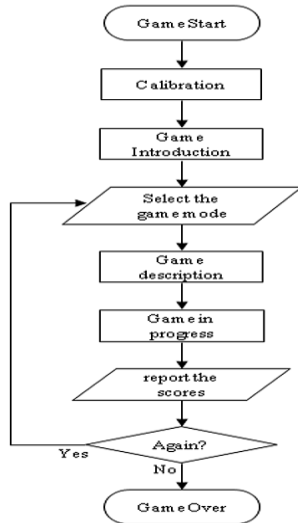


Figure 3. Game flow chart.

The screen of game beginning is presented in Figure 4. After entering the game, that will enter calibration mode first, and assisting visually impaired people to stand the best place and to confirm the game through the speech. Then, let visually impaired people to set the range of the game. When calibration is completed, the system will explain how to play the game by audio message, in this way, visually impaired people can choose the game mode and into the game.

Game screen is divided into nine blocks with squared, is presented in Figure 5. When the hamster appears, the visually impaired people can identify the site of hamster through the different voice, then the visually impaired people use infrared gun to shoot hamster. If successfully shoot, the system will make a sound, and increase the score.

The game were divided notes, such as “Do, Re, Me” and music two modes. In the notes mode, hamster will randomly appear; in the music mode, the system will choose a song, then the hamster will follow the song’s tone appearing. When the visually impaired people shoot hamster successfully, the system will make the next one to appear. When the visually impaired people shoot completely all the tunes, the system will calculate the time it takes and convert into the corresponding scores.

When the game is over, the system will calculate the scores and read out, and then, asked the visually impaired people whether playing again. If the answer is yes, the game will back choose the game mode. The over screen see the Figure 6.



Figure 4. Start of the game.



Figure 5. Game screen.



Figure 6. End of the game.

D. Experimental Design

Visually impaired people are the main user for this game. In addition, the blind people are harder to interview than the sighted people. When the game testing, we ask the subjects to wear goggles or close the eyes to making simulation. Before the game starting, we tell to user why we designed this game. And then, the user enters and plays the game.

Another important is, we want to know whether the users are able to follow the audio message to play the game or not. Therefore, we record the time when the users starting the game until the game over.

V. RESULTS

In this paper, we use the questionnaire and the user's experiences as a basis for experimental analysis. We invited five persons to be user and test the game. Theirs age from 11 to 50 years old. The average test time is 252 seconds and only one user restart the game, because he forgot the range which he set, and the other users caught a game complete.

A. Questionnaire

Table I is the results which investigating by questionnaire from five users. Our questionnaire is using Likert scale and it has three questions. The first one, there are 80 percent users fell that this game is funny and very interesting. The second, about guidance, the game has audio message and voice to guide user, there are 60 percent feel that this game is smooth. And the third, all users are thinking this game is very novelty.

TABLE I. RESULT OF QUESTIONNAIRE

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Do you think this game can catching your eye	1	3	1	0	0
Do you think the speech and sound can guidance you play the game smoothly	2	2	1	0	0
Do you think the game is novelty	4	1	0	0	0

B. Experience

Besides the questionnaire, we also asked the user about the experience or suggestions in this game.

We found that the most of the users had a high degree of interest in this game. After the end of the experiment, the users will be asked to play again. A few users share the experience with others.

Most of the users believe that this game is novel because they never had an experience to play game like that. However, a few users expressed that they did not find the scope of games when game is started. And they cannot continue the game.

In the future we may refer to these comments, and fix the game problems to remind users who cannot find the scope of game.

VI. CONCLUSION

In this paper, we developed an interactive game for visually impaired people. The game is equipped on the computer, and let the Wii Remote be an IR receiver. The

blind people just need taking an infrared-gun target at Wii Remote's CMOS receiver. The communication between the computer and Wii Remote, the game used WiiFlash API to drive the sensors which on the Wii Remote. And then, we also send the position information that got from CMOS receiver. On the other hand, we have designed a friendly user interface which using text-to-speech and voice to guide the blind user. After the game prototype was completed, we invited five users to play and test game. In the results, 80 percent users think the game is funny and interesting, 60 percent think the audio message and voice guide let game smoothly, and all users think the game is really novelty. In the future, we are going to improve the game's quality and let it work well.

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