A contemporary interactive computer game for visually impaired teens

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Abstract

Computer games have now become a part of many teens' development. Many teens today socialize through online games or talking about the games they are playing with friends because they can have fun together or share experience with each other. The content of the games does actually help shape the growth development of many teens and it is important to make sure that all teens have access to good games to help their development. However, there is a group of visually impaired teens who cannot access a large number of games due to their visual effect. The majority of game makers do not consider visually impaired teens as target customers, and they make modern games with the focus on beautiful graphics. This issue widens the gap between normal and visually impaired teens. Even though visually impaired teens can use computer more conveniently than they do in the past thanks to accessibility tools provided today, there is little accessibility tools for computer games. Realizing this problem, we completely redesign a contemporary game of a popular genre called "first person shooting" so that visually impaired teens can play with their hearing and touching abilities instead of visual ability. In order to provide ability to socialize with friends including normal teens, the game is designed to be multiplayer and allow normal teens to play with limited visual effect to ensure that visually impaired teens can play fairly with normal teens.

Keywords: computer games, visually impaired persons.

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Introduction

Computer Games today have a large impact on social and personal development of teens.[1] Teens today can make friends through playing online games together or share game playing experience with friends. Most games today are rich in graphic and visual effect. Computer games today are so visually advanced that they could simulate graphics so close to real-world images thanks to sophisticated graphic hardware technologies. However, this advancement is actually widening the social gap between and normal teens and visually impaired teens because game developers tend to focus more on computer graphics rather than the game playa and human interaction support for the visually impaired.

Even though computer technology today are well equipped with accessibility tools for visually impaired persons, computer games do not receive any benefit from the tools. In the United States, 0.8% of teens are visually impaired.[2] From observing visually impaired persons, computers

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are often used for work-related and information finding activities.

Very little games are available for the visually impaired, and almost all of them are audio-based games which are not common in contemporary games. This enhances the feeling of being neglected by the society for the visually impaired teens.

In order to help visually impaired teens socialize and play the same type of games that are popular among normal teens, we design and develop a game that can be played by both visually impaired teens and normal teens using limited visual, hearing and touching abilities. The content of the games will resemble first person shooting games popular among modern teens. The players will interact with the game via WiiMote[3] and gesture through Kinect[4] and receive game information through limited graphic, surround sounds, and vibration in WiiMote.

The game prototype was tested by visually impaired, and normal teens. The result of the test is promising. Most testers said that our game really allowed them to use other skills that they could not use with traditional games. Even normal teens found our game interesting and exciting to play.

Background

It is usual for teens today to play computer games which have become an important part of their culture and growth development.[1] Most of them are familiar with computer games. Computer games are found to help young children develop their psychomotor, cognition, and social interaction and many teaching methods include games to help learners' development.[1] However, unfortunately, people with visual impairment have little access to most computer games.[5]

In order to provide access for visually impaired children to computer games, method of playing must be considered.[5-7] Audio is often the choice because audio is the main communication method for visually impaired people. The majority of computer game developers provide accessibility support for visually impaired people by manually translating visual images from computer games into audio text describing the visual images and stories. Some games even use speech synthesis and Braille refreshable display. Early computer games that used speech-synthesis of text-based games include versions of popular MUD games.[8] The objectives of MUD games is to explore a fantasy virtual world, complete quests, go on adventures in different player's roles, and advance the created characters.

However, popular games nowadays have been changed into first and third person shooting type of games with sophisticated graphics. There are efforts to bring audio support to many mainstream games.[9-10] Examples of this type of games can be found from AudioGames.net.[9]

Audio-based games were also made with more sophistication. There are a few advanced audio methods used including auditory overview, sound positioning, and sonic palette.[11] For audio overview types of games, games will not express the position and status of all objects in the game unnecessarily in order to help visually impaired persons track the game status easily. Only necessary information such as the last moved objects are expected to be observed by the player. For sound positioning type of games, different sound with different perspective of dimensions were introduced. Multiple audio speakers can be used to represent different locations of objects in the game. For sonic palette games, several methods of audio interfacing are applied to be suitable to different types of gameplays. For example, recorded or synthesized audio text is used when the game wants to communicate very precise information to the players, such as game instructions and menus. It is important to note that the speed in playing the audio can affect the experience of the players. During fast game play, the audio speed should be high as well.

According to Chion et al[11] and Schaeffer et al[12] and, there are three modes of human listening skills: casual, semantic and reduced listening. Casual listening is used when listening to the source of a sound, attempting to understand what caused it. Semantic listening is used when players try to interpret auditory codes such as speech or Morse code. Reduced listening is used when

listening to feel the quality of a sound without considering its source, such as when appreciating music by listening to its tones, pitches, harmonics and rhythms.

Enlarged text and images could be designed for visually impaired people who are not completely blind.[10] The game player can choose suitable size and color of the text and images that are most comfortable to read. In some cases, the color of text and objects in the games should be easily and clearly distinguishable. For example, a visually impaired person should be able to distinguish between a hat and a cat.

It is quite obvious that people at different ages need different types of games due to their abilities and experience. Young adults may want games that help develop their analytical and computer skills. Young children may want games that help them develop the confidence which will allow them to live in the society with visually impairment. Wonderbaby.org is a website that list different types of games for children in different age ranges such as blind toddlers, kids younger than 7 years old, teens and young adults.

There are many new ways to interact with human today. Nintendo Wii Remote and Microsoft Kinect can be used to provide extra means for human-computer-interface for the visually impaired. Nintendo Wii Remote[3] allows game players to interact with games via hand and arm gestures, and Microsoft Kinect[4] allows game players to interact with games via body movement and sound. However, their recognition efficiency is still not at high resolution level. Better human body movement and sound recognition devices are expected in the near future. We believe that visually impaired teens can benefit greatly from this advance in technology.

Game Design

Our game is designed to be a top-view 2D third-person shooting game similar to simple modern shooting games which are popular in the market. The game is separated into two parts: game play and game controls.

For the game play, the style of the game is real-time interactive adventure-based. Players can control a character, a courageous prince, in the game who wanders around rooms (dungeon) looking to rescue a young princess captured by a deadly and mighty dragon. In order to reach the room of the princess, the prince has to solve puzzles, kill monsters, and collect items which will help him along the way to the room where the princess is captured. In each room, monsters and items may be located in different locations within the room, and the player must use hearing and motion sensing abilities to kill the monster and pick up items. This gameplay does not require the player to memorize much information. If the player walks around and hit an item in the room, the sound of the item will be heard. Each item has its own unique sound. If the player walks near a monster, the sound of the monster can be heard from a distance through surround sound system allowing the player to locate the position of the monster in the room. If the player gets too close to the monster, the player can be attacked by the monster. The most fun part of this game is the monster fight. The player has to locate the monster and throw weapon at the position where the monster is located. The player can move his body to evade attacks from the monster. In early stages of the game, monsters stand still. In later stages of the game, monsters can move quickly. This forces the player to interactively keeping track of the position of the monsters through the sound of the monsters. The game is designed to be played by both people with normal vision and visually impaired people. For normal-vision players, the game will display a dungeon room with dark fog limiting the view of the players. This way, visually impaired people and people with normal vision can play together fairly in the multiplayer version of this game.

Regarding the game control, players can control the characters freely in the game using Nintendo Wii Remote. By pointing the Wii Mote in the forward direction, the character will move forward. By turning the Wii Mote in the left or right direction, the character will move to the left and right respectively. By hitting the 'A' button or 'B' button, the character can shoot in the forward direction or pickup an item just in front of the character respectively. The game system allows the players to know the exact position

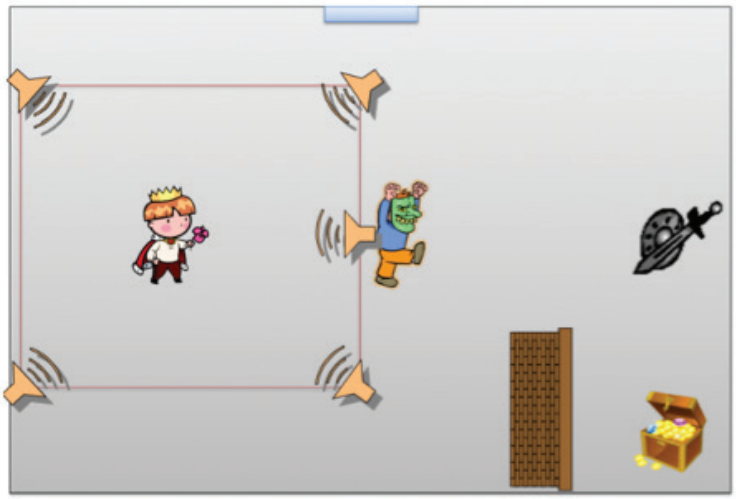

Figure 1: The audio control of Unawakening game. The player will hear sound through 5 speakers system. The speaker closest to the object (monster or item) will produce loudest sound of the object.

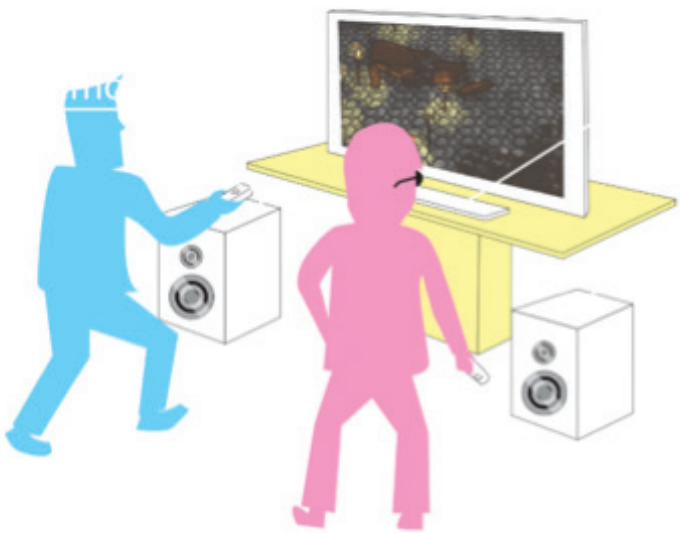

Figure 2: The hardware setup of the game (center and rear speakers are not shown).

Figure 3: A screenshot from the game. The normal-vision player will only see in the direction that he is looking straight at.

of the monster in each room by relating the forward direction of the character with the position of the monster. The audio experience through the 5.1 surround sound system will allow the player to locate monsters and objects **(Fig. 1 and 2).** The sound of the monster will be heard loudest at the relative speakers closest to the monster as shown in **Figure 1.** The Kinect device will also try to detect whether the player is standing and looking straight at the screen (calibration) so that the WiiMote sensor can properly detect the movement of WiiMotes. The screen will show limited view of the room which is the view that the player is looking straight at **(Fig. 3).**

Implementation

The game was developed and run on Microsoft Windows 7 platform. We use the Kinect and Nintendo Wii Remote drivers for Windows[13-15] for the communication between our game and Kinect and WiiMotes. The gesture control is provided by Microsoft Kinect library available at Microsoft.com website.[14] The implementation of the game play including audio and graphical presentation and multiplayer support for character movement and in-game animation are supported by Microsoft XNA Framework and Microsoft XNA Game Studio.[16-17]

Results and Discussion

We tested the prototype of our game with volunteers consisting of 8 visually-impaired people (all of them were completely blind) from Ratchasuda College and 15 normal sight people from the Faculty of ICT, Mahidol University, Thailand. The result of the test is shown in **Figure 4.** On average, visually-impaired people liked our storytelling and agreed that our game was entertaining and at the same time helped improve their listening skills. They didn't find our game and the control too difficult because they were already using hearing and body movement skills on regular basis. In addition, the lack of experience using WiiMote or Kinect did not seem to be a big problem for them. It took them some time to adjust their game play with WiiMote and Kinect. People with normal vision, who played the game with some handicap such as limited viewing screens, find our game entertaining but difficult because they still would like to rely on their most reliable sense which is sighting ability, but our game offered limited view of the game play. From the result, the visually impaired found our game a bit more difficult than the

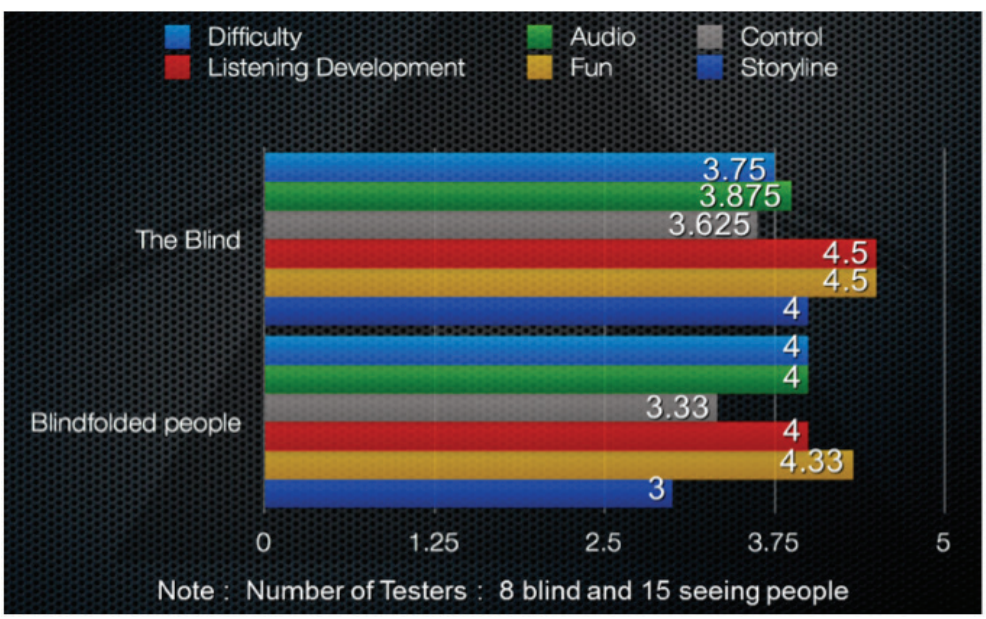

Figure 4: Game test results

people with normal vision did. We think this was because the visually impaired generally lacked the experience playing games, in particular this genre of game, and were unfamiliar with WiiMote. It is interesting to notice that the overall difficulty scores of the visually impaired and the people with normal vision were not far apart. After playing the game, both groups of participants found the game useful for improving their listening skills. They admitted that the story line of the game is quite satisfactory.

Conclusion

We presented a contemporary game for visually impaired teens which offers real-time interactive and adventurous experience by using Nintendo WiiMote, Microsoft Kinect and surround sound system. The visually impaired people have never experienced a game that they can use their superior hearing and touching skills together before. In addition, they can play with normal-vision teens. The addition of other senses of control for the visually impaired players really has a big impact on the fun and the feeling of being able to socialize with normal-vision teens. Visually impaired people want to live in the same society as people with normal vision and enjoy the same or similar experience that people with normal vision enjoy. Our game provides a channel for the visually impaired and normal-vision teens. to connect. We hope that more games like this will be developed in the future for them.

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