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Kinect Games For Visually Impaired Using Real Time Sensory Substitution

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ABSTRACT

Gesture based interaction is a 3D interaction game which is used to provide an efficient platform for players those who are blind. Mostly these games are popular among children and provide an entertaining feature for sighted players. Many games are already developed for blind people. But SQUASH game which is popular among normal people has a greater disadvantage over visually impaired. Proposed SQUASH game involves audio and haptic recording which is used to specify what gesture it should provide while gaming. The game provides audio or haptic recording to the players who are visually blind which make them to play the game easily and interestingly. This can be implemented by sensory substitution method using a controller. This paper explains the hardware scheme, experimental results, display of game area etc.

Keywords: Gesture Recognition, Wii remote, Exergames, 3D Interaction, Visual Impairments.

1. INTRODUCTION:

Games provide enjoyment to humans both by mental and physical nature. Nowadays computer games are attracting people; they focus mainly on mental activities. Normally keyboards, joystick and mouse acts as the input device for computer games. But these do not provide a real interaction with computers. For example, while playing tennis, buttons are used to hit the ball to other side of the net but it does not intimate the direction and power to be implied on the racket. To provide a real time gaming environment Xbox games came into the frame which use an input device

known as kinect that act as a motion sensor. 3D gestures and audio guidelines are provided to communicate with the game.

Gesture based games along with the video games provide a human-machine interaction. These games are controlled by controllers such as Wii remote and joy stick. These games are attracted by children and elder persons. The persons who are visually impaired are allowed to play exergames which is used to reduce their obese problems and their lonely nature. So that they can interact with the machine through their physical body movement known as gestures. The exergame for blind persons involves games like tennis, bowling, jumping and javelin throw. The gestured games show significant change in spatial and temporal issues. These issues are difficult to face for visually impaired persons. So we use sensory substitution method to enable them to play effectively. The real time substitution method provides different type of cues like audio cues, video cues, verbal cues and haptic cues. Earlier audio cues and verbal cues are used for gaming (i.e.) the visually sighted person will instruct the blind person to play the game based on the text displayed in the screen. Audio cues help the participants to hear the instruction of the game and proceed with the gaming. This method can also be a drawback as if any other noise interferes with the game then the players with visual impairment will find it difficult to play the game.

2. RELATED WORK:

In [1], tailored version of tennis game is designed which explores the motion sensing capability by using vibrotactile and audio cues to provide the required action. The children with visual impairment are allowed to play the game in both the version and the results are compared. The result shows not much difference in both the game version. This helps the players to engage in the game for longer time. The visually impaired people does not find an opportunity to do physical exercise, thus they suffer from obesity. The visually impaired players show low level of physical strength when compared to the sighted players. Former one have same level of physical strength compared to the later, but the opportunity to bring their physical activity level is resumed due to limited training, panic and absence of self reliance. [2] Focus on the measurement of physical power level for both sighted and non sighted players by conducting the case study involving 26 girl players and 20 boy players.

Visually impaired people find it difficult to access the touch screen phones as they do not provide audio and vibrotactile feedback. In [3] pilot evaluation method is used to help the non sighted persons to access the mobile phones with touch sensor which provide iphone accessibility mode to help blind persons to identify every entry by activating the finger gesture. User can dial the phone number by drawing the number in iphone accessibility mode, every time an input is recognized the respective number will be vocalized and included with the compiled phone number. When the given gesture is not recognized then the haptic feedback will be provided.

In [4], the sensory substitution technology is focused in which the person after losing the power of sight can retain the visuals. When the non sighted person sees the world the input ocular image will be sent to the retina which is turned into electric impulse and the image will be restored in the brain.

In [5], the mobile app for non sighted person is designed. When a user touches the numbers, voice command will be activated to notify the users. The application contains some frequently used app which helps visually impaired person to access it. Like in [3], number 5 is the default spot to help visually impaired persons to dial the number. When the non-sighted person touches the mobile screen the audio cue will be activated to recognize their gesture.

The non-sighted people can play the game with the help of Wii remote (a wireless device). In [6], the gestures based application detects the gestures made by the players using Wiimote. The Wiimote uses single stroke gesture movement to interact with the game. The accelerometer readings of new gestures are noted to compare with the already recorded readings using UGI (Uni-stroke Gesture Identification). The equivalent end result will be provided by recognizing the correct gesture.

3. EXISTING SYSTEM:

Earlier, the vibro-tactile cues are used with the controllers. These controllers are given to the players with visual impairments and the players are provided with vibration when they approach a hurdle in the game. In case of tennis the vibration will be provided when the ball approaches the player. These games are based on the performance of the players. The controller will create a sonification, when a ball approaches the sensing point players should provide their input with the controller remote provided in the game. This is explained by the Real Time Sensory Substitution (RTSS) technique.

The main aim of the method is to provide the haptic cues in replacement with audio and visual cues to enable the visually impaired players to respond to the sensor provided by the hand controller by giving input in the form of gestures even though the gaming is interfered by the external sound or noise. For example, a blind person playing a jumping game and when he/she reaches the hurdle the controller will provide them the sensor to notify the player to jump. This input is based on the performance of the player. If the player is running fast then the sensor will provide the input soon and it will reverse in case of vice-versa. This delay is rectified by using run time video analysis.

4. PROPOSED SYSTEM:

The proposed system describes the Real Time Sensory Substitution method with different level of gaming structures. Earlier visually impaired persons can play certain type of games like jumping, bowling, javelin throw etc. Main aim of the paper is to focus on other games for blind persons to make them play like normal players. The paper focus on squash game for visually impaired players with the help of Wii remote [7] by which they can play the game using hand gestures.

The gestures provided in the game are detected by Wii remote. It is a hand held wireless device which can be connected through Bluetooth. The Wiimote contains four buttons such as, A, B, 1 & 2. First two buttons are used to carry out and

record the gestures. Later two buttons are used to establish connection via Bluetooth with the computer. With the help of these buttons user can interact with computer to play the game.

In this application the user interact with the game by performing gestures using Wiimote. The user selects the menu option in the game by pointing the Wiimote pointer precisely. This style of selection is useful when the game provide several options. In order to play the game the precise pointing is not needed, the player can just do actions (gestures) within the specified area (as the Bluetooth connection is limited to certain meters). Players can move freely within the game area.

Fig 1. Nintendo Wii remote for blind persons

The function of Wiimote is to distinguish the nature of shot performed by the user (player). There are basically two categories of gestures namely, uni-stroke gestures and multi stroke gestures. We mainly focus on uni-stroke gestures since our application uses simple hand movements to play the game. Uni-stroke gestures are attained by pressing the Wii remote button. The button will be released when the player finishes the shot.

The gestures to play the game are differentiated by three different phases namely;

- **Enrollment phase:** In this phase, the gestures made by the players will be recorded. This can be done by holding the button B of the Wii remote. The player swings the Wiimote by holding the button and releases it after making the gesture. Thus the gestures will be stored.

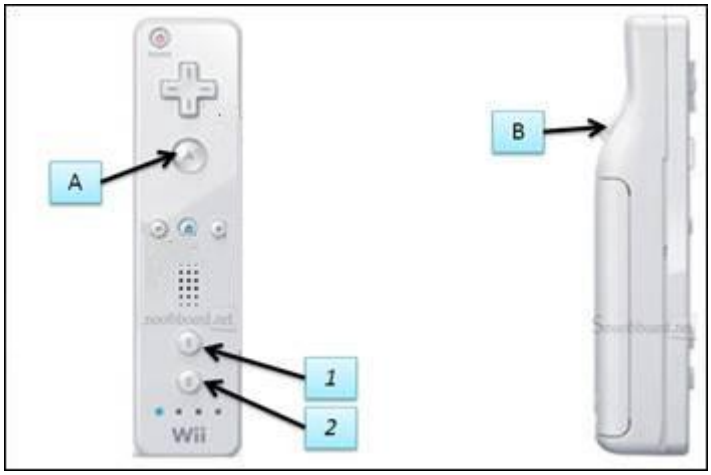

Fig 2. Wii remote buttons for performing different action in gesture application

- **Acknowledgement phase:** In this phase the new gesture made by the players will be compared with the already stored gestures. Button A will be pressed to make a new gesture. The gestures are compared to provide the outcome (direction to which the player make a gesture) of the game.
- **Tune-up phase:** In this phase the player swings the Wiimote in desired direction to strike the ball. The ball hits the squash court front wall and gets averted to the course of the strength applied. To make the right gesture the Wiimote will be tilted to the left side and swung towards the right side (same for left, up and down gestures).

Game Exhibit:

The game interface provides the list of options like tutorial to start a game, number of players to play the game and different levels of ball pace. The player can interact with the game only when the Wiimote is connected. The visually impaired user can interact with the game easily via Wii remote.

The points and voice interaction offer a real time atmosphere to the game. The points will be based on the numbers of strikes made by the player. The points will be increased when the player strike the ball after a haptic cue is recognized else it remains same when he/she misses the shot. The voice over (intimating speed increased/ speed decreased) will help the player to interact with the game when he/she swings the Wiimote after the vibration.

Fig3. Squash game area involving two players

The ball pace can be varied by selecting the options: slow, medium and fast. Each pace has different threshold timings. For example, if the participant select the medium ball pace then the deflection rate of the ball will be more when compared to the slow ball pace option and less compared to the fast pace option. Four rounds of gaming are provided and the points are noted based on the strike rate. Player can also choose the number of users (single/double) to play the game. The racket and ball position can be viewed on the screen and their progress is directed by the participant by swinging the Wiimote (racket) likewise.

5. EXPERIMENTAL RESULTS:

The visually impaired and sighted players are allowed to play the game. The players are instructed with the game rules by voice interface and will be given a Wii remote to interact. This provides a real time setting to the non-sighted players. They play the match by swinging the Wii remote in the desired direction. The players feel a vibrotactile cue in the Wiimote that notifies them to do gestures accordingly. This cue will be felt only when the ball approaches the player. He/she should do the action immediately else will miss the ball. The results are recorded based on the strike rate.

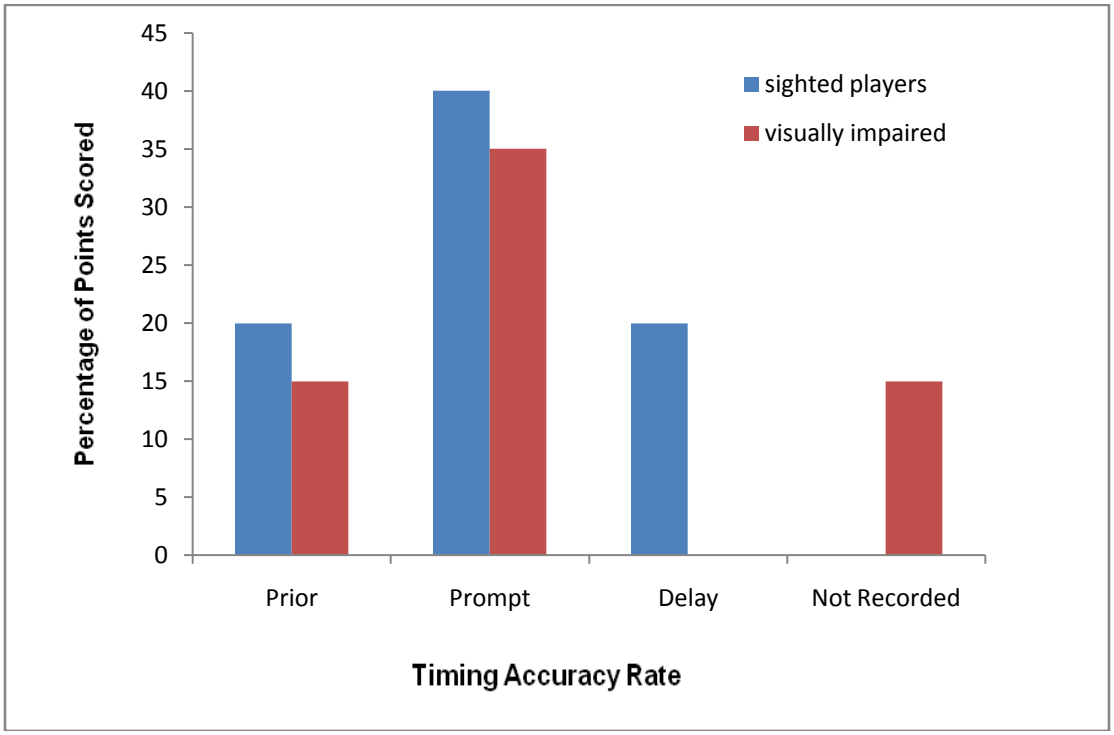

Fig4. Accuracy Chart

Figure 4 shows the experimental result of visually impaired players and sighted players with the help of Real Time Sensory Substitution method. The results show no major difference among both the players. The visually impaired players show momentous outcome compared to the sighted players, they respond to the game on time or in prior. The accuracy rate were noted based on the input (prior, prompt, delay, not recorded) given by the players.

6. WRAP UP:

The discussions made in this paper are uni- stroke gesture using Wiimote, its recognition and the desired output based on the gestures. We implemented different level of gaming (squash) to the visually impaired. The player interacts with the game using Wiimote and can change the ball pace respectively. The voice interface makes the players to feel like real game court.

For the future work to be considered, different shots that are not implemented in present game scenario would be focused. We also like to focus on the multi-stroke three dimensional gestures which are difficult to implement so far.

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