SonicWalker: Virtual Reality Simulation of Non-Visual Pedestrian City Navigation

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ABSTRACT

Virtual reality has been used to bring people into isolated environments that either mimic the real world or abstract worlds. This game demo presents SonicWalker, a virtual reality based city that places the participant into the environment of a person who is blind. The participant is required to navigate city streets without using any vision - relying only on 3D audio.

1. INTRODUCTION

People who are blind may find it difficult to navigate cross streets. People without any visual disability safely cross streets by looking at drivers and cars in order to ensure they are stopping and will remain stopped until the pedestrian has made it across the street. A person who does not have vision is not able to complete this visual task, and must rely on sounds in order to cross the street. Some crosswalks contain audible announcements indicating when it is safe to cross the street. These announcements only indicate the state of the lights, and do not reflect the state of any drivers who may not be paying attention. People who are blind must rely on determining traffic flow by listening for traffic patterns both at crosswalks and at cross streets that do not have crosswalks. It may also be helpful for people who are sighted to understand how a person who is blind navigates[5].

Experiments have been performed using Google Glass and its on board camera [2] to enhance non-visual representation of a real environment. Simulations have been created that allow people who do not have visual impairments to experience different types of visual impairments. Through virtual reality, participants have been able to experience macular degeneration, glaucoma and deuteranopia [1, 3, 4]. SonicWalker is different in that there is no display, which simulates the situation where a person has no vision. Without anything on the display, the user must rely only on sounds to navigate the simulated city environment.

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Figure 1: Visual representation of the virtual city. Players navigate this city using 3D audio only.

2. IMPLEMENTATION

SonicWalker was developed in Unity3D and contains a city environment. The player can move freely around the city. The object of the game is to simulate non-visual city navigation, and the player must get from one end of the city to the other as fast as possible and without being hit by any traffic.

Players wear an Oculus Rift during the game, however the video display is just black. The Oculus rift is used only for head tracking. Players also wear a pair of stereo headphones. The head tracking will move the player's virtual head in the scene, and 3D audio will reflect the position of the head. Using this technology, players are able to move their heads and listen for the positions of traffic noises, and then based on the audible information decide on whether or not it is safe to cross the street. Players move forward and backward by using an XBox 360 controller and turn by moving their head.

3. GAME PLAY

Players find themselves dropped in the middle of a city, accompanied by the standard sounds of a city environment - horns, engine noises and voices can be heard. Players must then go straight as fast as they can without being hit by a vehicle. To determine the safety of the environment, players must move their heads from side to side in order to correctly determine from which direction engine sounds are coming from. By using these combinations of sounds, players attempt to navigate the city streets in a straight line. Although there are no visuals (Figure 1), the full city and all of its environment are present, including traffic that obeys traffic lights and cars that may turn from one street onto another. When the player arrives at the goal, his time is read aloud. If the player comes in contact with a vehicle, the game will restart. The movement of the vehicles and the timing of the lights are random, so each time playing the game the scenario will be slightly different. The entire game demo consists of 10 cross streets. Players virtually walk in a straight line and each intersection contains more cars which creates an increasing level of difficulty at each intersection.

Players navigate the traffic by walking in a straight line and control the movement of the character by using an XBox 360 controller. The only controls that are available to the player are forwards and backwards. The player can turn his virtual head from side to side using the Oculus Rift in order obtain a different representation of the world through directional sounds. Each vehicle in the scene contains an engine noise, and the distance from the vehicle to the player's avatar controls the volume of the sound. In addition to volume, the spatial representation of the objects is represented by panning the sound. Players wear head phones while playing the game so these directional cues can be presented to the player without any additional non-game sounds that may be present in the room where the game is being played. This allows for players to turn their heads and receive more information about the state of the world based on how the sound changes.

For example, players may hear vehicles going from left to right, indicating an intersection. While vehicles are moving left to right, it would not be a good time to run across the street, unless the player can determine that the next vehicle is trailing far enough to allow safe passage.A vehicle not moving to your left may indicate it is at a red light, and thus it is probably not safe to travel across the street in the forward direction. The car is likely stopped at the player's left due to the state of the traffic light and continuing on in a straight line would result in the player walking into a traffic lane that currently has a green light. Of course, it is always up to the player and he can decide that crossing this street is worth the risk.

4. FUTURE WORK

One discovered side effect of this type of game is that the game is not enjoyable by people who are in the same room, but not actively playing the game. In its current form, people in the same room will only see the player with headphones, an Oculus Rift, and an XBox 360 controller moving his head left and right, and then either showing frustration if his avatar collides with a car, or jubilation if he completes the entire map. Splitting out the audio such that it is present in the headphones and through speakers is a simple task involving splitting the headphone audio out to both speakers and the headphones. Splitting the video feed will require more work. In its current incarnation, the Rift is running in mirrored mode, that is whatever the player sees is shown on the computer screen. In this case, the player sees nothing, so nothing is displayed on the computer monitor as well. The game could be modified such that different displays can be used at the same time with one only showing black, while the other shows the city scene. Another solution could be essentially creating a multiplayer version of the game, where the second player is in observer mode with graphics, while the active player is controlling the in-game character.

5. CONCLUSION

This extended abstract presents SonicWalker - a non-visual virtual reality city environment. Players must walk through the city and avoid traffic. It is not only a fun game to play, but it provides an environment where people who have sight can experience what it is like to be blind.

6. REFERENCES

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