Introduction

I have used Unity3D (version 2021.3.11f1) on a Windows system to create this project that represents an urban street simulation in virtual reality. While building this simulation I have used GitHub for version control where I backed up my files in case, I needed to restore previous versions. To test my build, I have used Quest HMD while attending the workshop however at home while lacking the hardware I had to use Unity HMD simulator.

I have included features in my application which include a C# script that adds road traffic simulation such as cars stopping for pedestrians, traffic lights and other vehicles on the road, I added more car models and sound effects for pedestrians, ambient and vehicles. Vehicles will also be able to use all the roads in the scene by using a waypoint system. To make the scene less empty I have integrated some other buildings and street decorations.

Analysis

Fidelity and Coherence:

Virtual reality provides users with a virtual environment that simulates a realistic environment (Zheng et al., 1998). This can be achieved with a level of fidelity. Features such as graphics, sound, user interface and interaction with the virtual world all provide users with levels of fidelity. Depending how these features are implemented it will influence how users perceive the world and feel present within.

I have implemented these features within my project which should impact the fidelity of the scene. For graphics, since my hardware doesn't have a good processing power, I had to reduce the settings of my project to a minimum. I have included in my scene, buildings, vehicles, pedestrians, roads, pavements, street decorations such as vegetation, traffic lights, benches. To implement these objects, I used low poly assets to have a smaller impact on performance on my system. As described by (Mel Slater 1999), immersion is affected by the VR system provided. Such factors as Field of View (FoV), resolution, tracking, sound quality, etc., will affect the fidelity.

Graphically speaking, my project doesn't resemble real life when it comes to textures which affects the fidelity as the scene doesn't look that realistic, this can be seen when looking at, buildings or the floor where the texture resembles a plastic like texture. Some other issues that might affect users' presence is how there's not a lot of assets on the scene that could make the user more present for example, most of the buildings look similar and the pedestrians use the same model.

To increase fidelity, I have added sounds to the scene on pedestrians, vehicles, and ambient sounds, which adds coherence to my project. As well as making the cars more autonomous as if they are being driven by real people.

Issues I found that would affect the users experience would be how pedestrians will always walk their path regardless of cars, meaning they would walk straight through cars and not wait until it is safe to move. This differs from reality as no real pedestrian would walk through a vehicle. This project also lacks on player interactions with the world other than moving and looking around. To fix these I would have to add colliders to the player object which would allow for the user's model to interact with the world such as stopping cars or making pedestrians change path to avoid the user. Also improving the lighting by adding light sources and more realistic sound effects and making the world seem fuller.

Sense of Embodiment:

This is when the user takes control over their avatar and feels like they are controlling their own real body. Users are aware of their avatar however, if the illusion is strong enough, they will start to feel their digital body real.

Some factors that can increase sense of embodiment is how the player controls their avatar, this is affected by how well the hardware can track users' actions and translate them into the virtual environment as well as feedback such as sounds when the user performs certain actions or from the surroundings. Another factor that affects the sense of touch, which will therefore impact sense of embodiment is the use of haptics (Hannaford and Okamura 2016). Another reason that users will feel ownership over their body is also their perspective when controlling the avatar. It has been found that when users play in first-person, they feel more embodied into the character while in third person, they feel more connected to the character and the actions that happen surrounding that character (Perron 2009).

In my application the sense of embodiment is not that well done, due to there not being any avatar for the user, or any way the user could see themselves for example in reflections, the way users see their avatar is by having floating hands that will be controlled using the HMD controllers. To improve on this, I would have to add colliders to provide haptic feedback and interactions with the virtual world, also I would have to give an avatar to the user so they will not feel like they are just floating around and could see their movement.

User Locomotion:

Walking: Some VR HMD offer 6-DoF (6 degrees of freedom) where users can move in 6 axis. This will give a realistic locomotion method since when they move in the real-world, they are moving in the virtual one too. This gives better sense of presence to the user as they can control better how their avatar moves, in a more natural way which is easy to learn and provides "proprioceptive feedback" (Slater et al., 1995).

Joystick: This is a controller-based locomotion where users just like with any game controller will use the HMD controller's joystick to move artificially around the environment. Unlike walking, users will be more static which could cause motion sickness (Costas 2017) so taking breaks would be advised.

Teleportation: This technique allows users to point where they want to go, and the viewpoint will be teleported the that desired location instantly. This can be done by triggering the motion using controllers or in some cases gestures such as jumping. This method allows users to stay stationary and traverse long distances more effectively (Bartoli et al. 2013)

Redirected Walking: It is a method where users will use the full tracked area where they will walk around. "Manipulating the geometry of tracking/graphics" (Dickinson 2022) users can walk in any direction and the application will redirect them on the correct path e.g., users will be walking in a circle but in the application, it will be going through a straight corridor. Users will barely notice that they are walking in a curve and as (Steinicke et all. 2010) tested, participants said they "differentiate between circular path and straight line at radius = 22m".

My application uses both joystick and walking locomotion methods since these are very accessible and easy to use for users. Although walking will depend on the user's real environment since they must have space to move around.

References

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