Virtual and Augmented Reality

Assessment 1

1 Virtual Reality Report

1.1 Graphical Fidelity

Graphical fidelity refers to how well the in-game graphics compare to a real-world experience. This includes aspects including graphical detail, interface, and interaction within the game. In the scene there are aspects that meet graphical fidelity. The first is the first-person perspective which simulates real human sight of the outside world. The game matches this allowing the player to move around the scene like a person observing the world. Whilst the player is in this perspective, different parts of the world come to life, this includes vehicles and pedestrians. This makes the game 'immersive' or grants the player, 'presence'. Dr Jamie Madigan describes in his book "Getting Gamers: The Psychology of Video Games and Their Impact On Those Who Play Them", the concept of spatial presence. He states that "spatial presence is frequently defined as existing when 'media contents are perceived as "real" in the sense that media users experience a sensation of being spatially located in the mediated environment." This can be observed on the scene when the player moves into objects such as buildings and traffic lights, they come to a complete stop, thus creating the feeling of a physical presence like real life.

A way to improve the presence of the scene is to add audio. Like the real world, sound is what makes the game world come to life. The scene for the assignment lacks sound. To add a more realistic flow to the game, adding sounds for the cars and the footsteps of the player and the pedestrians would enhance the experience massively.

Next is detail. This can include things such as texture, effects, lighting, shadows, and weather particles. The user interface could also be included in this. In a lot of cases, the more detail the scene has, the more immersive and interesting it is to the player. In the case of the assignment scene, multiple details have been added to the game. The shadows are one aspect which are realistic reflective of where the directional light comes from, thus making the scene more realistic. Additional features include the free roaming of the pedestrians and the unique colour of the buildings. The first-person perspective is also a part of this. This is because it feels as though the player themselves are in the scene experiencing the world around them. Unique colours of the buildings allow the player to view a world that has life to it. The pedestrians replicate the immersion of a thriving town street.

1.2 Locomotion

Virtual Reality locomotion refers to the movement a user takes to travel around in a VR environment. There are several different methods used for locomotion in VR. According to Boletsis and Cedergren (2019) in the article titled: "VR Locomotion in the New Era of Virtual Reality: An Empirical Comparison of Prevalent Techniques", they claim there are three prevalent VR locomotion techniques. The first technique is walking around as normal. This is known as motion-based. This is where movement in the simulation is done by physical movement of the player. One example of this would be the 'Walk the Plank' simulation where players must walk on a virtual plank off the edge of a skyscraper. This method offers a very high sense of presence provided the players are in a room large enough for the game. When the player moves, they travel in the simulation at the same rate, thus creating a thorough sense of presence. The main drawback to this locomotion technique is that the VR environment is limited by the scale of the room the player is in. A larger in-game environment such as the assignment scene would be impossible to do with this technique in their own home. As such this is not ideal. Additionally, if the player is colliding with household objects this will lower the sense of presence.

Boletsis and Cedergren identified controller-based technique as another locomotion method. This method uses controllers to move the player in the VR environment. This solves the problem in the previous method where the size of the room would limit the player's movement. An example of this would be the Oculus Rift S which provides controllers necessary for movement. This is the most ideal type of locomotion for the scene since it has a large open environment which would require the most optimal form of travel. Its sense of presence is lower than motion-based since it is obvious the player is controlling a character needing a joystick to move them. It does however provide a strong balance to motion-based VR systems. This is because it eliminates the risk of colliding with people and objects from walking around, so it still maintains some sense of presence.

Another method of locomotion Boletsis and Cedergren highlight is the teleportation-based technique. Boletsis and Cedergren describe it as, "VR locomotion techniques that fall under this type utilise artificial interactions in open VR spaces with noncontinuous movement". The picture below shows a video demonstration from 'boletsis.net' demonstrating the teleportation technique for in-game locomotion. This is inappropriate as a locomotion method for the scene just based on context alone. Teleporting is not a part of the scene. The presence of this method is atypical. Since teleportation is not realistic, the experience in VR would be surreal. Moreover, the sense of presence would be negatively affected by the lack of simple walking as a movement. Therefore, teleportation-based locomotion is the least ideal method of locomotion for both scene practicality and sense of presence.

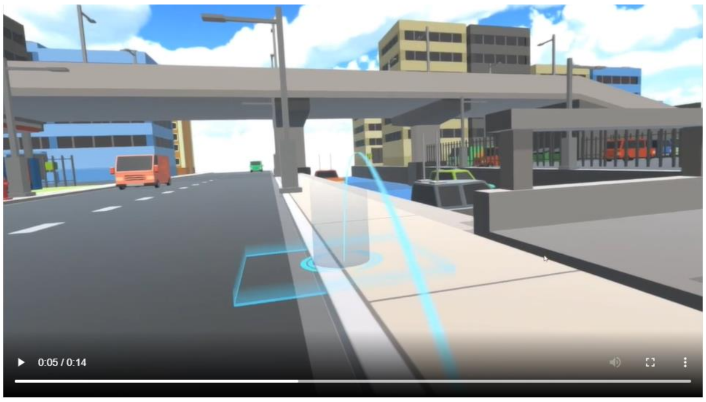

Figure 1 - Boletsis | 'Visual Jumps'

1.3 Agent Behaviour

Agent behaviour is the surrounding artificial intelligence around the player. In this case this will be the traffic lights, vehicles, and pedestrians. The user's experience will be affected by agent behaviour to a great extent. Having elements in a world move and operate independently gives the player less control over these events and therefore the player will need to change their mindset on how to navigate and interpret the world. This is backed up by a study on first vs third person perspective in digital games by Denisova and Cairns (2015). Twenty participants played the game in first person while another twenty played the game in third person. The results were significant in that the total immersion which included factors like emotional involvement and real-world dissociation was higher for the first-person group than the third person group. Since virtual reality is a completely immersive first-person experience, this is evidence that the player will be deeply involved with the game and thus be affected by agent behaviour. There is further evidence of this in a study by Bruneau (2015). This study found that large group sizes were more likely to be avoided by players who would take a longer avoidance path to avoid collision with the group.

Believability of the simulation is a major factor for the player and should be reflected in the performance of agent behaviour. One example is how people will move through a simulated crowd like a real one by moving out of the way to avoid collision. Similarly, the simulation should do the same. This falls into the sense of presence and is one area where the project scene lacks. Pedestrians in the scene have no reaction to each other and the player. Therefore, a major improvement to the sense of presence would be to have pedestrians move to the side when the player is in proximity.

Other improvements to be made would include adding more pedestrians, a better traffic light system and stronger interaction between the agents and the player. A diversity of pedestrians will improve the immersive experience of the game. NPCs of variability of height, age, gender, and clothing would improve the realism aspect of the scene. A more advanced traffic light system could include a button press for pedestrians who wish to cross the road. By having the player and the NPCs do this would bring the sense of presence to a whole new level, though it would be rather complex to implement. Lastly, a stronger interaction between the agents and the player would emphasise the entire realism experience to the player. This would be done by having the pedestrians and the cars interact with the player. Pedestrians could move out of the way of the player to avoid bumping into them and cars could brake to a stop in the event of collision. Furthermore, if the car fails to come to a stop, the player could die or be hurt to improve the sense of presence.

1.4 VR Sickness

Users of VR can experience negative side effects when in use. These can include nausea, eye strain, dizziness, and headaches. One factor that can contribute to sickness is the sensory conflict that occurs in Perceived motion. People’s bodies sense motion in a variety of ways, mostly from the vestibular (balance) system and visual input. Nausea can be caused when there is a conflict between these two. Munafo et al. (2017) did a study that involved a VR experiment with a motion-induced setting where 56% of participants reported motion sickness. Additionally, individuals who had high levels of low frequency lateral postural sway were the most likely to experience motion sickness in VR. In other words, postural instability is linked with nausea.

Another factor that can contribute to sickness is the visual eye-strain that can occur when using a VR headset. The direction the eyes look converge on closer objects. At longer distance the direction of eyesight is more parallel. This is known as the vergence-accommodation conflict. In real life these are both in sync, whereas in VR they are not (Weis, 2017). Hardware aspects such as lag between the body movement and the screen can cause sickness as well. Also, display flickering can cause VR sickness as well. Users who are exposed to a larger display size are much more likely to experience it (LaViola Jr, 2000).

There are some methods that can be carried out to mitigate VR sickness. The first is to simply limit screen time. The makers of the Oculus Rift and HTC Vive recommend taking at least a 10 to 15-minute break every 30 minutes (Fagan, 2018). This can help mitigate the issues with both eye strain and the lateral postural sway. Reducing lateral sway sickness can be solved by reducing rotational motion in simulations.

Improving some of the hardware aspects can assist in dealing with VR sickness. For instance, reducing the flicker effect can be reduced by having a brighter screen and a higher refresh rate. However, some researchers claim that flicker is not a major factor in VR sickness anymore due to hardware improvements (L. R. Rebenitsch, 2015).

1.5 References

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2 Augmented Reality Report

2.1 Section 1: Overview | An Overview of the Existing AR Types and Use Case

Poetker (2019) writes in Learning Hub about Augmented Reality. Augmented Reality is the layering of digital elements over an existing environment, so it is made of virtual components placed around a user's surroundings. It is used to augment experiences that occur in day to day life. Businesses, industries, and schools are using it build learning tools for educational purposes as well as enhancing customer experience.

There are several types of Augmented Reality. One example is Marker-based AR which uses markers to trigger anchors that activate the technology. It is most used in marketing and retail. This type can be used in people's homes to provide a digital overlay of potential household items. This is useful to consumers since they are able to see what an item would look like in their home without having to purchase it. It can also be used for art. The image below shows one such example from the Overly app. The example was screen captured from a YouTube video of theirs.

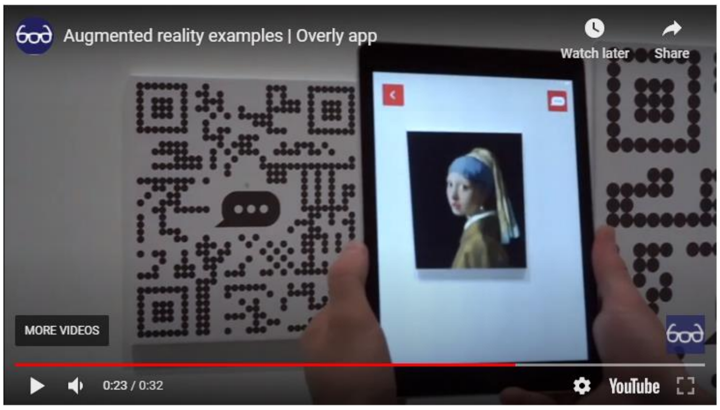

Figure 2 - Image to Show Marker-based AR

Conversely there is the Markerless AR. Lacking markers, this type allows the user to place where they want the virtual objects, thus making it much more versatile. The advantage of this is that users can try any combination of options they want without having to place markers down. Digital overlays can be customised and positioned anywhere in a room. As a result, this makes them ideal for product showcase and art. TIME publication designed an Apollo 11 Moon Landing experience where the user can see the shuttle land in their own living room.

Another type is Location-based AR. This combines specific locations with digital content. Objects are already predetermined in particular locations, so the user will see them when they reach the appropriate place. The most iconic example of this is the Augmented phone game: Pokémon Go.

Similar to Markerless AR, Superimposition AR can identify real life objects and enhance them. Enhancements can provide an alternative view of the object in size, location, duplication, and other things. One example the article states is a household chair being moved and duplicated to see how many will fit around a table.

Projection-based AR sets itself apart from the other types of markerless augmented reality as it does not require a smartphone or tablet. This works via light projection onto digital graphics onto a physical surface or object. This is more commonly known as holograms. These are virtual 3D objects to be interacted with by users. Practical purposes for holograms are demonstration of prototypes and education tutorials. (Poetker 2019) There is an example of a projection-based AR sandbox uploaded by developed by UC Davis with real-time water flow. Two images below show this.

Figure 3 - Images to Show Projection-based AR

2.2 Section 2: Development

This section will explore the development of the AR system that was built. The first workshop covered an augmented reality that covered floating 3D shapes. This one in particular covered spheres and cubes. Both shapes and cubes were used to enhance the experience further, adding variety thus making it look more interesting. To improve it, audio could be added creating a form of floating sound to further augment the experience.

The second workshop involves image tracking. The result shows two knights engaging in battle. Positives include the materials on display and the interaction between the knights. To improve the experience, there could be more animations added to the knights to make a more dynamic battle.

2.3 References

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