Augmented Reality Report

Development Section:

From the early stages of development (the UX storyboarding for the scene changes), it was decided that the project aimed to be an informative game that required the player to pay attention to the scene but did not require them to read multiple lines of text consistently—attempting to promote the sense of the game as fun more than an educational chore.

During the design of the Augmented Reality Project, there were various challenges. The placement of Isaac Newton (Sketchfab 2019). and the tree (Sketchfab 2023) was imperative to the functionality of the entire scene; therefore, using a lot of trial and error in the placement of these GameObjects, mainly the depth at which they were positioned in comparison to the positioning of the player's virtual line of sight, it was possible to deduct that the most comfortable distance between the player and the scene itself was a social distance rather than an intimate one. This avoided creating an uncomfortable sensation for the player and reduced the likelihood of cognitive overload since the project's target audience is children, who can be easily overwhelmed depending on their mental state (Fong et al., 2012).

Given more flexibility on the deadline, implementing animation using applications such as Blender for Isaac Newton and the tree itself (having the branches slightly sway to simulate wind, for example) would have created a more strongly immersive experience. The virtual simulation of the environmental physics of nature interacting with the in-game objects would make it harder to distinguish between the real world and virtual reality (Patterson et al., 2016); with more time available, exploring the potential implementation of these features would be possible.

The decision to utilize apple prefabs (Mesh, F. 2021) from a different source rather than the actual tree apples was made to maintain the consistency of the tree's shape and form, ensuring the player remained focused on the game's essential elements. These elements were Isaac Newton’s quotes, and the tapping mechanics used to drop and then collect the apples, which included fun facts related to the curriculum. These components were crucial for compelling the game and aligning with the project's requirements. In the late stages, the decision to include a trophy (Sketchfab 2017) when the player collects all four apples instills a sense of achievement and promotes a lasting positive impact on the player (Groening, C. and Binnewies, C. 2019).

Isaac Newton, renowned for his discovery of gravity and often highlighted in educational contexts, served as an engaging mascot for the game. His presence drew players' interest without extensive explanations of the game mechanics, as it is an exploratory experience, albeit somewhat limited due to time constraints. Throughout the project's development, scripts were designed to focus on one or two functionalities. This approach made it easier to identify and correct script errors and use
debug logs to track issues. Avoiding large, complex scripts helped distinguish the main problems, ultimately facilitating a more efficient method for fixing mistakes.

Given the opportunity to include more locations throughout the Isaac Newton Building, it could create a more real-world world, inclusive treasure hunt for the player as they would be able to be given a prompt once they have played the game to go around to find all the images that allow you to play the game and perhaps including room specific collectibles would add another layer creating a positive sentiment which is an essential factor in promoting immersion.

Finally, one of the main functionality scripts, the TapToDrop.cs script, was initially supposed to be a shake-to-drop. The player would shake the phone on Isaac Newton's prompt, “Quick! Shake the tree!” to cause the first apple to fall, teaching the player the basic instructions for the game. Unfortunately, during implementation, it was found to be immensely difficult as the testing phone was not detecting shakes. Testing the script in a virtual environment to troubleshoot was tedious because of time constraints.

Therefore, switching to the tap-to-shake script is more manageable, allowing for more effortless debugging. Using raycasting made detecting when the player interacted with the scene easier. A similar script was used for picking up the apples, along with a physical GameObject for the target zoom area, which made it easier to adjust the height and positioning of where the apples moved to once picked up to read the fun facts.
Each of Isaac Newton's lines was linked to a specific apple other than the introductory question to guarantee the relevant comment was made, despite some of the apples not colliding with him. In previous versions, the lines depended on apple collider contact, but this wasn’t effective because, as seen in the provided video, one apple did not make direct contact with Isaac Newton. In contrast, others hit the original apple before falling to the floor.

UXD Report

The scene layout was kept simple to avoid the potentiality of attention tunneling (Syiem et al., 2021), along with the use of image markers (see the video demonstration attached to the assessment documents), which limits the player to only being able to spawn the scene once they scan one of the three images. For this reason, two of the three photos provided are of images that are framed on the walls in the room used for the VR/AR workshops, limiting the player to a safe environment.

All of the UI text was kept in the same font; however, depending on where the text was required to be used (e.g., on the apples), the text size was not kept the same but was made sure to be kept at a legible standard. The text was standardised black except for the apple counter, which turned from red to green when all four apples were collected, taking full advantage of the colour theory that red is seen as negative and green as positive to create a form of positive reinforcement from completing the game (Mammarella, N. et al., 2016).

Furthermore, the UI text on the apples was centralized to provide a background from the apple prefabs. In hindsight, it would improve the UX design if the text were bolder and given an animation, such as shaking, to draw players' attention, as the human eye is drawn to sudden movements (Chen et al., 2008).

Consideration was given to creating the UI text as a pop-up above the apple or underneath it rather than centralised due to concerns about legibility when attempting to fit it into a small surface area. However, further research concluded that text was more visible when centered on the apples rather than using the two other options. Thus, the decision was made for this to be the method of presenting fun fact texts in the game during the project's final phase.

All UI text in the scene utilizes the same font, “LiberationSans,” to maintain uniformity across the game. However, the text for the AppleCounter GameObject is in “Electronic Highway” font, creating a more gamified feel to the project and experience, as fonts similar to these are usually associated with collectibles in games. Additionally, a background was added to the text to make the red words more prominent and to help prevent cybersickness (Zhang et al., 2024).

Additionally, even with the potential of implementing these features in the future, it is imperative to stay aware of the possibility of having the opposite effect by actually increasing the likelihood of cybersickness by having the text shake or anima; te therefore, it is essential to remember this during implementation and find willing participants that are prone to cybersickness to test the different animation versions and collect feedback on which would be the best approach.

Finally, the choice to use low-poly prefabs was due to the limitations of the provided phone. Testing different prefab qualities, such as high definition, showed that the phone would struggle if the prefab quality were too high. Therefore, it was decided that implementing low-poly prefabs was more advantageous for functionality and to avoid distracting the player too much from the game's objectives. Additionally, if the GameObjects are too realistic, it may confuse or distress the player, especially in young children. Therefore, maintaining a clear distinction between reality and the virtual world is essential to avoid such occurrences (Weiß et al., 2021).

References:

[1] Fong, S.F., Lily, L.P.L. and Por, F.P. (2012). Reducing Cognitive Overload Among Students of Different Anxiety Levels Using Segmented Animation. *Procedia - Social and Behavioral Sciences*, 47, pp.1448–1456. doi:https://doi.org/10.1016/j.sbspro.2012.06.841. [Accessed 9 Dec. 2024]

[2] Patterson, D., Roberts, S. (2016). Reality Reaching into Games - Weather as a Dynamic Link to Real-World Streams of Information. In: Marsh, T., Ma, M., Oliveira, M., Baalsrud Hauge, J., Göbel, S. (eds) Serious Games. JCSG 2016. Lecture Notes in Computer Science(), vol 9894. Springer, Cham. https://doi.org/10.1007/978-3-319-45841-0_16 [Accessed 9 Dec. 2024]

[3] Syiem, B.V., Kelly, R.M., Goncalves, J., Velloso, E. and Dingler, T. (2021). Impact of Task on Attentional Tunneling in Handheld Augmented Reality. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. doi:https://doi.org/10.1145/3411764.3445580. [Accessed 9 Dec. 2024]

[4] Sketchfab (2019). *LowPoly Isaac Newton*. [online] Sketchfab. Available at: https://sketchfab.com/3d-models/isaac-newton-akishaqs-7f834b4ca56f401e8b00e8cccf5328d7 [Accessed 24 Nov. 2024].

[5] Sketchfab (2023). *Apple_harvest*. [online] Sketchfab. Available at: https://sketchfab.com/3d-models/apple-harvest-a93e165ca3654b41bf93b9bb59e3ec7f

[Accessed 24 Nov. 2024].

[6] Mesh, F. (2021). *Casual Vegetable Pack - Created with FastMesh Asset*. [online] @UnityAssetStore. Available at: https://assetstore.unity.com/packages/3d/props/food/casual-vegetable-pack-created-with-fastmesh-asset-293783 [Accessed 7 Dec. 2024].

[7] Sketchfab (2017). *A cool little cup :)*. [online] Sketchfab. Available at: https://sketchfab.com/3d-models/a-cool-little-cup-just-for-fun-afd10a0435184da58cb5f391c0499b14 [Accessed 7 Dec. 2024].

[8] Groening, C. and Binnewies, C. (2019). 'Achievement unlocked!' - The impact of digital achievements as a gamification element on motivation and performance. *Computers in Human Behavior*, 97, pp.151–166. doi:https://doi.org/10.1016/j.chb.2019.02.026. [Accessed 9 Dec. 2024].

[9] Mammarella, N., Di Domenico, A., Palumbo, R. and Fairfield, B. (2016). When green is positive and red is negative: Aging and the influence of color on emotional memories. *Psychology and Aging*, [online] 31(8), pp.914–926. doi:https://doi.org/10.1037/pag0000122. [Accessed 9 Dec. 2024]

[10] Chen, K., Choi, H.J. and Bren, D. (2008). *Visual Attention and Eye Movements*. [online] www.semanticscholar.org. Available at: https://www.semanticscholar.org/paper/Visual-Attention-and-Eye-Movements-Chen-Choi/a437865f9484596a64d4c45762e09d61164f89fc [Accessed 10 Dec. 2024]

[11] Zhang, J., Che, X., Chang, E., Qu, C., Di, X., Liu, H. and Su, J. (2024). How different text display patterns affect cybersickness in augmented reality. *Scientific reports*, 14(1). doi:https://doi.org/10.1038/s41598-024-62338-y. [Accessed 10 Dec. 2024]

[12] Weiß, S., Klassen, N. and Wilko Heuten (2021). Effects of Image Realism on the Stress Response in Virtual Reality. doi:https://doi.org/10.1145/3489849.3489885. [Accessed 10 Dec. 2024]