Parallax - A Virtual Reality Tool for Teaching Astronomy Concepts

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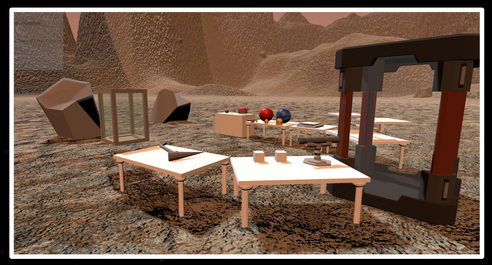

Figure 1 - The mars environment including various objects for the player to interact with in order to explore gravity, mass, and how they differ from planet to planet.

The Grand Challenge

Parallax seeks to be a learning experience that combines traditional teaching methods with virtual reality supplements to enhance student understanding of traditionally taught astronomy concepts. Lecture order and content is based upon the California Department of Education's standards for 8th graders' knowledge of astronomy. Lectures are followed by virtual reality sessions which aim to grant students additional insights on various topics related to astronomy by taking advantage of virtual reality's inherent interactivity and its capability to convey perspective.

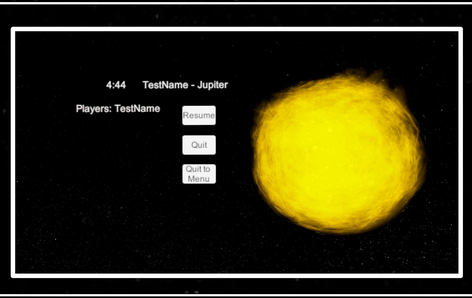

Figure 2 - Using Unity particle systems and photon networking, here is an example of the sun model as well as the UI elements that can be accessed by the player.

The Theory

The development of Parallax began based off of a few general theories that we came across again and again in our study of non-traditional pedagogy. Primarily, that when students control the pace and style of their learning, they understand material quicker and on a deeper level than students in a traditional classroom setting. This adherence to personalized learning inspired many of Parallax's lessons to be student driven and immersive rather than focus on lectures or assessment. Secondly, we sought for parallax to make material fun and interesting for students. This is why we implemented the networking system, to allow for students to learn and grow together.

Technical Specifications:

Parallax was created using the Unity game engine version 2019.2.2f1, with the assistance of the SteamVR and VRTK packages. Models were made in various versions of 3DS Max and Maya. Team Organization and file sharing were carried out with Google Drive, Trello, GroupMe, and Discord.

The Vision:

To begin working on Parallax, we needed to develop a vision of what we wanted it to be. Throughout development, we've toyed with various lesson plans as a base for our experience, and we ultimately decided that a 3 lesson plan would be best. Unfortunately, when complications arose with covid-19, we decided that it was in our best interest to solely focus on developing 2 lessons to ensure they'd be completed on time and to a quality we'd be happy with.

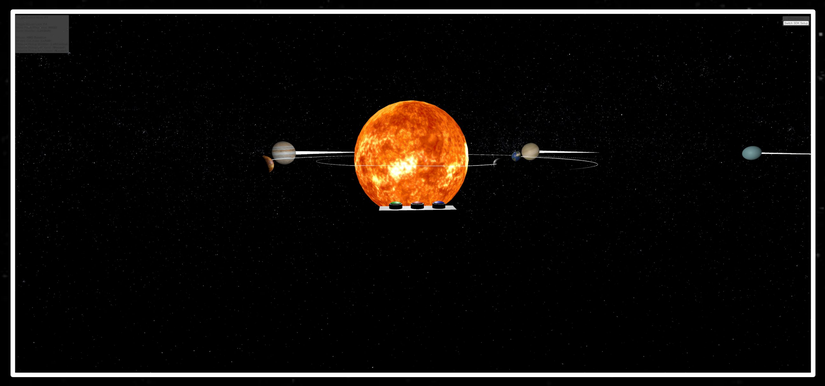

Figure 3- The solar system simulation room used in lesson 2. Near the sun is a control panel that allows the player to start and stop the planetary orbits. Players can get a closer look at the planets by plucking them from orbit.

Development:

Developing Parallax was a challenge, and as soon as we solve one, we had another right there lined up for it. Simply figuring out how to integrate VR into a project and use custom scripts took a whole month. Once we got VR integrated, we expanded our team and worked to constantly iterate on our project. Gradually, our rate of progress increased as we focused on team events and 'game jams', where we'd all try to get together and jam on the project. When Covid-19 hit, we lost contact with a lot of our team, and our rate of progress slowed, but we continued to polish up what we already had to ensure we'd have something to show.

Feedback from Testing:

At the end of Fall 2019, we took our project to Higher Ground to demo a lesson based around gravity on different planets and the scientific method. From these preliminary tests, we found that our platform was really good at engaging any players and viewers, which was incredibly useful for teaching them something new, but we hadn't yet railroaded the players sufficiently to really teach them the way we originally intended. With that feedback, we shifted our project to a plan that we could more feasibly railroad the players into learning what we wanted.

Final Product:

The final product of our efforts was two-lessons; Lesson 1 focuses on the planets, their properties, and the differences between them, allowing the players to go on stripped down simulations of each of the planets and measure the properties themselves using sensors, while Lesson 2 focuses on the scope of the solar system, and how the planets are located relative to each other. It allows players to linearize the planets or to watch them orbit, as well as to view the solar system in a condensed view, or in a more spatially accurate condensed view to just show the sheer quantity of distance between the planets, and how small they really are when compared to the distances between them.

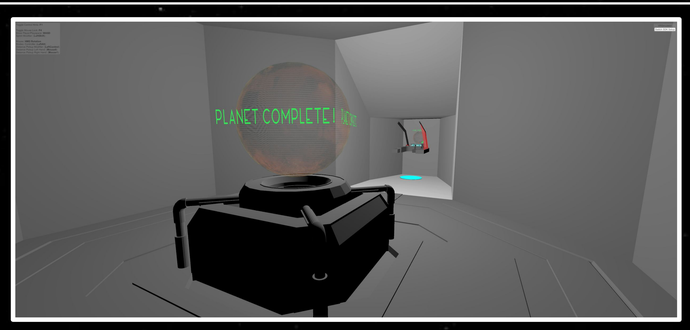

Figure 4- The main room of the player's spaceship. Here players can see a holographic view of the planet selected in the cockpit. Planets completed in lesson one are marked as shown.

Author Contributions/ Acknowledgements

NM- Gameplay Director, SC- Creative Director,

RM, SR, DH- Programmers

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