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New Worlds VR

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```
public void MoveAlongAxis(float velocity)
{
    Vector3 direction = GetAxisDirection();
    Vector3 trackingOffset = NegateTrackingAlongAxis();
    characterController.Move((velocity * Time.fixedDeltaTime
    * Vector3.ProjectOnPlane(direction, Vector3.up)
    - trackingOffset) - (Gravity() * Time.fixedDeltaTime));
    AlignPlayerOnAxis();
}
```

SAL method to move the player. A key challenge we overcame was negating the default VR headset tracking, which required vector math.

Introduction

New Worlds is a single-axis treadmill system designed for integration with Virtual Reality (VR). The goal is to immerse the user in a virtual world while walking on a physical track.

With the senior engineers hard at work on the treadmill, our task was to create this immersive VR world from scratch. We also needed to write software that could interface with the treadmill's data and move the player programmatically.

3D Cave

Because the treadmill only goes forward/backward, we needed to create a world that encourages single-axis exploration. We decided on a cave theme, seeing its excellent potential for immersion:

- Intense lighting & shadows
- High reverb audio
- Confined tunnels and spacious caverns
- Danger, heights, and lava!

We chose **Unity** as our game engine and learned as we went. Its beginner-friendly UI helped us quickly jump into action.
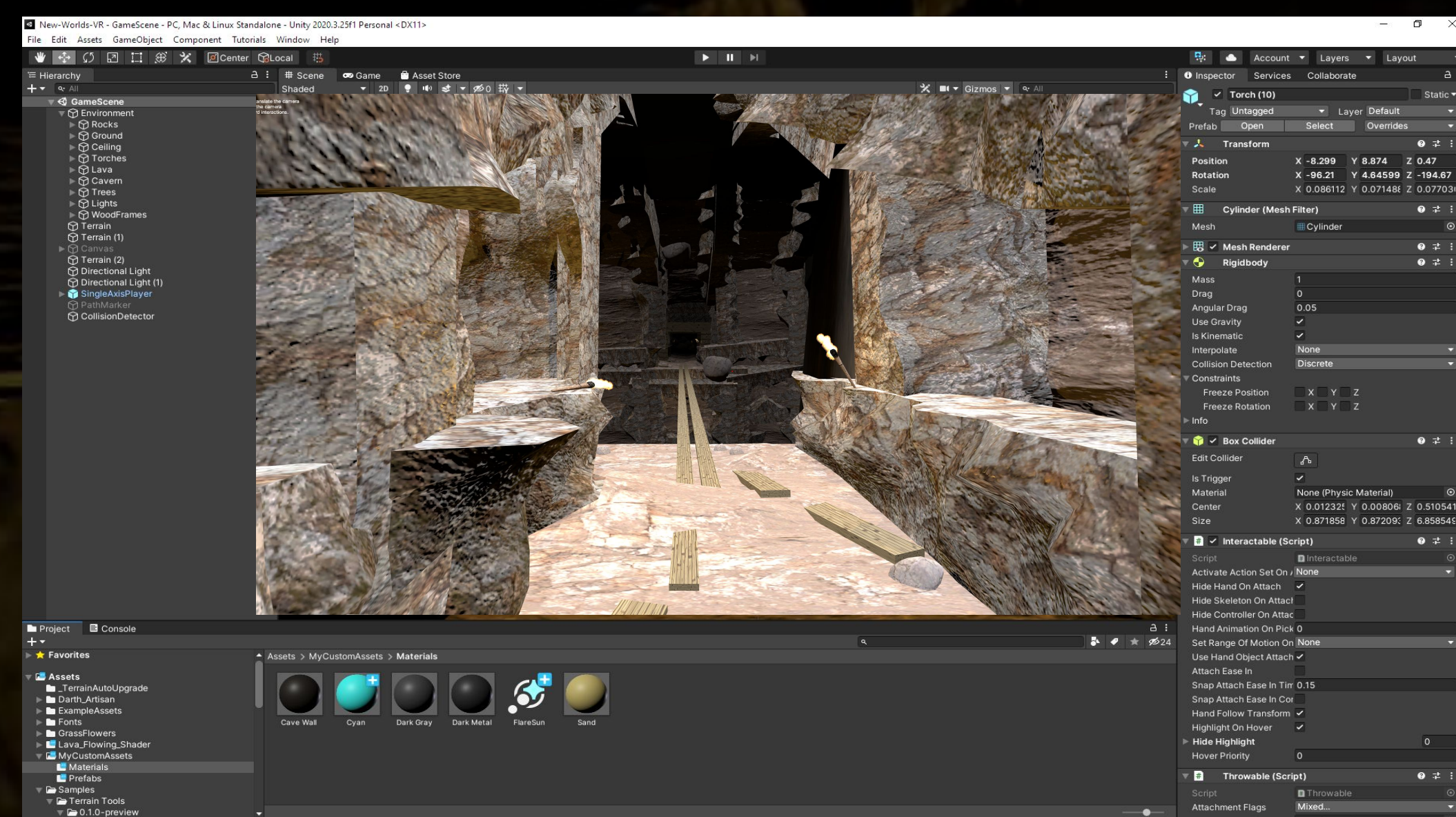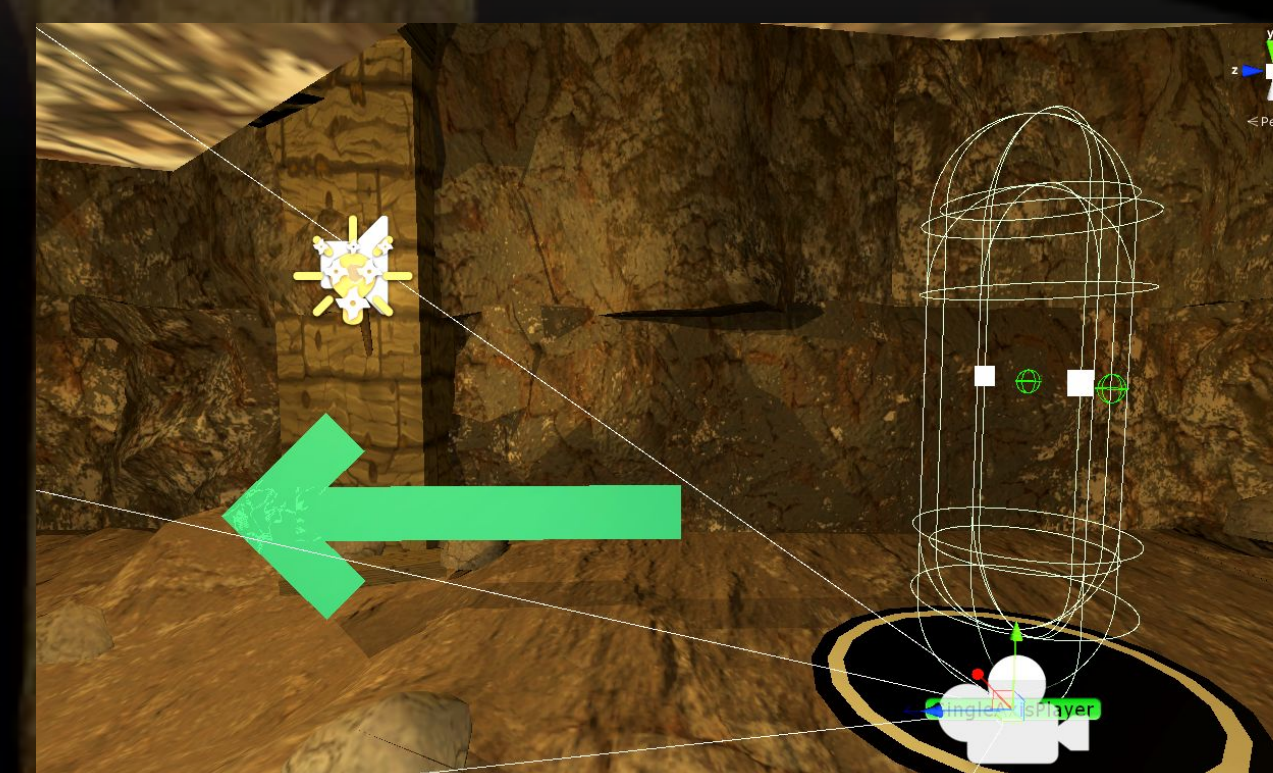

Building a cavern in the Unity Editor

Movement API

We achieved player movement using C# scripts. Our solution involved building an API we called SingleAxisLocomotion (SAL), featuring methods to:

- **Move** the player along the track axis
- **Calibrate** the physical and virtual axes
- **Negate tracking** of the VR headset along the track axis
- **Log** motion data to a file

Our SingleAxisPlayer prefab

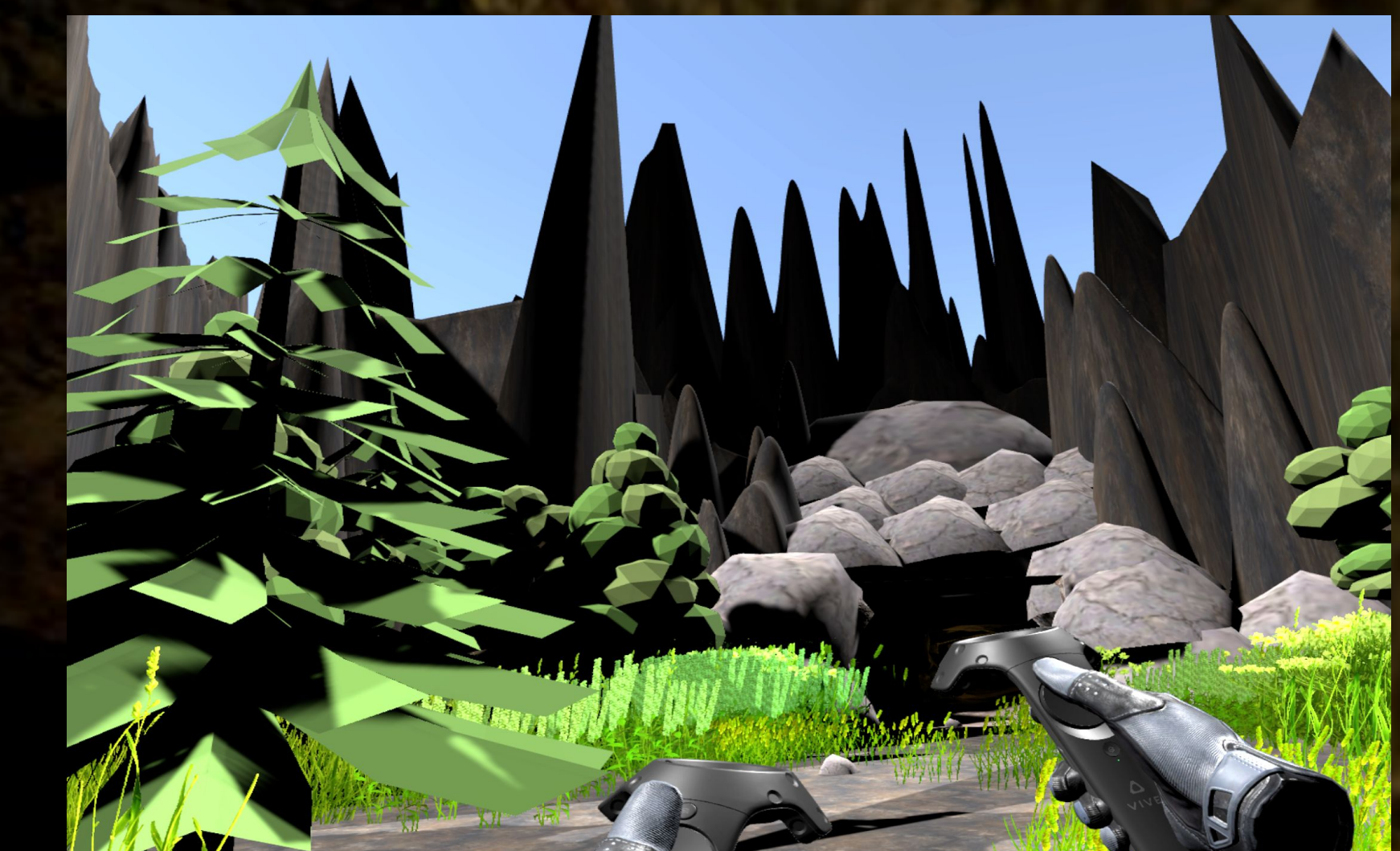

Grabbable rocks block the path

High plank walk over flowing lava

Immersive Experience

While moving along the track, the player encounters various immersive sections:

1. Detailed starting tunnel where the player picks up a torch to light the way
2. Cavern plank walk that tests fear of heights
3. Caved-in area with rocks the player must clear away
4. Lush forest surrounded by spiky cliffs as the player emerges from the cave

Velocity Data

We implemented a network-based approach to receive the New Worlds velocity data. We used NetMQ sockets and multithreading to listen for packets while not blocking Unity's main thread. The velocity data is then used to move the player on each frame.

Next steps will involve connecting to the treadmill PC and testing full system integration.

Ending area; looking back at the cave mouth

Acknowledgements

We would like to thank the engineering class of 2022 for including us on their team. We also thank Dr. Peter Staritz and Mr. Ben Roller.

Conclusion

We successfully delivered an immersive world that moves the player via external velocity inputs. Throughout this project, we learned a lot about virtual reality, 3D game design, and data communications. We also learned how to collaborate with a large team of engineers and contribute to daily standups.

VR is challenging but a lot of fun!