Blue Shift

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Game Overview

I aim to create a racing game with movement mechanics inspired by Outer-Wilds' tiny solar system. Instead of having roads and banked corners, players will have to take advantage of orbital mechanics to manoeuvre around turns. Players will be guided through the intended route of each track but will be encouraged to take creative shortcuts. The game will be time trial-based, players will be rewarded for completing the track as fast as possible. Each track will have three badges to obtain based on the player's time, this will incentivise players to replay each track until they earn all badges.

Movement Mechanics & Physics

Universe Physics

The racing physics will be governed by realistic Newtonian gravitational physics. Celestial bodies will attract each other and the player in accordance with the formula:

$$F = G\frac{m_1 m_2}{r^2}$$

The gravitational constant G can in our case be adjusted in accordance with the ship controller to make the movement feel responsive. Celestial bodies will be fixed in the world space and not be influenced by gravity. This will make tracks easier to navigate as the landscape is stationary rather than dynamic.

Ship movement

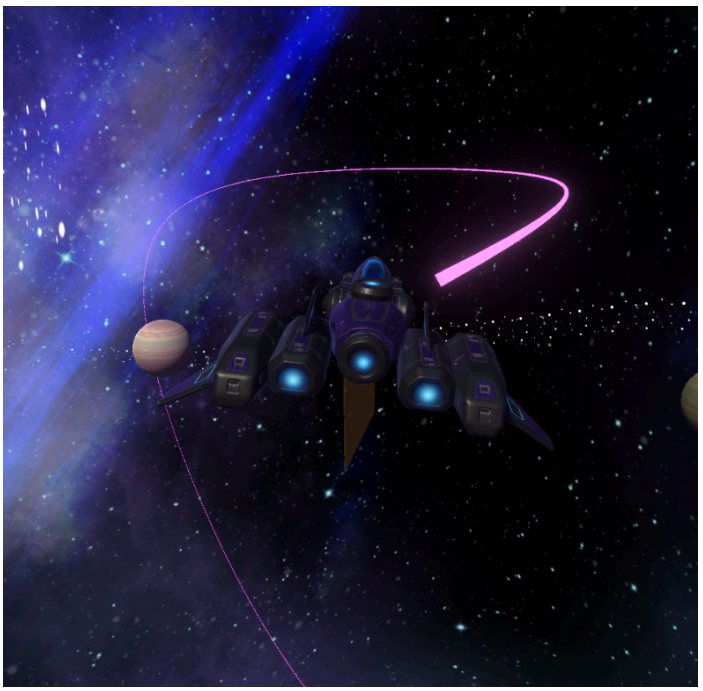
Since direction is relative in space, omnidirectional movement is crucial. The player will be able to control the ship's yaw, pitch, and roll as well as its thrust along 3 axes. This will allow players to quickly change their direction of thrust as they sling around large bodies without having to rotate their entire ship. The camera will be fixed to the player's ship in a strict follow-cam fashion. This is because both joysticks are already in use to fly the ship, so controlling the camera makes the controls too complex. To further ease player movement, holding x on the controller will apply the necessary forces to bring the ship's velocity to zero as fast as the thrust values allow. This serves a similar function to a brake in a car race, allowing players to slow down around a turn without having to negate the velocity manually. Note: A controller is required due to the complexity of controls.

UI & Player Feedback

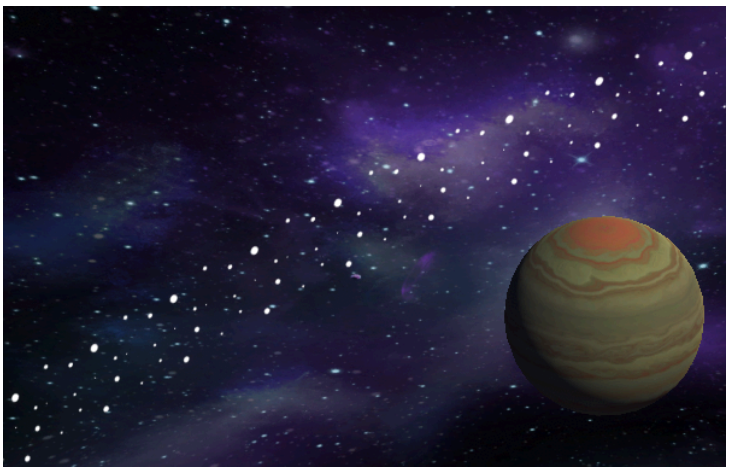
Space is inherently disorienting, player feedback is thus crucial to allow players to navigate tracks with confidence. Various UI elements will be introduced to assist the player both in navigating the track and controlling their ship:

Navigation Aids

- **Orbital path visualizer:** The system will calculate the player's trajectory and how bodies will affect it in real-time. This will provide players with a real-time indication of where their ship will go if they make no further changes. Additionally, it changes colour to indicate if a collision is likely.



- **Breadcrumb-like star trail:** A trail of stars highlighting the intended path through the track. Due to its textured nature, it also aids the player in gauging their speed and distance relative to the path.



Movement Aids

- **Thrust Indicator:** A live view of all user-controlled forces acting on the ship will be displayed to allow precise manoeuvres by indicating exactly how thrust is applied.

- **Velocity Indicator:** The Player's current velocity magnitude is displayed at all times to allow players to gauge how fast they need to go around turns next time they attempt the track.

- **Haptic Feedback:** The Player's controller will vibrate based on how strong the gravitational forces acting on the ship are at any given time. This will give tactile feedback with regards to how much risk the player is taking around a tight turn.
- **Particle effects:** Dynamic Particle effects show the player exactly how thrust is being applied to their ship. The particle trails additionally scale to indicate the player's velocity.

Racing Aids

- **Checkpoint times:** The delta time between the current attempt and the previous best attempt(if any) will be shown at each checkpoint so that a player can see if they

are faster or slower than the previous attempt. This will further assist players in seeing on which sections of the track they should focus to improve their time.

Track Design & Components

Static bodies

Large bodies will remain stationary throughout the race and will act as a sort of constant skeleton for each track. They will be what dictates the general flow of each track.

Checkpoints

To guide the player and ensure the flow of the track is not undermined, large rings called checkpoints will be strategically placed along the track. They will also assist the player by dividing their time up into manageable stretches of track. Players cannot reset to checkpoints but they must fly through checkpoints in order.

Track Design principles

The main elements of each track will be gravity-assisted turns. Entering and leaving a large body’s gravitational pull at the right moment can drastically influence the speed and angle of a turn. Adding unnecessary turns and hidden shortcuts will further enrich each track's experience. Given the three-dimensional nature of tracks, checkpoints must be placed in such a way that the approach angle to a turn carries great weight.

Tutorial design

The tutorial will be a series of short tracks each introducing a new axis of movement along with simple manoeuvres. Players will be prompted to stay as close to the intended path as they can. On the final tutorial track, all movement will be enabled and players will be encouraged to take shortcuts off the intended path.

Music & sounds

The game will feature electronic-synth inspired background music with a steady tense atmosphere. This should keep tension as the race progresses. Audio feedback will also be given upon completing a checkpoint, completing the race, and failing the race. This will further assist in communicating to the player whether they are doing the right things.

Track Badge time evaluation

Each track has three badges to unlock: Bronze, Silver, and Author. They are unlocked by completing the track within a certain amount of time. In order to determine the time needed for each badge, the following strategy was used:

- **Bronze:** Play the track with minimal input, trying to stick to the intended path. Corners are to be taken relatively loosely. Do this three times, and add 5 seconds to the average time taken, rounding up.
- **Silver:** Play the track without any shortcuts, trying to get the best time, corners must be taken sharply and the path can be loosely ignored. Do this three times, and add 5 seconds to the average time taken, rounding up.
- **Author:** The best time achieved by the author with all shortcuts, with 3 seconds added to it. Gaining this badge without taking shortcuts should be near impossible.

Iteration 1

The first iteration of the game features all the physics and movement mechanics, it consists of a test track used to fine-tune the universe parameters and controller settings. It further includes most player feedback elements and serves as a good foundational proof of concept. It has no race logic and player movement is restricted to 2 axes. All backend is in place for track components to be built.

Iteration 2

The second iteration enhances all the player feedback devices. It includes a ∓70 second track with difficult lines. It also includes a basic checkpoint system and all axes of movement are unlocked.

Annexure A: Reflection

I am very proud of this game. It was incredibly fun to design, implement and especially test. I think all the small prototypes throughout the year helped me compartementalize features and take a stepwise approach to individual sections of the projects. Dividing the project into sections also came much easier than last year. And everytime a section was completed, it was fully functional, which made testing and early playtesting possible.

I think the main weaknesses of the game as it stands is the lack of menus and a rather steep learning curve. I think the tutorial can be more fleshed out and more responsive. It could check whether a player has completed the task and congratulate them theron. The camera controller could also use some work. It is currently a sort of strict follow camera, where a more dynamic camera that reacts to the players thrust would make it much more engaging.

One of my main challenges was to make the player feel fast. I researched alot into how traditional racing games achieve this, but most of those techniques were only applicable to races that took place on roads, or had some foliage/buildings next to the track. I added the star-trail to create the same effect as the texture of the ground rushing past you. I made the particles trail based on your velocity to emphasize your speed. Improving the camera could have aided this greatly: making it lag behind the ship as the player accelerates for example.

Overall, I think the project was a major success, and I would definitely like to carry on improving it after this submission.

Annexure B: Music Questions

1. My sounds were mainly inspired by typical pop-culture futuristic space sounds. The background music is very electronic heavy. I wanted to add low humming sounds to the thrusters but removed them due to technically difficulties with getting them to be responsive.
2. My sounds were created digitally. Some were downloaded from ZapSplat, some were made with ChipTone.
3. I wanted to achieve a certain atmosphere and intensity with the background music, and the other sounds were there purely to give the player feedback.
4. My target audience was players who enjoy repeating short racing tracks to try and shave off every second they can and get the best time. Giving the background music a certain intensity without making it too overwhelming that it annoys players was the perfect balance between purpose and practicality.

Annexure C: Iteratively Removed Features

HUD Enhancements

- **Distance indicator:** *A UI element will show the distance and relative velocity of anybody the player selects.* During playtesting, players found that the star-trail together with the trajectory indicator was plenty. Adding this feature made the controls too complex and cramped the HUD. Players also tended to not use it.
- **Ghost Racer:** *A transparent copy of the player's previous best attempt will play as the player races to indicate where they can improve upon their previous attempt.* This feature was removed from the plan due to time constraints. Although it would be a nice addition, it was not as high a priority as polishing track and adding more tracks.

Obstacles

- **Moons:** *Orbiting the large bodies will be smaller, but still large moons that can act as obstacles but also sling the player in interesting directions. They can be used to disguise shortcuts.*
- **Asteroid belts:** *Large groups of small bodies that orbit a Large body. These will have little effect on the ship's gravitational pull, but will easily knock a player off course if they lack precision.*

Both these obstacles were removed from the game as it was already quite difficult to master. Given the size of this project, they added too much difficulty in the game. Perhaps if there were more levels and players could gradually ease into levels with obstacles they would be a good addition.

UI Enhancements

- **Track Selection screen:** This screen wasn't included due to the small number of tracks and time constraints. It was replaced with a button allowing players to skip to the next track.
- **Start screen:** The game starts off with the tutorial. A start screen allowing for some breathing time beforehand would have been a good inclusion. It was simply overlooked throughout most of the development of the game, and was thought of too late.