1 Project Proposal and Design Document

I selected the project "Manta Ray Migration – Simulate a large school of manta rays gliding through a dynamic ocean, interacting with smaller fish". And the theme is called "Dynamic Underwater Ecosystem Simulation". It is important to define my project and the broad theme to scope out the work involved.

1.1 Advanced/Custom features I am considering

- Boids (for simulating marine life, e.g. manta rays, small fish)
- Fog (for water)
- Moving sky box (deep in the ocean theme)
- Fluid animation using lerp (linear interpolating between positions)
- Using Quaternion for rotations of marine life to avoid Gimble lock
- Instancing draw calls
- Fragment Discarding (e.g. for transparent png's like seaweed)
- Two cameras, with seamless changing capability
- Randomised Terrain/marine life elements
- Post Processing (gaussian blur)
- Reflecting/Refracting Ocean

One feature that I am considering for my project is intelligent character behavior. Specifically I am considering Boids [1] by Craig Reynolds, for my interaction between my manta rays and small fish. I think this advanced feature is important to make an interesting simulation. For water effects, I want to implement a blue fog, simulating water of an ocean. I think adding a sky box would make the scene more realistic as well. It will be underwater, and will move slightly emulating the moving water. I will also use quaternions for rotating my marine life, before they hit each other, to make it realistic. I will use lerp to linearly interpolate between the point of rotation and the previous point to add fluidity to the movement. My final advanced feature would be to instance drawing multiple of the same models, so that we can optimize and reduce the amount of draw calls required to draw my marine life. Specifically I will instance draw my marine life, which will include starfish, manta rays, and small fish. The fragment discarding I will do will be used for the seaweed which I plan on having, something like two png's side by side, the way Minecraft uses it with grass in game. I will have two cameras, with capabilities of moving throughout the scene and seamless switching between cameras. One camera will be positioned initially on top, and one at the centre of the scene. I will also randomise where the seaweed, starfish, marine life will initially spawn in to give some interesting and different interactions every time I start my application. I intend to have post processing, specifically a Gaussian blur using a 3x3 kernel to better emulate what it would feel like to be underwater. The refracting of the ocean, will be based on the cube which is in a sense a slice of the ocean reflecting/refracting the water themed sky box.

1.2 Outlining my types of marine life

- Manta Ray
- Small Fish
- Starfish

Specifically, I'm thinking of adding hierarchical animation for my small fish. I can hierarchically move the fin of my fish with the body. The sketch below gives a visual explanation where I cut the model into two parts for animating.

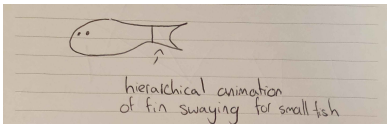

Figure 1: Sketch of the small fish hierarchical structure

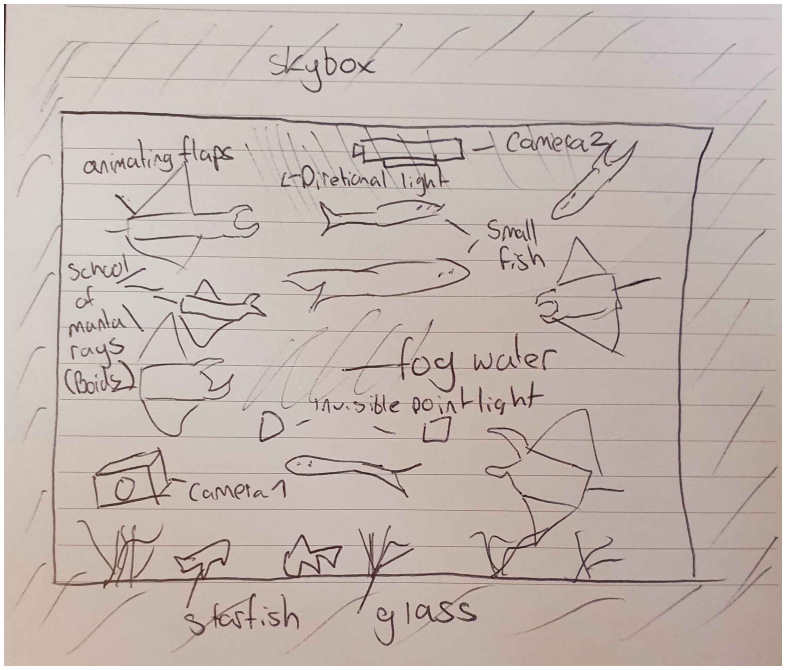

Figure 2: Sketch of the environment

Figure 3: Scene of the environment

Figure 4: Moving water themed sky box

1.3 Outlining my types of non marine life (in scope of project)

- Underwater seaweed (potentially bioluminescent)
- Water bounding box (ocean)

I want my non marine life to complement my theme, and project. I want some patch of land on my ocean, so that I can demonstrate fragment discarding to have transparent grass. My underwater seaweed will be glow, meaning it will cast a light on the ocean floor. I will have invisible point lights scattered through the scene to add more interesting light interaction with my marine life. The light will be a Phong illumination light, with point lights in the seaweed, and a general direction light from the top to bottom of my scenery. The water bounding box as mentioned is a bounding box of the scenery which will refract the themed skybox, but also be a barrier preventing the fish from swimming away from the barrier.

References

[1] Boids: Artifical life Simulation *https://en.wikipedia.org/wiki/Craig_Reynolds_(computer_graphics) Craig Reynolds*