

DECLARATION: I understand that this is an **individual** assessment and that collaboration is not permitted. I have read, understand and agree to abide by the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at <http://www.tcd.ie/calendar>. I understand that by returning this declaration with my work, I am agreeing with the above statement.

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)
- Fog (for water)
- Sky box
- Fluid animation using lerp (linear interpolating between positions)
- Using Quaternion for rotations to avoid gimble lock
- Instancing draw calls

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. I am also considering Boids for my crabs and starfish, where the starfish are obstacles for the crabs, which would make for interesting simulation of walking. For water effects, I want to implement a blue fog, simulating water of an ocean. I think adding a skybox would make the scene more realistic as well. 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 my marine life like manta rays.

1.2 Outlining my types of marine life

- Manta Ray
- Small Fish
- Starfish
- Crab

Specifically, I'm thinking of adding hierarchical animation for my small fish and my crabs. Although I may decide to have another underwater creature, because animating 10 legs on a crab might be more hassle than its worth. I think a manta ray flapping animation based on hierarchical structure could work well. What I mean by this is splitting the left and right side of the fins of the manta ray and using hierarchical structure moving each section of the fin. The sketch below hopefully describes what I mean

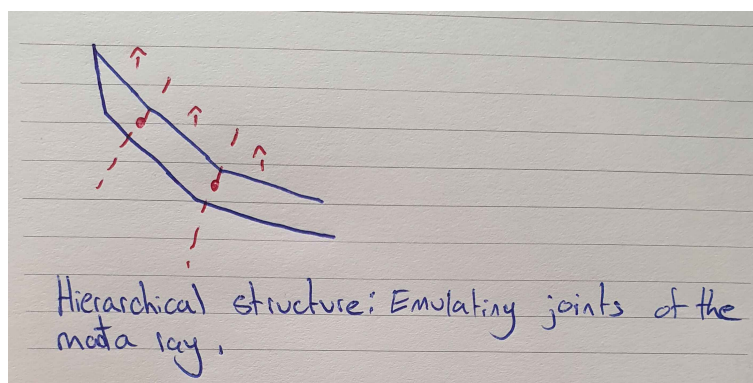


Figure 1: Sketch of the manta ray hierarchical structure

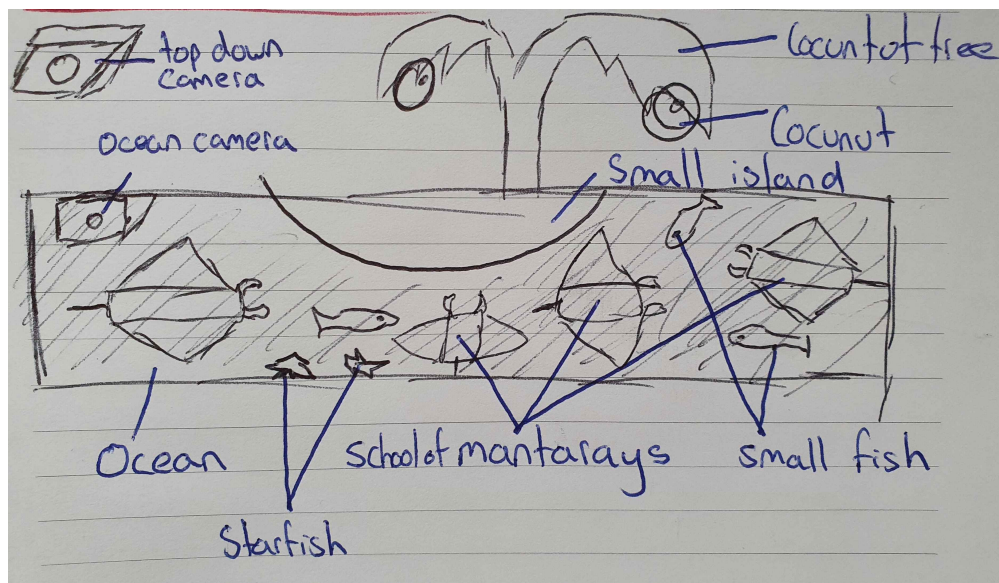


Figure 2: Sketch of the environment

1.3 Outlining my types of non marine life

- Coconut + Coconut tree
- Underwater seaweed (potentially bioluminescent)
- grass
- sand

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 alpha blending of transparent grass. My underwater seaweed will be bioluminescent, meaning it will cast a light on my marine life. The light will be a Phong illumination light, with point lights in the seaweed, and a general direction light above my landscape as the direction of a sun/daylight. I want a coconut on my patch of sand as well to add some personality to the environment.

References

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