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Marine Illusion: Generating Authentic Drone Images of Aquatic Mammals

IDIG4002 - Project Report

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Algorithms & Techniques

1.1 Scenes
1.1.1 Island with surrounding land

In creating the **Island Scene**, a combination of 3D modeling techniques and rendering algorithms was employed to achieve realism. The water surface, which was made using a plane, was rendered using Blender's **Cycles engine**. This choice was crucial for its ray tracing capabilities, allowing for realistic light reflections and refractions on the glass-based material used to simulate water.

The island and seabed were sculpted on a new plane, where the terrain was manually shaped to create a natural-looking landscape. Depth variation and smoothness were key focuses to ensure realism. For texturing the terrain, the **Node Wrangler** add-on in Blender was utilized to automate the setup of texture nodes, streamlining the process. A realistic beach texture from Polyhaven[1] was applied, enhancing the surface details without the need for custom texture creation. The scene was captured from various angles using four strategically placed cameras, showcasing the depth and scale of the environment.
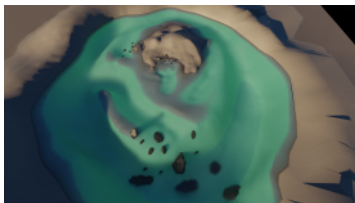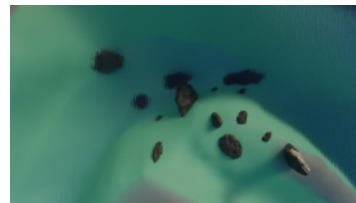
(a) Entire island.

(b) Camera position 1 - Small island.

(c) Camera position 2 - Bay.

(d) Camera position 3 - Open sea.

Figure 1.1: Different scenes and camera positions

1.1.2 Seal on a Beach with Rocks

Plane for Water Surface: Instead of the usual Ocean Modifier, a cube was used to create the water. This choice allowed for more depth and a better look. Textures and shading were added based on a tutorial [2] to make the water seem real.

Water Texture: The water's look was created by hand, adding details like bumps using noise texture and other settings. This made the water look more lively and real.

Sand: The beach sand was made using a technique called mesh subdivision, giving it more detail. Then, sand textures from a website [3] were added for a natural look.

Rocks: Rocks from a 3D model pack [4] were placed randomly to look like a natural rock setting. Realistic textures from the same website [3] were added later to make them fit well into the scene.
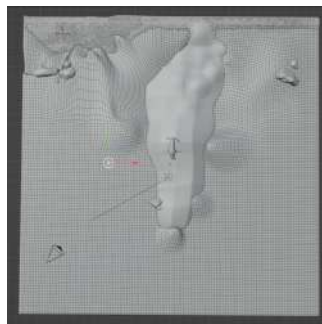
Figure 1.2: Cube mesh

1.1.3 Shark in Open Waters

Two parallel planes were used. The first plane was created using Blender's built-in ocean modifier [5], experimenting with light behavior. The second, lower plane simulated sunlight reflection, adding to the realism. Adjustments in shading and texture were made for an underwater effect. Transparency roughness was tweaked to mimic the look of water. The Blenderkit addon [6] was used for additional resources and effects.
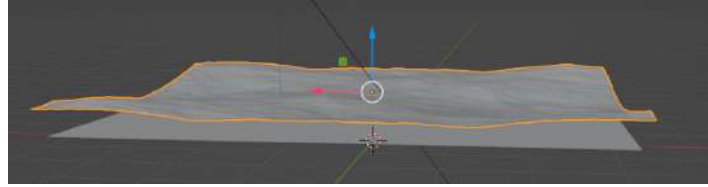

Figure 1.3: Two parallel planes

1.1.4 Multiple Sharks with Mountains

The Blender World attribute with an HDR image created a realistic background. Mountains and a plain were added using the Landscape addon, specifically the Lake 2 Landscape mesh [7]. Mountains were included to make the environment look realistic and to create natural reflections on the water and mammals. Noise texture was applied to the water to create wave effects. Multiple self-made shark models with different textures and poses were placed at varying depths for added realism.

Figure 1.4: Sharks with different textures and depths

1.2 Animals

1.2.1 Dolphin

The Dolphin model was incorporated into the scene as a pre-made asset, sourced from CGTrader[8].

1.2.2 Whale

The Blue Whale model in Blender was crafted with a focus on anatomical precision, guided by a reference image[9]. The process began with aligning the reference image across different axes using Blender's Numpad shortcuts. The whale's body was modeled by forming and bridging circles of varying sizes to create the main structure, ensuring symmetry through mirroring. Detailed adjustments to vertices were made for alignment with the reference image.

Fins and the tail were similarly constructed, with careful shaping and mirroring to achieve the correct form. The eye was intricately modeled using a subdivided face transformed into a circular socket with **Loop Tools**, and a **UV Sphere** was added to represent the eye itself. The nostrils were created using the **Knife tool** for precision cutting and extrusion for depth, with added edge loops for smoothness. Some images showcasing the progress of the modelling can be seen in Figure 1.5
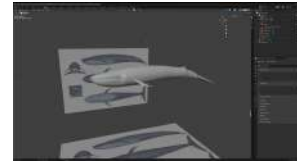
(a) Before bridging edge loops of body.
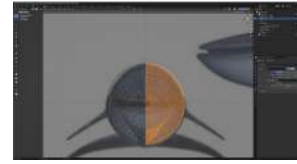
(b) Mirroring the half of the body to ensure symmetry.
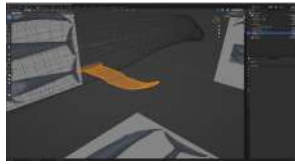
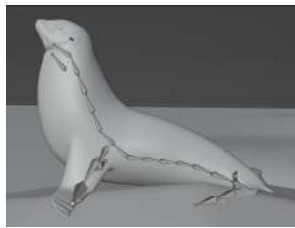**(c)** The finished finn.

(d) The finished whale, after smoothing.

Figure 1.5: Progression of the Blue Whale model.

1.2.3 Seal

The seal model was downloaded from a free website [10]. Its pose was changed to look like it's resting using a method from a YouTube video [11]. This meant adding a structure like bones to the model, which made it possible to position the seal realistically.

(a) Original

(b) Rigged

Figure 1.6: Seal rigging and posture adjustment

1.2.4 Shark

A reference image created by AI was used as a guide [12]. The modeling process was based on a tutorial [13]. Own textures were developed to give the shark a realistic appearance. The shark's teeth were omitted because they weren't needed for a drone shot perspective and would have required more time. A mirror modifier was used to replicate half of the shark, simplifying the modeling process. A cube mesh was used, and a subdivision technique smoothed the model. A metallic-looking texture and a mix shader were applied to enhance the shark's realism.
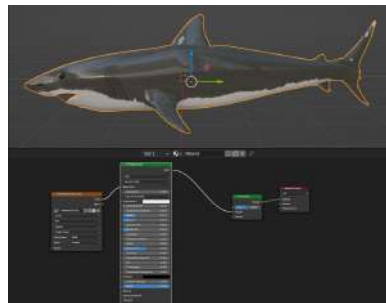

Figure 1.7: Shark texture with BSDF

1.3 Other models

1.3.1 Rocks

The rock models in Blender were created starting from a basic cube, enhanced with a subdivision surface modifier for smoothness. The transformation into rock-like forms was achieved using the Displace modifier with a **"Voronoi"** texture, adjusted in scale and intensity to mimic natural rock features.

Manual adjustments to the object's faces further refined its irregular and realistic appearance. The final touch was applying a detailed rock texture from AmbientCG[14] using the Node Wrangler add-on, adding depth and authenticity to the models.

Problems

During the project, several challenges were encountered and overcome. Creating a realistic water texture was initially difficult, but was resolved by utilizing Blender's Cycles engine for its advanced ray tracing capabilities, resulting in a more lifelike water surface. Sculpting the island and seabed posed another challenge due to the complexity of achieving natural-looking terrain. This was addressed through a combination of mapping and manual sculpting. Applying textures to complex models like rocks and terrain was streamlined using the **Node Wrangler** add-on, which automated the setup of texture nodes, significantly improving efficiency. Additionally, maintaining symmetry in the Blue Whale model was challenging, but was effectively managed using the mirroring technique to ensure anatomical accuracy. These challenges not only tested but also enhanced our proficiency with Blender's tools and features.

Adjusting the seal's pose was a considerable challenge, to appear more natural required the implementation of bone rigs, a time-consuming process learned through a tutorial. Achieving realism in drone shots was difficult due to the high-angle perspective which made details less noticeable. This issue was addressed by enhancing elements like lighting and texture. Struggling to achieve smooth curves in mesh models was another challenge. It was necessary to find a balance between increasing the number of vertices for smoothness and keeping render times reasonable. Modeling the shark from scratch took a lot of time. Because of this, some small details were left out, especially those that weren't important for the drone shot view. Additionally, a minor issue with the mirror modifier in Blender resulted in a thin line appearing between mirrored parts of the shark model, possibly indicating a bug in blender.

Work distribution

Contributions by Thomas:

- Island Scene with Surrounding Sea: Thomas developed the Island Scene, focusing on creating realistic terrain and water textures using Blender's mapping and Cycles engine.
- Blue Whale Model: Thomas was responsible for modeling the Blue Whale, emphasizing anatomical accuracy and lifelike texturing, utilizing techniques such as subdivision surfaces and mirroring.
- Rock Models for the Island Scene: Thomas also created rock models specifically for the Island Scene. These rocks were crafted by transforming basic shapes into natural-looking rocks through mapping, manual sculpting, and texturing, adding to the scene's realism.
- Thomas also had the main responsibility for writing and structuring the report.

Contributions by Hamza:

- Seal and Beach Scene: Hamza created a beach scene with a resting seal. He picked a seal model and adjusted it to make it look natural. He also designed the beach setting, adding realistic textures to the sand and rocks.
- Water Surface Creation: For the water, Hamza used a unique approach by using a cube shape. He added special textures and details to make the water look real and moving.

- Shark Modeling: He was responsible for modeling the shark, using AI-generated images as a guide. The process included adding textures for a metallic look and using a mirror effect to ensure symmetry.
- Shark in Open Waters: In this scene, Hamza focused on creating a realistic ocean environment with a shark. This involved special lighting and texture techniques to make it look like underwater.
- Sub Scenes with Sharks and Mountains: He created another scene with several sharks and mountains. This part of the project was about making the environment look real, with different textures and natural elements like mountains for reflections.
- Render Challenges: Both worked on various technical aspects, such as balancing the level of detail in models with the time needed for rendering.

Results

Due to the limitations in the length of the report, only some final rendered images are displayed here. However, the rest of the rendered images have been attached.

For the rendering process, we utilized the **"Cycles"** render engine in Blender, known for its realistic rendering capabilities. This was powered by a **NVIDIA GeForce RTX 3070** GPU, enabling us to produce high-quality 4K renders. In the Output tab in Blender, we selected the **"4K UHDTV 2160p"** preset, set the **Color Depth** to 16, and reduced the **Compression** to 0%. These settings were crucial in capturing the details and realism of our aquatic mammal models.
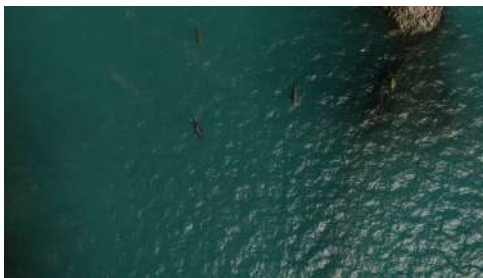
(a) Multiple sharks with different depths and textures

(b) Dolphins and two whales with different orientations.

Bibliography

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[14] Lennart Demes, Rock 020, Link.