[Project: Abyss]

Technical Design Document

Version [0.7]

Version History

Version Number	Edited By	Date
0.1	Austin Morris, Rob Power	27/8/2023
0.2	Austin Morris	25/10/2023
0.3	Alexander McTernan	05/11/2023
0.4	Rob Power	08/11/2023
0.5	Austin Morris	09/11/2023
0.6	Maxime Paradis	09/11/2023
0.7	Austin Morris	10/11/2023

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Game Overview

Embark on an immersive subterranean journey with a partner in "Project: Abyss." Equipped with cutting-edge diving gear provided by a tech company, plunge into the unexplored depths beneath our feet. Descend in a shark cage, expertly controlled by your partner, while your loyal DiveBot accompanies you on a quest to photograph and document the unknown. Safeguard your discoveries in a journal, earning rewards for each remarkable find. Exercise caution, for the depths conceal both wonders and potential threats.

Game Summary

"Project: Abyss" delivers a gripping cooperative underwater odyssey. Players assume the roles of two daring researchers contracted by a major tech conglomerate to delve into the recently uncovered Hollow Earth—a hidden layer beneath the ocean floor. Despite your pivotal role, corporate motives cast you as expendable assets, tasked with gathering data in an exceedingly perilous environment.

The exploration reveals an untouched realm teeming with unprecedented flora, fauna, and mysterious aquatic life forms. Your mission is to capture the mystique of this subterranean world through photography, meticulous documentation, and sample collection. Venture deeper into the heart of Hollow Earth, discovering traces of an ancient, intelligent civilization that has left behind intriguing clues.

However, corporate indifference adds a layer of complexity to your journey. Navigate ethical dilemmas involving the preservation of the natural order versus succumbing to corporate greed. As you uncover the secrets of the abyss, your choices will shape the fate of this hidden ecosystem and determine whether humanity learns from its past or repeats its mistakes in the pursuit of knowledge.

Platform

This game will be developed for PC, with a possibility of porting to major consoles like XBOX & Playstation.

Development Overview

This section discusses key aspects of the development of the game, as opposed to the game itself.

Development Team

Full Name	Role	Specific Role
Austin Macodnald Morris	Programmer	Build Engineer
Alexander McTernan	Programmer	Communications Contact
Tyler Brost	Programmer	Backup Build Engineer
Jarod Beach	Programmer	Programmer
Maxime Paradis	Programmer	Programmer Contact
Renz Leo Nicolas Dela Cruz	Programmer	Programmer
Aaron McAfee	Artist	Backup Comms Contact
Rob Power	Artist	Art Contact
Connor McCooeye	Artist	Artist
Scott McIntyre	Artist	Artist / Backup Art Contac
Dante Frazzoni	Artist	Artist/Level design
Yousef I	Artist	Artist
Liam Desrosiers	Artist	Artist
Adam Propp	Artist	Artist / Backup Art Contac

Development Environment

You would need access to our GitHub repo in order to work on the game. Once you clone, and have Unreal Engine 5.2 installed with some form of IDE, you will be able to work on the project. We recommend GitHub desktop for cloning, and Visual Studio for your IDE.

Development Hardware

During development, we used PCs with Intel i7-9700k processors, Nvidia 2080 Graphics Card, and 32GB RAM. The development environment was based on Windows 11.

Other development systems include:

Rob Power
Intel i9-9900k processor, Nvidia 3080 Graphics Card, and 32GB RAM. Windows 10 environment.

Jarod Beach
AMD Ryzen 3700X 8-, Nvidia Geforce 1660 Ti Graphics card, 16 GB RAM,Windows 10 Environment

Adam Propp:
Intel i7-12700k 12-Core processor, Nvidia Geforce RTX 3080 Graphics Card, 32GB RAM. Windows 11 environment.

Austin Morris
AMD Ryzen 5 1500X Quad-Core processor, Nvidia GeForce GTX 1060 6GB Graphics Card, and 16GB RAM. Windows 11 Environment.

Renz Leo Nicolas Dela Cruz:
AMD Ryzen 7 3700X 8-Core processor, Nvidia Geforce RTX 2070 Graphics Card, and 32GB RAM. Windows 10 environment.

Scott McIntyre:
AMD Ryzen 7 5800X 8-Core processor, Nvidia Geforce RTX 2080 Graphics Card, and 32GB RAM. Windows 10 environment.

Tyler Brost
AMD Ryzen 5 3600 6-Core processor, Nvidia GeForce GTX 1660 Super 6GB, and 16GB RAM. Windows 10 environment.

Maxime Paradis
Intel Core i7-10750H 6-Core processor, Nvidia GeForce RTX 3070 Laptop Graphics Card, and 16GB RAM. Windows 11 environment.

Alex McTernan
Intel Core i7-10700k 8-Core processor, Nvidia GeForce RTX 3080 10GB Desktop Graphics Card, and 32GB RAM. Windows 11 environment.

Connor McCooeye:
AMD Ryzen 7 5800X 8-Core Processor, Nvidia GeForce RTX 3070 Graphics Card, and 16 GB RAM. Windows 10 environment

Liam Desrosiers:
Intel Core i7-10700k 8-Core Processor, Nvidia GeForce RTX 3070 Ti Graphics Card, and 32 GB RAM. Windows 10

Yousef I:
Intel Core i7-6700K 8-Core Processor, Nvidia GeForce GTX 1080 Graphics Card, and 32 GB RAM. Windows 10 pro

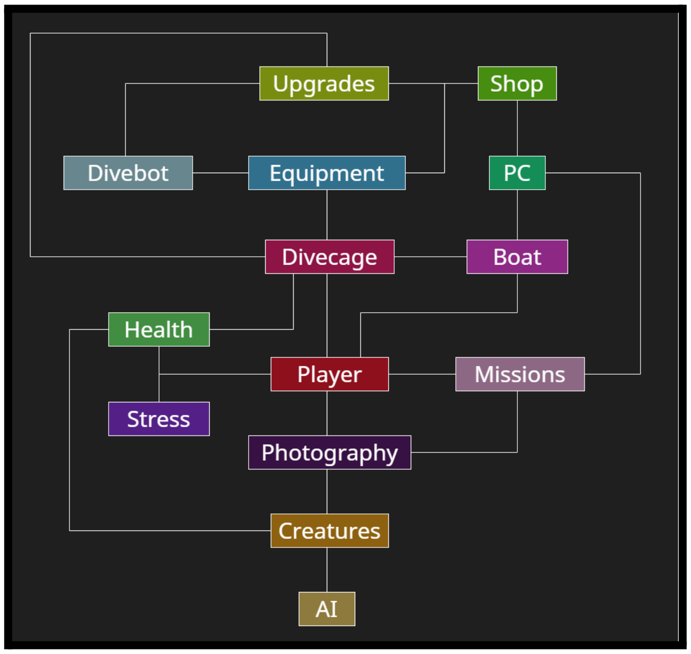
Development Software
This product has been developed using Unreal 5.2.1, VisualStudio 202x, VSCode, 3DS Max 2024, ZBrush, Substance Painter, Adobe Illustrator, Adobe Photoshop, Blender.

External Code
External code includes the utilization of the Unreal Water System plugin.
The project also uses a plugin for Steam networking capabilities created by Tilan.
We also use the plugin UMLet for making UMLs in VSCode.

Game Mechanics

Main Technical Requirements
- Critical functionality involves underwater photography, exploration, and completing missions.
- Performance constraints include managing AI behavior and rendering underwater environments effectively.

Architecture



__**Core Systems:**__
- Underwater Environment Rendering:
  - Utilizes Unreal Engine's rendering capabilities.
  - Manages different biomes, lighting conditions, and underwater effects.

- Player Control System:
  - Handles player input for movement, photography, and interaction.
  - Integrates with stress and health systems to impact player interactions and impactful decision-making.

- Mission System:
  - Manages main and side missions from H.E.I.R.
  - Tracks mission progress, completion, and unlocks.

AI System:

- Hostile Fish AI:
    - Implements behavior trees for hostile fish.
    - Responds to stimuli such as light, noise, and player stress.
    - Manages aggression, retreat, and attack behaviors.

- Friendly/Passive Fish AI:
    - Implements behavior trees for friendly fish.
    - Handles avoidance behaviors when approached by the player.

- Environmental Creatures AI:
    - Manages large schools of unresponsive fish.
    - Utilizes particle systems for efficient rendering.

Photography System:

- Camera Mechanics:
    - Controls the player's camera for taking pictures.
    - Limits the number of pictures per dive.
    - Displays UI feedback for discovered and known fish.

- Gallery and Collection:
    - Manages the storage and organization of taken pictures.
    - Updates the Collection entry for each discovered fish.

Boat and Dive Cage:

- Boat Steering System:
    - Enables player possession and control of the boat.
    - Handles turning and speed control.

- Storage Container:
    - Stores purchased items from the shop.
    - Automates retrieval and display of items.

- Picker Upper:
    - Manages equipment drop-offs via drill drop pods.
    - Controls the Picker Upper for collecting dropped items.

- Dive Cage Door and Health:
    - Manages the Dive Cage door for diver entry/exit.
    - Tracks health state affected by hostile fish attacks.

PC Terminal:

- Missions Tab:
    - Displays current and completed missions.
    - Distinguishes between Main Missions and Side Missions.
    - Include junk email that introduces slight humor and realism.

- Map Tab:
    - Shows explored areas and mission markers.

    - Displays active missions for reference.

- Journal Tab:
    - Manages the Gallery, Collection, and Cameras.
    - Provides information on discovered fish.

- Shop Tab:
    - Handles player purchases and upgrades.
    - Displays available money and item details.

DiveBot System:

- Movement and Photography:
    - Controls DiveBot movement with a propeller.
    - Enables limited photography for mission assistance.

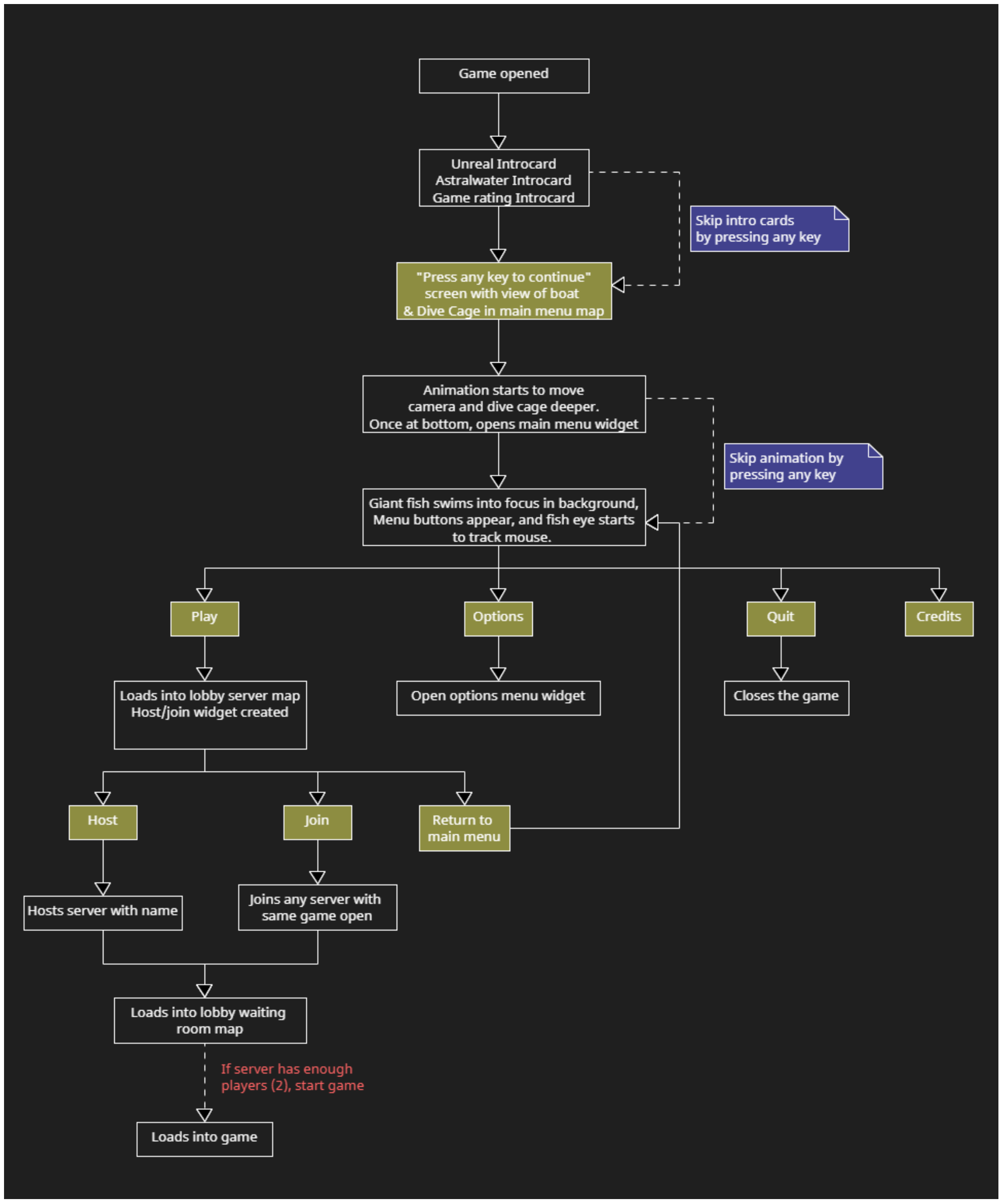
- Equipment Attachment:
    - Allows DiveBot to equip various items for assistance.
    - Integrates with the Dive Cage for stationary use.

- Petting Interaction:
    - Implements player interaction to pet the DiveBot.

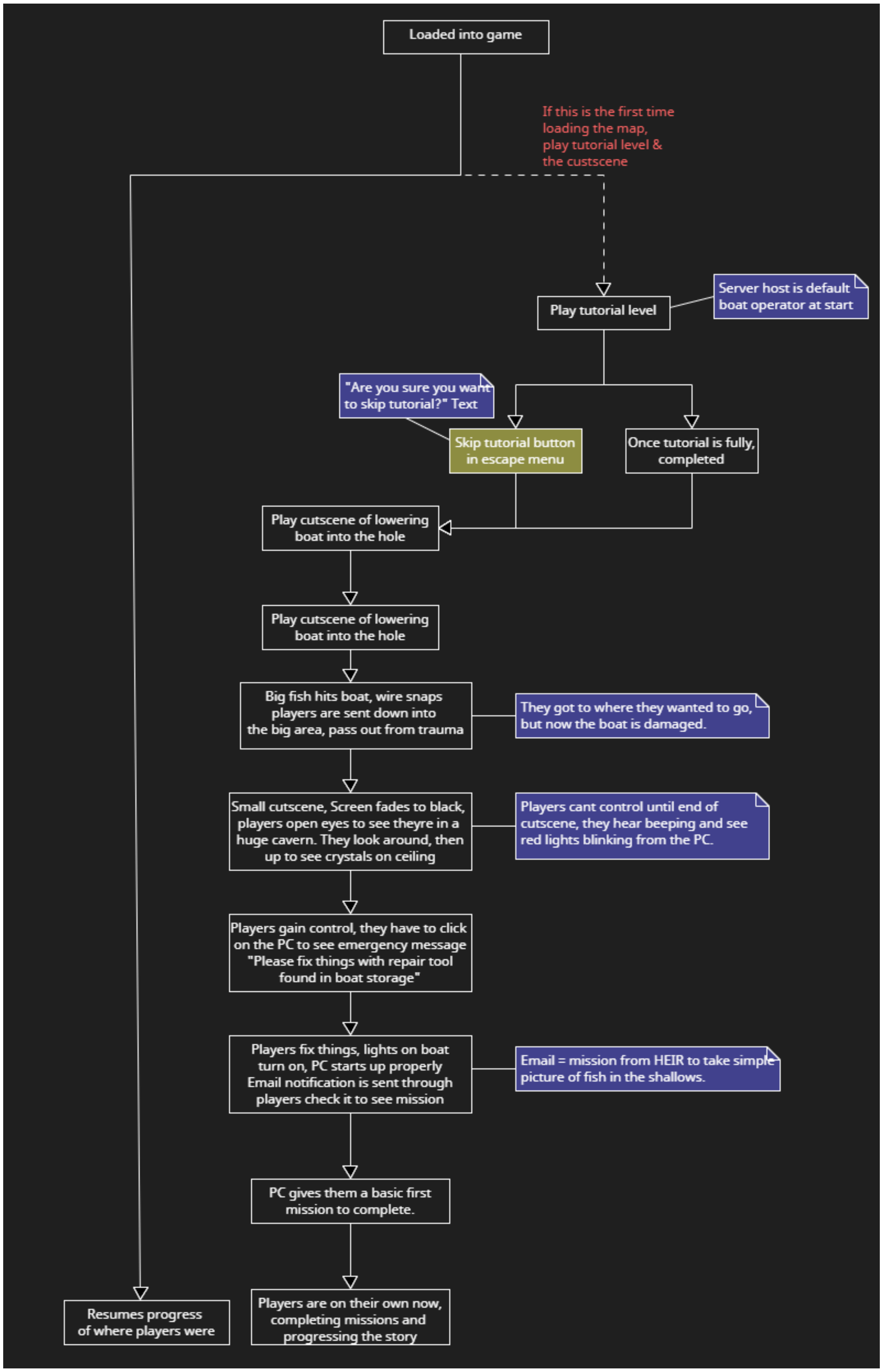
Game Flow

The game has different states, including title screens, menus, and playing. The main control loop involves player exploration, mission acceptance, and underwater photography.

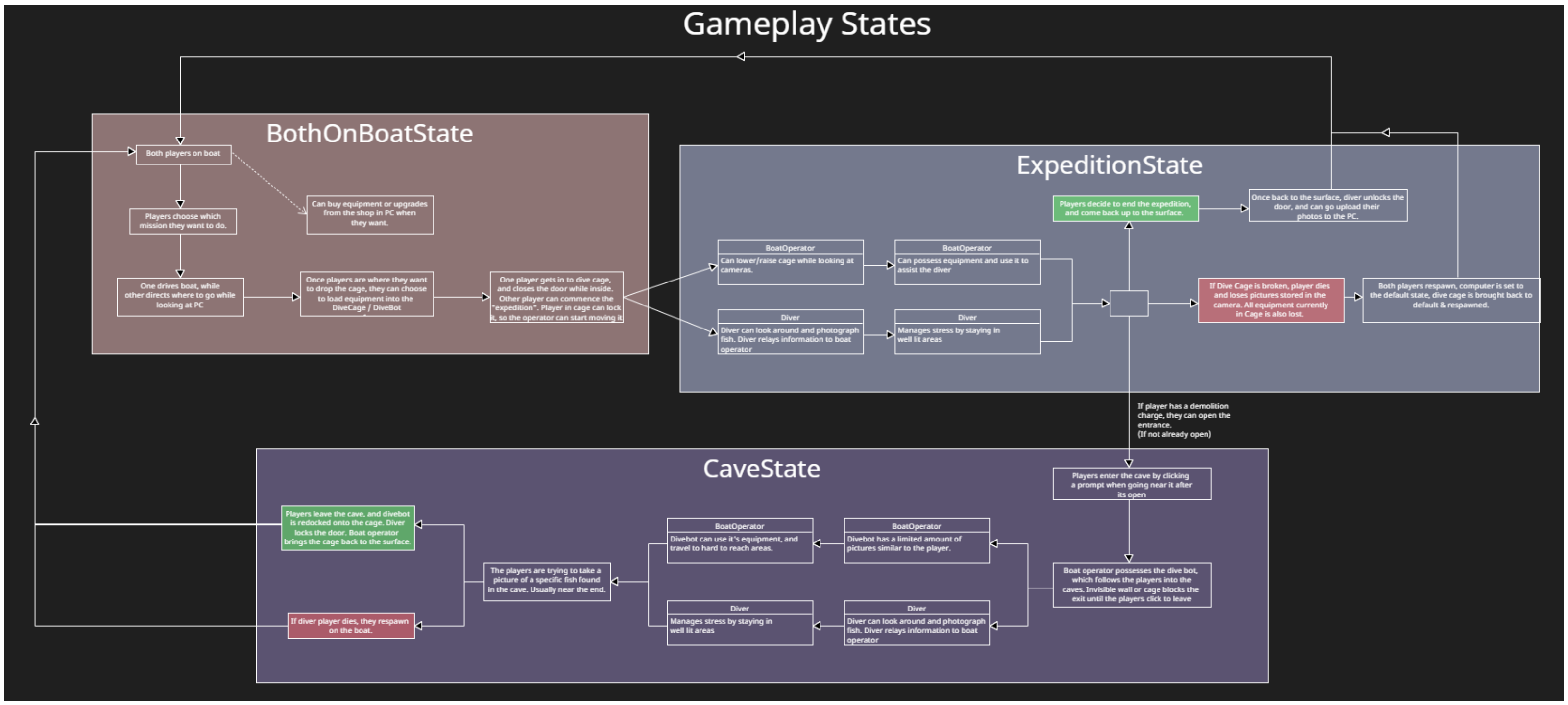
Menu Flow:


Game opened
Unreal Introcard Astralwater Introcard Game rating Introcard
Skip intro cards by pressing any key
"Press any key to continue" screen with view of boat & Dive Cage in main menu map
Animation starts to move camera and dive cage deeper. Once at bottom, opens main menu widget
Skip animation by pressing any key
Giant fish swims into focus in background, Menu buttons appear, and fish eye starts to track mouse.
Play
Options
Quit
Credits
Loads into lobby server map Host/join widget created
Open options menu widget
Closes the game
Host
Join
Return to main menu
Hosts server with name
Joins any server with same game open
Loads into lobby waiting room map
If server has enough players (2), start game
Loads into game

Loading Into Game Flow:


Loaded into game
If this is the first time loading the map, play tutorial level & the custscene
Play tutorial level
Server host is default boat operator at start
"Are you sure you want to skip tutorial?" Text
Skip tutorial button in escape menu
Once tutorial is fully, completed
Play cutscene of lowering boat into the hole
Play cutscene of lowering boat into the hole
Big fish hits boat, wire snaps players are sent down into the big area, pass out from trauma
They got to where they wanted to go, but now the boat is damaged.
Small cutscene, Screen fades to black, players open eyes to see theyre in a huge cavern. They look around, then up to see crystals on ceiling
Players cant control until end of cutscene, they hear beeping and see red lights blinking from the PC.
Players gain control, they have to click on the PC to see emergency message "Please fix things with repair tool found in boat storage"
Players fix things, lights on boat turn on, PC starts up properly Email notification is sent through players check it to see mission
Email = mission from HEIR to take simple picture of fish in the shallows.
PC gives them a basic first mission to complete.
Resumes progress of where players were
Players are on their own now, completing missions and progressing the story

Gameplay Loop:


Gameplay States
BothOnBoatState
Both players on boat
Can buy equipment or upgrades from the shop in PC when they want.
Players choose which mission they want to do.
One drives boat, while other directs where to go while looking at PC
Once players are where they want to drop the cage, they can choose to load equipment into the DiveCage / DiveBot
One player gets in to dive cage, and closes the door while inside. Other player can commence the "expedition". Player in cage can lock it, so the operator can start moving it
ExpeditionState
BoatOperator
Can lower/raise cage while looking at cameras.
BoatOperator
Can possess equipment and use it to assist the diver
Diver
Diver can look around and photograph fish. Diver relays information to boat operator
Diver
Manages stress by staying in well lit areas
Players decide to end the expedition, and come back up to the surface.
Once back to the surface, diver unlocks the door, and can go upload their photos to the PC.
If Dive Cage is broken, player dies and loses pictures stored in the camera. All equipment currently in Cage is also lost.
Both players respawn, computer is set to the default state, dive cage is brought back to default & respawned.
If player has a demolition charge, they can open the entrance. (If not already open)
CaveState
Players enter the cave by clicking a prompt when going near it after its open
Boat operator possesses the dive bot, which follows the players into the caves. Invisible wall or cage blocks the exit until the players click to leave
BoatOperator
Divebot has a limited amount of pictures similar to the player.
BoatOperator
Divebot can use it's equipment, and travel to hard to reach areas.
Diver
Diver can look around and photograph fish. Diver relays information to boat operator
Diver
Manages stress by staying in well lit areas
The players are trying to take a picture of a specific fish found in the cave. Usually near the end.
Players leave the cave, and divebot is redocked onto the cage. Diver locks the door. Boat operator brings the cage back to the surface.
If diver player dies, they respawn on the boat.

The main gameplay will consist of a loop between three states.

1. **BothOnBoatState:**
   This state will be the transition/intermission between the other two states. Players will be able to travel to new destinations, interact with the PC Terminal, and enjoy the peaceful nature of their well-lit boat. Once the players decide they want to progress, one of them will enter the Dive Cage and lock the door. This will commence the ExpeditionState.
2. **ExpeditionState:**
   The expedition state consists of a unique role for each player. The Boat Operator, and the Diver. The boat operator will be able to send the diver down into the depths once the player is in the locked dive cage. The boat operator will also be able to control equipment, which can be used to assist the diver.
   The Diver's job is to successfully take photographs of fish needed to complete missions, without triggering certain hostile fish to attack them.
   Players will have two choices now; to enter any cave that they might want to explore, or to return to the boat with their photographs.
   If players decide to explore a cave, we move to the CaveState.
3. **CaveState:**
   When the dive cage is docked in a specific location near a cave, the players will be able to enter the cave. The boat operator will control a dive bot which was docked on the dive cage. This cave will have similar gameplay elements to the expedition itself, including photographing creatures, and trying not to trigger any hostile creature attacks. Most caves will have a specific creature that must be photographed for a mission to progress the story to the next biome. Finally, once players are satisfied, they can return to the entrance to enter the dive cage and be raised to the top, also leading back to the first state of both on the boat. The gameplay then loops.

Graphics

The game utilizes Unreal Engine for 3D graphics, focusing on rendering underwater environments, marine life, and player-controlled objects. The PC Terminal uses 2D graphics and art to emulate a virtual desktop environment. Constraints may involve handling different biomes and lighting conditions.

Audio

Sound elements include music playback, sound effect playback, and underwater ambient sounds. Unreal Engine’s audio features are employed. Constraints involve creating realistic underwater audio experiences.

Artificial Intelligence

The AI will mainly be controlled through an inheritance chain of AI Controllers, the most generic of which will have customizable properties to change their behavior. More complex Fish will be given their own AI to allow for specific behavior.

Behavior: Creature behavior will be determined by the type of fish, and occasionally be unique depending on the specific creature. The main types are hostile, environmental, and friendly. These Behaviors will be processed through an AI Controller, passing relevant information to its component.

Networking

Our project gives the option of singleplayer, but it can be more greatly appreciated with a second player. This means many aspects of the game need to be networked to complete the whole experience. All movement is to be networked and as well as game states, including but not limited to missions, quests and inventory of various items. This will take diligent work for the team to complete.

Physics

Physics simulation involves collision detection, object interactions, and environmental interactions. Unreal Engine's built-in physics engine is utilized. The water plugin is used for buoyancy physics.

Game Objects and Logic

The Boat:

The boat serves as the primary hub for the player's activities. It includes several key elements and associated logic:

- **Navigation:** The boat allows the player to choose dive locations, navigate between them, and plan their overall strategy.
- **Upgrades and Repairs:** The boat is the place where players can upgrade their equipment, purchase new items from the shop, and interact with the PC terminal.
- **Safe Zone**: The boat acts as a safe zone between dives, providing a moment of respite where players can recover health, manage stress, and plan their next moves.

The PC Terminal:
The PC Terminal is a central component on the boat where players can access various functionalities:

- **Data Analysis:** Players can review collected data from dives, including information about creatures, underwater environments, and potential mission objectives.
- **Photograph Management:** The PC Terminal allows players to manage their photograph collection, and choose photos for upload to the Collection entry.
- **Mission Planning:** Players can review and accept new missions in the form of an email system from the company that sent them down, set waypoints for navigation, and plan their overall progression through the game.
- **Minigames**: (NYI) There will be minigames for players to engage with on the PC, which adds a fun meta-game component that players can choose to do.

Divecage:
The Dive Cage is a crucial element of the game, providing a means for players to explore the underwater environment:

- **Deployment and Retrieval:** The Dive Cage is way for players to safely explore the depths of these unknown waters. One player will go down in a divecage to photograph creatures, while the other player ensures their safety by managing equipment and movement of the cage.
- **Upgrades:** The Dive Cage can be upgraded to enhance its durability, functionality, and defensive capabilities.
- **Equipment:** Equipment can be socketed in to the Divecage before expeditions to implement more engaging gameplay elements. This equipment will be unlocked over time as you progress through the story more.

Players:
Players control the main character and interact with the game world through various actions:

- **Movement:** Players can navigate both on the boat and underwater. Movement controls include swimming, land movement, and Divebot controls.
- **Equipment Interaction:** Players can interact with different equipment during expeditions when using the PC Terminal. Each equipment will have unique abilities and often unique controls.
- **Health and Stress Management:** Players must manage their health and stress levels, considering the underwater environment, encounters with creatures, and the overall success of their dives.

Creatures:
Creatures are diverse and dynamic elements of the underwater ecosystem:

- **Spawning:** Creature spawning will be mixed, with specific hostile creatures being placed in certain areas, while environmental and friendly creatures will often have somewhat-randomized biome specific spawning. This means that creatures will have specific zones where they can spawn.
- **Types:** There will be 2 main types of creatures, swimming creatures (Fishes) and crawling creatures (Crabs, spiders…)
- **Behavior:** Creature behavior will be determined by the type of fish, and occasionally be

unique depending on the specific creature. The main types are hostile, environmental, and friendly. These Behaviors will be processed through an AI Controller, passing relevant information to its component.

- **AI:** The AI's will mainly be controlled through an inheritance chain of AI Controllers, the most generic of which will have customizable properties to change their behavior. More complex Fish will be given their own AI to allow for specific behavior.
- **Photography:** Creatures will be able to be photographed by the player when they're close enough.
- **Movement:** Movement will be different depending on the type of creature, Swimming creatures will swim through water and be unable to move on land, having physics and gravity enabled when they exit the water. While crawling creatures will walk on land and in the environment, whether the creature is in water or not.

Data Management and Flow

Unreal Engine provides a Save Game system that allows you to save and load game-related data easily. In "Project: Abyss," this system can be utilized as follows:

1. **Save Game System:**
   Save Game Class: Create a custom Save Game class (e.g., UGameSaveData) that inherits from USaveGame. This class defines the structure of the data we will want to save.
   Data Serialization: Unreal Engine uses reflection to serialize and deserialize data. Ensures that all relevant game data, such as player progress, mission status, collected photographs, and boat upgrades, will be included in the Save Game class.
   Saving Data: When triggered (e.g., on player request or at specific checkpoints), call the UGameplayStatics::SaveGameToSlot function to save an instance of our Save Game class to a specific slot.
   Loading Data: To load saved data, we will use UGameplayStatics::LoadGameFromSlot. If there's no saved data, create a new instance of the Save Game class.

2. **File Types and Locations:**
   Save Game Slots: Unreal Engine saves data in slots, which are essentially files. We will define specific slots for different save files, such as "SaveSlot_Player1" or "SaveSlot_AutoSave."
   Data Persistence: Saved data is stored in the game's "Saved" directory. Ensure that the Save Game class includes all necessary information for complete data restoration.
3. **Compression/Decompression:**
   Built-in Compression: Unreal Engine provides built-in support for compression when saving data. If the saved data becomes large, enabling compression can be considered to reduce file size and optimize storage.
4. **Loading and Processing:**
   Game Initialization: When the game starts, check for the existence of saved data. If found, load the data during the initialization phase.
   Data Processing: Upon loading, process the loaded data to update the game state. For example, instantiate the player character at the saved location, restore mission progress, and initialize the boat's state.
5. **Versioning and Upgrades:**

Version Control: Implement version control in the Save Game class to handle changes in data structure over different game versions.
Upgrading Saved Data: When the game undergoes updates that impact saved data, implement mechanisms to upgrade existing save files to the new data structure.

User Interface

Project: Abyss uses minimal UI to enforce proper immersion into the horror/exploration experience. One of the main sources of UI will be the PC Terminal.

Game Shell

<u>**Menus:**</u>

Astralwater Logo Card - This will be a simple screen with the Astralwater name, which transitions into the Unreal Engine logo upon game start.

Unreal Engine Logo Card - Created with the other logo cards.

Algonquin Logo Card - Created with the other logo cards.

Press Any Key To Continue - Created once all logo cards are completed, accepts player input to continue.

Main Menu - This is created once the player reaches the bottom of the main menu map. There will be a play button, an options buttons, and a quit button.

Host Game - You will be able to host a game server using a steam plugin which another player can join. Once the player joins, a countdown will start to commence the game.

Join Game - You will be able to join any hosted games with a menu as long as your versions of the game are the same.

Pause Menu - The pause menu will not pause the game, but it will open up a menu that says "Resume", "Options", and "Quit".

Options Menu - This options menu will have 4 basic settings.

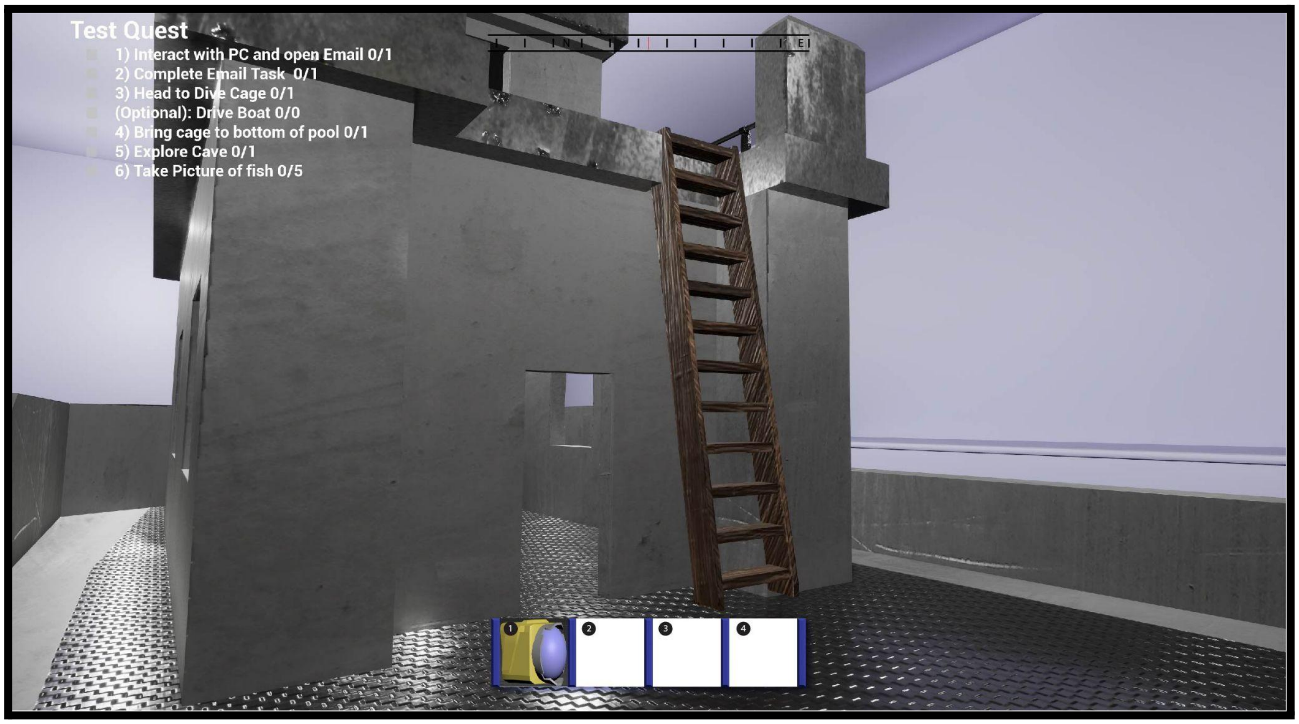
1. Change screen mode - Fullscreen, Windowed, Fullscreen Windowed
2. Graphics - Low, Medium, High, Very High, Ultra
3. Resolution
4. VSync - On/Off

Play Screen

This is a discussion of what is presented to the player during game-play. This includes the depiction of all game elements, as well as other information presented in the game's heads up display (HUD). Any audio and tactile feedback provided should also be discussed. Diagrams should be provided as concept art to illustrate how the game screen appears during play.

Since our UI is mostly diegetic, the player will have a very clean Play Screen.

HUD - What item is currently selected on hotbar, and a compass.



Test Quest

1) Interact with PC and open Email 0/1
2) Complete Email Task 0/1
3) Head to Dive Cage 0/1
(Optional): Drive Boat 0/0
4) Bring cage to bottom of pool 0/1
5) Explore Cave 0/1
6) Take Picture of fish 0/5

Photography Camera UI - When equipped, a border will show the frame of the camera, as well as a focus element. The focus element widget shows up when the camera is facing a valid object in range. It will activate and show a description of the object, and whether it has been discovered before. This will choose the closest valid object.
Damage State - While this is a work in progress, when the player is damaged, a red vignette will appear around the edge of the screen and possibly showing the diver's "Mask" cracking in spots to remain diegetic.

Keyboard Controls:

<u>Player</u>

- WASD = Player movement
  - On solid ground, the player will walk at a normal movement speed.
  - In water, the player's gravity is lowered and the movement is more momentum based to give the illusion of movement in water.
- Mouse Movement = Look direction
  - This Uses a 2D axis to determine the look direction of the camera.
- Spacebar = Jump, Move up (Underwater)
- E = Interact
  - This includes taking control of the PC Terminal, Divebot and Boat objects.
- T/G = Raise/Lower Divecage
  - This will eventually be controlled in the PC Terminal.
- Right-click (Hold) = Aim Photography Camera
- Left-click = Take Picture
- Mouse Scroll Wheel = Zoom Photography Camera In/Out
- P or Esc = Pause

<u>Boat</u>

- W/S = Speed up/Slow down
- A/D = Turn Left/Right
- R = UnPossess Boat

<u>Divebot</u>

- W/S = Move Forward/Backward
- Mouse Movement = Look direction
    - This Uses a 2D axis to determine the look direction of the camera.
- Right-click (Hold) = Aim Photography Camera
- Left-click = Take Picture
- R = UnPossess Divebot

Gamepad Controls (Unfinished and Deprecated):

<u>Player</u>

- Left Thumbstick = Player movement
    - On solid ground, the player will walk at a normal movement speed.
    - In water, the player's gravity is lowered and the movement is more momentum based to give the illusion of movement in water.
- Right Thumbstick = Look direction
    - This Uses a 2D axis to determine the look direction of the camera.
- Bottom Face Button (A for XBOX) = Jump, Move up (Underwater)
- Left Face Button (X for XBOX) = Interact
    - This includes taking control of the PC Terminal, Divebot and Boat objects.
- Top/Right Face Button = Raise/Lower Divecage
    - This will eventually be controlled in the PC Terminal.
- Left Trigger = Aim Photography Camera
- Right Trigger= Take Picture
- Left/Right Shoulder = Zoom Photography Camera In/Out
- Start = Pause

<u>Boat</u>

- Left Thumbstick Y-Axis = Speed up/Slow down
- Left Thumbstick X-Axis = Turn Left/Right
- Left Face Button = UnPossess Boat

<u>Divebot</u>

- Left Thumbstick Y-Axis Up/Down = Move Forward/Backward
- Right Thumbstick = Look direction
    - This Uses a 2D axis to determine the look direction of the camera.
- Left Trigger = Aim Photography Camera
- Right Trigger = Take Picture
- Left Face Button = UnPossess Divebot

Technical Risk

1. **Unfamiliarity with Unreal Engine 5.2.1:** To mitigate, the team will undergo training and engage with Unreal Engine documentation.
2. **Complex AI Behavior:** Regular testing and iterative development will address any issues related to AI behavior.
3. **Performance Issues with Underwater Rendering:** Optimization techniques will be employed, and Unreal Engine's capabilities will be leveraged for efficient rendering.
4. **Limited Depth in Exploration:** Adequate testing will be done to ensure that depth-related mechanics, such as pressure and temperature changes, are realistic and engaging.