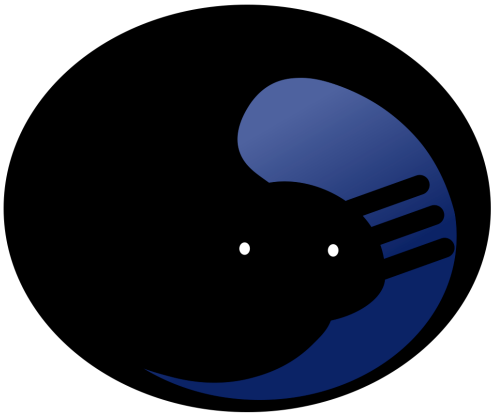
Master in Informatics and Computing Engineering
Faculty of Engineering of the University of Porto

Polymer Reef

Game Design Document



Computer Games Development
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1. Game Overview

1.1. Game Concept

1.1.1. Premise

Embark on an adventure and help an axolotl find his path after his habitat has been destroyed by plastic pollution by exploring reefs and caves, and crossing the vast ocean in search of a new home. You will need to hunt and hide in order to survive, all the while maturing and gaining experience from an unfair environment and a journey triggered by circumstances beyond your control.

1.1.2. Player Motivation

The player will be motivated by the experience of a different narrative and fun gameplay combination that will challenge the player's ability to navigate and explore the mysteries of the underwater world. Direct feedback, constant challenges and clear goals will help us retain the player focus. Besides that, all the game dynamics will have in consideration the Maslow hierarchy of needs, especially moral security and self-realization through morality.

1.2. Features

The game will feature an immersive subaquatic aesthetic that is dark but nonetheless beautiful, contrasting the colorful fauna and flora with the greyer plastic waste. The action will be punctuated with quiet, ethereal sounds to establish ambience, with these becoming louder and with well-defined rhythm in more tense situations.

The game is played from a first-person perspective so that the player can more naturally relate to and bond with the protagonist in light of the challenges they will face. The player will have relative freedom to explore the world, being able to move in all directions, however being limited by natural world borders and the intensity of the pollution of the water in certain places.

1.3. Game Background

Polymer Reef aims to be more than an exploration game and more than entertained adventures, our goal is to transmit to the players a warning about a real world issue: The plastic pollution. Plastic is a substance the earth cannot digest.

1.4. Target Market

Since our game is a form of raising awareness for a global problem in our planet, we plan to target all audiences, not limiting age ranges or genres. However the game will be more appealing for people that enjoy adventure style games, especially explorer type players.

1.5. Genre

This game fits in the serious[1] adventure[2] game genre.

2. Gameplay & Mechanics

2.1. Gameplay

After starting up the game, the opening cinematic sequence segues into the main menu screen. When the player choose Start Game on the menu he starts in a very grungy and dirty environment.

This works as a motto for the player to move and go look for a happier, cleaner region.

The first chapter ensures that the player understands that, and all the game components that are going to be important during all game, namely, player movement, health and energy control, water quality importance.

In chapter two, the player understands how to battle against the loss of health, videlicet through eating worms / or catching power ups.

In chapter three, the player knows the first moving enemy he will have to face and outrun.

Chapter four, brings an all new world into the player eyes, stealth mode is the way here, he has to take advantage of the ground conditions and try to overthink his predator.

Chapter five tests the player reflexes, in a sea of jellyfish he has to try go between them without being electrocuted.

The game ends after all this adventures with a very simple, very beautiful, and very right end, in a clean and food-rich environment the player meets someone from the same species and the last cinematic gets in.

2.1.1. Objectives

The main objective of the game is to find a cleaner place to live.

This objective is then divided in a whole bunch of smaller objectives, which are sparse between the different chapters:

1. Understand the basic game components, find an exit as soon as possible.
2. Understand more advanced game components.
3. Escape from predators by overrun them.
4. Escape from predators by overthink them.
5. Escape the jellyfishes sea
6. Find the mate.

2.1.2. Play Flow

The game flow is given mostly through subtitles but also through intuitive sound, UI, and other game elements.

[1] Game intended to educate the player by promoting, among others: education, social change and health care.

[2] Game in which the player assumes the role of a protagonist in an interactive story driven by exploration and puzzle-solving.

2.2. Mechanics

2.2.1. Physics

Our game has a strong underwater physics control, with the movement rules having in consideration both gravity and water resistance.

2.2.2. Movement

The movement is made with a first person approach.

The direction of the movement is done through the mouse.

The user can move freely on the x axis 360º degrees, and on the y axis around 180º degrees.

The arrow wasd keys are used to accelerate the player, in any given direction.

2.2.3. Objects

During the gameplay the user has to interact with a bunch of objects (power ups, garbage and worms, lights, other axolotes, etc), this interaction is done simply by coming in contact with the object.

2.3. Screen Flow

2.3.1. Screen Flow Chart

Our game's screen flow chart is the following.

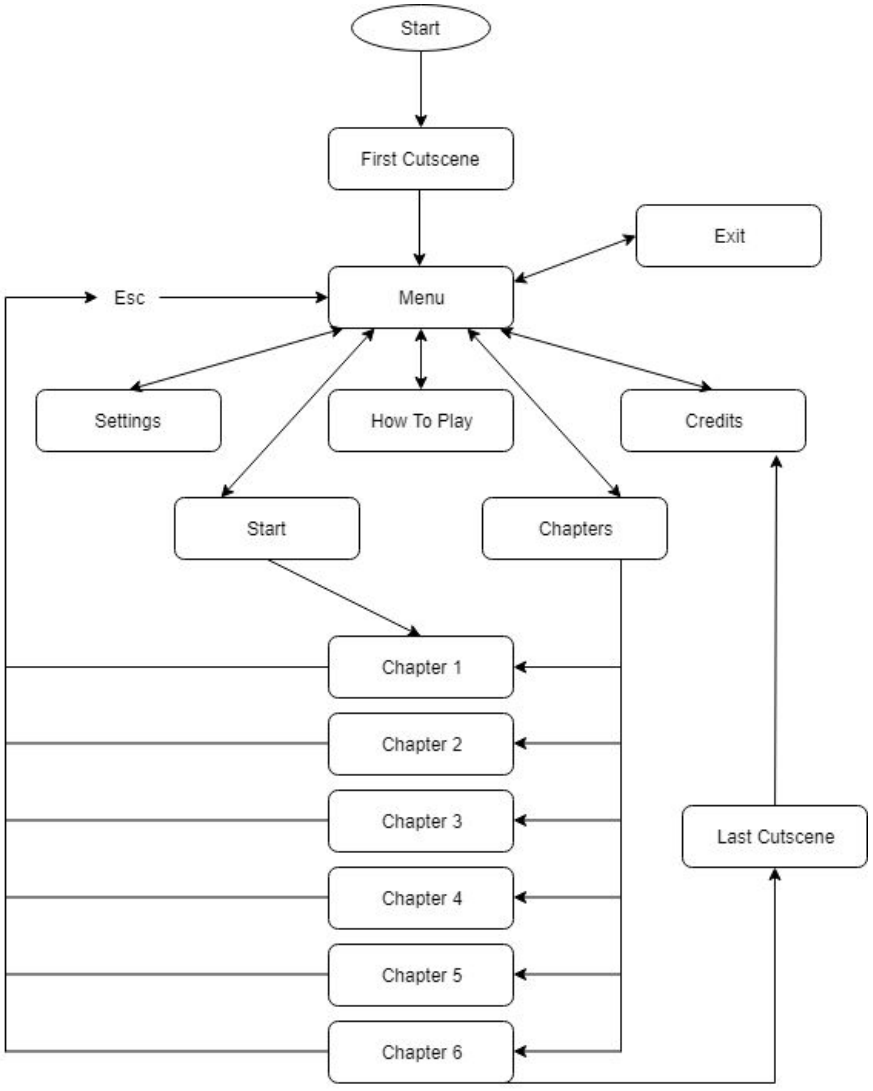

Figure 1: Polymer Reef's Screen Flow Chart

2.3.2. Screen Descriptions

2.3.2.1. First Cutscene

The first cutscene introduces the player to the game backstory and sets where the action will happen. It's where we show the player the consequences of using plastic, like fishes being inside plastic bags and losing their lives to garbage.

2.3.2.2. Menu

The main menu presents the player with a list of primary options available, which are: starting the game itself, opening the chapters menu, opening the settings menu, opening the How To Play menu, opening the credits menu, and exiting the game application.

2.3.2.3. Start

The “Start” button will display a waiting screen while loading the first chapter of the game along with all the necessary game systems, after which it will take the player to the game screen automatically.

2.3.2.4. Chapters

The “Chapters” button will display a secondary menu screen with buttons to load each of the game chapters; all of them act as the “Start” button, but instead load the respective chapter.

2.3.2.5. Settings

The “Settings” button will display a secondary menu screen with options to change some settings of the game systems, such as audio volume and display subtitles.

2.3.2.6. How To Play

The “How To Play” button will display a secondary menu screen with explanations of the game possible inputs and respective actions.

2.3.2.7. Credits

The “Credits” button will display a secondary menu screen presenting the list of people who developed the game and in general contributed for its creation, grouping them by the area in which they worked.

2.3.2.8. Last Cutscene

The last cutscene plays once the player gets to the end of chapter 6, which concludes the story, and after which it takes the player back to the main menu.

2.3.2.9. Exit

The “Exit” button will shut down game systems and close the application.

2.4. PowerUps

2.4.1. Light Particle

Impact: Increases energy stat in 50%
Locations: You can find it on levels 1, 4, 6
Use scenarios: Low light regions, long distances

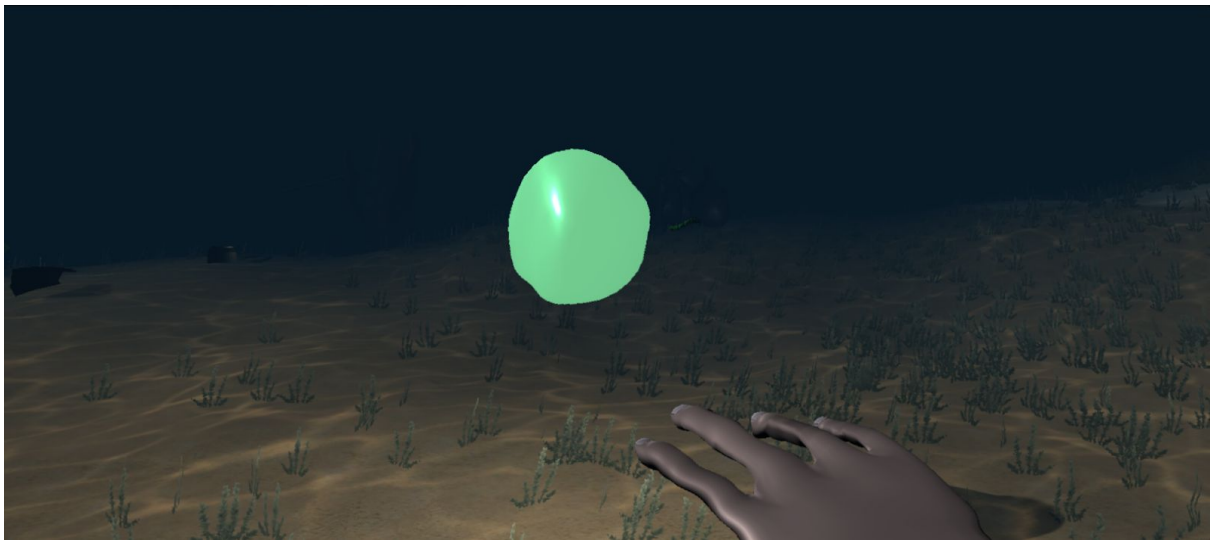

Figure 2: A light particle

2.4.2. Energy

Impact: Increases energy stat in 25%
Locations: You can find it on levels 3, 4
Use scenarios: Low light regions, short distances

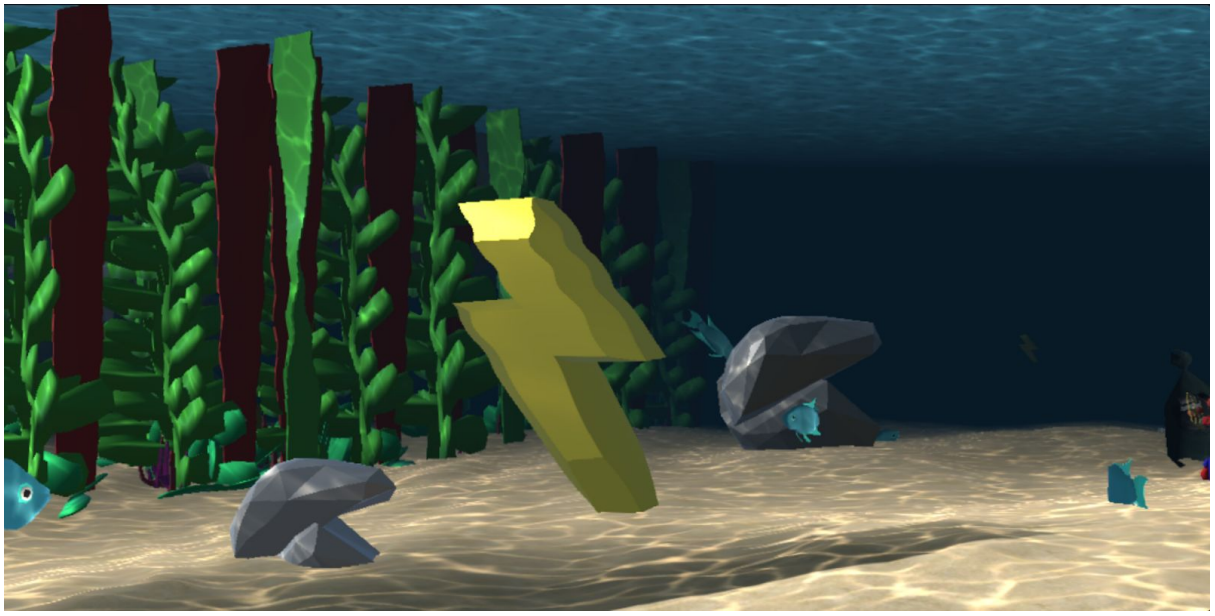

Figure 3: A speed particle

2.4.3. Health

Impact: Increases health stat in 50%
Locations: You can find it on levels 2, 3, 4, 5
Use scenarios: Low water quality regions, regions with predators

Figure 4: The health power-up

2.4.4. Speed

Impact: Increases speed stat in 150%
Locations: You can find it on levels 3, 4, 5
Use scenarios: Regions with predators

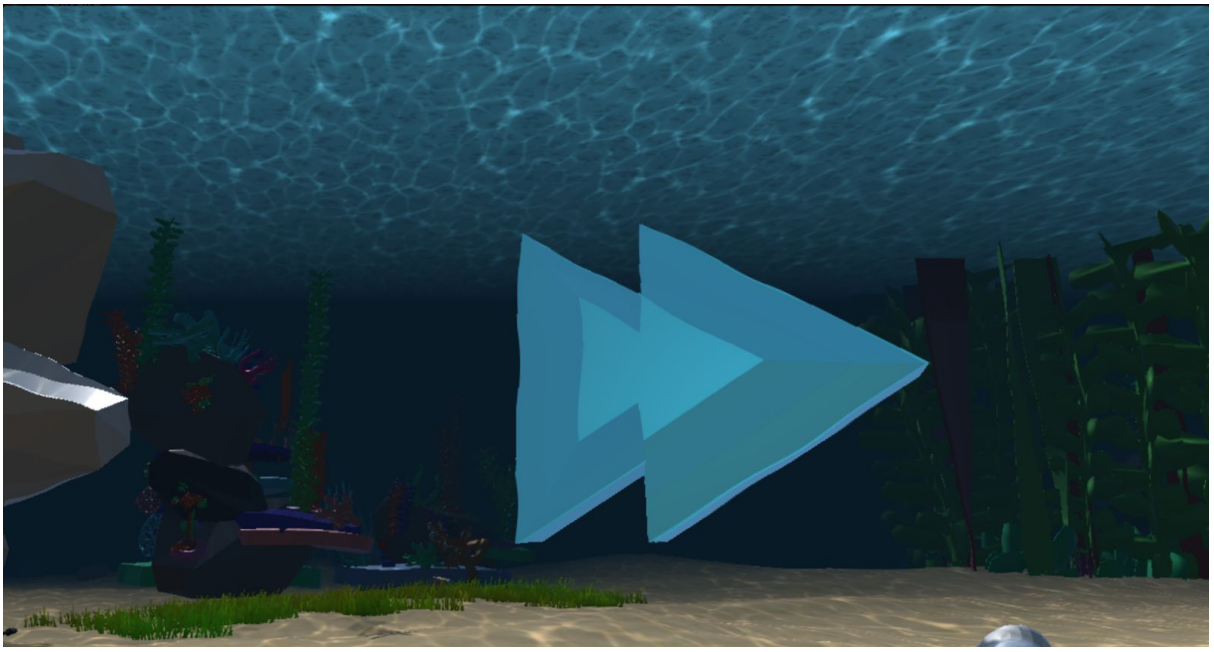

Figure 5: The speed power-up

2.5. Game HUD

The game HUD is composed of four elements: the health, energy and water quality bar and the subtitles; as seen in the figure below.

Figure 6: Player HUD

All the three aforementioned bars can be seen in the top left corner, the health bar is the largest and perhaps the most important one, it indicates the player's current health (further explained in the next section) and once if it becomes empty, the player loses the game. Directly above the health bar, the water quality bar can be seen; it indicates the quality of the water in the player's current position. Water quality is inherent to the level but it can affect the player's health either negatively or positively as described in the next section. The energy bar can be seen next to the water quality bar and it indicates the amount of energy the player still has (energy is further explored in the next section).

Lastly, the subtitles can be seen at the center of the bottom of the display. Subtitles are used to guide players throughout the game and early on they also serve as a guide, explaining game mechanics and controls to the players.

2.6. Players and Stats

This game is a single player game and the player's stats are: speed, health and energy.

2.6.1. Speed

The speed stat defines the player's movement speed and can be temporarily augmented by consuming the speed power-up. This speed increases up to 1.5x, however it decreases in rapid successions afterwards.

2.6.2. Health

Health is the most complex stat, as it is influenced by several factors that can have negative or positive impacts.

Factors with a negative impact on health are trash and hunger; eating trash greatly reduces the player's health and hunger is manifested in a constant health loss, as a way to encourage the player to find and eat food. The opposite impact can be attained by eating worms and consuming the health power-up; although worms don't give as much health as the power-up, they both instantly improve the player's health.

Water quality can both have a positive, negative or neutral influence on health; when water quality is above 80, the player gains health based on the percentage (but this gain might not be observable because the player is still affected by hunger), between 60 and 80, water quality has no influence over the player's health and below 60, water quality, has a negative impact on health (this impact increases as water quality decreases).

If the player's health decreases to 0, the game ends and the menu is reloaded. A message displaying "You had no health" appears on the screen, warning the user to be more careful next time.

2.6.3. Energy

The energy stat can only be influenced positively by consuming power ups like energy and light particles, (greatly recuperating player's energy) and decreases at a constant rate when the player's lights are turned on.

2.7. NPCS

The world contains multiple NPC's, all of them being fish. While navigating each chapter, the player can encounter normal fish, doctorfish, paradise fish, jellyfish, worms (that the axolotl can eat to increase its health) and scary predators (showed in topic 3.3.3) like morays and zebrafish. In the last level, there's also another axolotl.

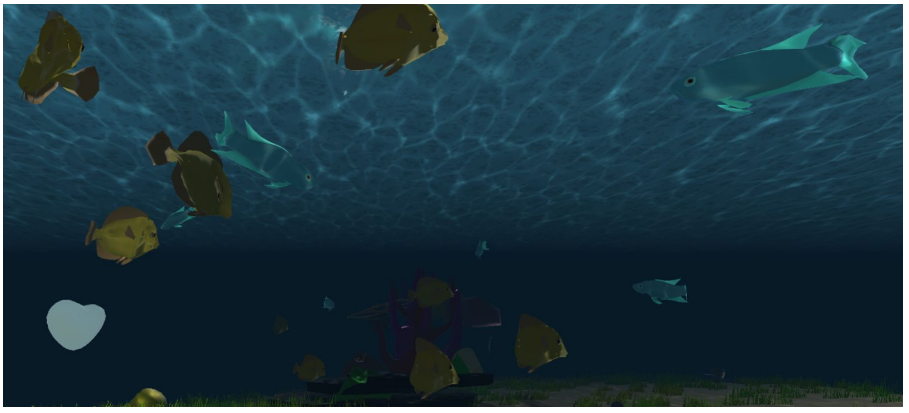

Figure 7: A school of doctorfish and normal fish

Figure 8: A worm and a school of paradise fish

3. Story Bible

3.1. Story and Narrative

The story of the game begins with a small axolotl underwater, with lots of pollution and trash around it. When exploring the world it is evident that to survive he has to look for a less harmful habitat. In the beginning the path is indicated by particles of light that he instinctively picks up and with this energy manages to illuminate its path. He sees the fish fleeing and follows them.

Slowly the pollution begins to diminish and a new world is revealed to the small axolotl: it finds food and some aid in its path, as well as other fish around him. Though, of course this is not easy, and he is forced to flee from ferocious fish and hide in dark places. After overcoming this challenge, he is faced with an adverse sea of jellyfish prepared to attack the player. The latter finds himself obliged to sneak nimbly between them in order to advance in his course. At last he finds his promised land, clean and full of life. This place is the ideal place to start over and where you know someone of your kind with whom to share your life. However, time passes and this time is the couple's new child that lost his parents to the plastic, starting the cycle all over again.

3.2. Game World

Our story is told in a open-world map, meaning the main character can go where he wants. He can go back and forth in any level, with no need of any loading screen or waiting time. Despite this, our levels aren't all loaded at once.

Because of the amount of assets and objects that each level has, we developed a script that loads a chapter when the player is in the previous one. After passing to the next level, the previous one is unloaded. This facilitated decreasing the frame rate and ensures that the player doesn't suffer from lagging.

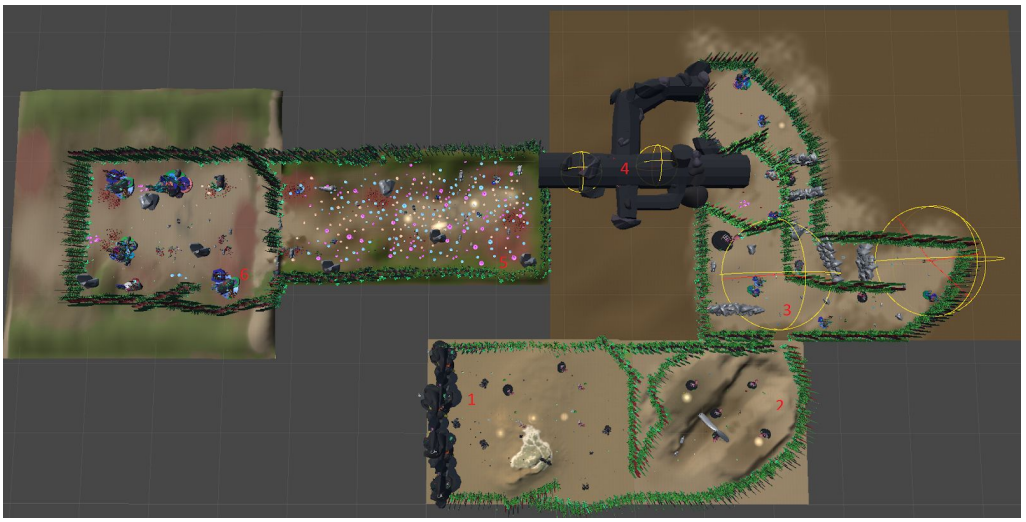

Figure 9: The game's world and levels

3.3. Characters

3.3.1. Axolotl

- **Back Story:** The axolotl loses its parents due to pollution.
- **Personality:** Unsafe and more fragile of having to abandon his habitat and losing his parents, but brave and ready to embark on a new adventure.
- **Appearance:** Typical appearance of axolotl in nature, with lights in his head. However the user can only see his paws.
- **Abilities:** It has the ability to emit light when it has the energy needed for it and gain speed when catching the speed power-up.
- **Relevance to the story:** Main character.
- **Relationship:** This character's relationships are essentially with the parents at the beginning and end when they find their mate. The remaining relationships are to flee or avoid enemies.

3.3.2. NPC's Characters

a. Predators

The mysterious predators **Moray** and **Zebrafish**, presented in Chapters #3 and #4, can "detect" the axolotl, when he is near them, and will chase him down. If the player gets eaten by them, the game ends.

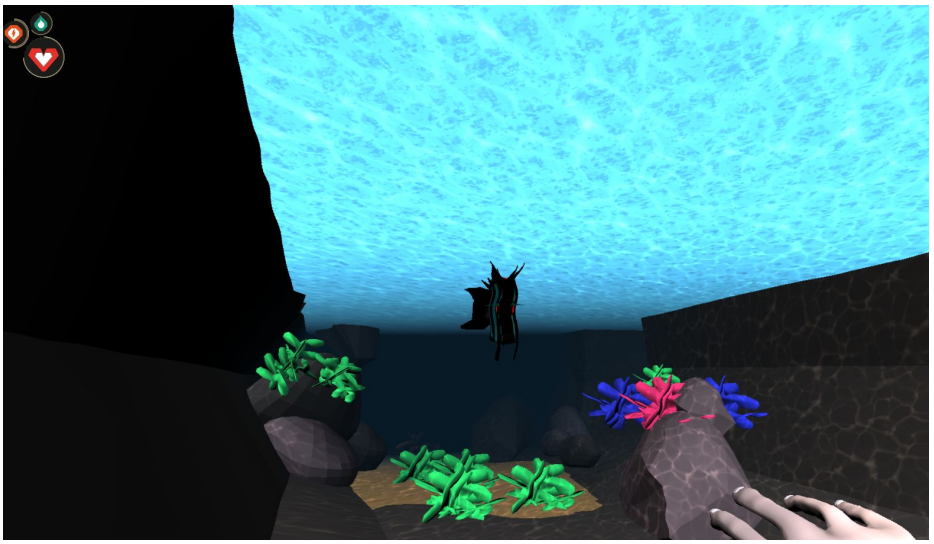

Figure 10: A zebrafish hunting the player

The **Jellyfishes** are colored and with different temperaments (movements). Although they do not want to hurt the main player, their tentacles, when touched electrify our character causing damage. No more relevant information about these characters is given.

b. Others

The parents and the partner appear only at the beginning and at the end, respectively, to contextualize the story. The shoal of doctorfishes that appears in chapter 1 are fleeing and indicate to the axolotl the direction it should take. The various other fishes that appear throughout the game, except those present in chapter #1, are harmless and serve only as an environment. No extra information is given about these characters.

4. Game Level Design

4.1. Chapter #1

The first chapter of our game is an introduction to the world and how the player must face the consequences of a sea full of plastic. A cutscene appears first, showing a fish trapped in a plastic bag and the player losing his parents to plastic rings.

In this level, the player learns the consequences of a dark ambient and how he must chase the light particles to increase the illumination. The user also learns the controls (move, look around and turn the lights on and off).

The level design was mainly created to show the ocean filled with garbage and trash, and to pass a message to the players that this is already happening in real life and what could happen in other parts of the oceans as well.

The level contains a huge trash wall, with reefs full of plastic and garbage, trash falling down to the sand and little plastic objects around like cans, plastic bags and straws. The player can see fish trying to abandon the area in search of a better place. The goal is to chase the fish and find the exit to the next level.

Figure 11: The trash wall

4.2. Chapter #2

The second chapter of the game intends to reinforce the problematic conflict of plastic pollution by presenting a different challenge: finding food. In this level the player is introduced to the mechanics of eating whilst being taught the different results that can come from consuming power ups and eating worms or trash.

Throughout the level, trash can be seen on several places, almost as if it is blending with the ecosystem. It can even be seen being eaten by other fish.

The level was designed to be a small valley with two large boulders forming a sort of bridge, meant to look as if the whole zone had been the same for a long time, until it was flooded with garbage and is now deteriorating.

Figure 12: Fish eating trash

4.3. Chapter #3

The third chapter of the game consists of surviving an encounter with predators. In this level the player is being chased by multiple predators, and the objective is to swim away

from them by going through multiple stone walls with small openings in order to break line of sight with the predators and escaping without being attacked.

The player also learns that the speed boost helps him increase the distance between him and the predator, for a moment. By learning this, the player can use the speed power-ups later, when facing other predators.

The level design was inspired by a normal course, with obstacles and ways to escape or hide from predators. Despite having less garbage than the previous chapters, it still contains some plastic trash around the area.

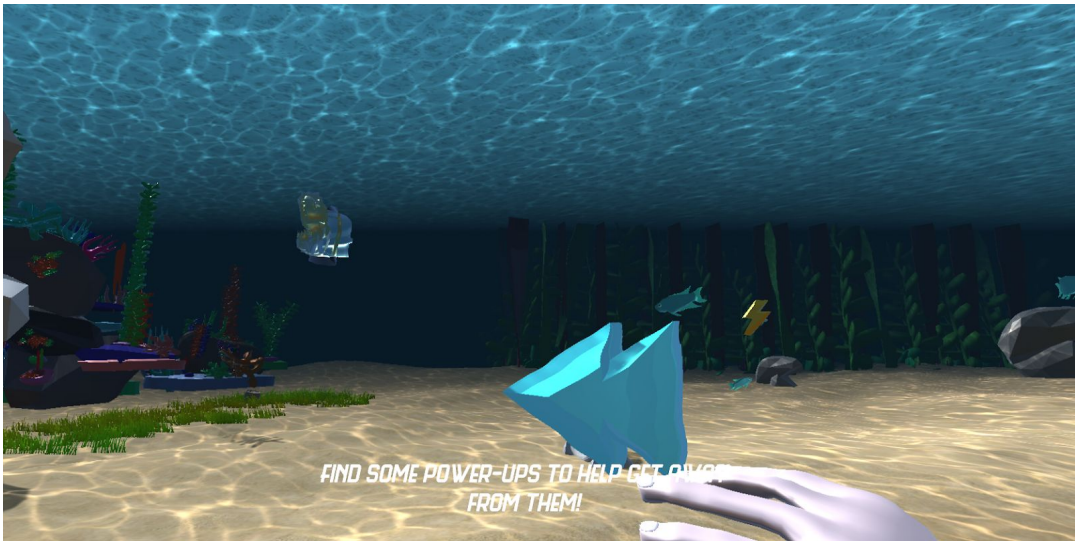

Figure 13: The moray predator and the speed power-up

4.4. Chapter #4

The fourth chapter of the story is placed on a much different map, in relation to the other levels. The user starts inside of a cave, where he learns that there are new and mysterious predators lurking around. The player learns that he must first go to the left, by going through a secret passage inside the cave. There are speed power-ups available to use in the cave, and the player needs to catch them to escape the zebrafish.

By going to the left, he will find a secret area, containing fish and various power-ups, including health and energy. With this, he will be ready to escape the cave, through the other path on the right.

The cave was mostly created by our designer, and can be seen as a small maze. We placed a secret area, where the player can see it in the third level, so he can see the power-ups and surprises inside it.

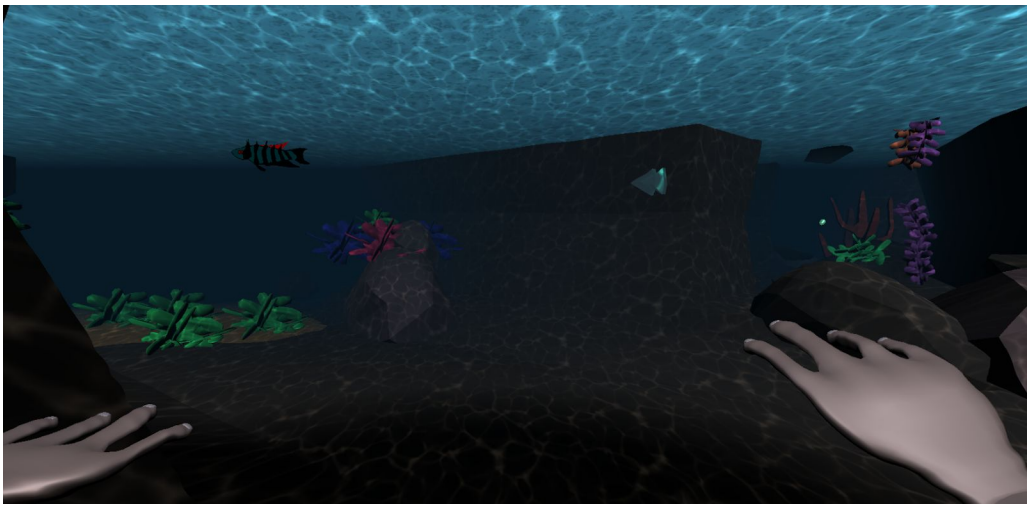

Figure 14: The zebrafish predator inside the cave

4.5. Chapter #5

This chapter presents a much cleaner scenario in relation to the beginning and with almost no pollution, which conveys the sensation of the adventure being almost to the end.

However, it introduces a new challenge to the player since it is imposed that he has to cross a sea of jellyfish to get to his destination. The jellyfish are moving randomly, forming a maze that the user will have to struggle to decipher successfully, since the contact with them diminishes the life of the axolotl and there are few power-ups along the way.

We also ensure the player goes to the middle of the level, by decreasing the water quality on its sides. Since there are more jellyfish in the middle, the axolotl is going to face a harder and more complex challenge.

The continual decline of jellyfishes denounce the end of this chapter and the passage to the next.

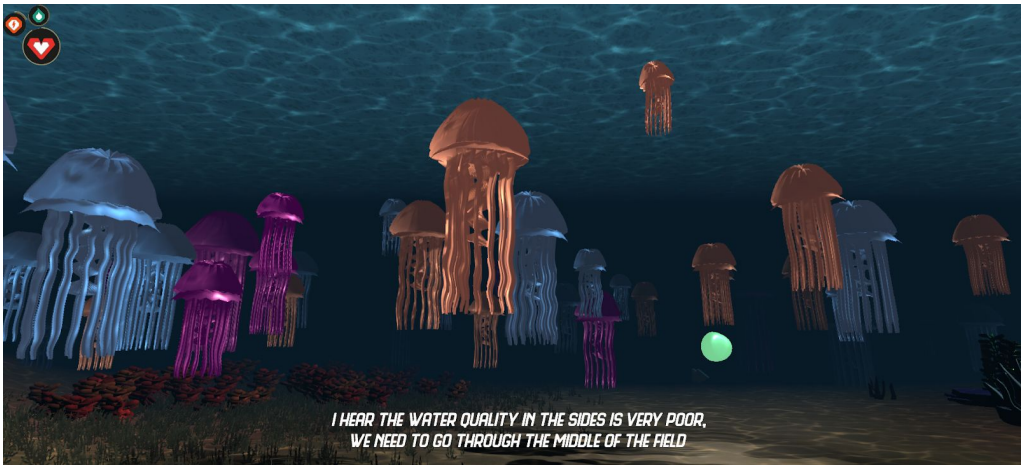

Figure 15: The sea of jellyfishes

4.6. Chapter #6

This is the final chapter, after all the aforementioned adventures, this level accumulates all the game emotions and history here on this point. The objective is to encounter the player mate, the map is compound with the most beautiful assets you will find on the game, and a considerable amount of worms (food).

The difficulty of the level is intentionally very low, there are no significant threats here (apart from a very few jellyfish).

When the encounter finally occurs the last cinematic gets in and the game ends.

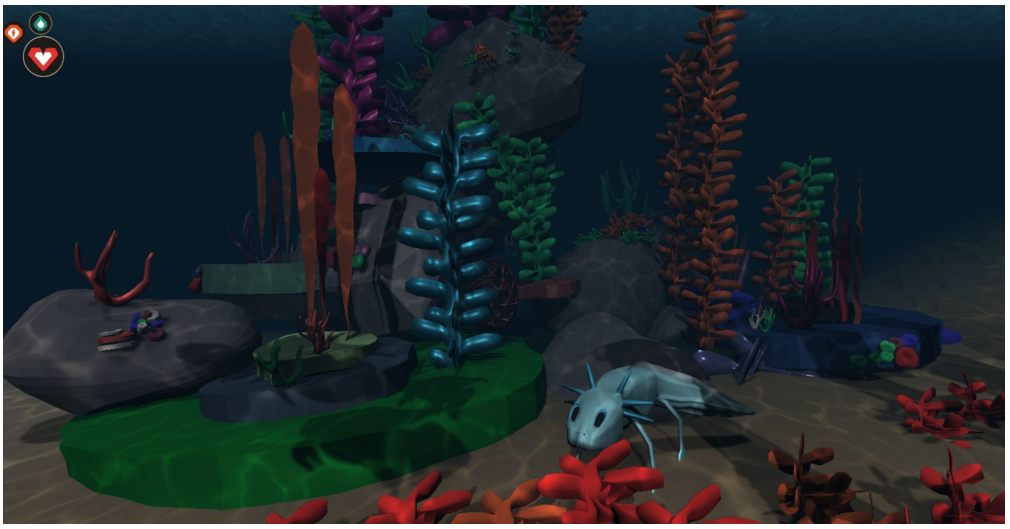

Figure 16: The partner axolotl and the final reef.

5. Game Engine

5.1. Technology Used

During development of the game three main technologies were used, the game engine Unity, the sound effects software FMOD and the 3D computer graphics software toolset Blender.

Unity was used for creating the game logic, level design and integrate all audio and visual assets. We also had to create some textures and materials with the help of our designer in Unity, since only a few textures came correctly after importing from Blender. This was the main platform for the game.

FMOD was used for the sound design, to create sound events that are called in the game scripts.

Blender was used to model all 3D assets (environment, collectibles, characters) as well as animating some of these assets.

5.2. Scene Management

Each chapter is kept on a separate scene. Scenes are loaded dynamically at certain points of each chapter, with the help of triggers. The one behind the player is unloaded and the one the player is moving towards is loaded, ensuring there are never too many scenes loaded at the same time.

The scene handlers are also loaded at the border of two scenes, again with the help of triggers.

5.3. Collision Detection and Interaction

For collision detection, the Unity Collider component, available in the Unity scripting API, is used. This component is used for both collisions and triggers, meaning the collision is detected but the objects can still intersect, for features such as water quality changes and initiating scene loading.

The player can also interact with power ups, food and trash, once an intersection is detected between the player and the collectible, the collectible disappears and, according to the type of collectible, some action is triggered in the player.

The collision also helped with borders and walls, as well as other fish, rocks, caves, reefs and plants, to ensure that the player doesn't pass inside it.

5.4. Terrain

For the bottom of the ocean, we used the Unity Terrain Engine. This engine provided us with multiple tools to create each scene's floor quickly and easily.

5.5. Visual Effects

Visual effects used, such as the fog effect and the underwater look are free visual effects available on the Unity asset store. We had to learn how to integrate the fog with the player and we managed to do it, by using it as a dark ambient to the game. When the lights are running out, the fog will become more intense and closer to the player.

5.6. Delivery Platform

The game is available in Windows, Mac and Linux.

6. Art Style Guide

We placed in the links file, a reference to the folder that our designer Maria Isabel Quaresma made for the Art Concept, and a link to the design report as well.. This folder contains multiple game screenshots and for each asset created, using Blender, its respective blender file and a small video showing it.

We also would like to give a special thanks to Maria Isabel Quaresma, for working everyday, creating multiple and beautiful assets, despite being alone. We faced various issues in Unity like not being able to import materials and textures, and we helped each other adapting each asset from Blender to Unity.

The list of assets, including animations and materials, created by her are the following:

- Axolotls (main player, parents, partner and child);
- Fishes (normal fishes, doctorfishes and paradise fishes);
- Predators (morays, zebrafishes and jellyfishes);
- Different colored worms;
- Multiple Reefs, plants and rocks;

- Trash (plastic and rotten bags, cans, cups and straws, usb cables and a huge trash wall);
- Power-Ups (energy, health, speed and light particles);
- A huge cave that served as the map for level 4;
- The HUD and Logo of the game.

7. AI

7.1. Predator

To check if a predator can see the player, the script checks the following: We first ensure that the player is within the view radius and view angle of the predator; then we cast a RayCast in the direction of the player to check if the view is being obstructed by any objects.

When a predator sees the player he chases him, and when he doesn't see the player he roams around randomly within a given radius.

If the predator catches the player, the game ends and the menu is reloaded. A message displaying "You got caught by the predator" appears on the screen, warning the user to be more careful next time.

Figure 17: The view radius of the predator

7.2. Fishes

For the fishes, we used two different scripts. The first, used in the first chapter, allows the fishes to navigate in any direction, by creating one or multiple waypoints.

The second is for the fishes to roam around randomly to any position inside of a box area. The fish are spawned when the level is loaded, and we created multiple waypoints for the fish to swim to, inside the area.

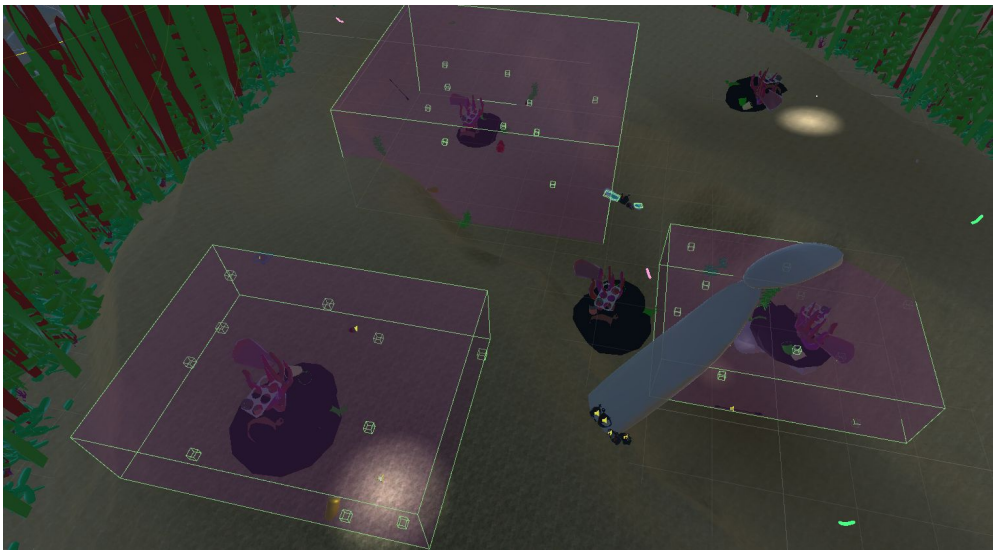

Figure 18: An example of an area where the fish are spawned with waypoints (small cubes)

7.3. Jellyfish

The jellyfish follow a slightly different movement than the other fish. They only move vertically, up and down randomly. When they reach the maximum or minimum value, they move the other way.

8. Sound

We placed in the links file, a reference to the report that our sound artists Bruno Boaro, Gabriela Ferreira and Ivo Amaro created, with the assets created, and the concept that they use for the development of the sounds.

This sounds were created using FMOD Studio, and here is the list of the music and audio used in the game:

- The main theme of the game, used in chapters 1, 2, 5 and 6;
- The predator theme, used in chapters 3 and 4;
- The fishes theme, used when a player passes through some fishes, also serving as the main theme for the menu;
- The axolotl's sound, heard in successions of 10 to 20 seconds, throughout the chapters;
- Two sounds to turn on and off the lights of the player;
- A sound to catch light particles;
- A sound to catch energy, health and speed power-ups;
- A sound to eat worms;
- A sound when the player eats trash;
- A sound when the trash falls in the sand;
- A sound when the player health is low;
- A sound when the player touches the jellyfishes;
- A sound when the player is catched by the predator.

9. Interface

The interface was created with simplicity and intuitiveness in mind, with a reduced set of inputs while still retaining interesting gameplay mechanics, and a minimalist menu design.

9.1. Visual System

The game features responsive menus, with a sleek design, that adapt to various screen sizes. Most primary options are contained in the first menu, which is presented when the application is started, after a short cutscene.

Figure 19: The main menu

The remaining menus employ a similar design. All subtitles, cutscenes and menu animations can be skipped. In the game screen, the HUD is confined to its upper left corner and displays all the relevant information while occupying the least amount of space possible.

9.2. Control System

The game is designed to be played with keyboard and mouse: with the keyboard the player can control the movement of the character on the horizontal plane as well as the emission of light by the character into its surroundings, which is a characteristic of its species in the game universe; the mouse controls the direction the character is facing, as well as the depth at which is moving, that is, by looking down while moving, the player can increase their depth.

9.3. Help System

To help the player understand some of the more immediate goals of a particular area of the game, hints are presented under the form of subtitles, giving suggestions to the player to look out for specific items in the world, or simply echoing the thoughts of the character when confronted with a particular scene.

10. Project plan

Our plan started by sorting out ideas about what our game should be and have. After long discussions and planning in the first meetings we organized between ourselves what each other would do. We started by developing the mechanics, dividing the tasks among ourselves.

In the middle weeks, the models, animations and sounds began being integrated in the game. Despite some difficulties integrating everything on Unity, we managed to work it all between each team and all the assets were fully integrated in the application.

In the end, we focused more on creating and developing the scenes, the menu and joining everything together, as well creating trailers and beautiful scenarios for the demonstration.

On the final week, we tried to fix all the bugs and improve each level, to increase the user's experience. The following chart shows our planning for all 13 weeks of developing our game.

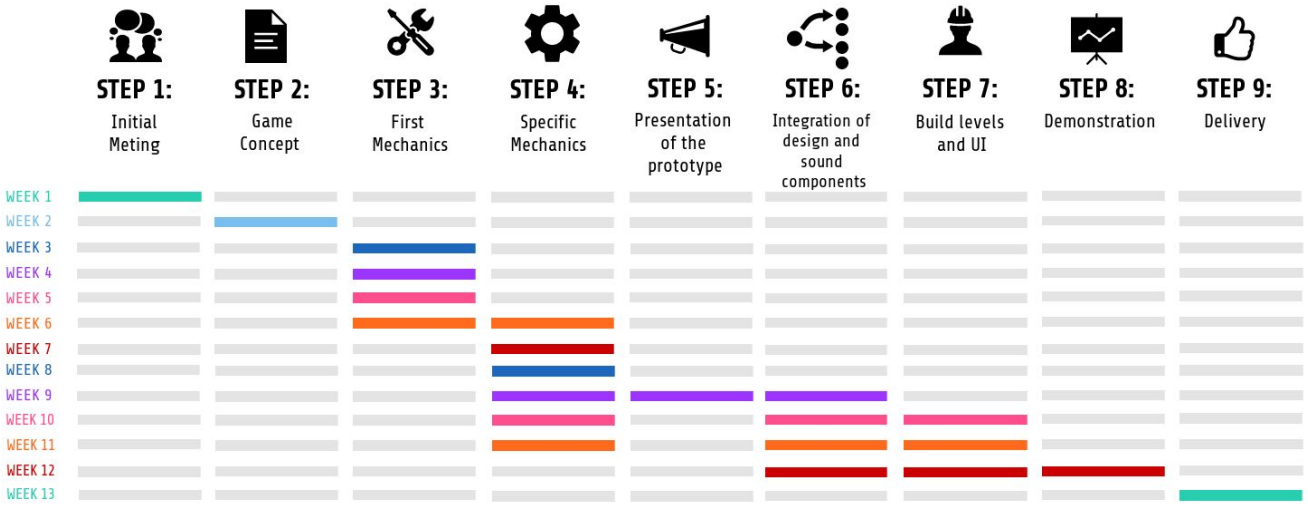

Figure 20: Project plan chart

11. Resource plan, budget, schedule and milestones

In the beginning of the development process we implemented the core features and mechanics of the game (player movement, fish, jellyfish, underwater aspect, collectables, predator AI, and more). Then we started combining everything we had done with the design team, and the sound team. We created a scene that included everything we had done for testing, and for an intermediate presentation.

After the feedback received we changed what was necessary and started creating each scene separately. We tested the final result of each scene and combined them to see what the user experience was like. At this point we were pleased with the result and the development process was finished.

Despite the budget for our project being 0€, we believed we developed an enjoying experience with beautiful scenery and an important message to the users playing our game.

12. Test plan

We used alpha testing for our game, with the help of our colleagues in FEUP, as well as friends and family. Despite having some bugs in the beginning, we were able to fix them and the feedback was considerably positive.

13. Videos

We created a demo for the game, showing all the chapters, the interface, main mechanics, assets and sounds. The link of the video can be found in the links file.

We also placed in the links file, the link to the trailer, used on the presentation.