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1. Introduction

1.1 Presentation

The 'Divers' team comprises six students from various nations with diverse academic backgrounds. Brought together at ISEP to participate in the EPS, our objective is to leverage our collective skills to develop a sustainable solution for a real-world challenge.

Table 1: Divers team

Name	Country	Field of Study
Hernán Nieto Marabini	Spain	Biomedical Engineering
Chaehee Kim	South Korea	Industrial Engineering
Ida Schmitt	Germany	Interactive Media
Isak Björk	Finland	Electrical Engineering & Automation
Louis Van Nederkassel	Belgium	Product Development
Oda Kristine Johansen Fossvoll	Norway	Information Technology

1.2 Motivation

The motivation for this project is based on the growing concern about the degradation of marine ecosystems and the decline of natural reef habitats. Coral reefs and other complex seabed structures provide important habitats for many marine species, including fish, invertebrates, and algae. However, many of these ecosystems are currently under pressure due to factors such as climate change, pollution, overfishing, and habitat destruction.

Artificial reefs have been proposed as one possible approach to support marine biodiversity and help restore degraded habitats. By creating structures that mimic the complexity of natural reef environments, artificial reefs may provide shelter, feeding areas, and breeding grounds for marine organisms. Understanding how different materials and structural designs influence these habitats is therefore an important topic in marine environmental research.

1.3 Product

The idea of this project is to create a marine habitat for underwater enviroments, in order to promote the live of the diferent species that habit the the seabed of the coastal plate. Since this is the environment of many endangered species and its a global problem, our goal is to improve this situation while monitoring the characteristics that may affect this danger that threat the sea life.

For this project, we have thought of an structure made to sit in the sea floor, with the purpose of being colonized by many aquatic species to use it as a shelter where to follow their natural way of living. This intends to recreate a natural environment, and ir order to get that we need to review the most suitable material, as well as the best designs for the viability of the project.

To fulfill the task of monitoring the conditions, we have to research about the sensors that can take that job properly, and an organizational model that allow as to get information we need, without disturbing the environment and complying with all regulations.

Finally, our final target it is to create social awareness, the amount of trouble is going under the sea it is a big problem, and most of the people doesn't even know about it. With all the information we can recolect, the best chance is not only with the science or research, it is to concern people about the biggest resource on earth, the sea.

1.4 Problem

The basis for develop this idea starts on a global view of a huge environmental problem, the sea is dying. The causes of this problem are multiple; the global warming is raising not only the level of the oceans but the temperature of them. This is alterating the conditions of most of the underwater eco-systems, and this evolves in multiple species having to migrate from their original enviroments to new ones.

Another big problem is the massive fishing made by human hands. All around the wolrd, fishing is a daily practice, and even it is strongly regulated by governments and various institutions, it has affected the natural cycle of the sea-life. Now it has become a huge problem, since a lot of fish species are being depleted and others are being affected by the food chain, every creature in the sea is in danger.

The third big issue going on, concerns the levels of oxygen in the sea. With most of the fauna being altered, the flora is also damaged, the Great Barrier Reef and other coral reefs responsible of producing between 60 % and 80 % of the oxygen we breath, are rapidly dying, already more than 50 % of it has died in the last decades, so a global problem is incoming, and it is our job to do the possible to solve it.

1.5 Objectives

This project focuses on developing a sustainable and technically feasible solution to remediate the loss of seafloor habitats. Our goal is to counteract current environmental decline by providing artificial structures that serve as refugia for marine life, thereby enhancing biodiversity and population recovery.

More specifically, the objectives are:

1. Create an appropiate structure for life to happen: This is one of the most challenging objectives, as creating a marine habitat that marine life accepts and colonizes appropriately will undoubtedly be a lengthy process. Understanding how life underwater functions—which shapes, textures, materials, and processes are best accepted by different species—is as complex as life itself. Therefore, constant adaptation will be the core mindset throughout the entire process.
2. Ensure the sustainability without life disturbance: Accomplishing everything mentioned above sounds great, but the critical factor for life to thrive in a way that mimics natural flow is to minimize human or robotic interactions and disturbances in the environment. Therefore, ensuring total naturalness will also be of vital importance.
3. Recolect information from this habitats to improve them: Although the project generates a clear positive impact on society, it must provide a way to measure that benefit. This will be achieved through data collected by sensors that we will implement according to specific needs. This information will also be used to improve and pave the way for better models of our project.
4. Create social awareness about the situation and the urge for a solution: Making people realize the scale of the problem we face is a major step forward; in this way, we will no longer be

fighting a constant uphill battle. The goal is to encourage everyone to do their part in improving the state of the sea so that, in the future, these artificial habitats are no longer necessary. However, all of this begins by alerting the public and making them aware of the severe risks involved.

1.6 Requirements

1.6.1 Functional Requirements

The system must collect and transmit real-time environmental data (e.g., water temperature, pH levels, turbidity) using sensors at pre-defined intervals.

A reliable wireless communication protocol must be established to send data to a cloud-based dashboard for real-time analysis.

The solution must incorporate energy-harvesting mechanisms (such as solar or wave energy) and utilize Deep Sleep modes to ensure continuous operation without external power.

The structure must provide complex cavities and textured surfaces, specifically designed to encourage the settlement of local marine species **[1]**, **[2]**.

1.6.2 Non-Functional Requirements

To avoid failures observed in projects such as Osborne Reef, the structure must be composed of pH-neutral, non-toxic, and eco-friendly materials that do not release harmful substances into the marine environment **[3]**, **[4]**.

The habitat must be designed to withstand high currents and storm surges without displacement or structural failure.

All electronic components, including sensors and batteries, must be enclosed in IP68-rated waterproof housing to resist saltwater corrosion **[5]**, **[6]**.

The design should allow for modular expansion and easy access for sensor or battery replacement if necessary.

Tests

Report Structure

Chapter	Description
1. Introduction	Brief comments about the project proposal
2. Background and related work	Previous similar projects with commmon useful knowledge
3. Project management	Distribution and important aspects about the project itself

Chapter	Description
4. Marketing plan	Analysis of the market and economical feasiblity
5. Eco-efficiency Measures for Sustainability	Sustainable responsabilities in diferent aspects
6. Ethical and Deontological Concerns	Diferent ethical points of view for our project
7. Project development	Evolution from the design to the prototype
8. Conclusions	Final ideas of the outcomes achieved and next steps
9. Acknoledgements	...
10. Bibliography	Information sources

[1] Nicholas A. J. Graham, Kirsty L. Nash, 2013. The importance of structural complexity in coral reef ecosystems. *Coral Reefs*, 32, pp.315–326.
[2] PHAROS Project, 2024. *Artificial Reefs.*
[3] Florida Department of Environmental Protection, 2024. *Osborne Reef Waste Tire Removal Project.*
[4] Artificial reef preparation
[5] Tao Yu Vivian W.Y. Tam Wenkui Dong Wengui Li Fulin Qu, 2021. Durability deterioration of concrete under marine environment from material to structure: A critical review. *Journal of Building Engineering*, 35, pp.102074, ISSN 2352-7102.
[6] Polycase, 2020. *IP68 Waterproof Rating.*