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Abstract

Hosted by the Instituto Superior de Engenharia do Porto (ISEP), the European Project Semester (EPS) program facilitates an interdisciplinary environment for engineering students of diverse nationalities. The projects serve as a multidisciplinary platform for the joint acquisition and application of technical skills, specifically oriented toward the lifecycle of a proof-of-concept prototype, from initial design to rigorous testing.

The ongoing degradation of marine ecosystems due to climate change and anthropogenic pressures has severely reduced natural underwater habitats. Traditional artificial reefs offer structural restoration but typically lack active environmental monitoring capabilities. To address this limitation, this paper presents Maris Habitats, an innovative smart modular reef system developed within the European Project Semester (EPS) framework at ISEP in 2026.

The proposed solution integrates stackable Reef Modules made of basalt fiber-reinforced concrete with a removable Smart Module. The Smart Module consists of a Smartlogger and a Smartlogger attachment. The Smartlogger contains the sensors, battery, SD card, and electronic components needed for local environmental data logging. Throughout the development process, a robust theoretical framework was established, positioning the project at the forefront of ethical design and sustainability.

Significant technical challenges were encountered and mitigated, including managing multiple design iterations, navigating a steep learning curve through external expert consultations, and overcoming the inherent complexities of prototyping. Experimental testing of a downscaled prototype validated the core operational logic and structural integration. Future developments will focus on pilot tests and academic conferences to collect empirical data, establishing credibility before initiating institutional or commercial agreements, with the long-term goal of global oceanic deployment.

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