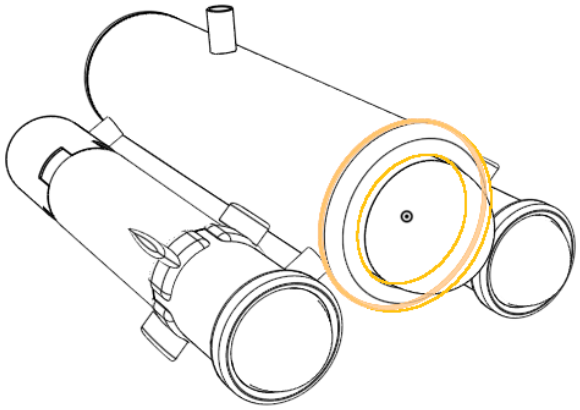
project

ROV-E



By

ENTA CPROB
CLUBE DE PROGRAMAÇÃO && ROBÓTICA

ENTA
ESCOLA DE NOVAS TECNOLOGIAS DOS AÇORES

Azores - 2023/24

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Introduction

The Azores

The Azores, located in the North Atlantic, have a unique geographical position that makes them an important place for the study of the oceans.

Due to its location, the Azores region is affected by a variety of marine currents, including the Gulf Stream, Labrador Current and North Current. These currents bring warm and cold waters to the region, creating a diversity of marine environments and unique ecosystems. In addition, the Azores region is known for its volcanic activity and underwater earthquakes, which results in a large amount of

underwater hydrothermal vents. These environments are important for the study of marine biodiversity and the evolution of life on Earth.

Another reason why the Azorean seas are important is because of their position in the middle of the migratory path of several species of fish and marine animals, including whales, dolphins and sea turtles. This makes the Azores region an important location for monitoring and protecting populations of these species. Furthermore, the Azores region is important to the local economy, with fishing and tourism being key sectors. It is important that studies are carried out to monitor and preserve marine ecosystems and the species that depend on them.

In summary, the seas of the Azores are important due to their unique geographic position, the diversity of marine environments, volcanic activity and submarine earthquakes, the position in the migratory path of several species of marine animals, and their importance for the local economy

The ROV

This project aims to explore the deep, unexplored undersea environments of the ocean and collect data on water conditions, including pH, temperature and salinity.

The importance of this project lies in the need to better understand undersea ecosystems and water conditions, which play a key role in the health of the oceans and the stability of the global climate. Our ROV is designed to operate at considerable depths, allowing us to access areas that are inaccessible to human divers.

In addition, the ROV is equipped with a series of sensors and instruments that allow it to accurately measure water conditions. This data will be collected and transmitted to the surface, where it will be analysed and used to better understand the conditions of the subsea environment.

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Abstract

This document intends to present the preliminary “ROV-E” project that consists in an evolution of the earlier “Amazing ROV” developed by ENTA CPROB. The team decided to make deep changes in the concept of the project adding new technologies capable of providing features that permit collecting even more data, get more control over the vehicle and make deeper missions.

In the last months the team has received some suggestions and is making an effort to apply as many as can be done in a useful time.

This project also resumes the huge effort of the ENTA students, involved in it, and the know-how developed, by them, in several valances as 3D modelling, electronics, coding, project management, team build, team work, maths, physics and computing science in general.

This contest is promoted by FLAD, so we decided to do all the documentation in English.

Acronyms

For this document the following acronyms are defined:

ENTA	Escola de Novas Tecnologias dos Açores
ENTA-CPROB	Clube de Programação e Robótica
ROV	Remote Operated Vehicle
ROV-E	Remote Operated Vehicle Evolution
PC	Personal computer
TMP	Temperature
PRESS	Pressure
US	Ultrasounds

Objective

The objective of the project is to develop a ROV System capable of collecting data to be used as references for studies of real life problems related to the seas. The vehicle should collect data under the sea and on the water surface. Some of the proposed data to be collected are:

- Water Conductivity
- Underwater Temperature
- PH
- Eco Sensing
- Surface Wave Modulation Movement
- Live video streaming

The system should be capable of presenting that data in a traditional webpage storing this data in some cloud computing based server.

The Team

The “ROV-E” team is made up of members from the ENTA-CPROB. They are:

Students:

- Gonçalo Raposo Sousa
- Emanuel Melo Borges
- João Lopes Vieira
- Sílvia Ferreira Pacheco
- Martim Leitão

Teacher advisor

- Paulo Leite

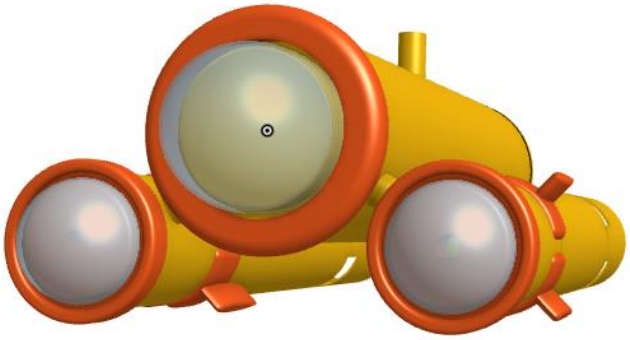
Project Description

The ROV system includes 2 basic components: The Vehicle, the remote control unitT

The Vehicle

The vehicle has a new design (fig.1) based on the standards of the industry, all the sensing units and CPUs reside inside the vehicle. The communication with the surface, with the control unit, are made via optical fibre. With the correct material this device could submerge to 2km.

Fig 1



The system will be equipped with 1 raspberry PI V4 (pic 2), This will be the brain of the system and will be able to livestream the video obtained by a raspberry Pi Camera installed in the central dome window. Will also be equipped with 1 arduino uno responsible for the sensors

Pic 2

Sensors

The ROV is equipped with a variety of sensors with many applications such as:

- pH Sensor;
- Temperature sensor;
- Conductivity sensor;
- Gyroscope
- Eco Sensor
- Video Stream

The output of these sensors will be used as data for the ROV's missions

The Remote Operation Station

The ROV will be remote controlled by a laptop, where it will be connected to the raspberry via Fiber Optics. Should be possible to control the vehicle from a standard web page via the internet.

The control interface, in the laptop, will present real time sensing reading and real time video.

The Data Storage

The data collected by the sensing network will be stored in a database over the cloud and/or locally. The data should be available for future requests.

Divulgation/Studies

We are developing contacts with the "Ocean School of Azores" to conduct experiments in the ocean with the objective of retrieving data capable of solving real problems such as detecting abnormal variation in the values of the ROV readings.

We will develop contact with the Azores University, with the department of Oceans, to present, share and get feedback on the usability of this device.

The objective is to improve future versions of the vehicle to be used in Hi level investigations / studies

Uses of the Project

When it comes to the utility of the ROV itself, there are a plethora of real-life scenarios where it can be used.

Water quality (pH sensor)

The pH of seawater is measured on a scale of 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. Changes in the pH of seawater can affect the ability of marine organisms to carry out their normal functions, such as nutrient absorption and respiration. For example, a reduction in pH (acidification) can affect the ability of some hard shell species to form their shells and thus affect their survival.

Furthemore, the quality of the water used in various industrial processes is critical to the quality of services and goods many sectors provide. Which means that managing the water quality can have a direct impact on the return on investment.

Alongside providing a better water quality, it can also help the environment in aspects such as:

- Reducing water waste;
- Energy saving;
- Prevents downtime;
- Meets supply chain sustainability requirements;
- Reduces the use of hazardous chemicals

Temperature abnormalities (Temperature sensor)

When studying a body of water on a certain site, studying it's temperature can help identify any abnormalities within itself such as:

- Changes in the sun;
- Emissions from volcanoes;
- Variations in Earth's orbit;
- Levels of CO_2

Preserving habitats and population health (Conductivity sensor)

The salinity of seawater can be influenced by factors such as evaporation, precipitation and the addition of fresh water. Changes in salinity can affect the ability of many marine organisms to carry out their normal activities, such as reproduction and nutrient uptake. Furthermore, changes in salinity can also affect marine community structure, such as species distribution and population dynamics.

Not only does this affect other species but it also affects us humans, as it can pollute our water reserves which, compared to the total amount of water on earth, is very few.

Mission Navigation (Gyroscope)

Since the new ROV has a lot of it's design based on industrial designs, a gyroscope has been implemented as well. This will aid the vehicle in its orientation when conducting a mission.

The Importance of the pH, Conductivity and Temperature sensors

In summary, water pH and salinity are important factors that affect marine life and the balance of the oceans. It is important to monitor and control changes in these parameters to ensure the health and resilience of marine ecosystems.

Marine Life

The combination of water temperature, salinity, and pH can affect marine life, including fish, invertebrates, algae, and microorganisms. Some species are more sensitive to changes in water conditions and may migrate or disappear if these changes are too drastic.

Marine Food Chain

Water temperature, salinity, and pH can also influence food production in the marine food chain. For example, changes in water conditions can affect the proliferation of algae, which are the basis of the marine food chain. This can affect the amount of food available for fish and other marine animals.

Extreme Climatic Phenomena

The combination of water temperature, salinity and pH can also influence the intensity of extreme weather phenomena such as hurricanes and tropical cyclones. Changes in water conditions can affect the formation and intensity of these weather events as well as marine life and coastlines.

Bill of Materials (EN/PT)

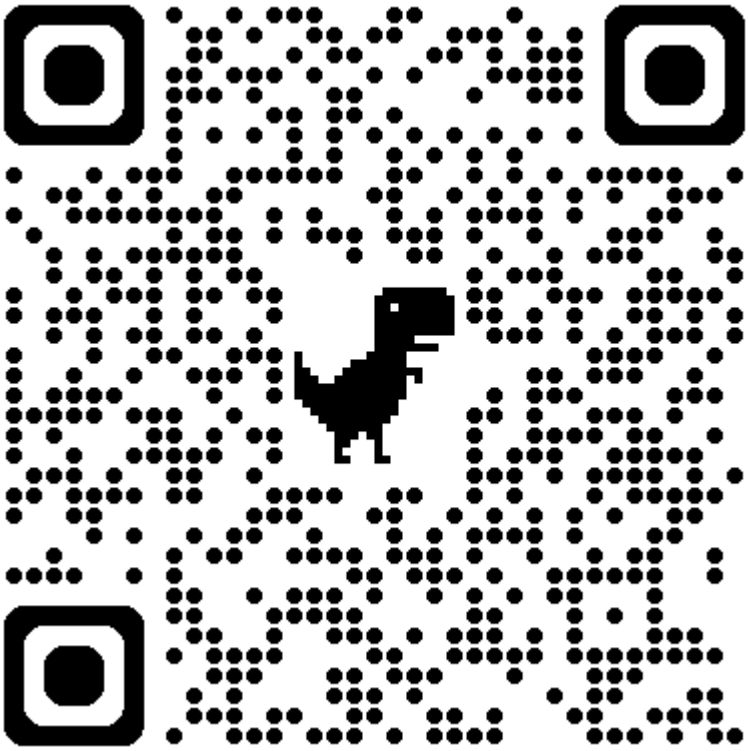
(English)
As a small academic project, the main goal of the construction of this vehicle is to be as affordable as possible. All the structural parts of the ROV will be 3D printed in our lab, some of the electronics was made by us too and we bought others, as described in the following list.

(Portuguese)
Como se trata de um pequeno projeto escolar, a intenção é que seja o de produção barata, como tal toda a estrutura do veículo foi impressa em 3D, na nossa oficina, assim como alguns dos módulos eletrónicos desenhados e desenvolvidos por nós e outros comprados, conforme descrito na seguinte lista

id	desc	qnt	unit cost	sub total
1	Steel Structure (Offered)	1	€0.00	€0.00
2	Raspberry PI 4	1	€60.00	€60.00
3	Arduino Uno	2	€20.00	€40.00
4	FO Interfaces	2	€100.00	€200.00
5	Camera	1	€70.00	€70.00
6	Motors	2	€60.00	€120.00
7	Wires, screws and others	1	€50.00	€50.00
8	Plastic domes	3	€5.00	€15.00
9	Motors	2	€60.00	€120.00
10	Wires, screws and others	1	€50.00	€50.00
			total	€725.00

The Code

You can find the last version of the code in this GITHUB Repository:
https://github.com/pmleite/enta-cprob-rov-os



GITHUB Code Repository QRCode Link