SHARKS

Team Number: 93

Coach: Dr. Emad Ramadan

Senior Design Project – Term 232

Autonomous Mini-Submarine

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Introduction

Diving into Innovation: Introducing Our Next-Generation Submarine for Precision Navigation. In the world of underwater exploration, our revolutionary submarine, equipped with AI technology, offers unparalleled maneuverability in confined spaces, setting new standards for precision navigation.

Problem Statement

The challenge of navigating confined underwater environments hinders exploration ventures. Existing solutions lack agility and compactness, limiting progress. Our submarine addresses this issue with AI-driven maneuverability, paving the way for groundbreaking discoveries.

Constraints & Target Specification

Constraints:

- Maximum weight is 7 kg.
- Maximum speed of 2 knots (1 m/s).
- Maximum flow resistance 1 knots (0.5 m/s).
- Maximum rise/fall speed 1 knots (0.5 m/s).
- Corrosion rate less than 10 microns/year
- Maintain reliable communication up to 10 meters away.
- Operate for at least 1 hour on a single charge.
- Autonomous operation.
- Image resolution is greater than 4 MP.

Target Specification:

- Maximum size 50 cm in all directions.
- Operating depth of up to 3 meters.
- Carry a minimum of 0.5 kg of scientific instruments or cameras for data collection.
- Capable of operating in seawater of salinity 37 g/dm^3
- Budget less than 10000 SAR

Project Impact

1.Enhanced Efficiency: AI-powered obstacle avoidance and path planning streamline underwater missions, saving time and resources.

2.Cost-effectiveness: 3D printing reduces production costs, making the drone accessible to organizations with budget constraints.

3.Safety Assurance: Autonomous navigation reduces risks, ensuring personnel and equipment safety.

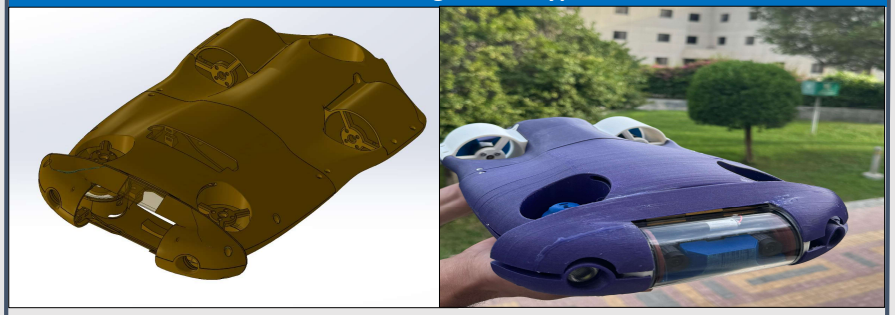
4.Environmental Responsibility: Acrylic pipe insulation minimizes environmental impact, protecting aquatic ecosystems.

5.Data Integrity: Corrosion detection ensures infrastructure reliability, facilitating timely maintenance.

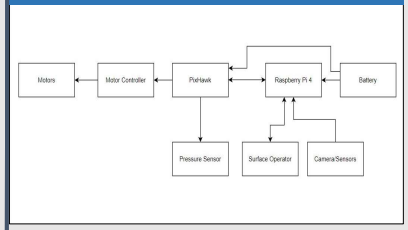
6.Technological Advancement: Our project pioneers innovative AI integration and 3D printing in underwater exploration, driving industry progress.

7.Accessibility: Our project offers excellent accessibility, allowing for easy disassembly and reassembly.

Final Desing & Prototype

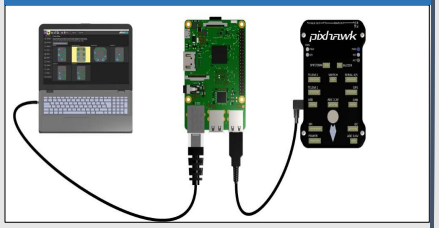


Circuit Block Diagram



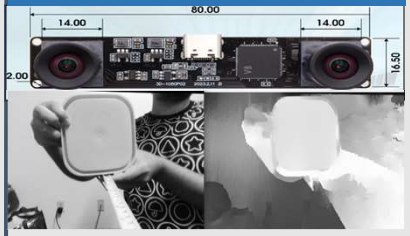
- The battery feeds both the Pixhawk that is responsible for motors control and the Raspberry Pi that collects all the data and communicate to the surface operator.

Communication System



- Pathfinding and object detection are done on an external computer to provide more processing power and a longer battery life.

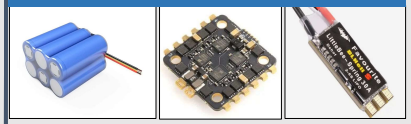
4MP Stereo Camera



Propulsion System

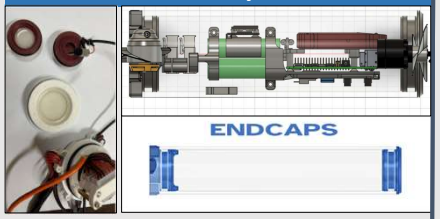
- 3x for the vertical propulsion system.
- 2x for the horizontal propulsion system.

Battery & Electronic Speed Control



- 6 Lithium batteries ensure extended usage time.
- An electronic speed control (ESC) regulates and adjusts the speed of an electric motor, ensuring precise control and efficient performance.

Isolation System

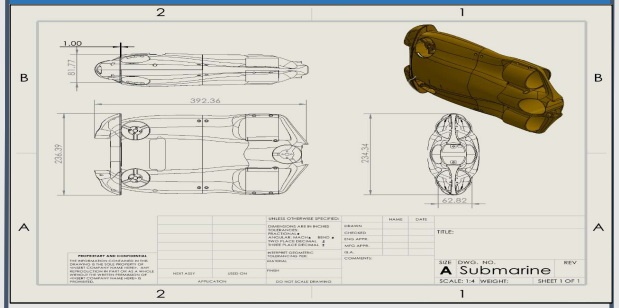


- The endcaps are filled with epoxy to ensure further isolation.

Testing & Validation

The below results showcase the outstanding results that have successfully met our project specifications, highlighting the culmination of our senior design endeavor.

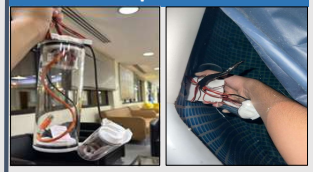
Design Dimensions



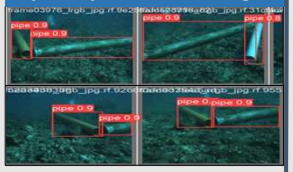
As shown above in 3D-drawing the **maximum dimension is 385.3 mm = 38.53 cm**

Operating in Seawater	**The body of the submarine is made of PLA**
Total Cost	**The mini-submarine cost is 6100 SAR**
Operating in 3m Depth	**Acrylic pipe maximum pressure = 138 KPa. Applied pressure = 29.4 Kpa**
Power Consumption	**Total power consumption is 85.48 Wh The Supply is 12 V. Battery Capacity in Ah =** $\frac{85.48}{12} = 7.123Ah = \mathbf{7123\ mAh}$
Total Weight	**2.55Kg** (Body weight 1.4 Kg; Scientific instruments 1.150 Kg)

Electronic Pipe Isolation Test



Pipe Inspection Utilizing AI



Learning Outcomes

1. Master navigation in confined underwater environments using AI-driven maneuverability.
2. Innovate solutions for underwater exploration by prioritizing agility and compactness.
3. Refine problem-solving abilities by addressing limitations in existing solutions.
4. Gain expertise in robotics and automation for groundbreaking discoveries.
5. Exhibit teamwork and collaboration in real-world underwater exploration challenges.