Miniature Autonomous Submarine

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Introduction

The project aims to develop a surveillance miniature autonomous submarine capable of operating in areas that are inaccessible to humans. The miniature autonomous submarine is designed to be cost-effective and highly accurate, reducing the need for human resources and improving operational visibility in challenging environments. It is particularly useful in Search and Rescue operations, as it can navigate through hazardous and confined spaces that traditional rescue teams may find difficult to access. This makes it a valuable tool in remote or dangerous waters where rescue teams may face significant risks.

Problem Statement

Private security organizations have the responsibility of safeguarding and inspecting coastal facilities. They require cost-effective and precise around-the-clock surveillance coverage. Our product the miniature autonomous submarine can offer a solution for traditional security organizations. This submarine is equipped with autonomous navigation technology that allows it to dive and provide continuous civilian capabilities.

Target Specifications

Metric	Unit	Acceptable value
weight	kg	≤7
speed	m/s	≤1
flow resistance	m/s	≤0.5
rise/fall speed	m/s	≤0.5
Corrosion rate	microns/year	10
Autonomous operation	-	-
reliable communication	meter	10
Operate/charge	hour	≥1
Image resolution	MP	4

Constraints

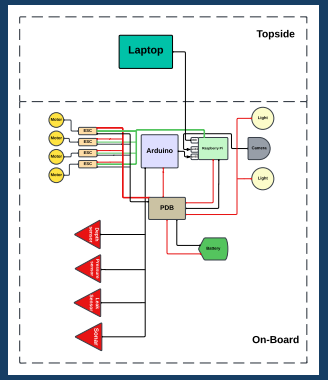
- Maximum dimension of 50 cm in all directions.
- Operating depth of up to 3 meters.
- Carry a minimum of 0.5kg of scientific instruments or cameras for data collection.
- Capable of operating in seawater of salinity 37g/dm3.
- Budget less than SR 10,000.

Prototype Design

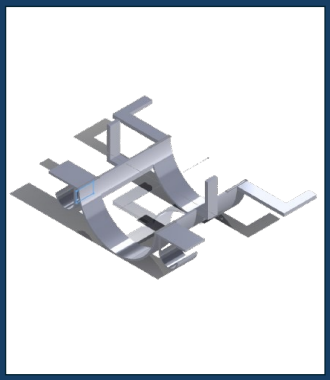
The system consists of:

- 3-D printed base
- On-board sensors and sonar
- Topside monitoring device

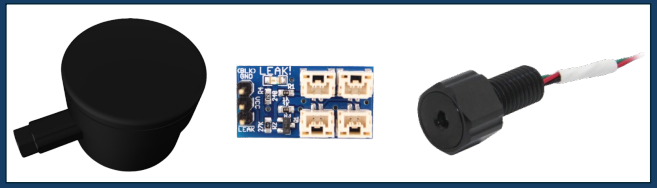
Connection diagram



3-D printed base



On- Board Sensors and sonar

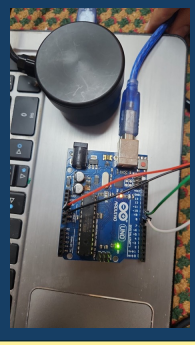


Validation

Our prototype	Constraints
$30\,\text{cm} \times 25.8\,\text{cm} \times 12.4\,\text{cm}$	Max Dimensions of 50cm in each direction
0.623 Kg	Carry 0.5Kg of Sensors
16MP	Camera resolution 4MP
9546SAR	costs<10,000 SAR

Autonomous operation

Our submarine is equipped with a Raspberry Pi connected to the internet, in addition to a ping sonar that has a 25-degree beam width and operates at a frequency of 115 kHz. This configuration is ideal for maneuvering through tight spaces, as the sonar provides obstacle avoidance capabilities. The submarine's autonomation system uses these sonar readings to control its movements independently, without requiring input from the surface.



Conclusion

The miniature autonomous surveillance submarine can enhance security measures in remote or narrow areas, reducing the need for human personnel while improving security management in hazardous settings.