Miniature Underwater Drone

THE UNIVERSITY of ADELAIDE

Motivation

- Inspiration : Our project inspired by the "Lego-powered Submarine" project from the Brick Experiment Channel.
- Underwater Exploration: The core motivation of our project is to advance the capabilities of underwater exploration.
- Potential: We acknowledge the immense potential of underwater drones in scientific research, environmental monitoring, industrial applications, and education.
- Need for Versatile Alternatives: Our project is driven by the need for cost-effective and versatile alternatives to traditional underwater exploration methods.
- Untapped Potential: We believe there is vast, untapped potential in underwater ecosystems, resources, and geological formations that current limitations and risks associated with human intervention prevent us from fully exploring.

Aim and Scope

- Aim:

Our project aims to design, construct, and deploy a Miniature Underwater Drone for underwater exploration.

- Sensor and Camera Equipped:

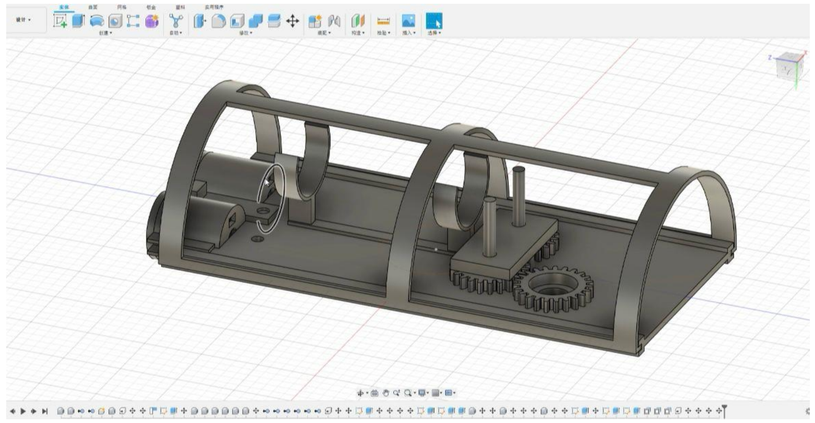
The drone is equipped with advanced sensors and cameras for high-precision underwater perception.

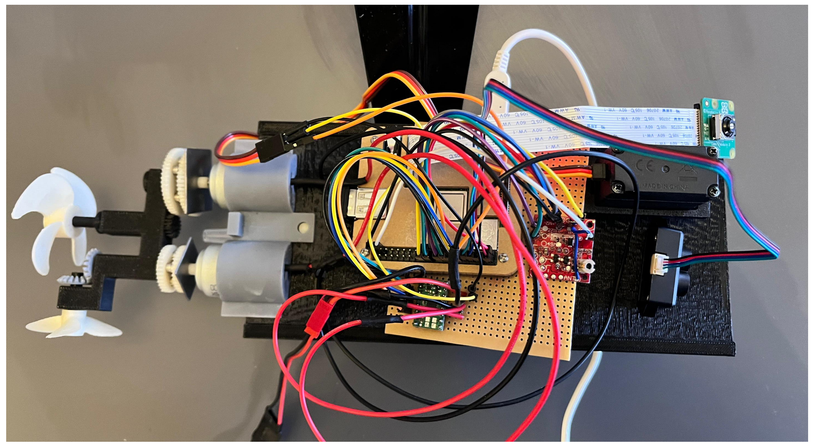
- Expanding Capabilities:

Our goal is to expand capabilities in marine scientific research, resource exploration, and environmental protection through this technology.

Objectives

- Reliable Prototype: Develop a reliable and efficient prototype using 3D printing technology for construction. Advantages include rapid prototyping, customization, and cost-efficiency.
- RF Control System: Develop and integrate an RF control system based on Raspberry Pi Model 3 A+ for wireless communication between the operator and the drone.
- Depth Control: Implement a depth control mechanism, potentially using adjustable ballast or variable buoyancy systems, and integrate depth sensors for autonomous depth management.
- Environmental Observation: Incorporate a high-resolution camera system for clear underwater footage, with a live video feed for environmental monitoring and observation.





Approach

Hardware Configuration

- Raspberry Pi 3 A+: The computational core of the drone, handling sensory input and movement control.
- Propulsion System: Dual DC motors controlled by the DRV8833 motor driver for propulsion and steering.
- Buoyancy and Depth Control: Servo motor integrated into the ballast tank system for buoyancy adjustments.
- Sensory Systems: TF Mini LiDAR for obstacle detection and Honeywell pressure sensor for depth monitoring.

Software Architecture

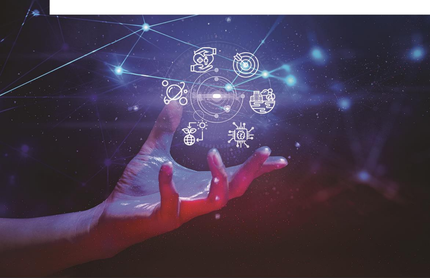
- Python-based Control System: Translates user commands into motor control and sensory readings.
- LiDAR-based Obstacle Detection: Adjusts drone trajectory to avoid obstacles detected by TF Mini LiDAR.
- Depth Maintenance Algorithm: Ensures the drone maintains the desired depth using feedback from the pressure sensor.
- Streaming and Communication: Offers real-time video streaming and remote monitoring of the drone's surroundings.

Recommendation for Future Work

- Enhanced Propulsion: Consider upgrading to brushless motors for increased efficiency and maneuverability.
- Improved Communication: Integrate acoustic modems for extended communication range, particularly in challenging underwater conditions.
- Advanced Sensory Integration: Add sensors for temperature, salinity, and pH measurement to enhance the drone's research capabilities.
- Machine Learning & AI: Implement machine learning algorithms for autonomous navigation, object detection, and equipment malfunction prediction.
- Structural Enhancements: Explore materials like carbon fiber or specialized polymers to enhance durability and reduce weight for greater depth capability.
- Enhanced User Interface: Create a more intuitive user interface, potentially with VR integration, for an immersive piloting experience.

Conclusion

- The Miniature Underwater Drone Project is a significant step forward in underwater exploration and technology.
- The project aims to create a reliable prototype for use in scientific research, environmental monitoring, industry applications, and education.
- Ongoing refinement and testing are essential to ensure stability, buoyancy, and maneuverability of the drone.
- The development of underwater drone technology holds immense promise for marine exploration and research.



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