JELLYFISHBOT

Fadeel Attaullah, Daniel Ho Yu Chen, Cristine De La Cruz, May Maung, Khine Thazin Myint, Warner Wu
Sponsored by Dr. John Michael McCarthy and Dr. Sasha Voloshina

UCI Samueli School of Engineering

Executive Summary

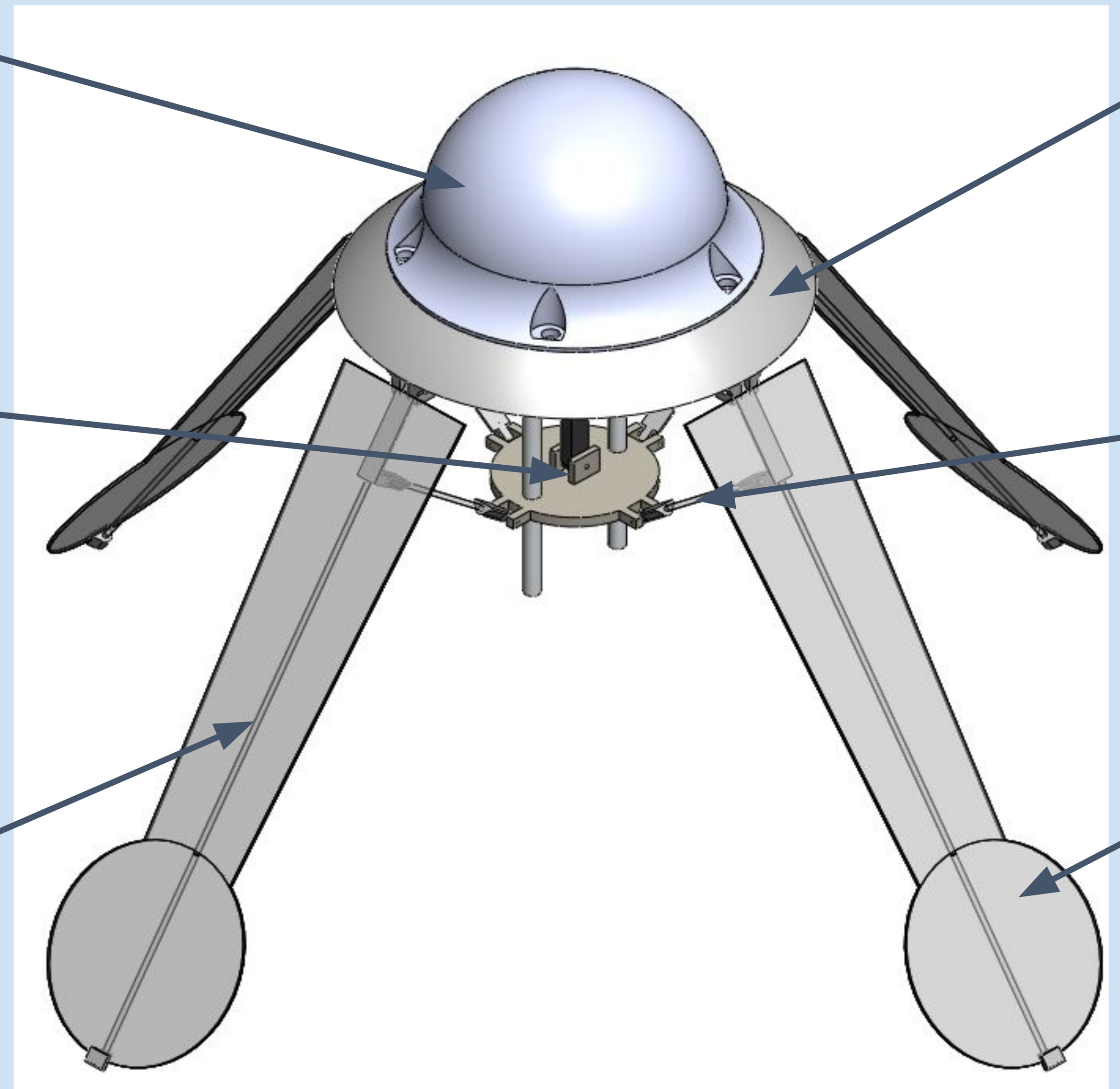
This project focuses on the development of a jellyfish robot that replicates the natural propulsion mechanisms of a jellyfish with the use of linkages. Existing jellyfish robots tend to be very bulky, require a lot of energy to move, and are hard to maneuver, making them unrealistic in real-world applications. To address these limitations, this project will analyze past designs and develop an improved model that prioritizes efficient propulsion. The design process includes modeling and dynamic analysis of the linkage system to optimize swimming efficiency. Dynamic analysis will be evaluated using SolidWorks simulations, and experimental tests will be conducted to compare the robot's propulsion against a biological jellyfish.

Proof of Concept

Chassis
- Water resistant
- Houses electronics

Crank shaft
- Converts rotary motion into linear motion
- Efficient way of powering multiple legs

Legs
- Acts as the tentacles of the jellyfish



Frame
- Supports the paddles and fiberglass rods

Joints
- Uses energy from motor to propel the jellyfish

Paddles
- Allows for more drag to be created in the power stroke over the recovery stroke

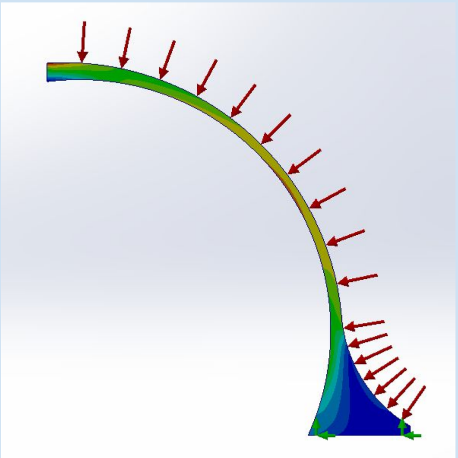
Engineering Analysis - Legs

Brief: Legs must have optimal flex for efficient propulsion
Requirements: Legs shall have 25 - 40 degrees of deflection during peak velocity
- <20 degrees: minimal energy storage / weak propulsion
- >40 degrees: strains material / long recovery

Loads: 0.156 KPa (Triangular Dynamic Pressure Distribution)
Materials: Fiberglass Rod (3mm OD) / Rigid PVC
Fixtures: Two Fixed Hinges
Results: Achieved 25 - 30 degrees of deflection, given max speed of 0.56 m/s

Engineering Analysis - Chassis

Brief: Chassis must house / protect electronics from water
Requirements: Chassis shall withstand pressures at 2m water depth

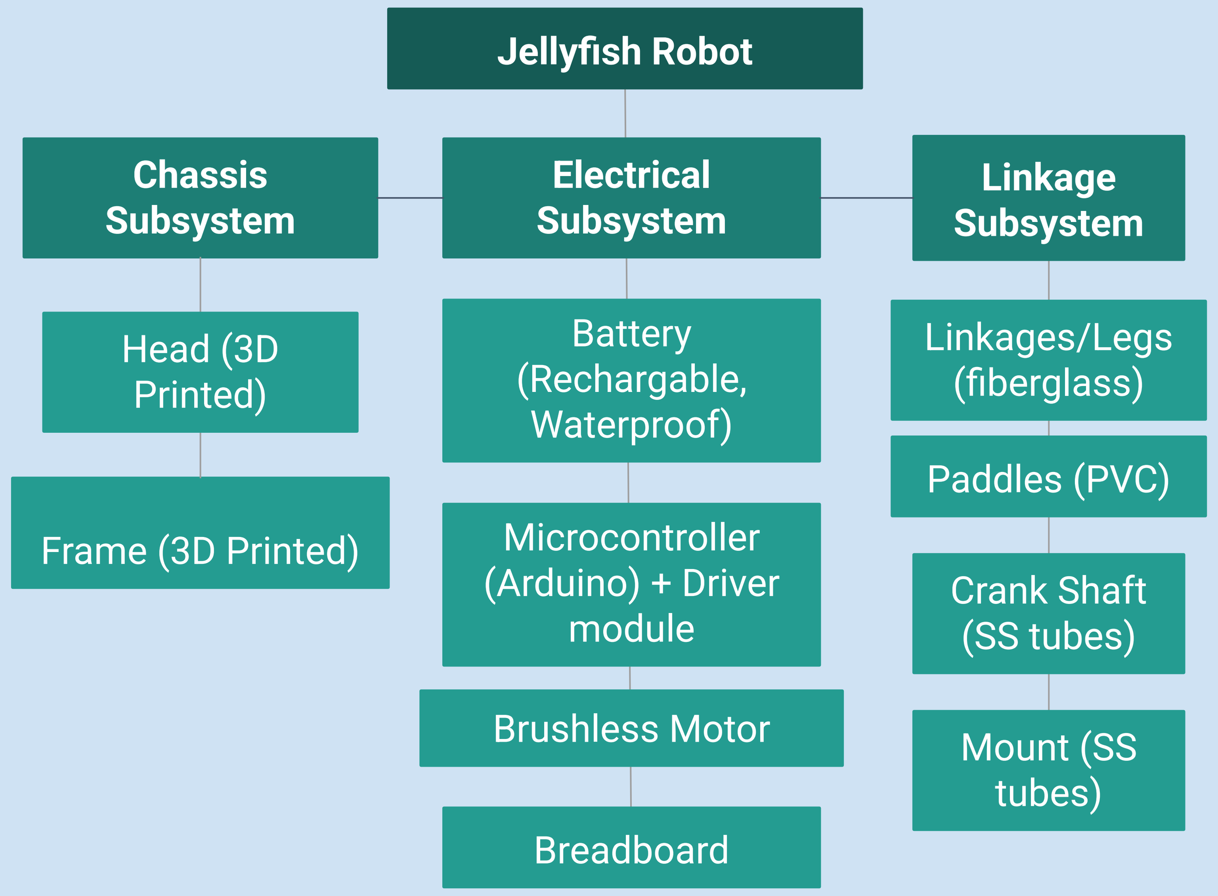


Loads: 19.6 KPa (Static P @2m depth)
Materials: PLA (solid)
Fixtures: Fixed base
Results: Max Stress: 0.4 MPa
> Yield Stress: 600 MPa
> Deformation: 0.083mm

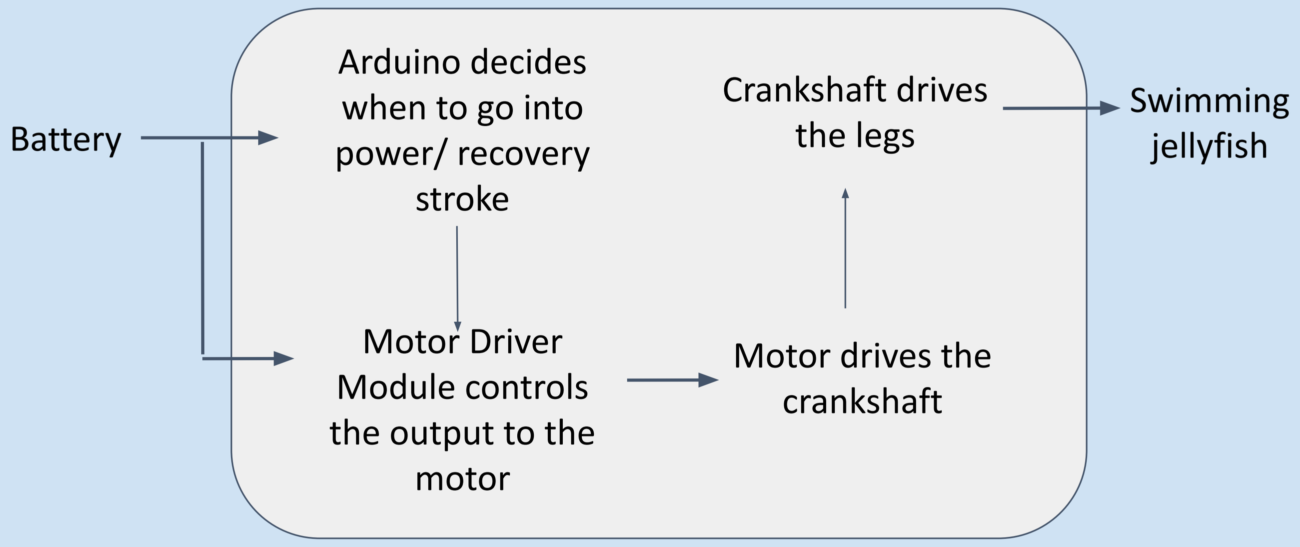
Design Process Timeline

Week 1-2	Week 3-4	Week 5-7	Week 8	Week 9-10	Spring Quarter
Identify Problem & Objectives Define the purpose and identify performance requirements.	**Research and Concept Development** Analyze the propulsion of biological jellyfish and study past solutions.	**Design and Simulation** Analyze three different linkages to choose which one is best suited for biomimicry. Generate a complete detailed CAD model of all subsystems and integrate it the first prototype.	**Subsystem Testing** Generate a complete parts list and create testing plans for each subsystem. Carry out these testing plans to verify the limits of each subsystem and to check for areas of improvement.	**Assembly and Testing** Fully integrate subsystems into one final prototype (Prototype A). Begin to test the movement of this prototype to ensure it meets the performance requirements.	**Improvements** According to the first quarter, work on future improvements to create an improved second prototype (Prototype B).

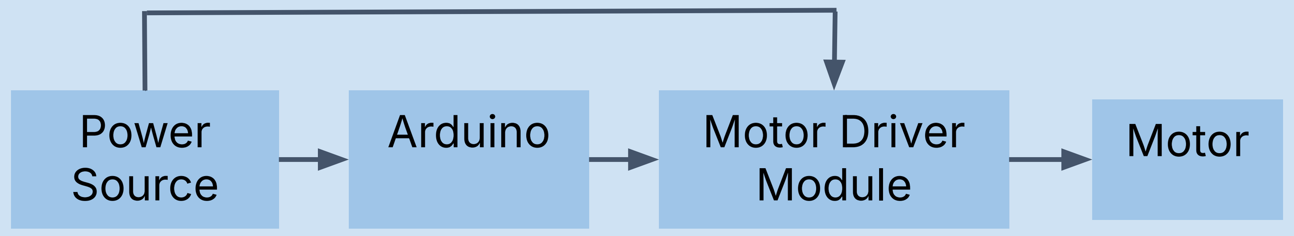
Physical Decomposition



Grey Box Diagram



Electronics



The Arduino pwm pins only output 5V but the motor requires a 12V input so a motor driver module is used as a bridge to overcome the limitation.

Future Improvements

- Designing a system to efficiently dissipate heat in the chassis to prevent the overheating of the electrical components
- Integration of navigation and maneuverability with the addition of a magnetometer
- Improve the buoyancy of the robot to ensure stable and efficient swimming

Acknowledgements

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References

- AquaJellies by Festo
- Junzhi Yu Research Article
- IEEE Robojelly