Autonomous Underwater Vehicle Team

Kennesaw State University

Kennesaw- Marietta, GA

2016-2017

RoboSub

Team Leadership

- AUV: *Leviathan*
-
- President: Jake Massingill
- Vice President: Albert Cheng
- Treasurer: Jessy Redington
- Secretary: Cody Meier
- Mechanical Lead: Jacques N’Guessan
- Electrical Lead: Albert Cheng
- Software Lead: Vinh Nguyen

Presentation Overview:

- Mechanical
  - Outer Structure
  - Inner Structure
  - Subsystems
- Electrical
  - Flow chart
  - Components
  - Specific Subsystem
- Software
  - Objective Executer
  - PID_Loop
  - YOLO

AUV Overview:

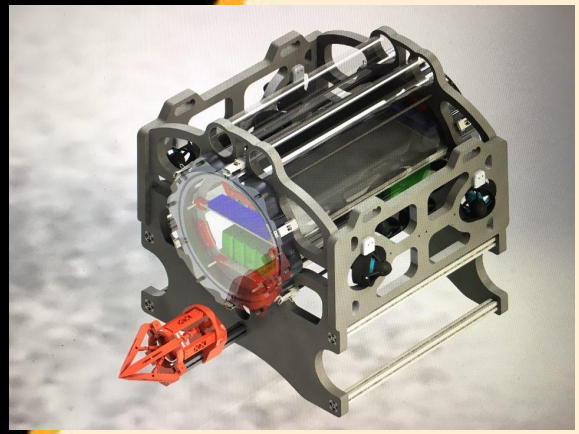
- Name: *Leviathan*
- Weight: ~115 lbs (as of older model)
- Thrusters: BlueRobotics T200 (10)
- Subsystems: dropper, mechanical claw, torpedoes
- Image Processing via neural network
- Sensors: 2 camera, 3 hydrophones*, pressure sensor

Mechanical - Housing

- Cylinder
  - Dimensions: 12” diameter, 24” length, ⅛” thickness
  - Material: acrylic
- Flanges
  - Contain 2 O-rings to seal
  - Attach to housing by threaded rods
  - Manufacturing: Waterjet, CNC via Withers Tool
- Endcaps
  - Front: clear acrylic to accommodate camera
  - Back: aluminum with cable penetrators for motors and auxiliaries
  - Attaches to flanges with clasps
  - Manufacturing: Waterjet, CNC via Withers Tool

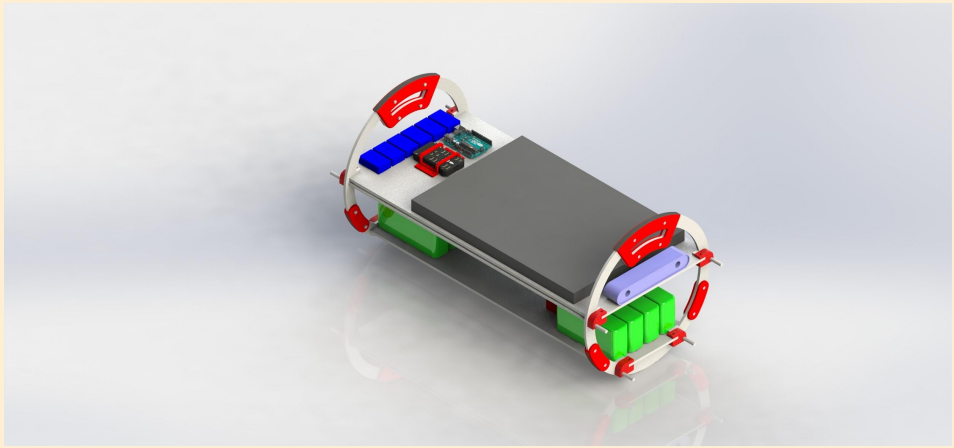
Mechanical - Outer Structure

- Planned design
  - Materials: 8020, Delrin, 3” dia. 24’ length acrylic tube
  - Manufacturing: waterjet
  - Rationale: modular, lightweight
- Difficulties
  - Buoyancy from housing and delrin frame
- Resulting design
  - Added 4 vertical motors
  - Trimmed delrin frame and replaced with more 8020



Mechanical - Inner Structure

- Purpose: stabilize and hold electronics
- Design
  - Materials: aluminum, ABS filament
  - Manufacturing: waterjet, 3D print



Mechanical - Subsystems

- Mechanical claw
  - Initial Design
    - Materials: ABS filament, Savox servo
    - Manufacturing: 3D printing
  - Ultimate Design
    - Materials: VEX claw, Savox servo
    - Manufacturing: none

Design Process

- Design Goals
  - Use a single servo (Savox SW-1210SG)
    - Torque rating (@ 7.4v): 319.4 oz*in
    - 210 degrees of rotation
  - Optimize cost and operability
  - Maximize grip strength
  - Manufacture in house from present materials
  - Perform multiple tasks
- Due to shortage of support material with Stratosys 3d printers, final product could not be printed

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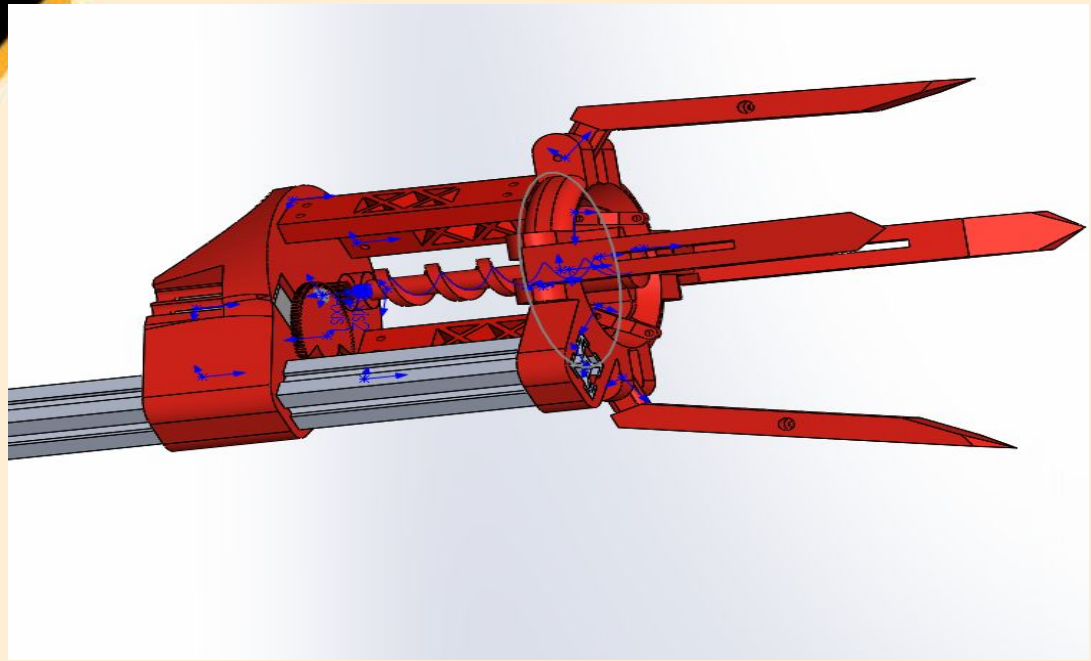
Early Design



Mechanical - Subsystems

Dropper:

- Purpose
  - Deliver payload of 2 markers for “Cultivate Pearls” task
- Initial Design
  - 8 chambered cylinder with revolving door attached to HiTec HS-5646WP servo
  - Materials
    - ABS filament
    - 1” diameter ball bearings
  - Manufacturing
    - In-house 3D print
- Ultimate Design
  - Scaled down to .5” diameter ball bearings and smaller housing and 4 chambers

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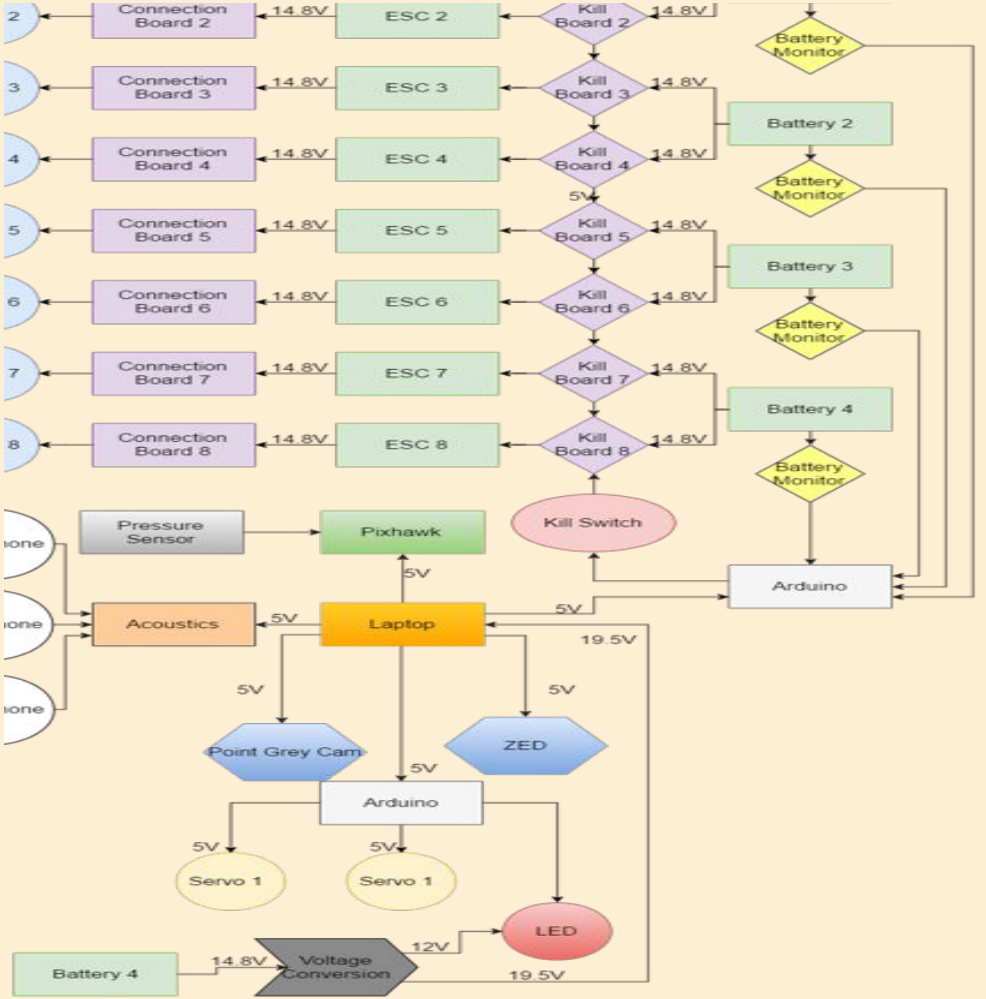
Electrical Power Diagram



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Electrical Overview

- 12 BlueRobotics T200 thrusters (currently 10)
- 12 ESCs (mixed BlHeli and Afro)
- Kill Switch Boards with mosfet/relay (replaced with transistor switches and relays)
- Connection Boards (removed)
- 2 Arduinos (changed to 1)
- 3 Hydrophones (not used)
- PixHawk flight controller
- Zed Stereoscopic Camera (replaced by Logitech webcam)
- Point Grey Camera (replaced by Logitech webcam)

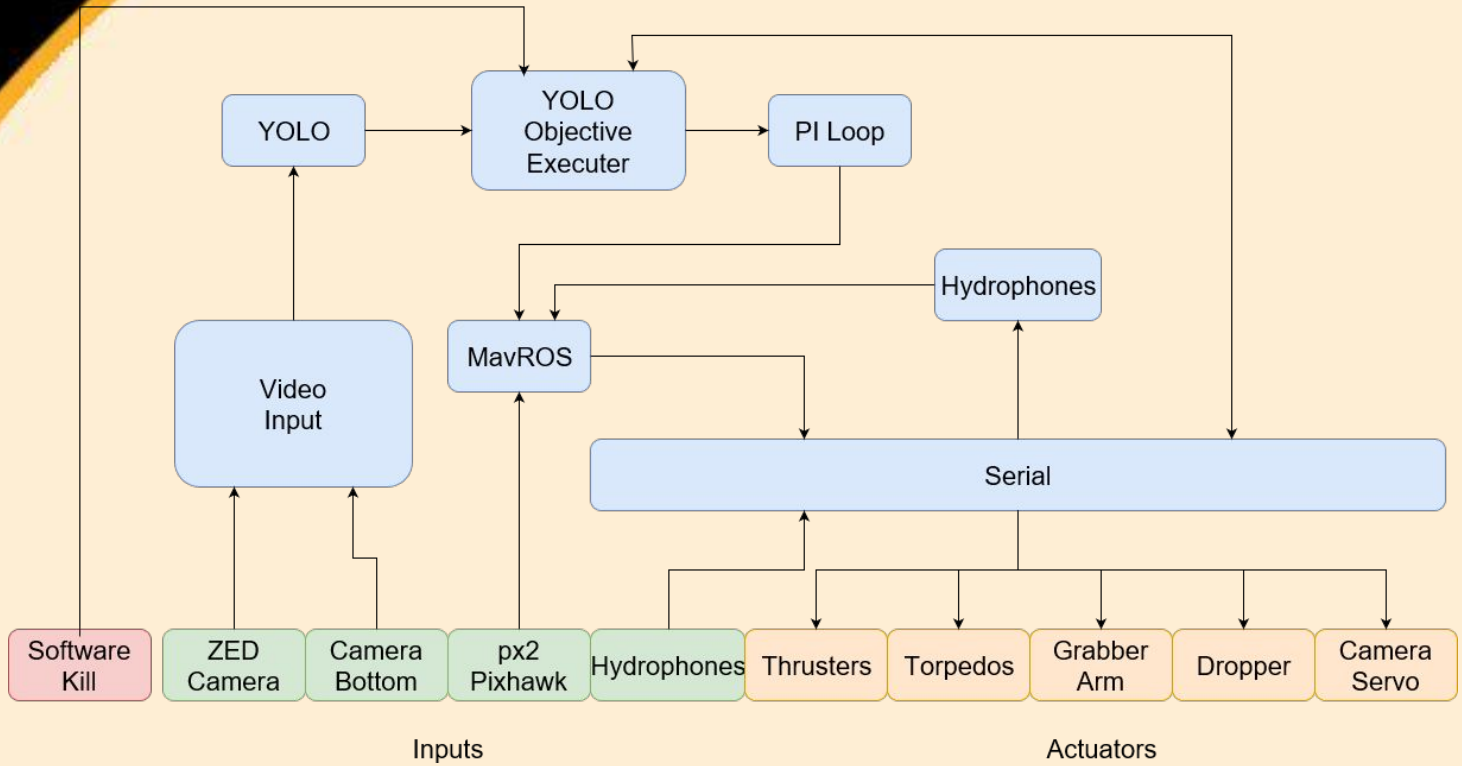
Electrical - Torpedoes

- 3D printed
- Self propelled
  - Brushless motor and ESC
- Light activated
  - Arduino controlled

Electrical - Kill Switch

- Original design used a optocoupler connected to the gate of a n-channel MOSFET that is in series with the ESC and Battery
- Twist on / twist off physical switch
- Designed to work in tandem with Arduino Voltage checkers
- Had to switch to individual transistor DC relay

Software - Overview:



Software - Objective Executor:

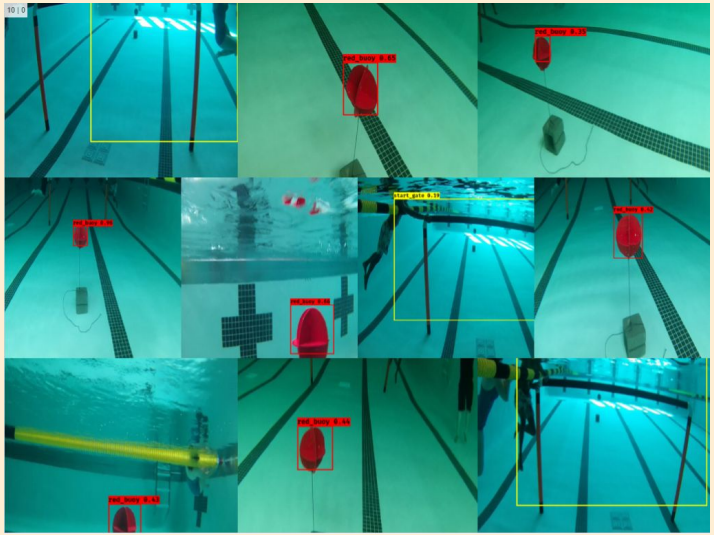
- Simple State Machine
- Second Iteration from first solution *SMACH to simple state machine
- C++
- Objective is State
- Pointers are used to pass around control

Software: PID_loop

- Proportional-Integral-Derivative Movement Controller operates on pixel coordinates
- Using a bounding box generated from the neural network an error value is solved for as the difference between the desired setpoint and the measured process variable
- This controls movement for our sub as well as indicates completion of a task

Software: YOLO

- Neural Network for object recognition



Returned values

- Object type
- Shape and location of a box around the object
- Confidence value

How to use YOLO

1. Collect data from the competition environment
   a. Record videos
2. Label the data by drawing bounding boxes around objects
   a. Upload videos as images to labeling website
      i. Shadysource.github.io
   b. Package all labels and images into a dataset file
3. Train a pretrained detection model on the dataset file
   a. (Takes <30 minutes with several hundred images)

Acknowledgements

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Contact Us!

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