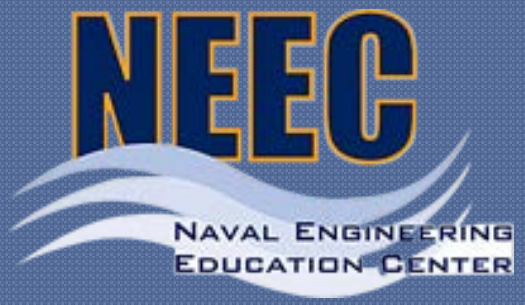
Team 21
Autonomous Robosub

Sponsored by:



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Dr. Michael Frank

Advisors: Dr. Clark, Dr. Harvey

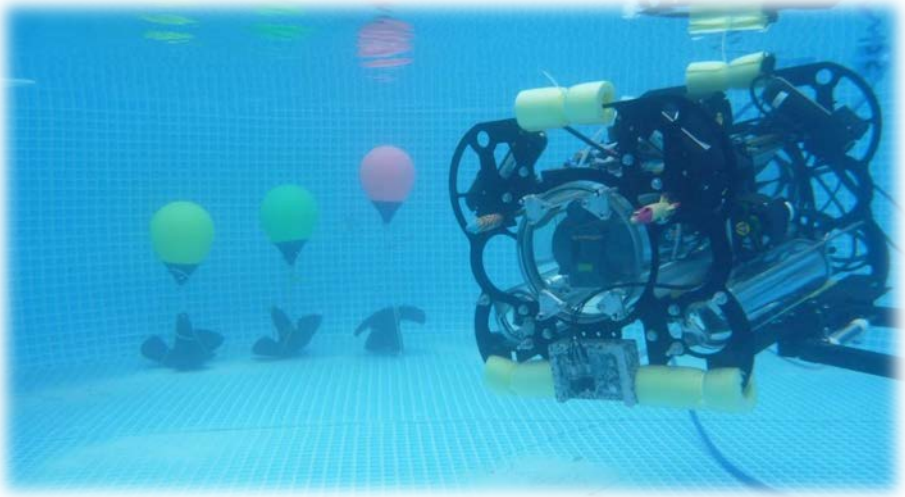
Team: Santiago Franco, Darryl McGowan, Kyle Miller, Sondra Miller, Gregory Robertson, Stuart Royal, Alex Smith

The Competition

- 16th Annual AUVSI RoboSub Competition
- Held in San Diego July 22-28, 2013 at TRANSDEC Pool
- **Goal:** Design and build autonomous submarine able to complete competition tasks
- **Equipment:** Thrusters, sensors, cameras, microcontrollers, computer, and manipulators

Competition Tasks

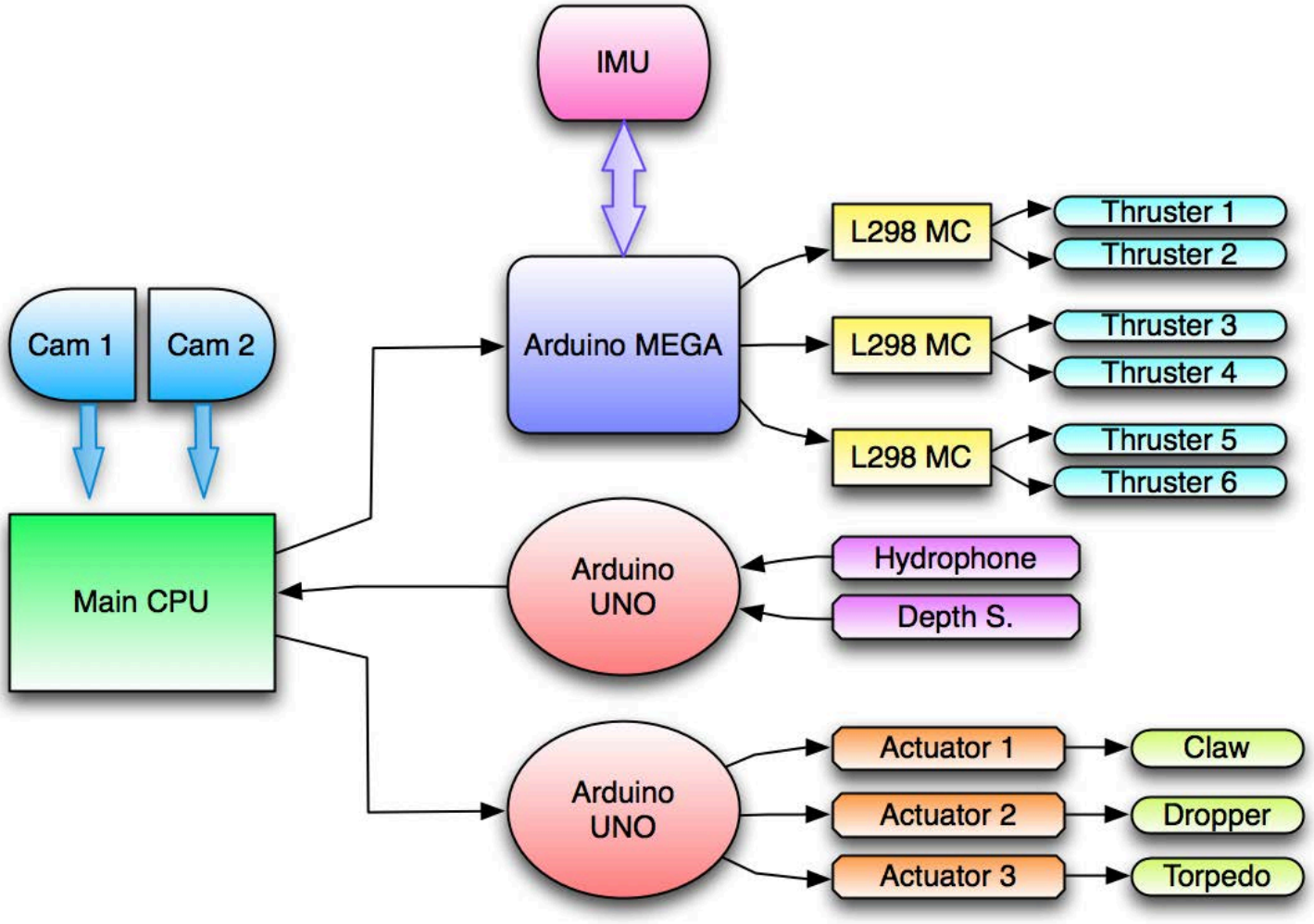
- Gate
- Buoy bumping
- Follow path
- Drop markers
- Pick up wreath
- Fire torpedoes



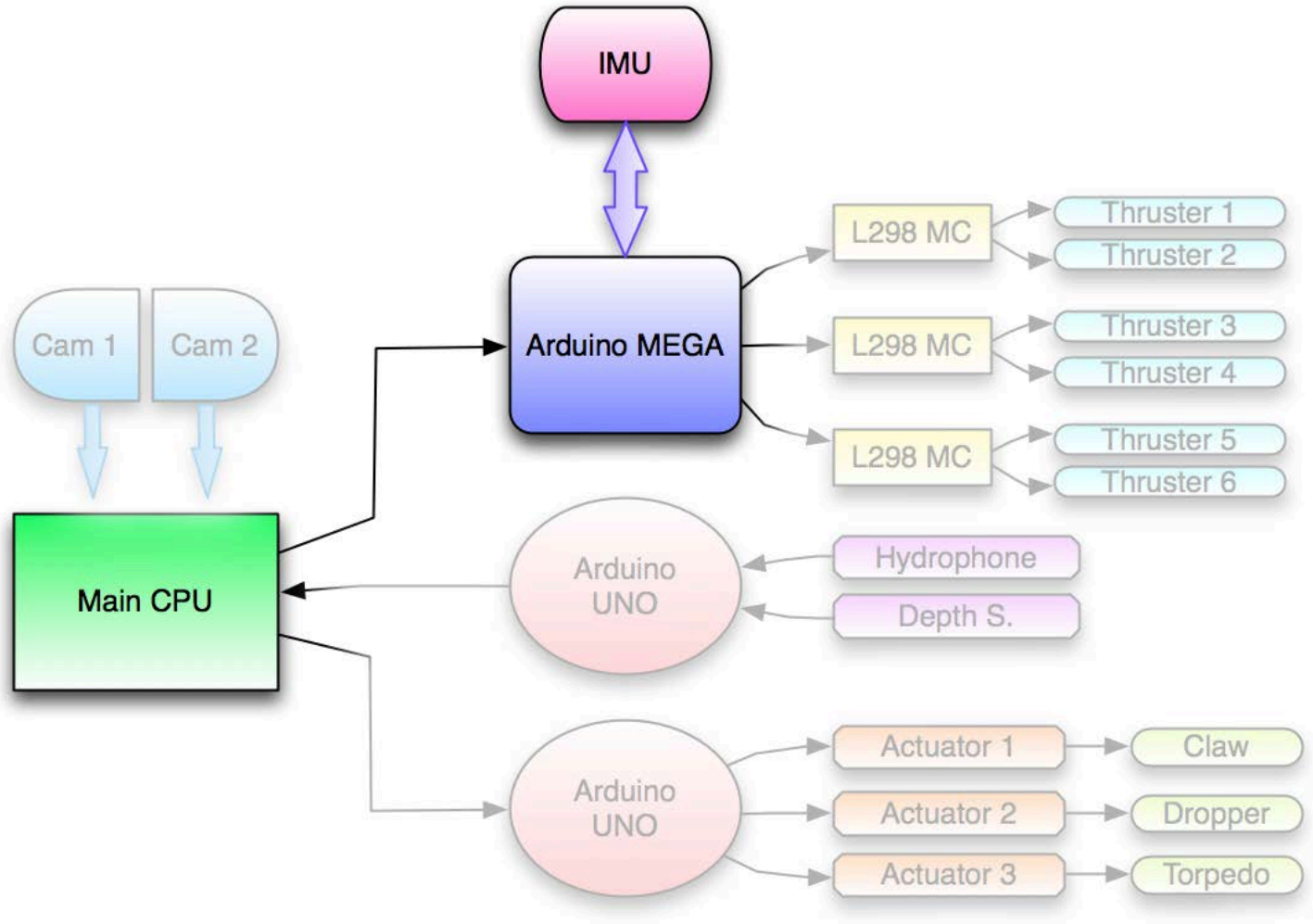
University of Central Florida

Components

System Control



System Control



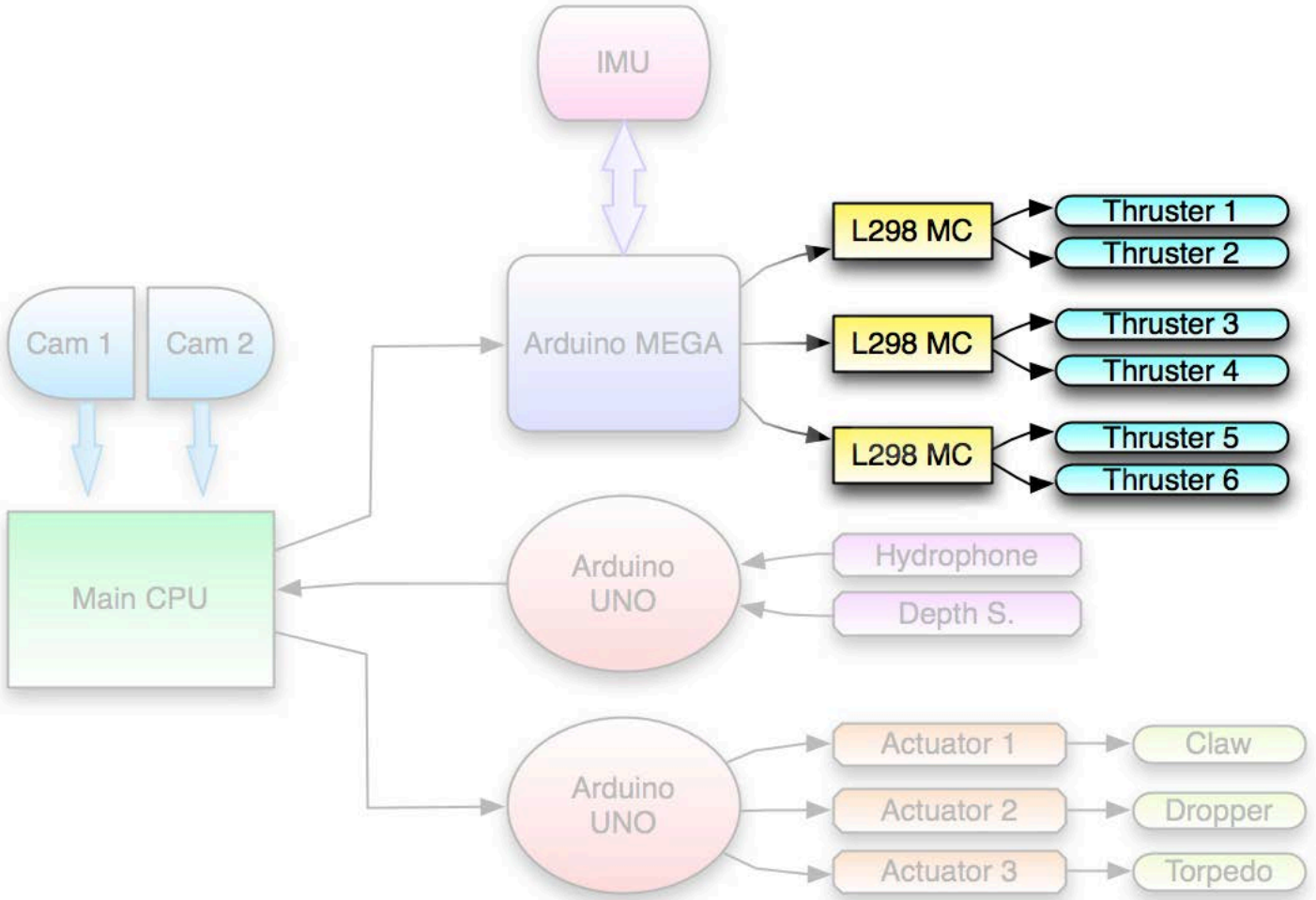
Hardware

- Main System Controller
  - Intel i3 2330M, 8GB RAM, Wi-fi, 6 USB Ports
  - Controls all subsystems
  - Contains top level controller

- Subsystem Controllers
  - Arduino UNO
  - Arduino MEGA
    - Controls all 6 thrusters
    - Directly connected to IMU

- Inertial Measurement Unit
  - Razor 9DOF IMU
  - Acceleration along 3 axes
  - rotation about all 3 axes

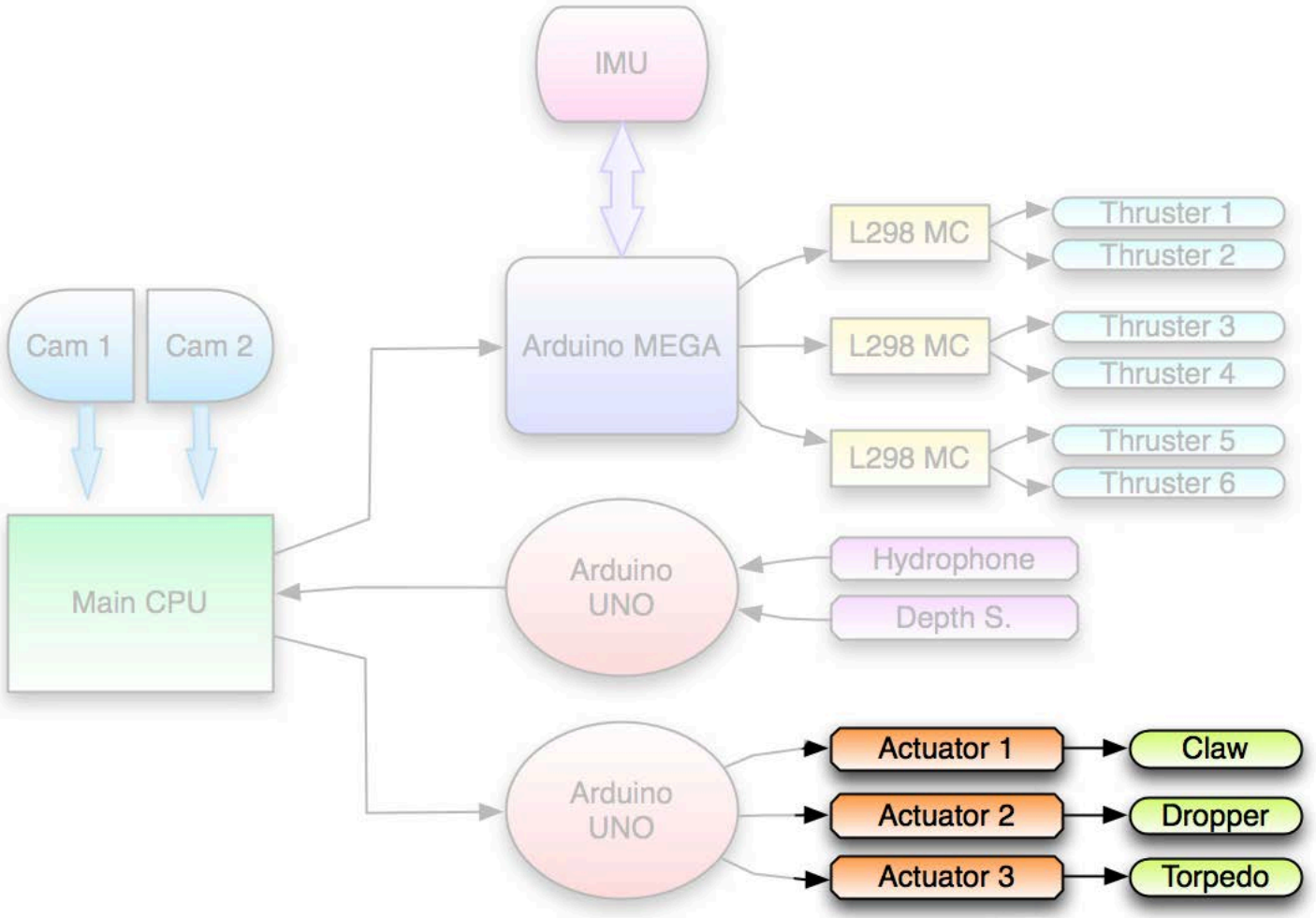
System Control



Thrusters

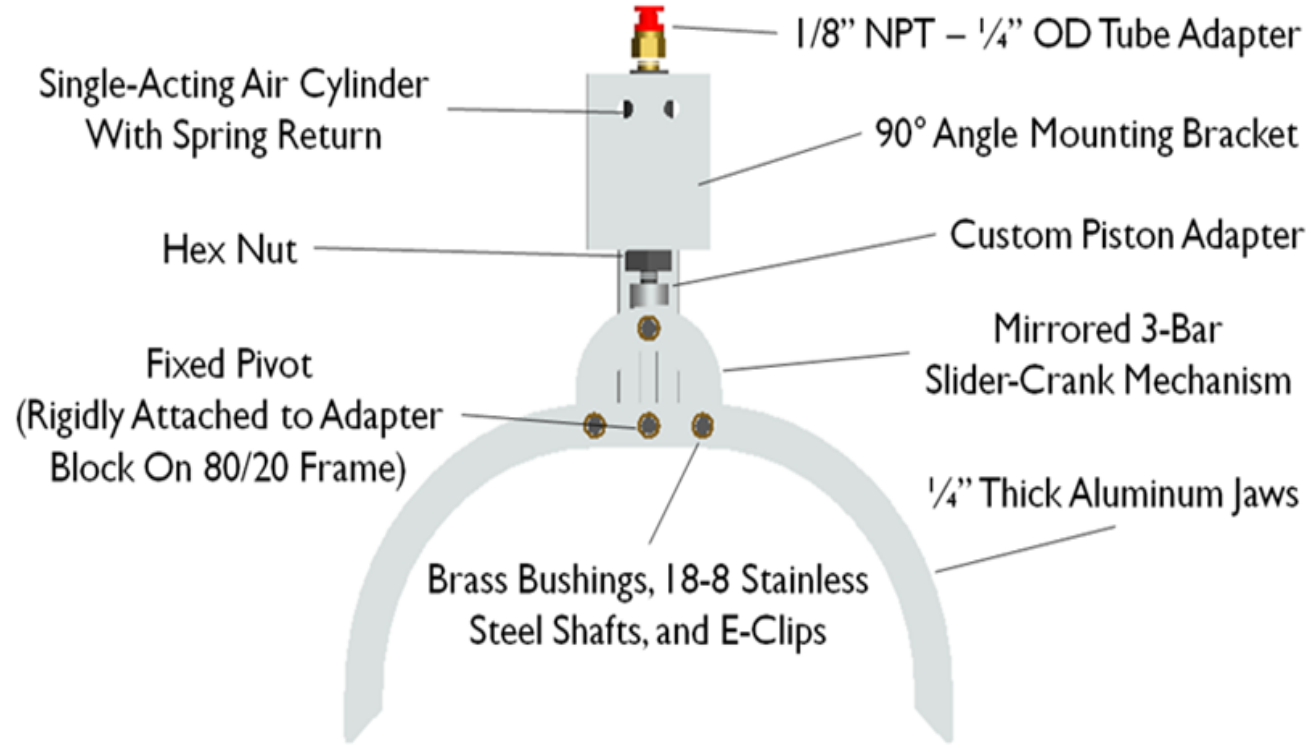
- Seabotix BTD 150 Thrusters (6)
  - Capable of delivering almost 3 lbs each
  - 4.25A with applied 19V
- L298 H-Bridge Motor Driver
  - Standard Mode (2 Motors)
    - 2A per motor
  - Bridge Mode (1 Motor)
    - 4A per motor

System Control



Pneumatic System: Claw

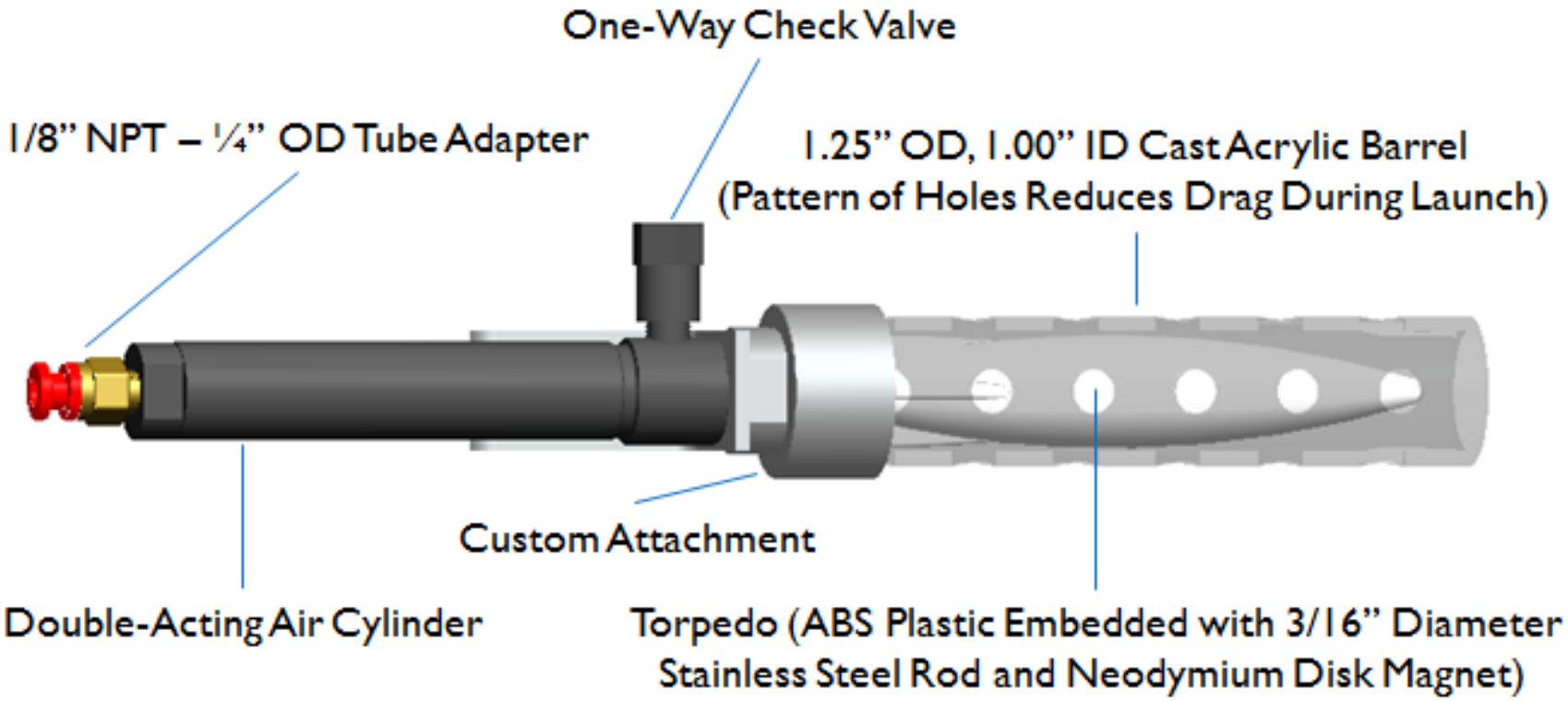
- Two actuating valves fed by air tank distributing 100psi



Extension of Air Cylinder Piston (0.5" displacement)
Causes Out-Of-Plane Jaws to Rotate Closed

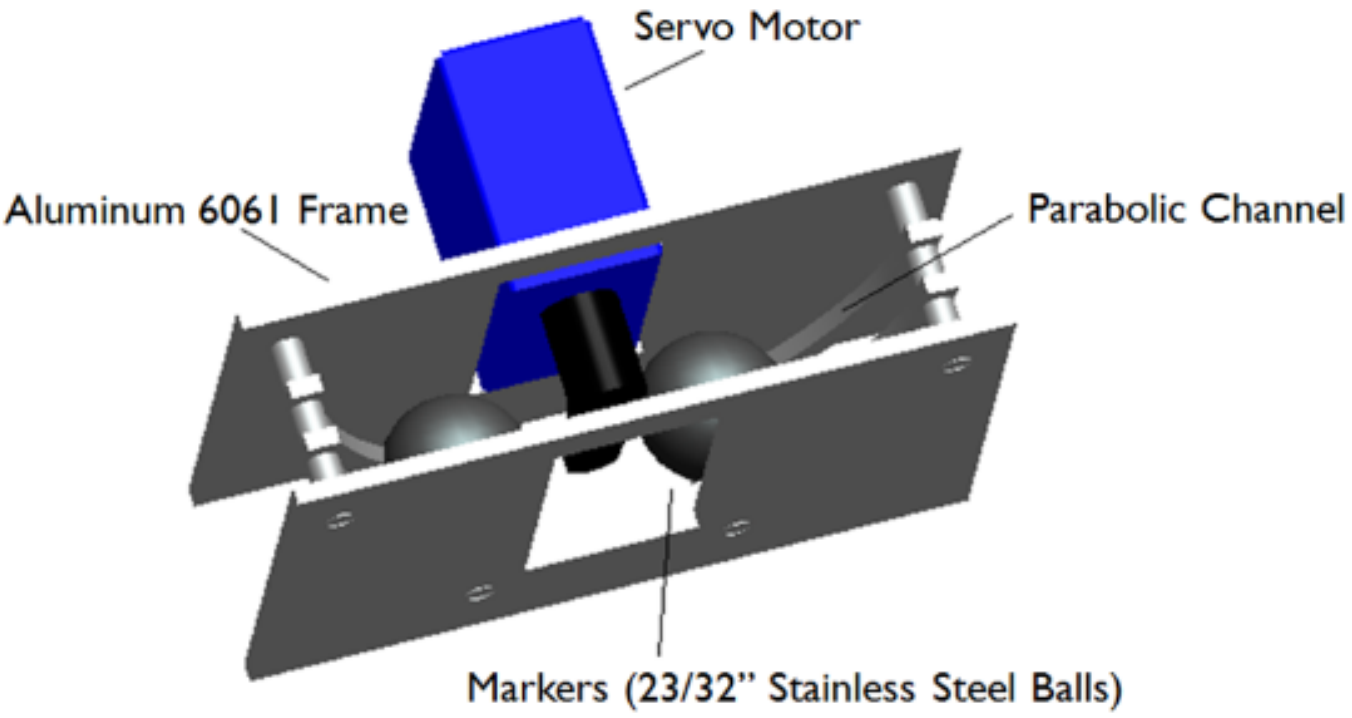
Pneumatic System: Torpedo

- Two launchers capable of 3-4ft target range.

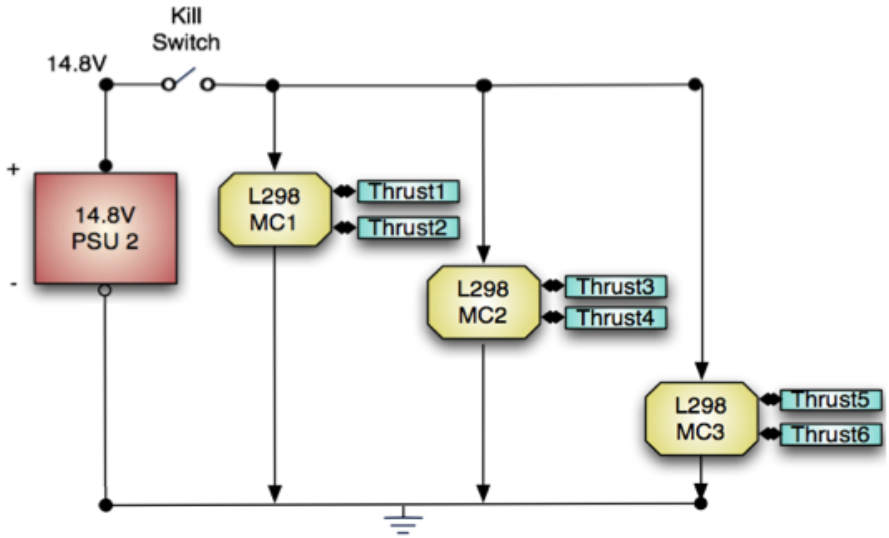


Marker Dropper

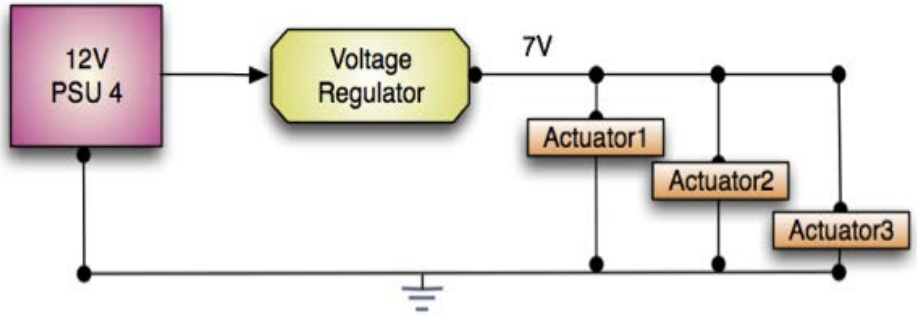
- Contains two ball markers dropped by servo motor



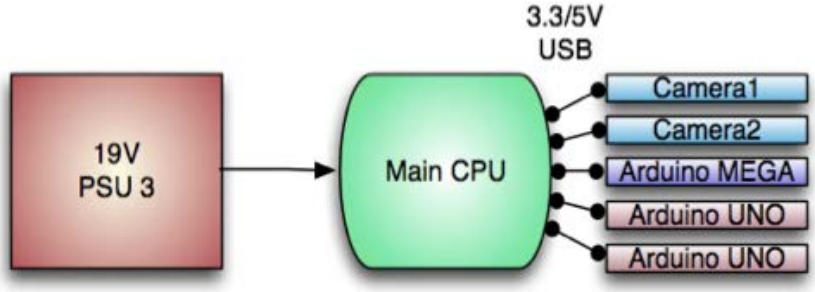
Power Distribution



Power setup for thrusters



Power setup for actuators



Power setup for computer

Power System

- 2x 14.8V Polymer Li-Ion Batteries
  - Only powering thrusters
  - Only using 1 at a time
  - 30A max discharge rate

- 1x 19v 4Ah Li-Ion External Laptop Battery
  - Powers main CPU unit
  - Lasts roughly 2-3 hours
  - Powers all USB devices

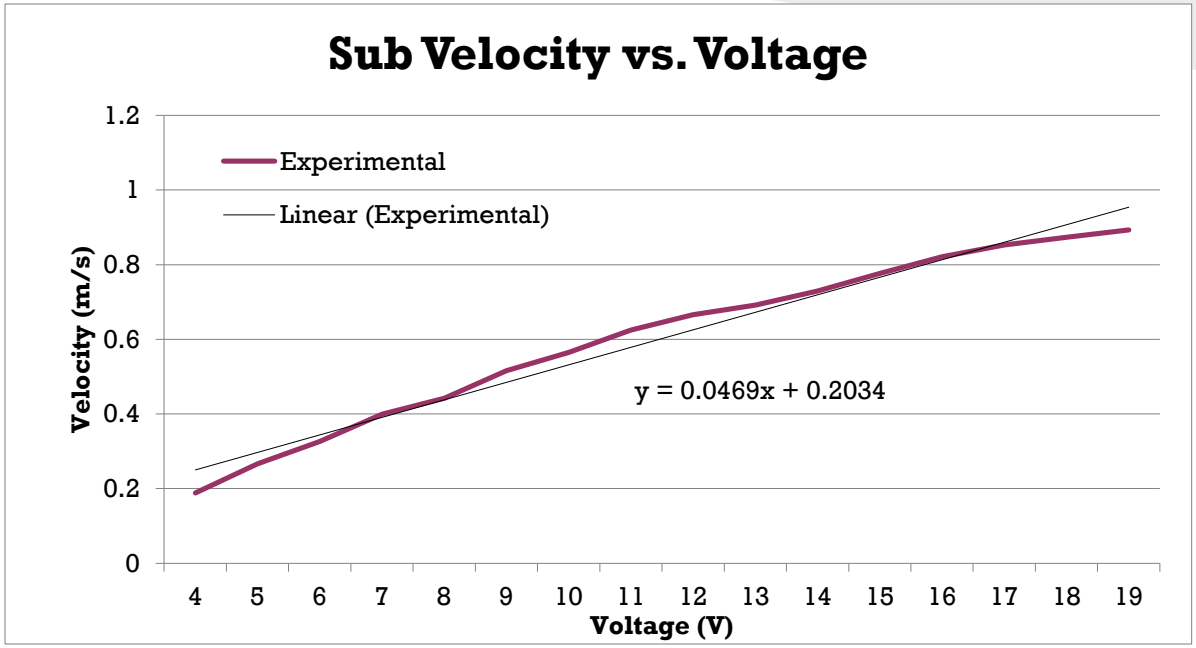
- 1x 12v Li-Ion 18650 Box Battery
  - Regulated to power actuation system
  - 4A max discharge rate

Analysis

Robosub Specifications

Test Description	Competition constraints	Actual	Outcome
Vehicle Weight	<110 lbs	90 lbs	Pass
Vehicle Balance	must be steady in water	IMU and centralized weight	Pass
Vehicle Size	< 3 ft X 3 ft X 6 ft	2.3 ft X 2.1 ft X 3.8 ft	Pass
Watertight Hull	none	watertight	Pass
Vehicle Safety	•Torpedoes do not bruise •Covered thruster blades •No contaminants can enter pool	•Torpedoes do not bruise •Shrouds on thruster •Non-corrosive batteries •Safe materials for water	Pass

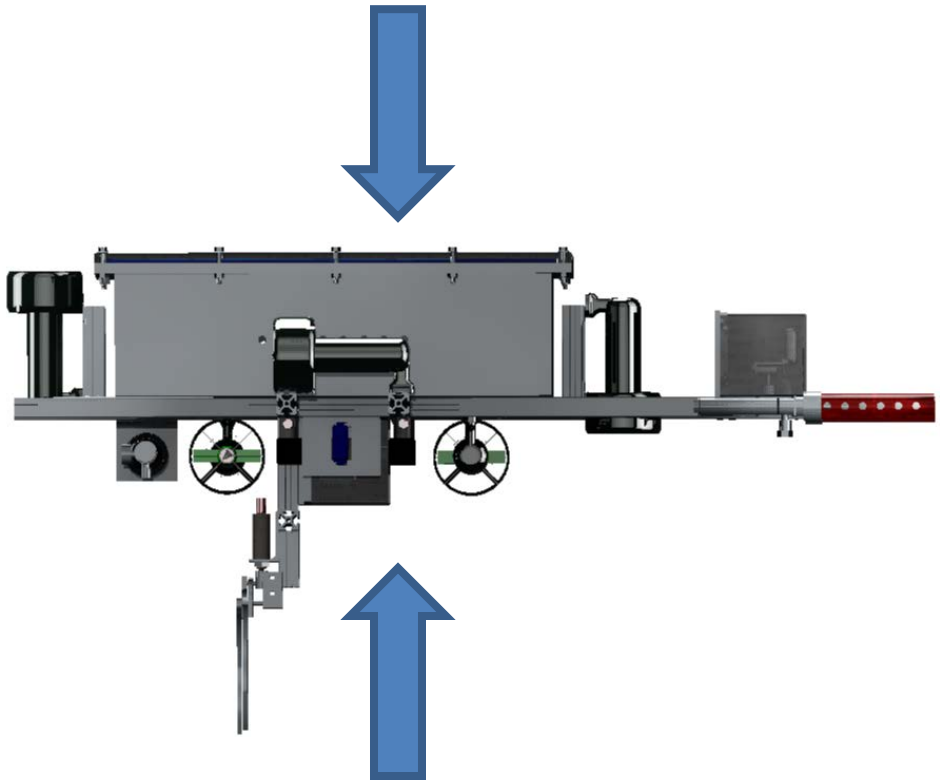
Thruster Details



- There is a linear relation between voltage and thrust as well as voltage and current draw.

Sub Buoyancy

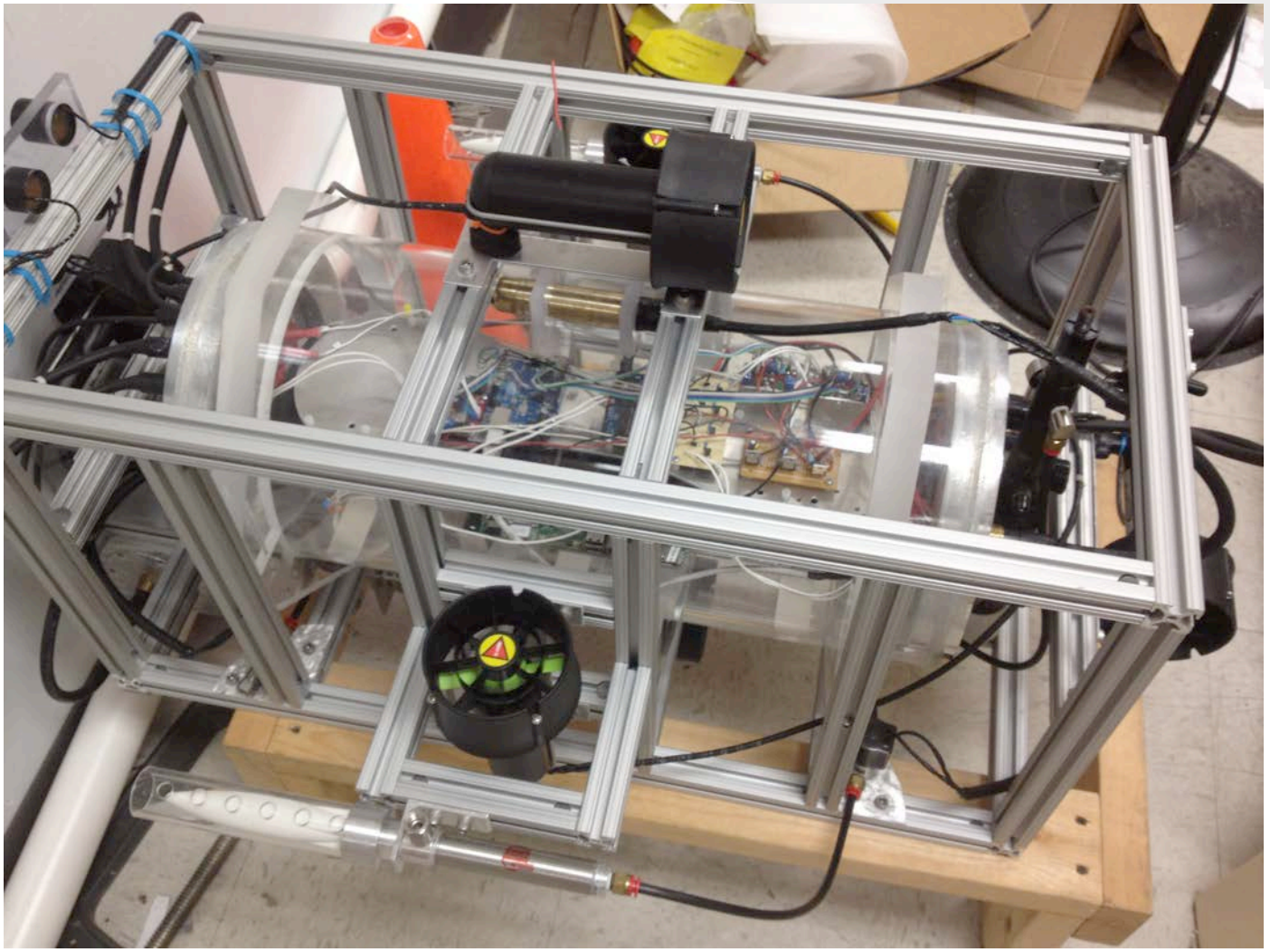
$$F_g = mg = 92\ lbf$$



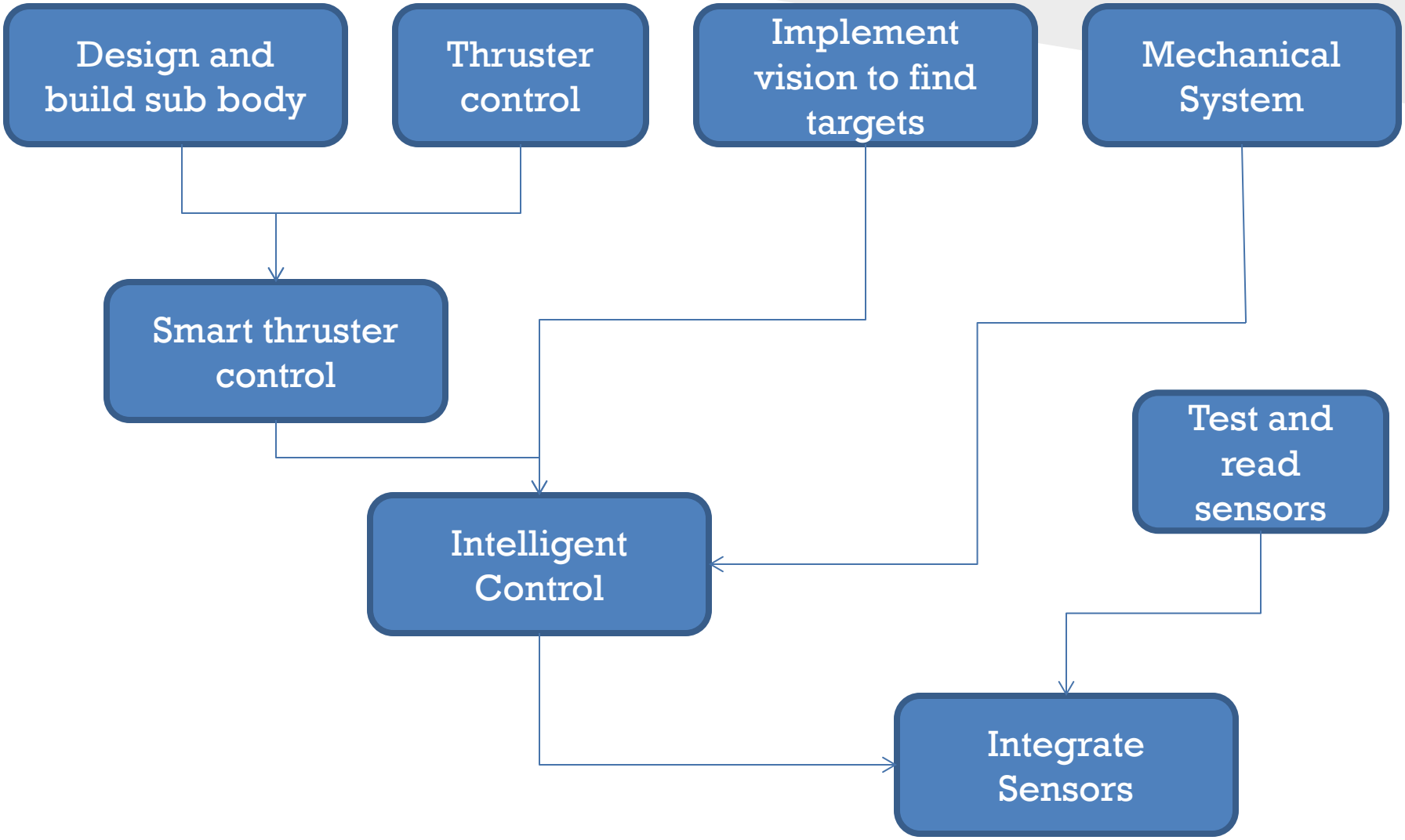
$$F_B = V_s \rho_l g = 91\ lbf$$

Progress Overview

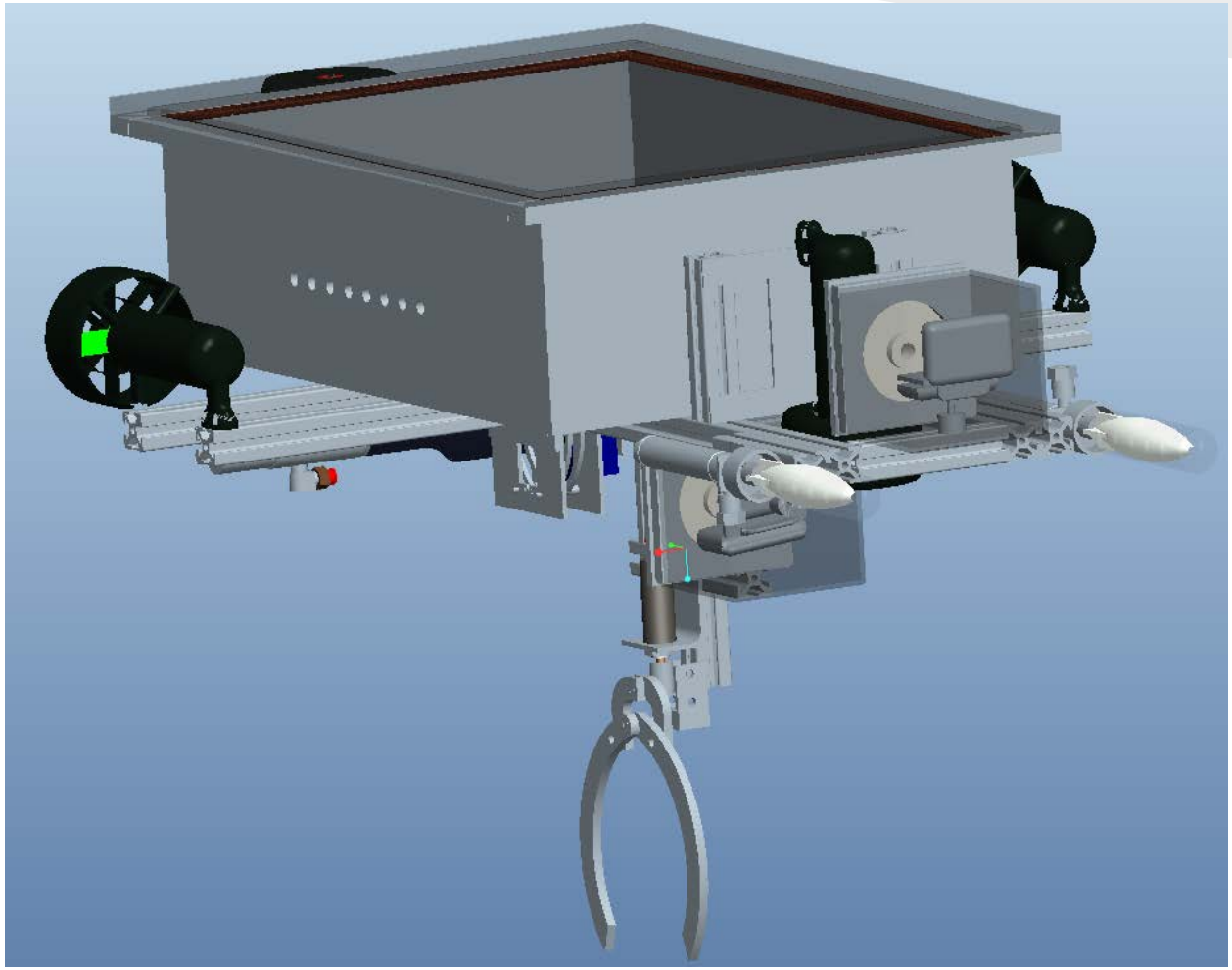
Previous Robosub



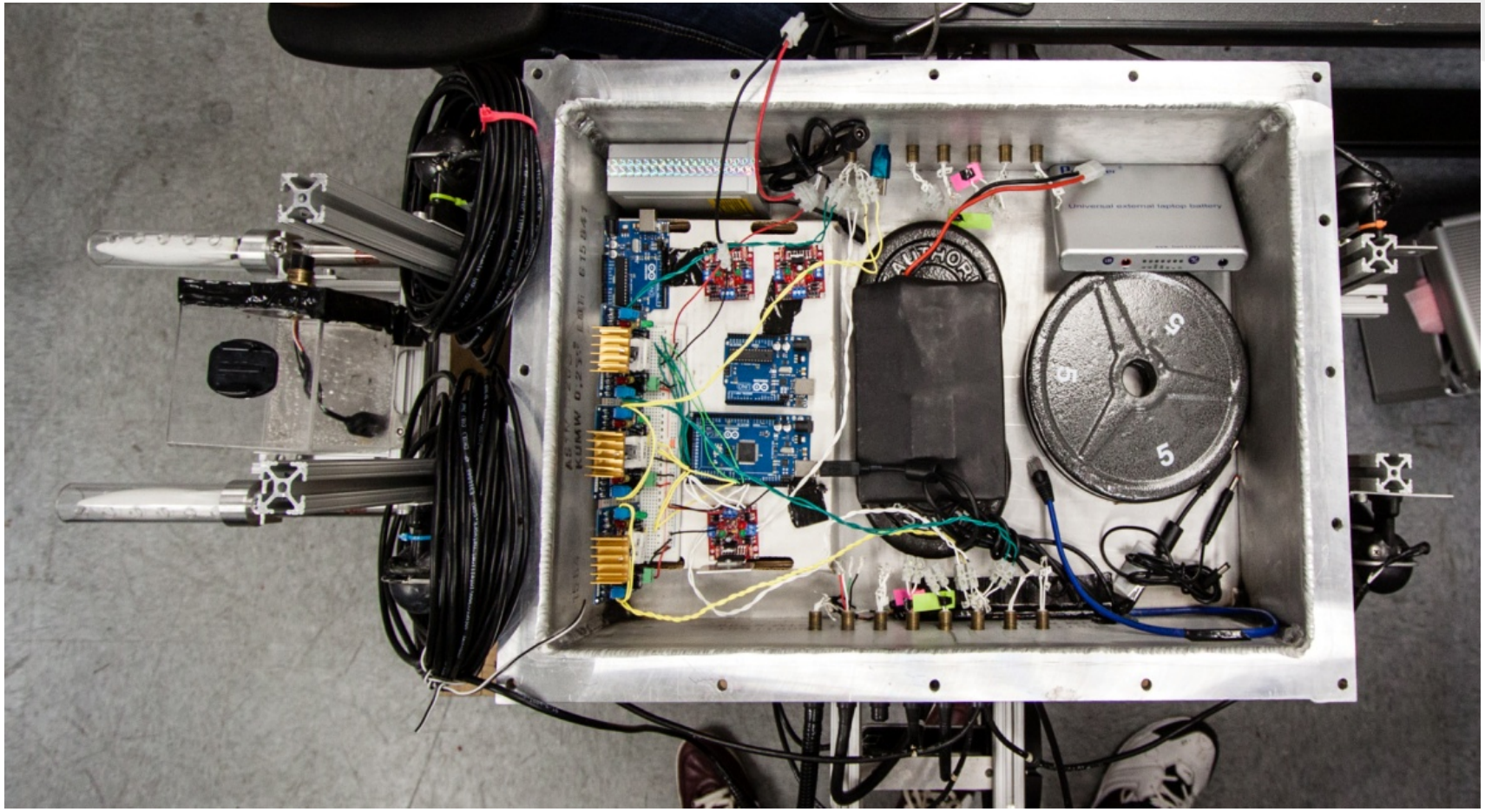
Design Process



Final Design: CAD Model



Final Design Photos



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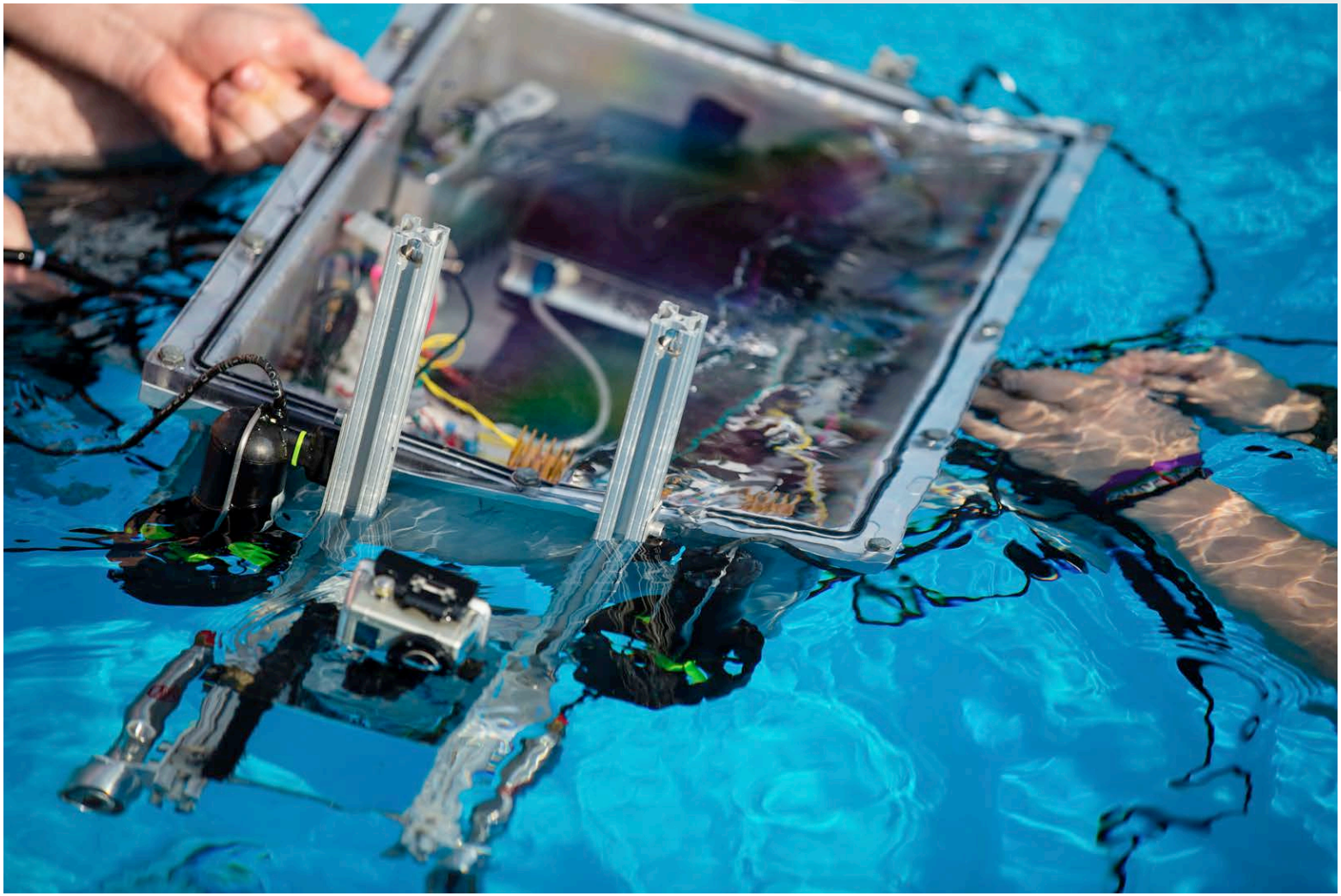
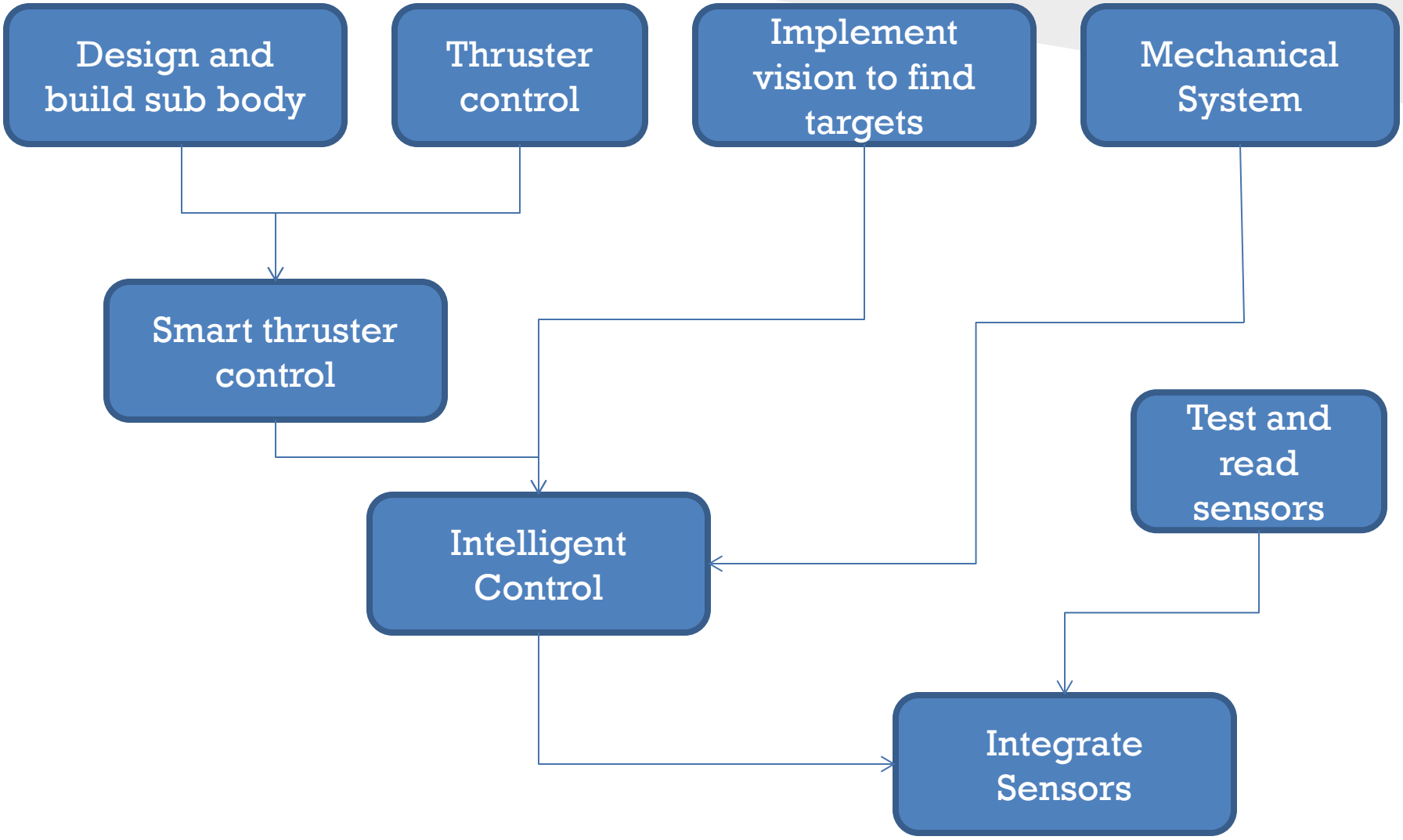
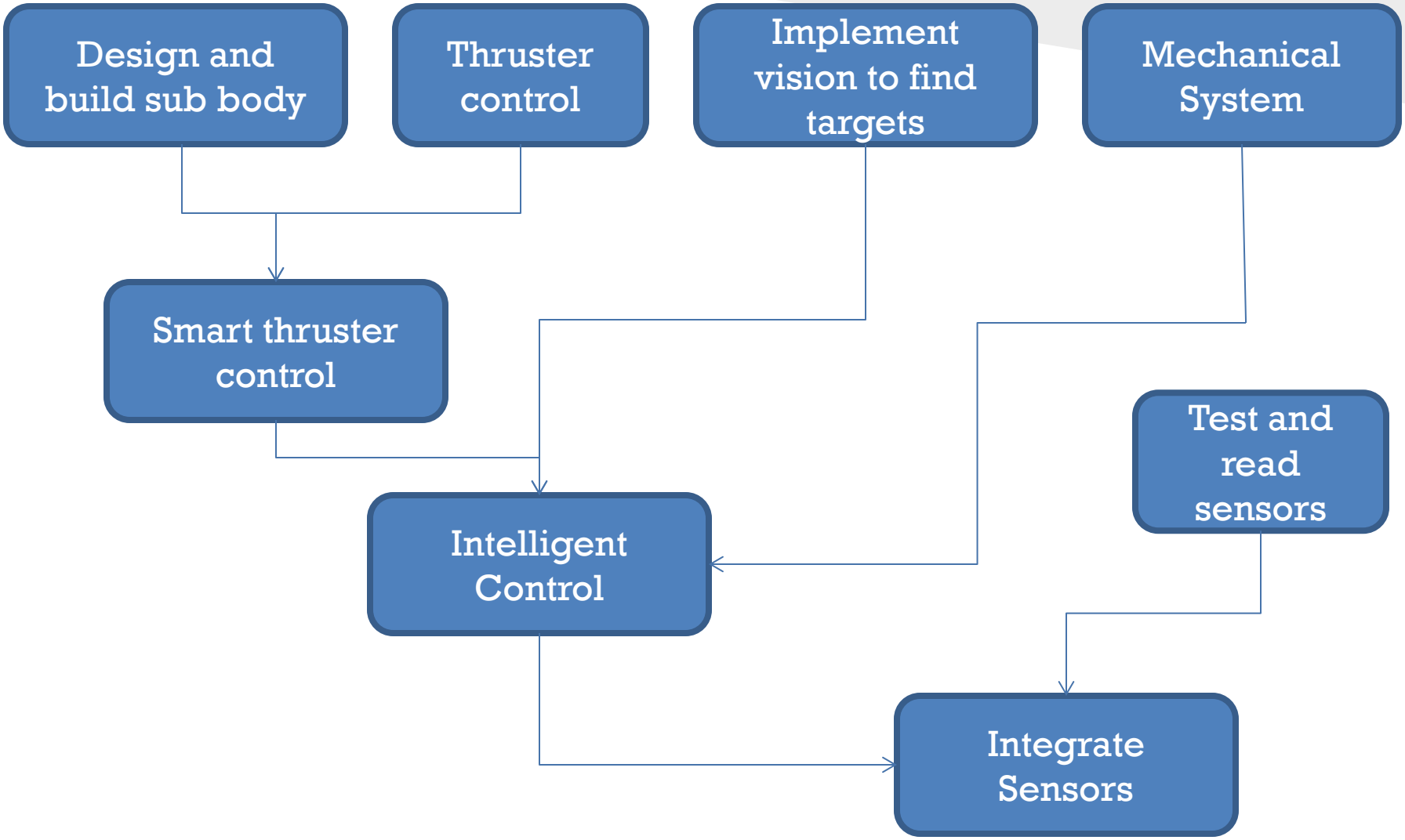


Design Process



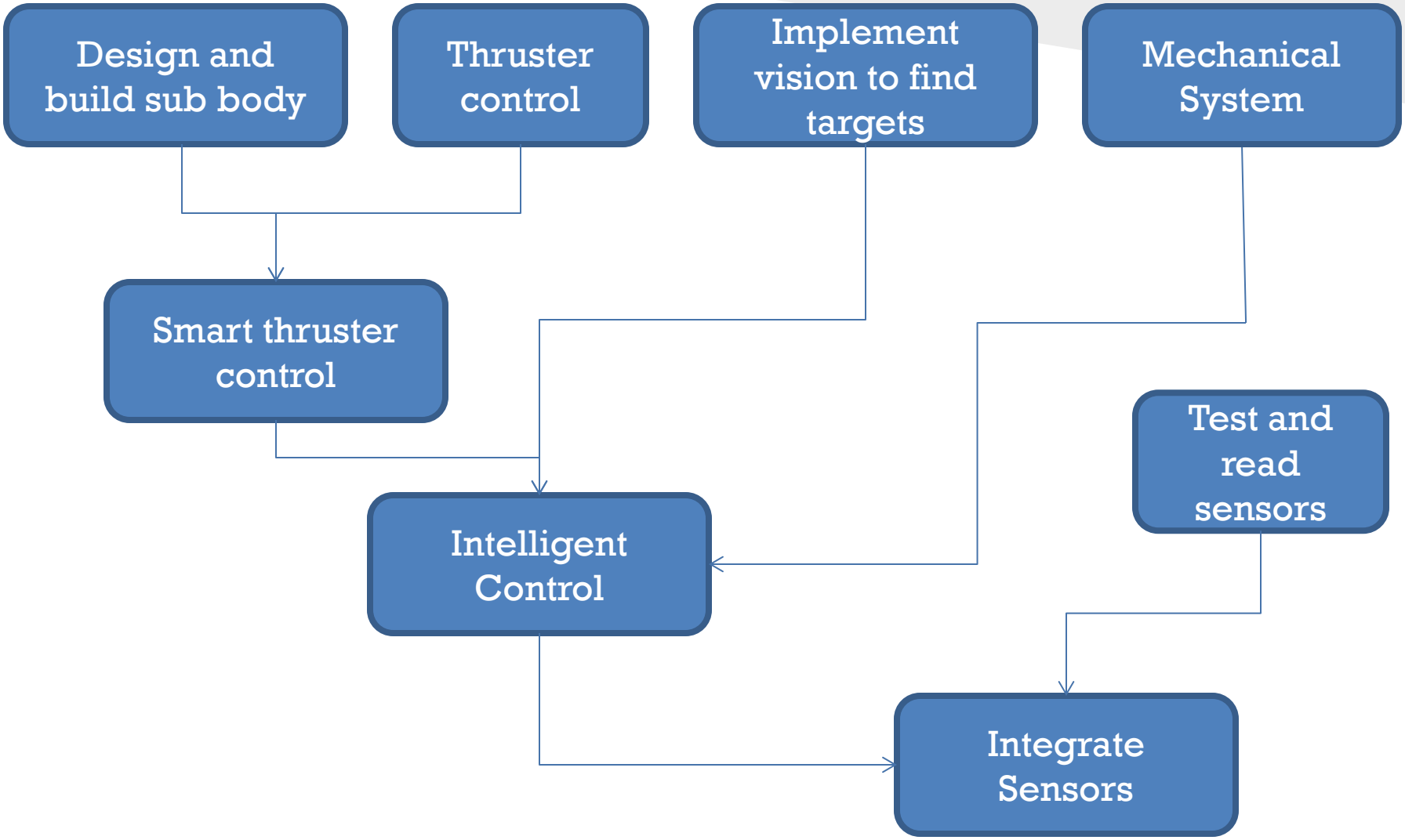
Video of Sub Moving

Design Process



Video of Object Recognition

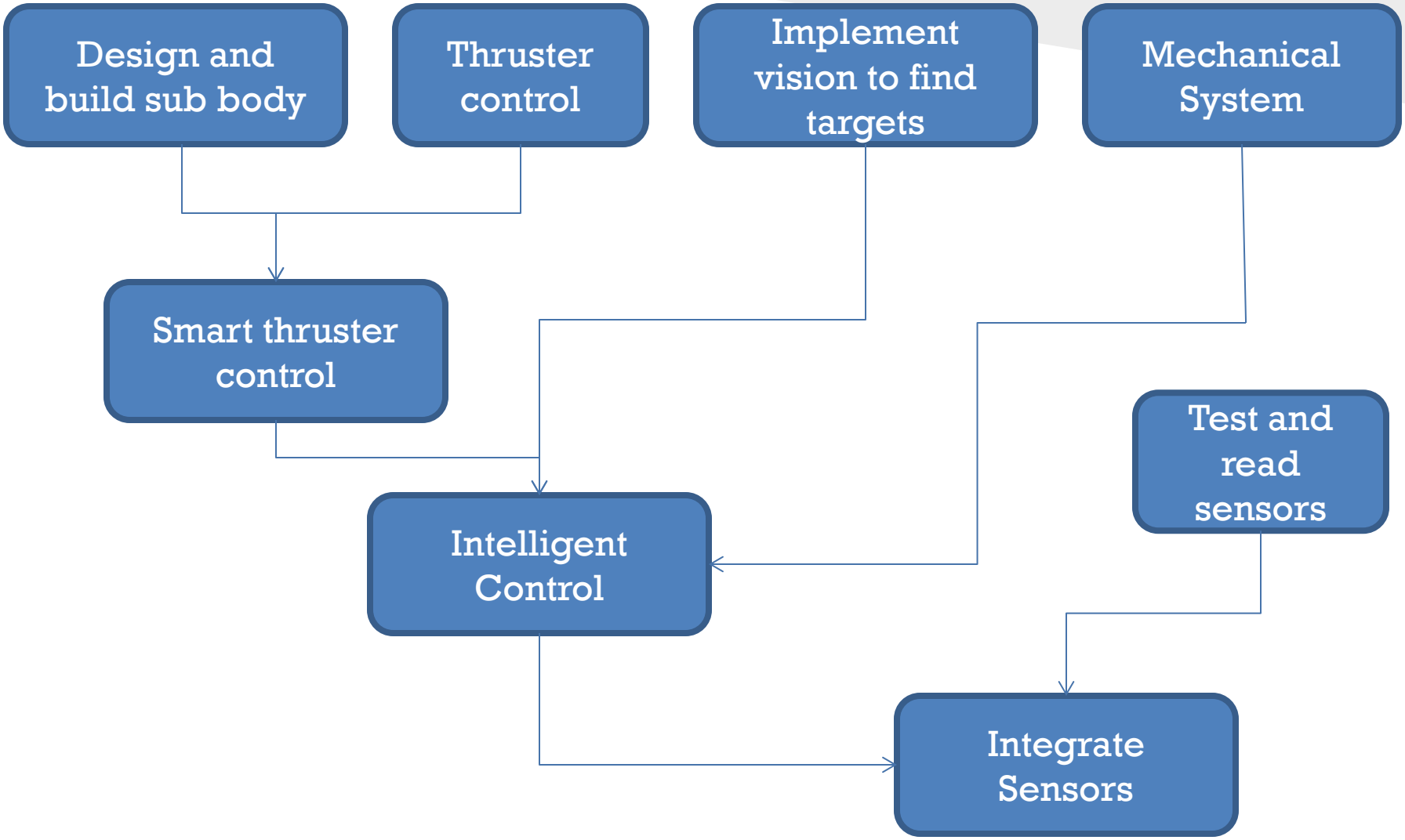
Design Process



Video of Mechanical Systems

Next Steps

Design Process

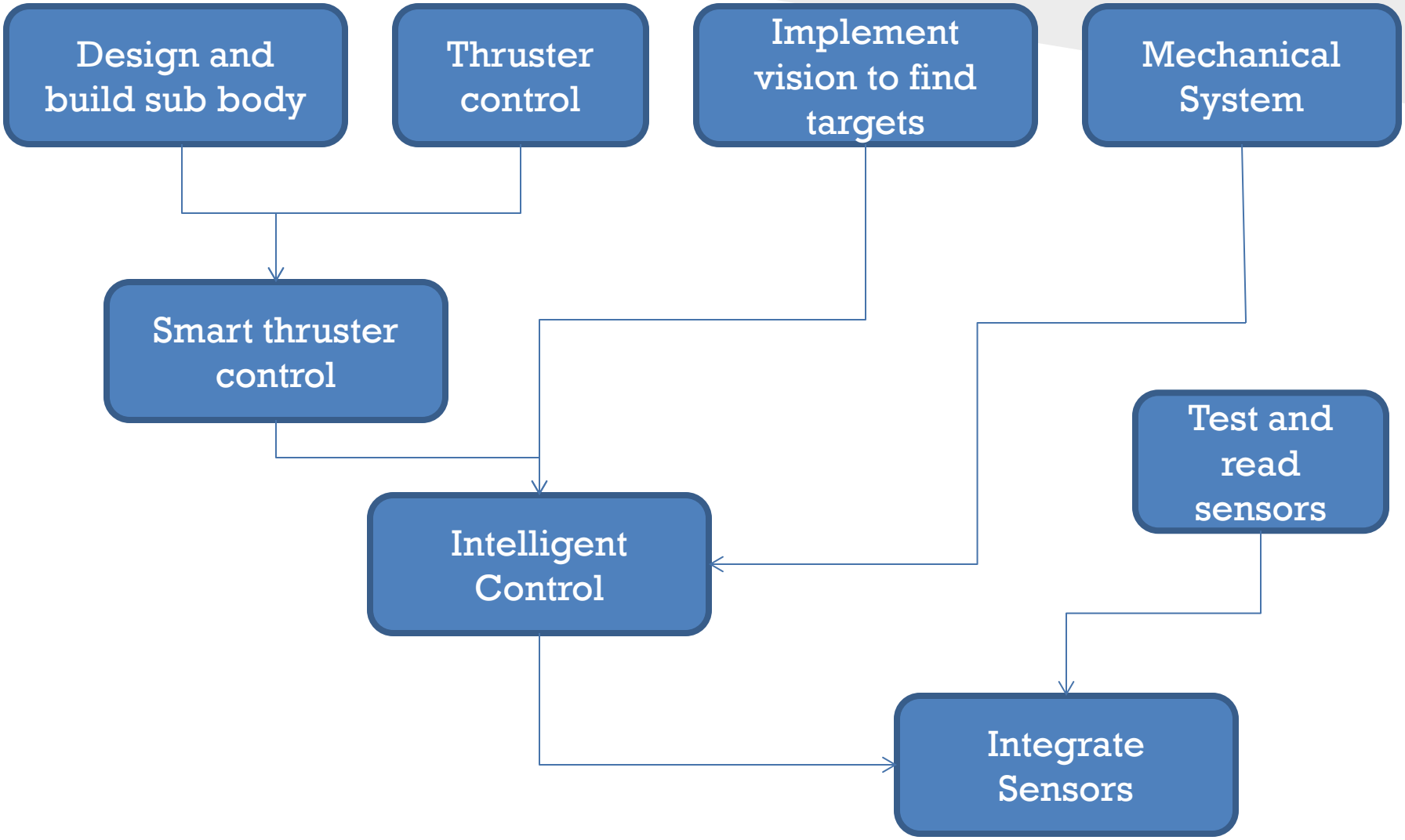


Next: Intelligent Control

- Determine target location in vision system
- Send target location to thruster controller

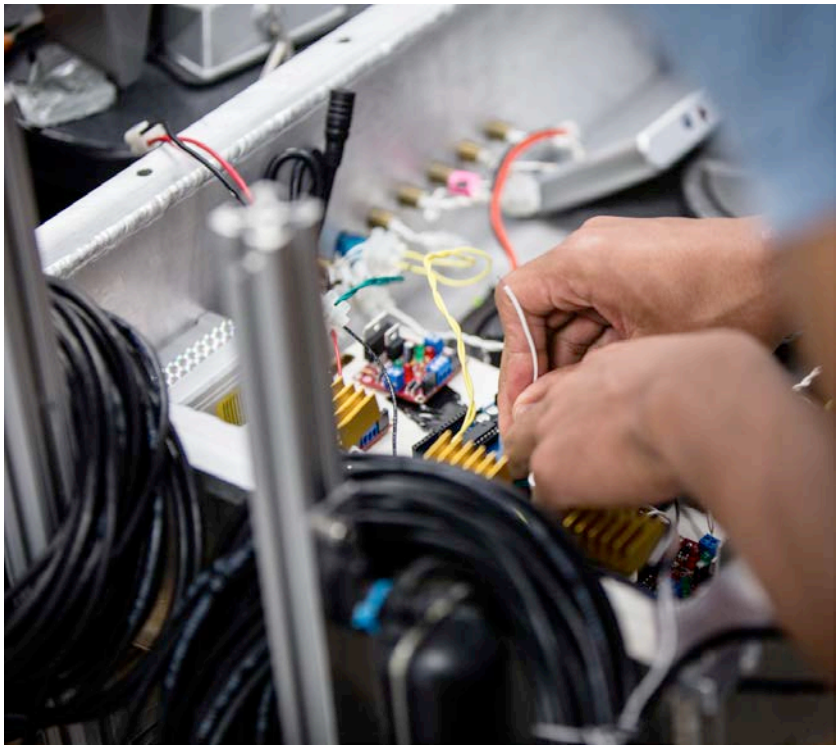
- Implement thruster control algorithm
  - Experimental measurements and calculations

Design Process



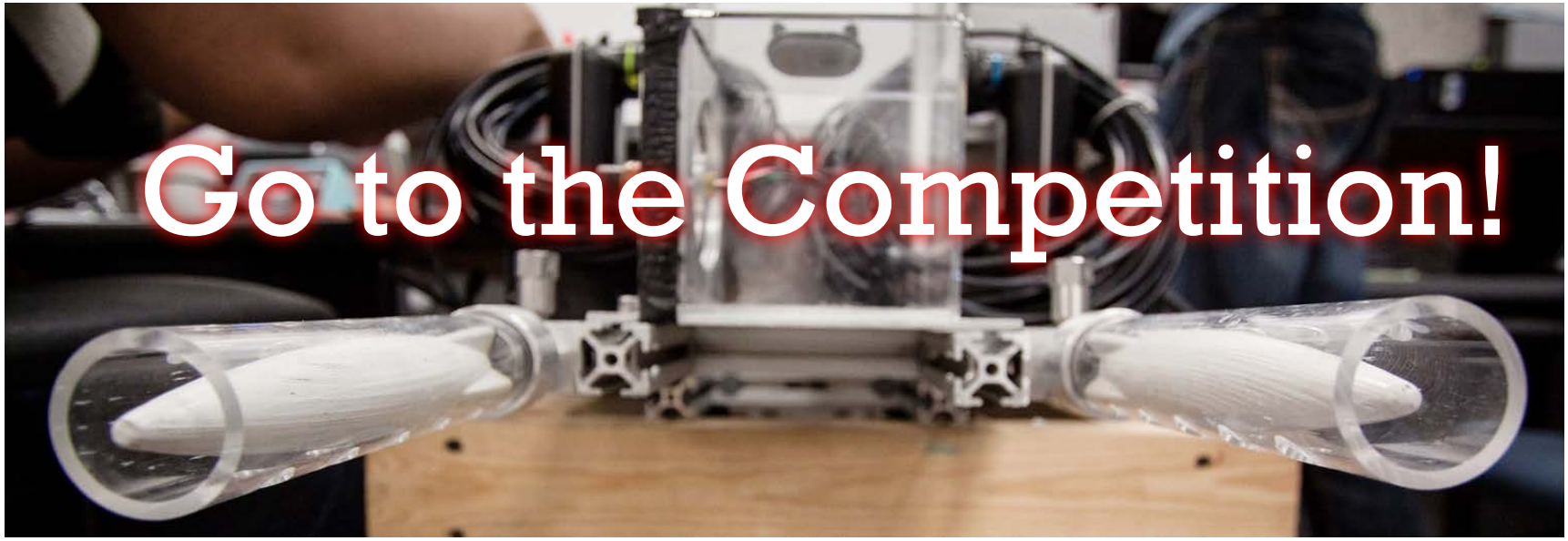
Next: Integrate Sensors

- Interpret data from pressure sensor for depth control
- Obtain pitch, yaw, and roll of sub from IMU data
- Combine to get precise controls and movement of sub



Schedule

- Continue development and testing of sub this summer
- Create documentation concerning components and electronics for next year's team



References

Kelly, Kurran, and Pedrow Brandt. *Robosub AUV Thruster Analysis*. Rep. RoboSub Club of the Palouse, 7 Dec. 2012. Web.16 Mar. 2013.

Jepson, Antony, Ryan Kopinski, Tra Hunter, Eric Sloan, Kashief Moody and Hang Zhang. *AUVSI Robosub 2012 AUVSI Robosub 2012*. FAMU/ FSU College of Engineering, 15 Apr. 2012. Web.

Questions?

Ask away!