ROBOSUB – TEAM 4

Requirements and Needs Analysis

October 2014

Dennis Boyd

- Lead Programmer, Web designer
  - Primary programmer
  - Develop and maintain the webpage

Elliot Mudrick

Bjorn Campbell

- Treasurer, Electrical systems
  - Responsible for money
  - Acquisition of parts
  - Power and heat distribution in the sub
  - Circuit design

Elliot Mudrick

Samantha Cherbonneau

- Programmer, Secretary
  - Documents group minutes
  - Manages and finalizes documents
  - Responsible for writing code allocated by lead programmer

Elliot Mudrick

Kevin Matungwa

- Programmer, Vice Team Leader
  - Assumes team leader responsibilities when required
  - Responsible for writing code allocated by lead programmer

Elliot Mudrick

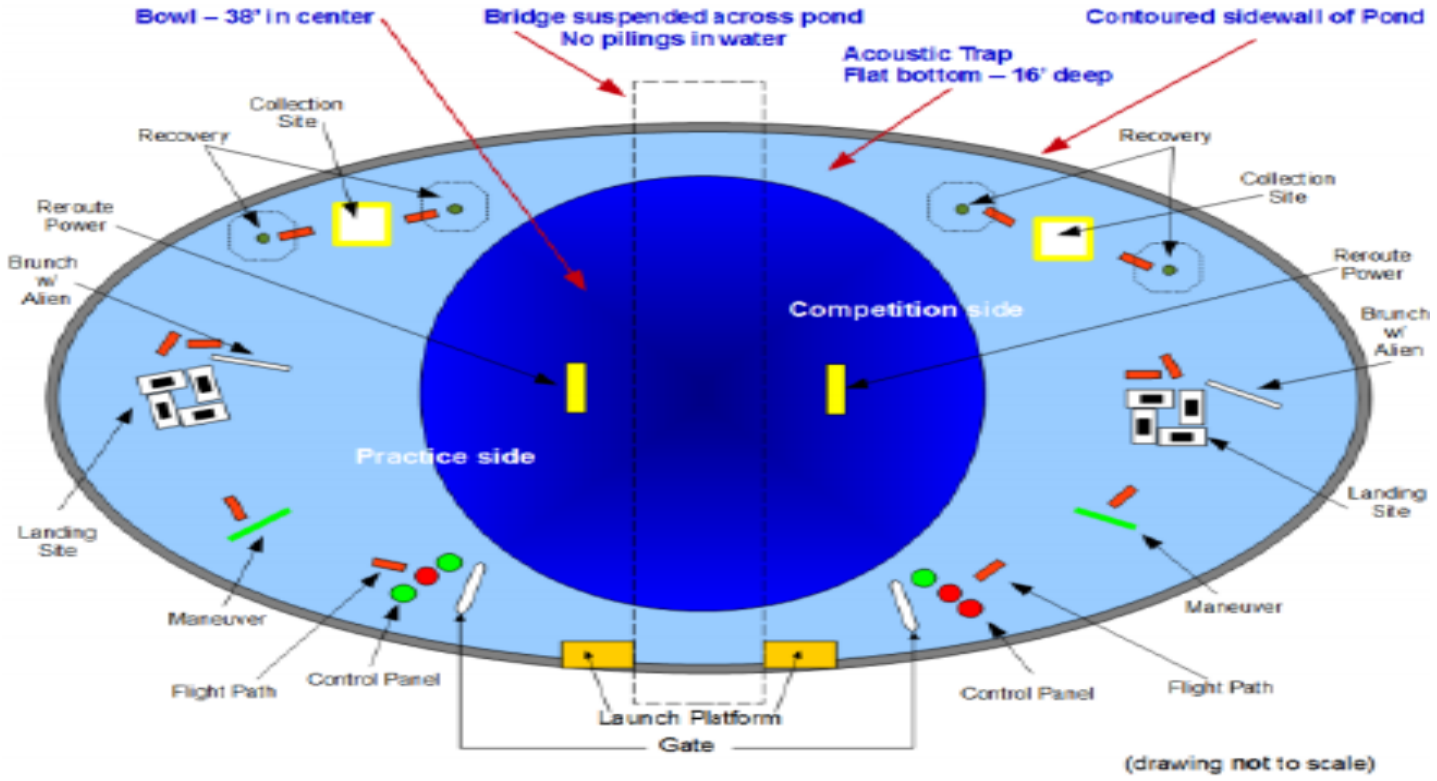
Elliot Mudrick

- Team leader, Programmer, Web designer
  - Responsible for timelines
  - Team coordination
  - Programming tasks assigned by lead programmer
  - Develop and maintain the webpage

Elliot Mudrick

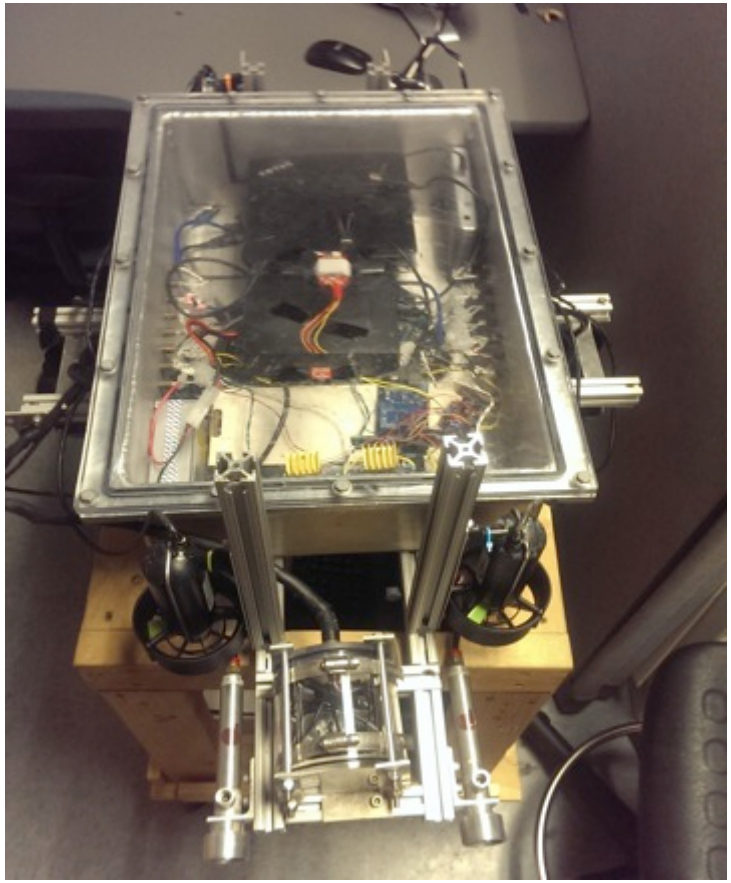
Overview of the RoboSub Competition

- Association for Unmanned Vehicle Systems International (AUVSI)



Elliot Mudrick

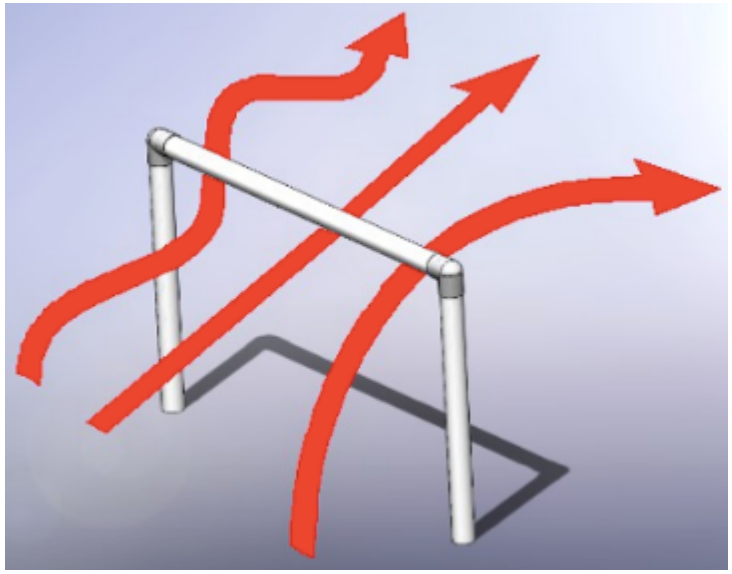
Overview of the Current RoboSub

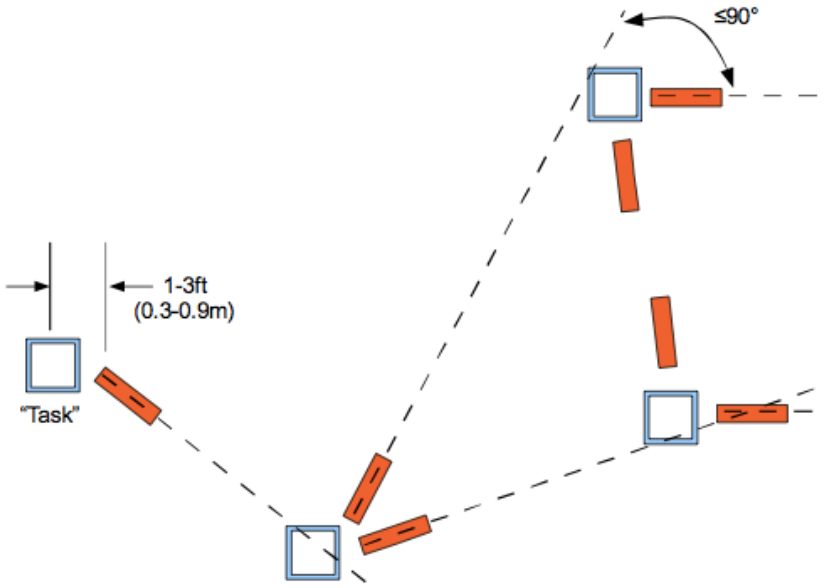


Elliot Mudrick

Required Capabilities

- Run autonomously
- Pass through the validation gate
- Follow a path of orange line segments that guide the sub between tasks

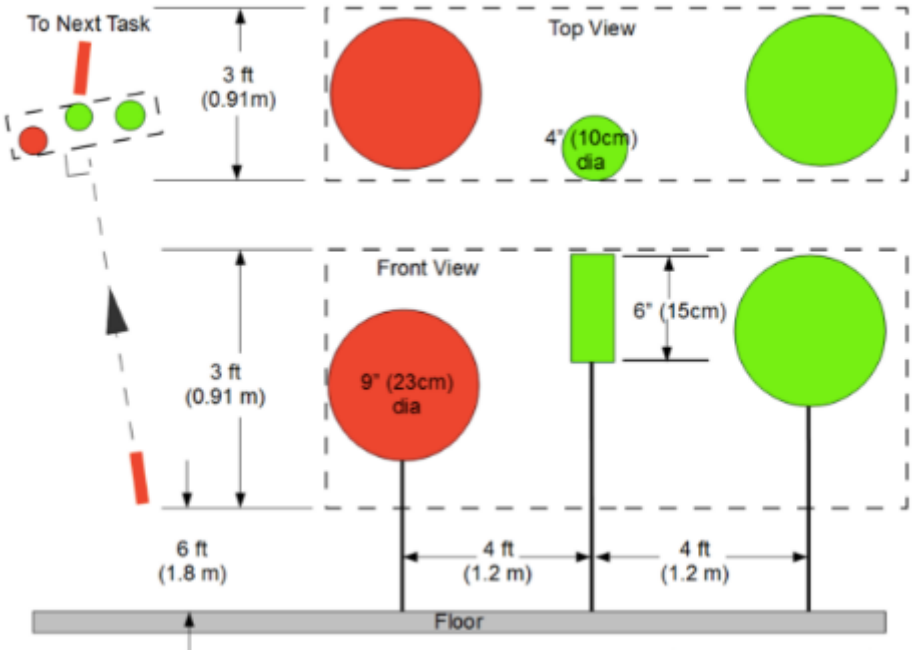


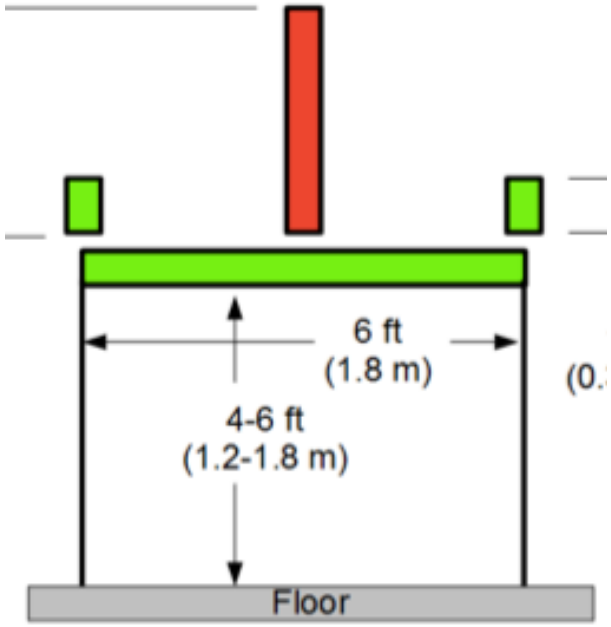


Sam Cherbonneau

Desired Capabilities

- Movement & Color Recognition
  - Bump a buoy until on proper LED color
  - Maneuver around/over PCV based on color and location of risers

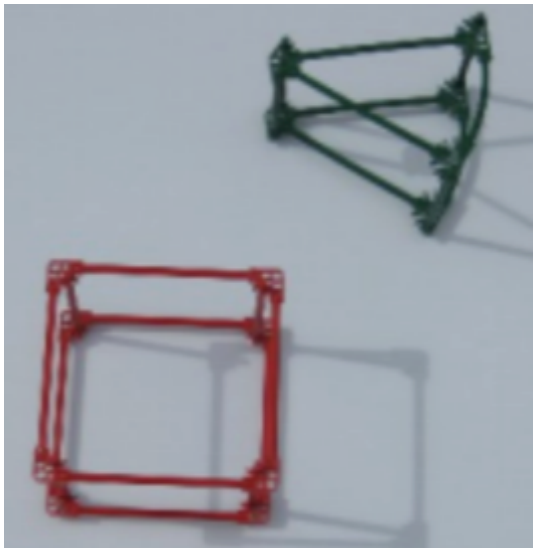


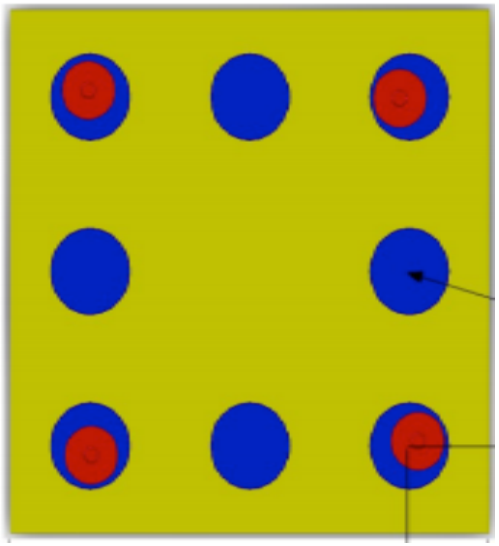


Sam Cherbonneau

Desired Capabilities

- Gripping, Shape & Color Recognition
  - Drop marker in a bin with primary alien target, another in a bin with secondary alien target
  - Grab colored objects and deliver to box
  - Remove power pins and then place back

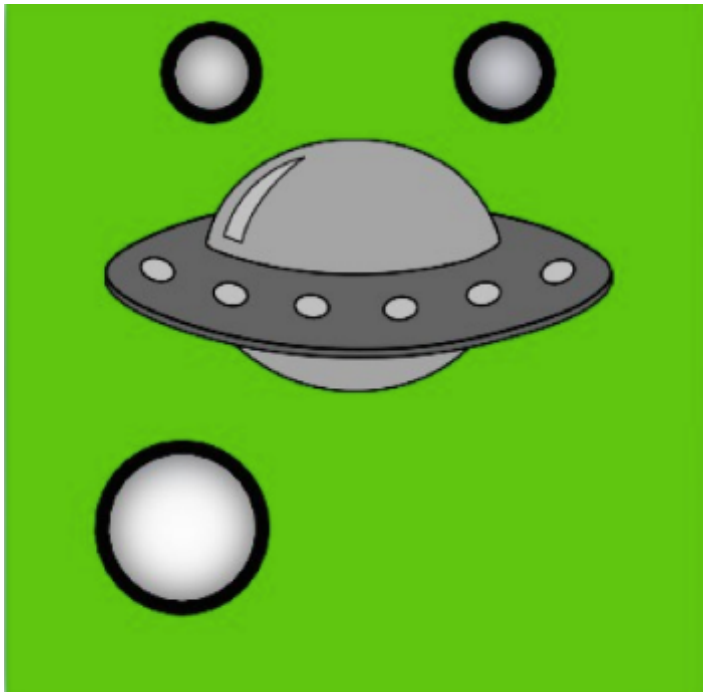


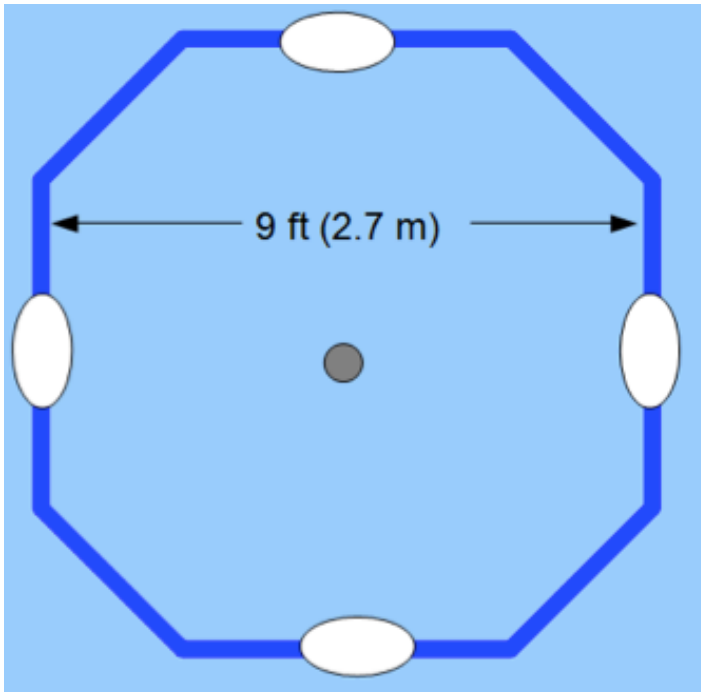


Sam Cherbonneau

Desired Capabilities

- Precision
  - Fire a torpedo through a small hole in a target
  - Surface inside octagon based on acoustic pinger placement





Sam Cherbonneau

Functional Requirements

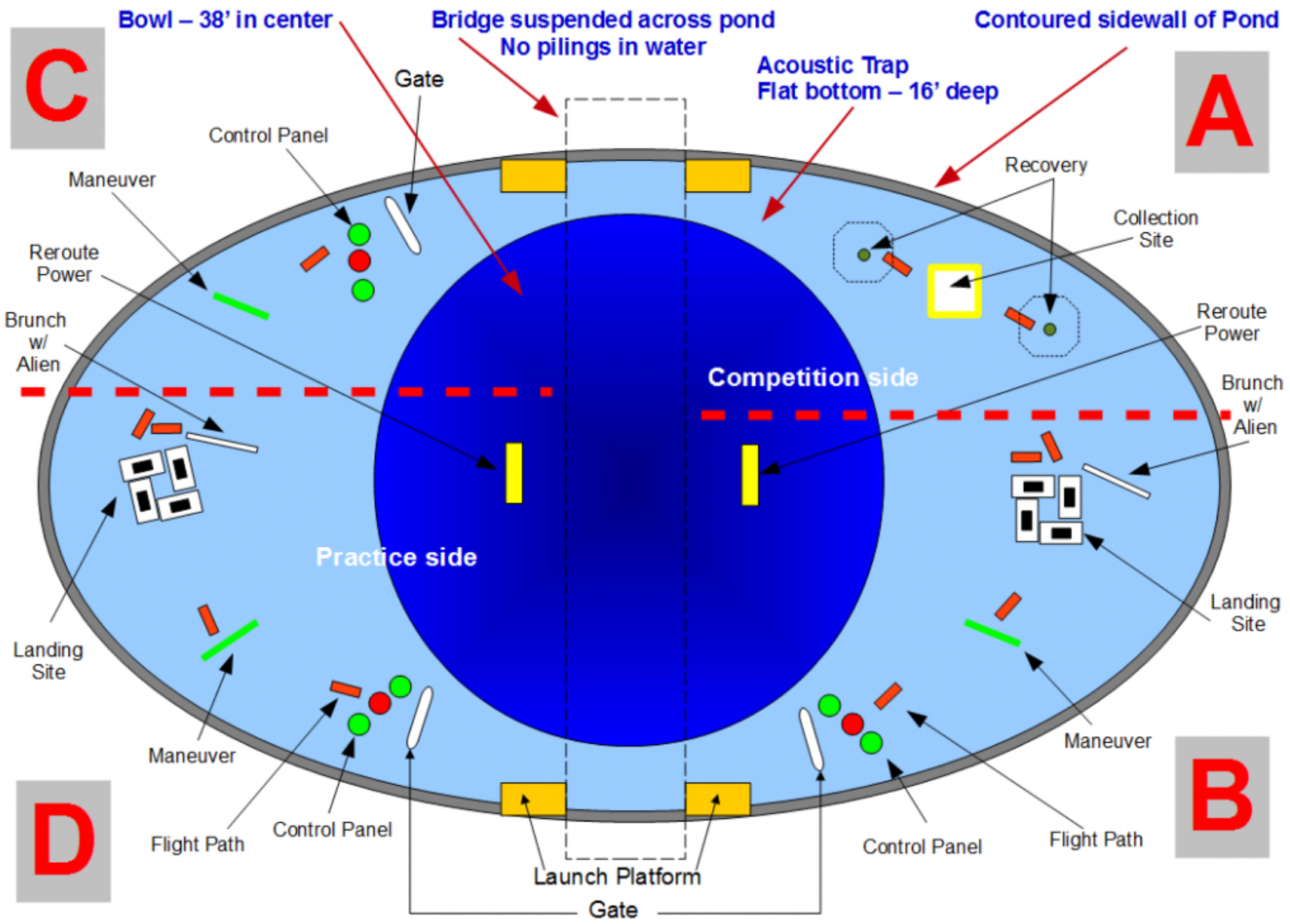
- Path
- Control Panel Buoy
- Maneuvering
- Landing Site
- Brunch
- Reroute Power
- Recovery Area
- Interference
- Acoustics

Bjorn Campbell

Path

- Consists of Line Segments
- Made of Aluminum Sheets
  - 6” wide by 4’long
    - Raised off the floor 1’-2’
    - Blaze Orange Duke tape
- Line Segments are like Arrows
- Start at the Control Panel
  - Maneuvering area
  - Landing Site/Brunch
    - 2 Different paths
      - One points to Reroute Power
      - One Points to Recovery area

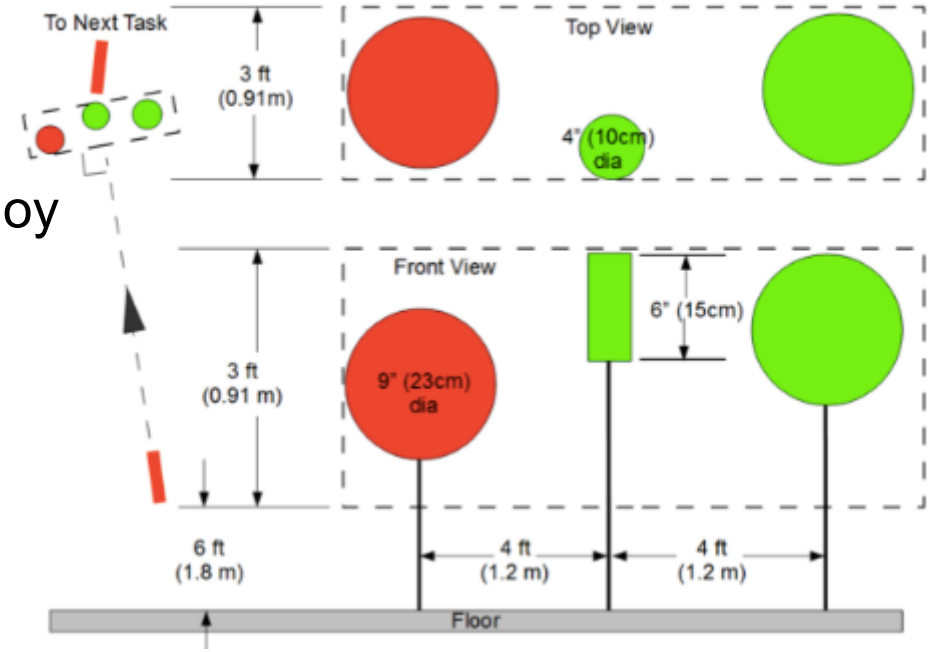
Bjorn Campbell



Bjorn Campbell

Control Panel

- 3 Moored Buoys
  - RED/GREEN/BLUE (RGB) buoy
    - 4” diameter and 15” long
  - RED buoy
    - 9” diameter
  - GREEN Buoy
    - 9” diameter



  - RGB buoy Cycles through Red and Green every 5 seconds
    - Most points received by turning the RGB buoy Green
    - Points awarded for touching the Red then the Green Buoy

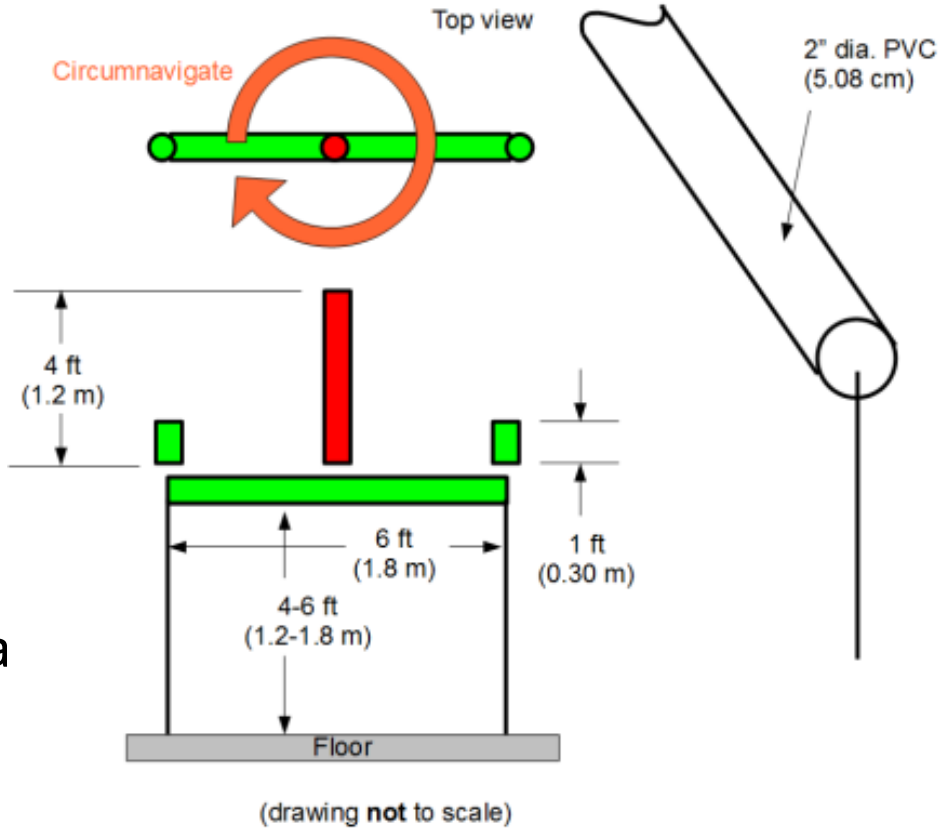
Bjorn Campbell

Maneuvering

- Platform
  - 6’ long 2” diameter PVC Pipe
  - 1’ Raisers on the Sides
  - 4’ long 2” diameter PVC pipe Center A

- 2 Different ways to Navigate
  - First move your sub between a side ledge and the Center

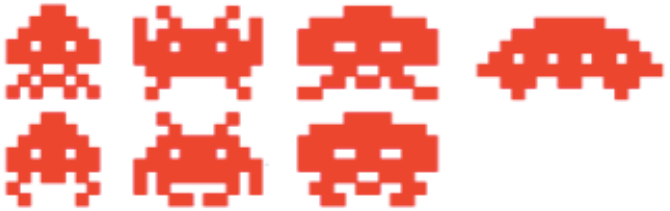
  OR
  - Circumnavigate around the center PVC



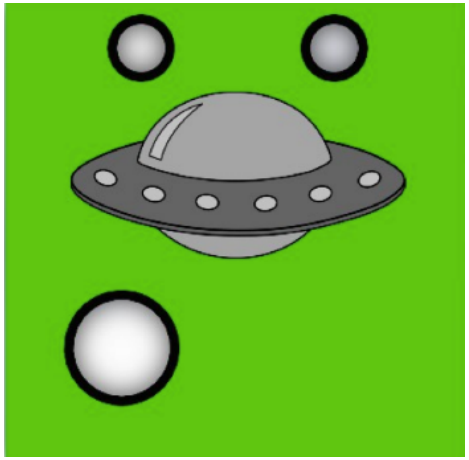
Bjorn Campbell

Landing Site / Brunch

- Landing Site
  - BLACK bins surrounded by a white border.
  - Drop Markers into the Primary Bin
  - Primary Bin determined by an Alien silhouette.



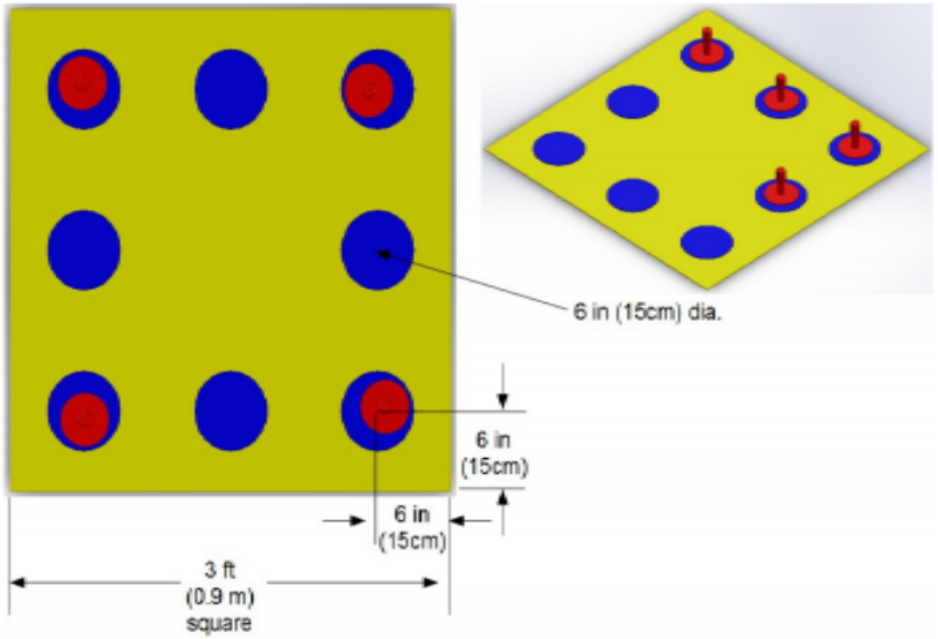
- Brunch
  - Single Square Green Board
    - Spacecraft in the center
    - Above the Spacecraft are 4X5” holes with 7” black borders
    - Below the Spacecraft are 2X10” holes with 12” black borders



Bjorn Campbell

Reroute Power

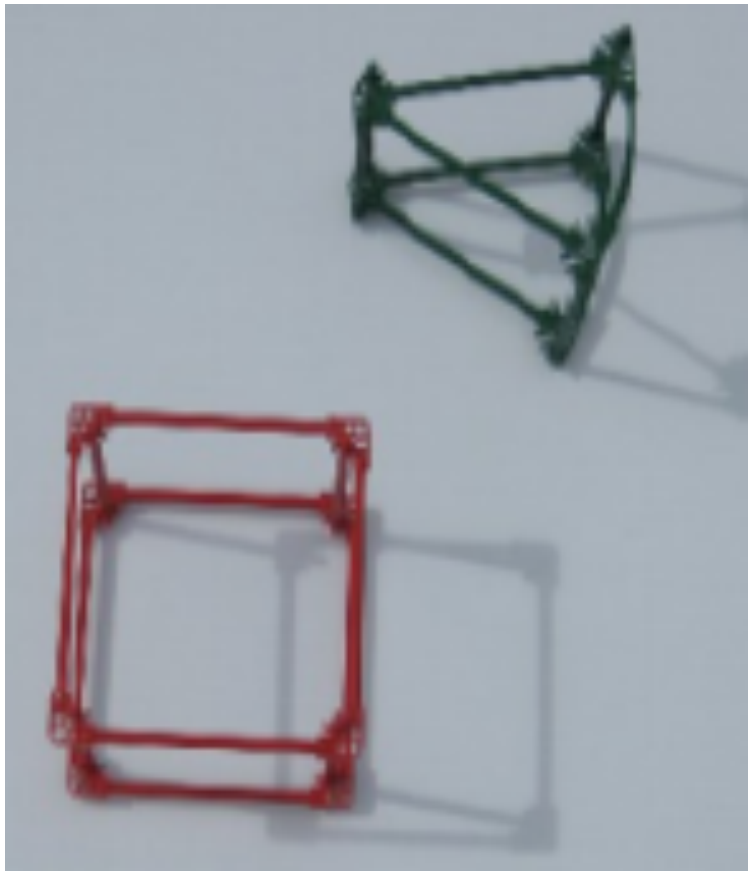
- 8 Blue circles arranged on a 36” yellow square
- 4 Red Power Pins
- Remove 1 Red Power Pin and place the Power Pin in an unoccupied blue circle



Bjorn Campbell

Recovery

- Two different Recovery Areas
- Directly above Acoustic pinger will determine the location of the Sample Box
- Recovery Area is an Octagon of ½" PVC pipe in a "diameter" of 9 ft
- Travel to Collection Site by Path line
- Remove mars rocks/cheese from the Collection Site and place them in the Sample Box.



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Interference / Acoustic Pinger

- Interference
  - The AUV will not interfere with course components otherwise disqualification can occur.

- Acoustic Pinger:
  - Teledyne Benthos ALP-365 pingers
    - They can be set from 25-40 kHz in 0.5 kHz increments.

Bjorn Campbell

Non-Functional Competition Requirements

- Journal Paper
  - 10 Pages describing the rationale behind the design.
  - Video introducing the team, the sub, and strategies for the competition

- Resumes
  - Zipped to the Journal Paper.
  - Encouraged by AUVSI
  - Benefit to the Competitors

Bjorn Campbell

Constraints

- Based on the 2014 Competition
- Will be different this year (hopefully similar)
- Set ground rules for what sub can compete
- Will dictate how certain components and systems may be designed

Dennis Boyd

Weight Constraints

- The below table will determine the weight requirements of the AUV:

Table 1: Size and weight constraints on AUVs entered into the competition.		
	Bonus	**Penalty**
AUV Weight > 125 lbs (AUV Weight > 56.7 kg)	N/A	**Disqualified!!!**
125 lbs ≥ AUV Weight > 84 (56.7 kg ≥ AUV Weight > 38 kg)	N/A	**Loss of** 250 + 5(lb – 125) 250 + 11(kg – 56.7)
84 lbs ≥ AUV Weight > 48.5 (38 kg ≥ AUV Weight > 22 kg)	**Bonus of** 2(84 – lb) 4.4(38-kg)	N/A
AUV Weight ≤ 48.5 lbs (AUV Weight ≤ 22 kg)	**Bonus of** 80 + (48.5 – lb) 80 + 2.2(22-kg)	N/A

- Required: <= 125 pounds

Dennis Boyd

Basic Constraints

- Only one vehicle per team.
- Judges may disqualify a vehicle for unreasonable safety hazards.
- Vehicles must operate autonomously.
- All vehicles are battery powered. All batteries must be sealed. Maximum DCV will not exceed 60 V for the batteries or battery systems.
  - Significant restraint for computer, controllers, motors, etc.

Marker & Torpedo Constraints

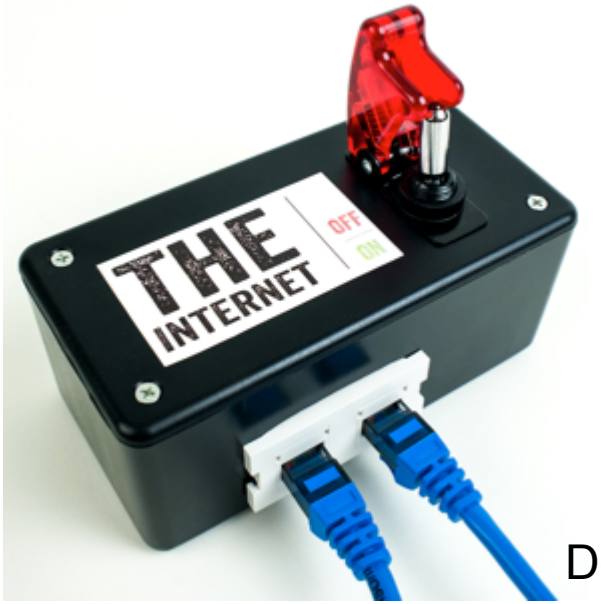
- Each marker must fit within a box 2.0” square and 6” long.
  - Each must weigh less than 2.0 lbs.
  - Each marker must bear the team name or an emblem.
- Torpedoes must not be loaded in team tents.
- The torpedoes size, weight, markings are identical to the Markers.
  - The torpedoes must travel at a “safe” speed.

Dennis Boyd

Kill Switch Constraint

- All vehicles must have a kill switch that a diver can readily activate.

- All vehicles must be buoyant by at least 0.5% of their mass when they have been shut off through the kill switch.
  - Important design requirement



Dennis Boyd

Additional Safety Constraints

- Judges will disqualify any vehicle that poses an unreasonable risk to the integrity of the host facility.
- No materials (except for the markers/torpedoes and compressed air used to blow ballast) may be released by the vehicle into the waters of the arena.
- For the safety of your vehicle, we require it to be slung on a harness or sling of some type.

Dennis Boyd

Capabilities Test Plan

- **Path**
  - Test by placing orange tape marker in the pool
- **Control Panel**
  - Use LED lights to ensure the sub recognizes the buoy
- **Maneuvering**
  - Build test gate and ensure robot can maneuver successfully

Kevin Matungwa

Capabilities Test Plan

- **Landing Site**
  - Build 2 boxes and ensure the sub can drop markers in each accordingly (primary and secondary)
- **Brunch**
  - Ensure sub can fire torpedoes through an open hole using the camera vision
- **Reroute Power**
  - Construct a board with two circles and verify robot can grab and remove pin, and preferably return to same circle
- **Recovery Area**
  - Construct following Mars Rock and Green Cheese and ensure the robot can do the following
    - Recognize and follow an acoustic pinger
    - Grab the rock and cheese within 3 degrees of freedom
    - Follow orange tape to collection site when guided by pinger
    - Carry rocks or cheese and release at top

Kevin Matungwa

Constraints Test Plan

- **Sub, Markers, and Torpedoes Weights**
  - Separately measure dry weight of sub, markers, and torpedoes on a scale to ensure less than 125 lbs, 2 lbs, and 2 lbs, respectively

- **Marker and Torpedo Dimensions**
  - Use tape measure to ensure markers and torpedoes are within 5.08x5.08x15.24cm box each

- **Torpedo Travel Speed**
  - Test torpedoes in pool to ensure they are moving at a safe speed

Kevin Matungwa

Preliminary Budget

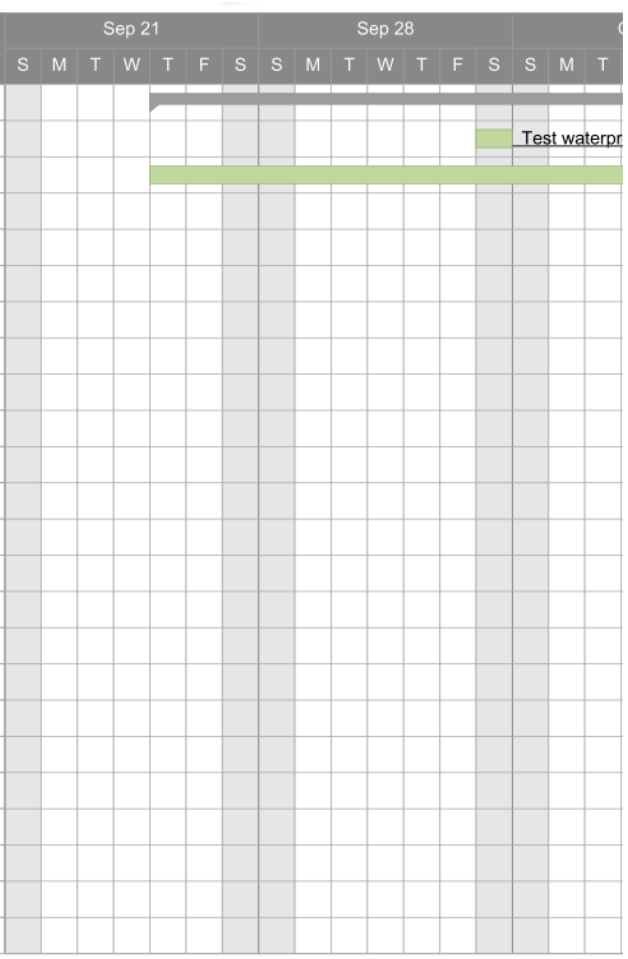
- Roughly $250

- Need to Purchase Immediately
  - Depth Sensor
  - Chargeable Battery
  - Waterproof Seal Around Sub (most likely)
- Desired Purchases
  - Functional Gripper Arm
  - Torpedoes
  - Pinger Sensor
  - *Note: Will wait to purchase until we receive formal requirements for competition*

Bjorn Campbell

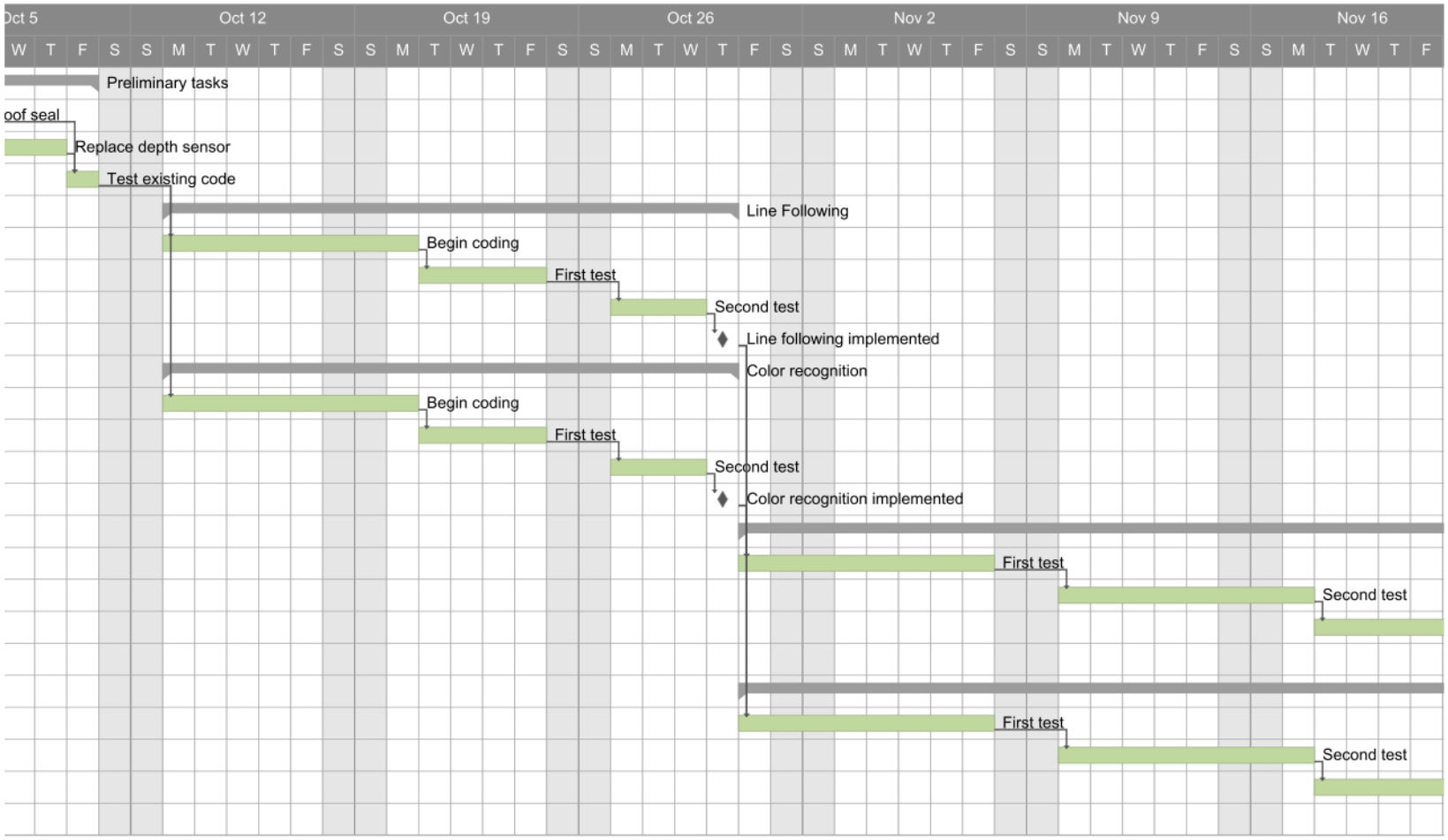
Preliminary Schedule

	Task Name	Start Date	End Date	Predecessors
1	**Preliminary tasks**	**09/25/14**	**10/10/14**	
2	Test waterproof seal	10/04/14	10/04/14	
3	Replace depth sensor	09/25/14	10/09/14	
4	Test existing code	10/10/14	10/10/14	2, 3
5	**Line Following**	**10/13/14**	**10/30/14**	
6	Begin coding	10/13/14	10/20/14	4
7	First test	10/21/14	10/24/14	6
8	Second test	10/27/14	10/29/14	7
9	Line following implemented	10/30/14	10/30/14	8
10	**Color recognition**	**10/13/14**	**10/30/14**	
11	Begin coding	10/13/14	10/20/14	4
12	First test	10/21/14	10/24/14	11
13	Second test	10/27/14	10/29/14	12
14	Color recognition implemented	10/30/14	10/30/14	13
15	**Red/Green PVC Maneuverability Task**	**10/31/14**	**12/10/14**	
16	First test	10/31/14	11/07/14	9, 14
17	Second test	11/10/14	11/17/14	16
18	Third Test	11/18/14	11/25/14	17
19	Maneuverability Finalized	11/26/14	12/10/14	18
20	**Buoy Task**	**10/31/14**	**12/10/14**	
21	First test	10/31/14	11/07/14	9, 14
22	Second test	11/10/14	11/17/14	21
23	Third Test	11/18/14	11/25/14	22
24	Buoy Finalized	11/26/14	12/10/14	23



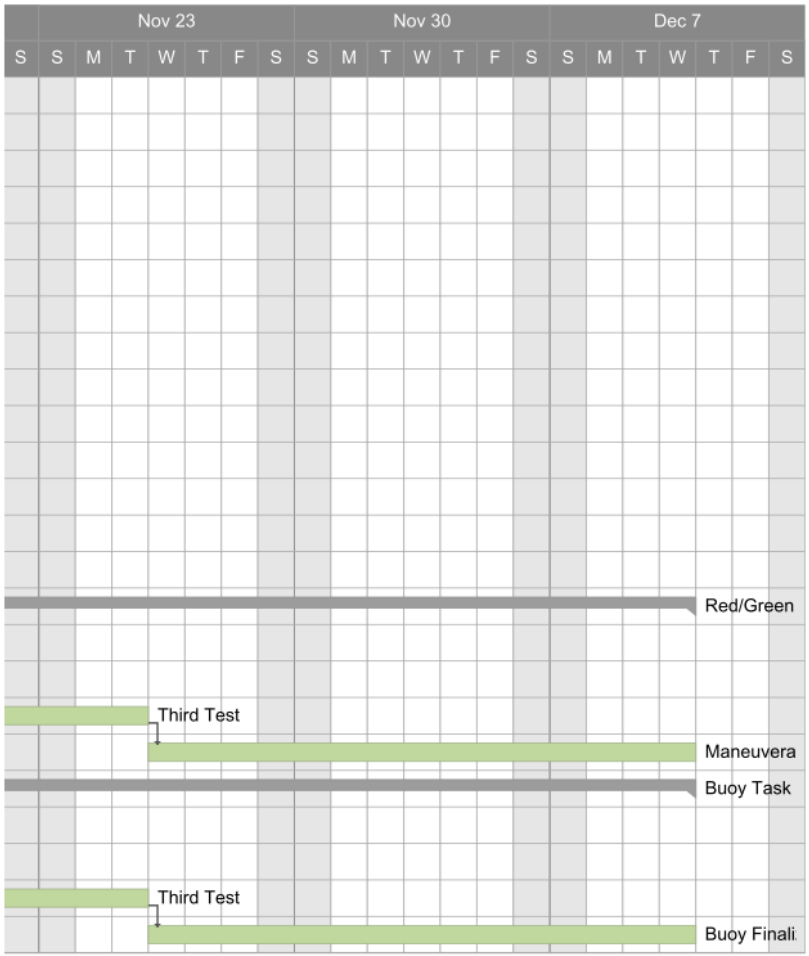
Elliot Mudrick

Preliminary Schedule



Elliot Mudrick

Preliminary Schedule



Elliot Mudrick

Preliminary Risk Assessment

- Risks to Sub
  - Water damage
  - Overheating
  - Dry rot
  - Shatter/Crack if pressure is too high
- Risk to Persons
  - Exposed wires in water could lead to electrocution
  - Drowning during testing

Elliot Mudrick

Questions?