Autonomous Water Quality Sampler (AWQuSam)

Project Proposal

Florida State University Department of Oceanography

October 28, 2011

Agenda

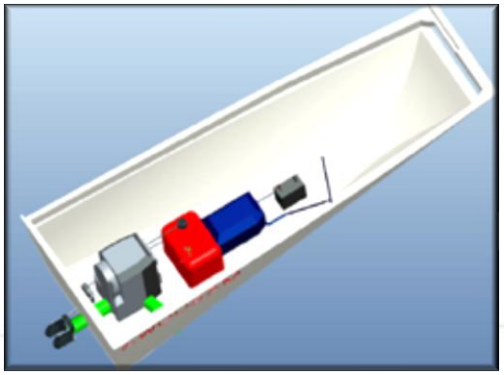
Friday, October 28, 2011

- Project Overview
- Data Acquisition
- Data Logging
- Data Transmission
- Base Station Receiver
- Navigation
- Propulsion
- Steering
- Housing
- User Interface
- Budget
- Project Schedule

Project Overview

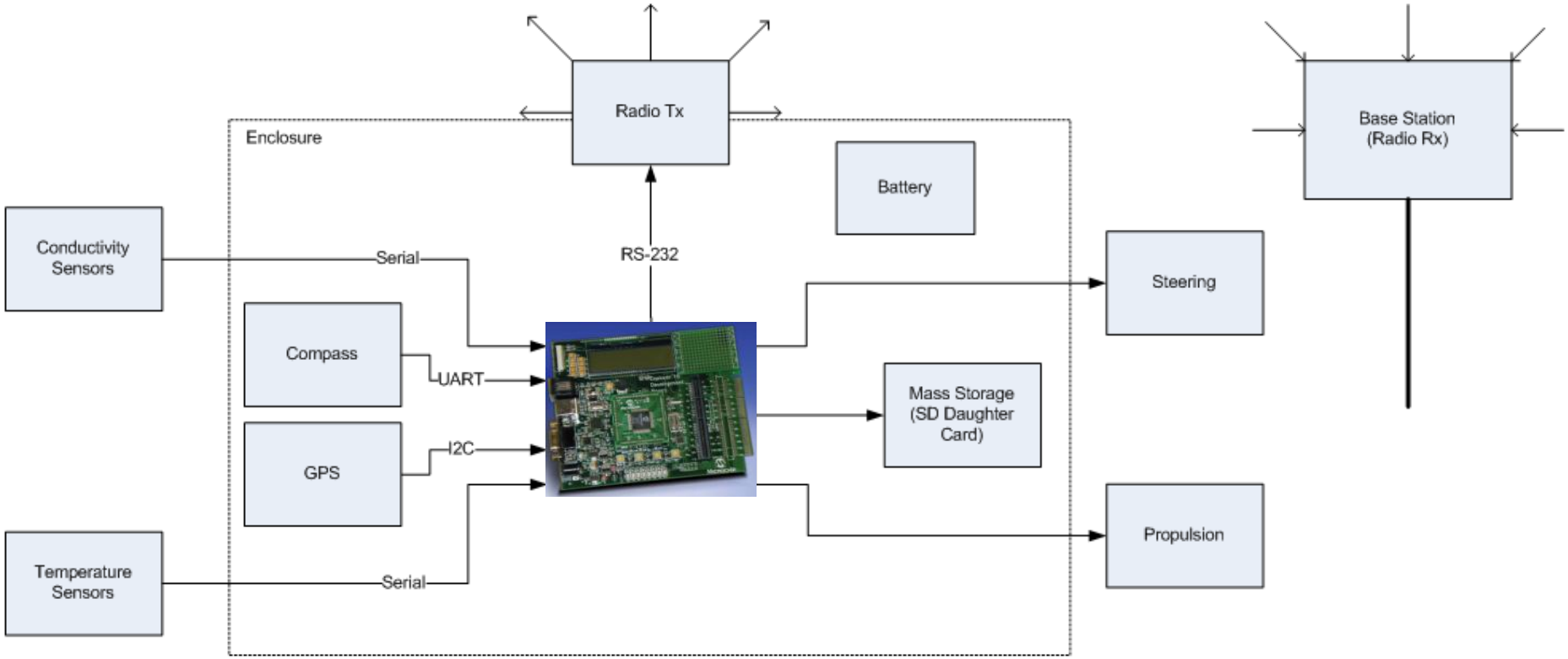
Brad Wells

Problem Description



- Gather Water Quality / Hydrographic Data
- Florida Shelf
  - Shallow Environment

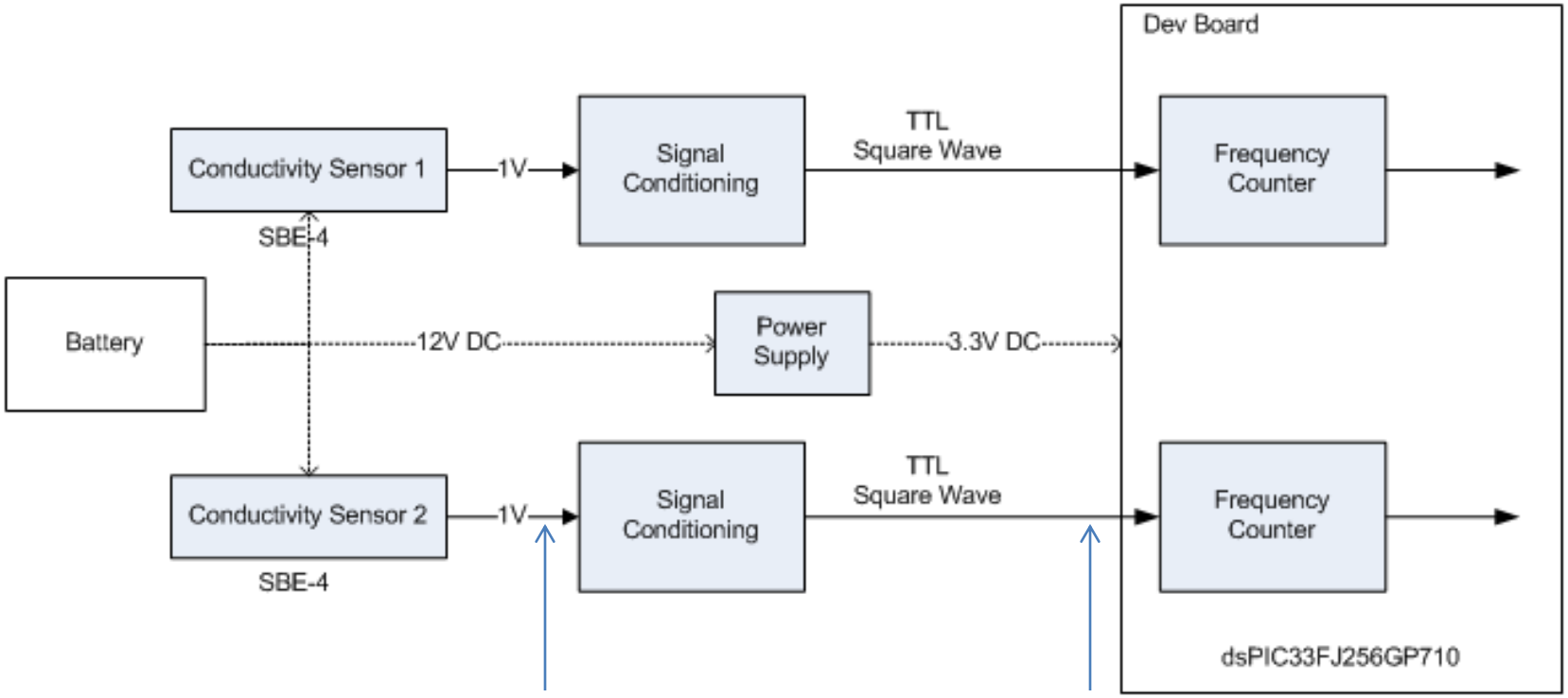
Proposed Solution



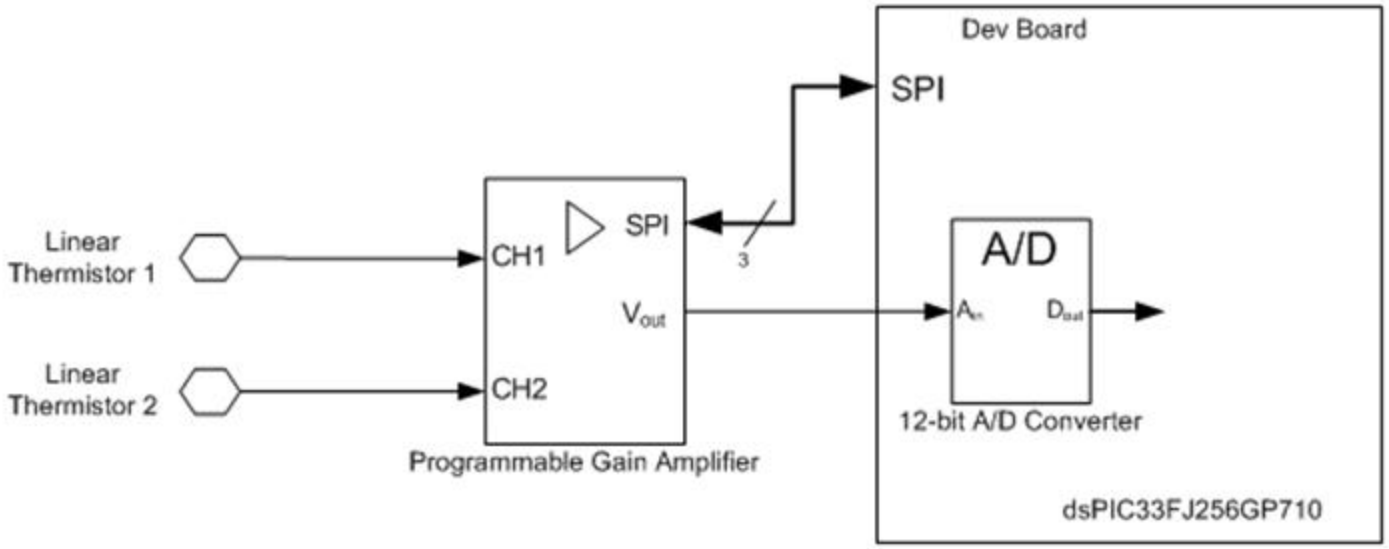
Data Acquisition

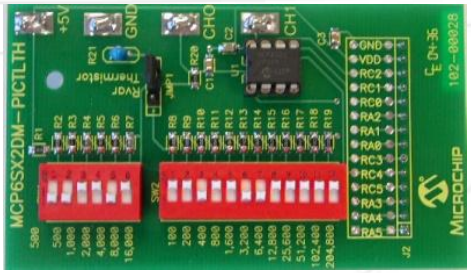
Brad Wells

Conductivity Sensors



Temperature Sensors





Data Logging

Brad Wells

Data Logging

PICtail Daughter Board for SD Cards

- Interfaces with Explorer16 Development Board
- SPI Interface

Required to log:

- Position
- Conductivity
- Temperature

Data Transmission

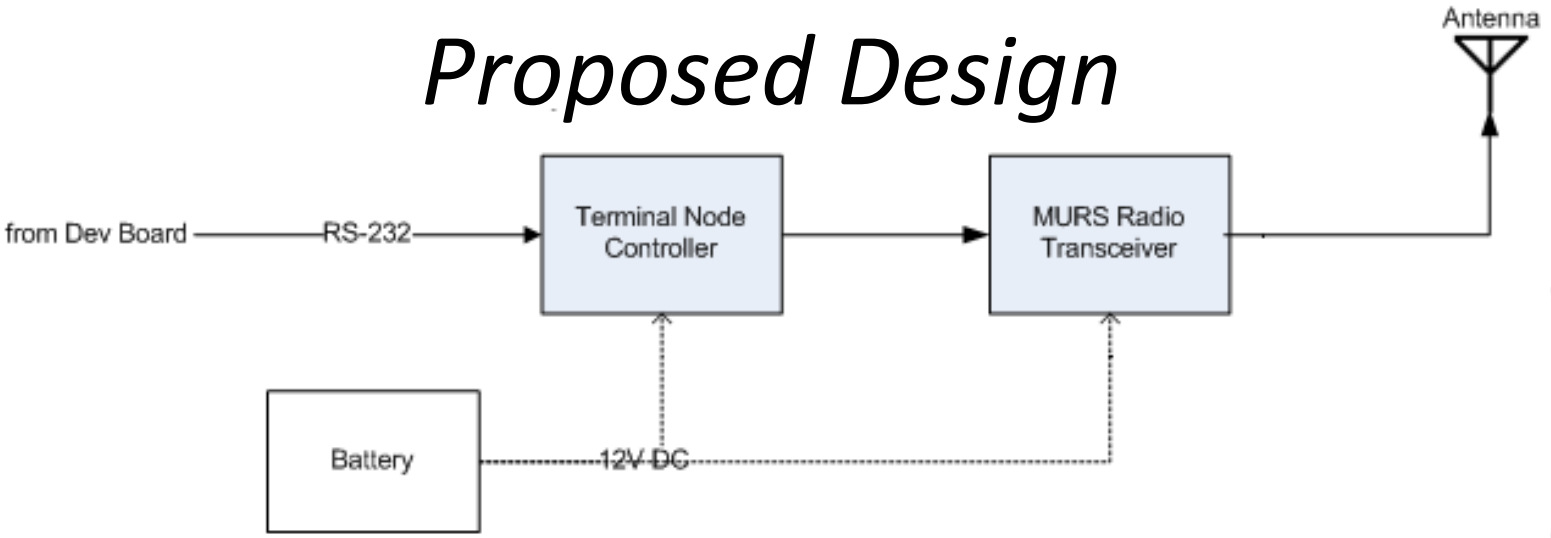
Triesha Fagan

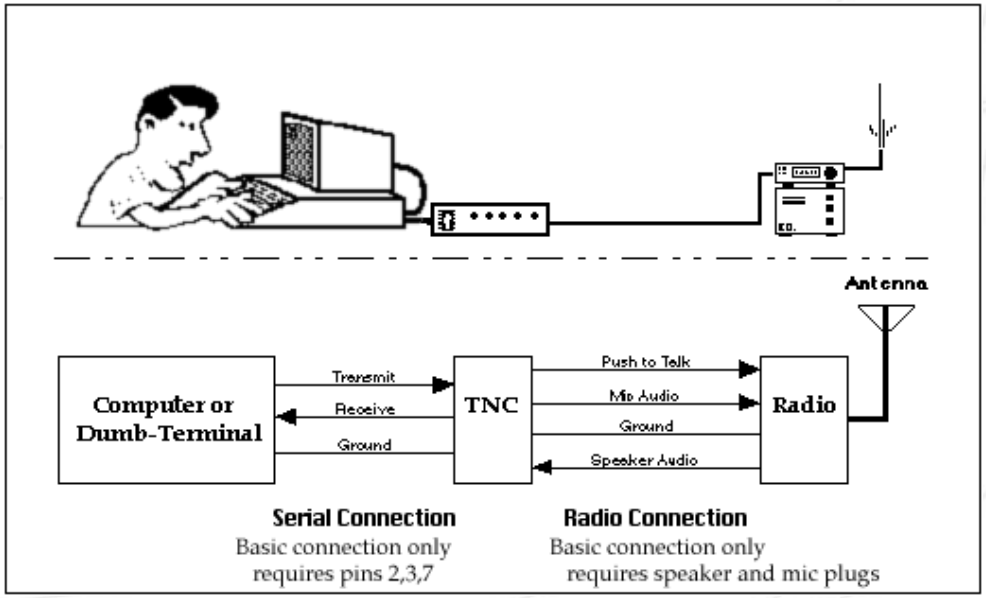
Radio Selection

Multi-**U**se **R**adio **S**ervice

- Unlicensed
- 151MHz to 154MHz
- No limit on antenna gain
- Data communication is permitted

Mobile (AWQuSam) Unit:
Proposed Design



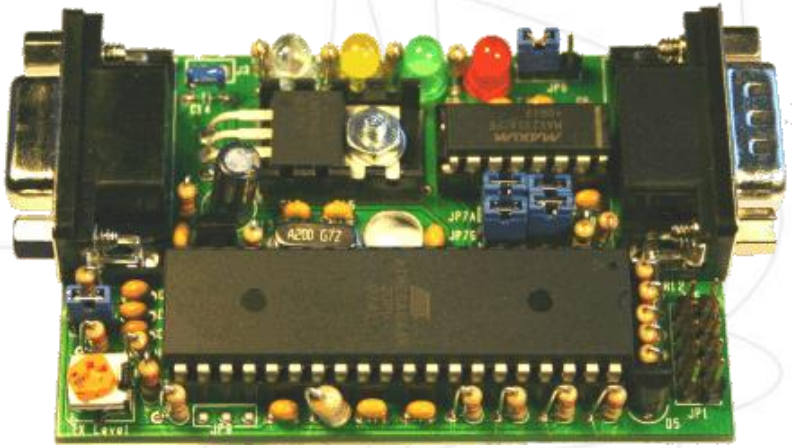


Mobile Antenna

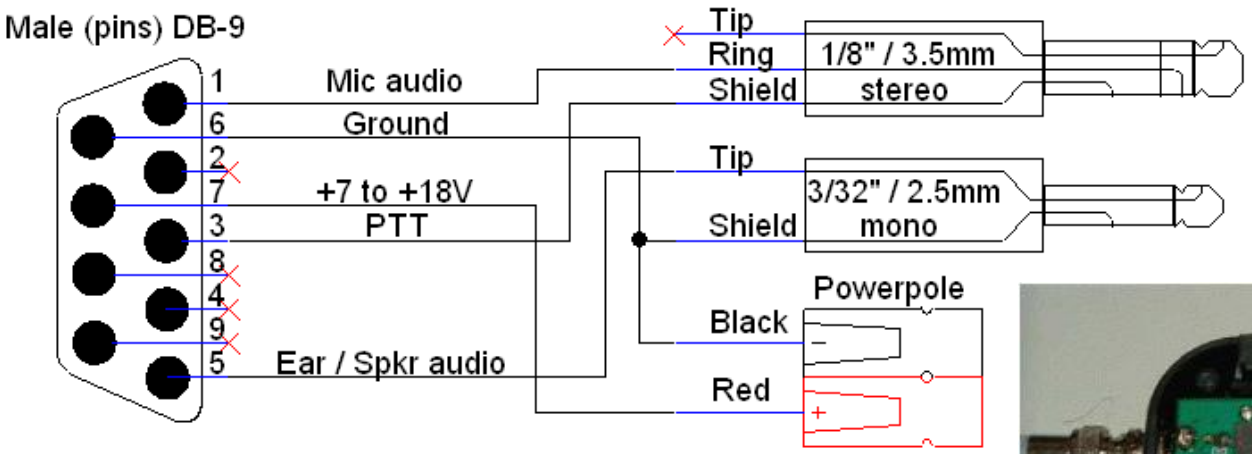
Firestik MURS45

- 5/8 Wave
- Gain: 6dBi
- Omni-directional
- 151.820 to 154.600 MHz

Terminal Node Controller



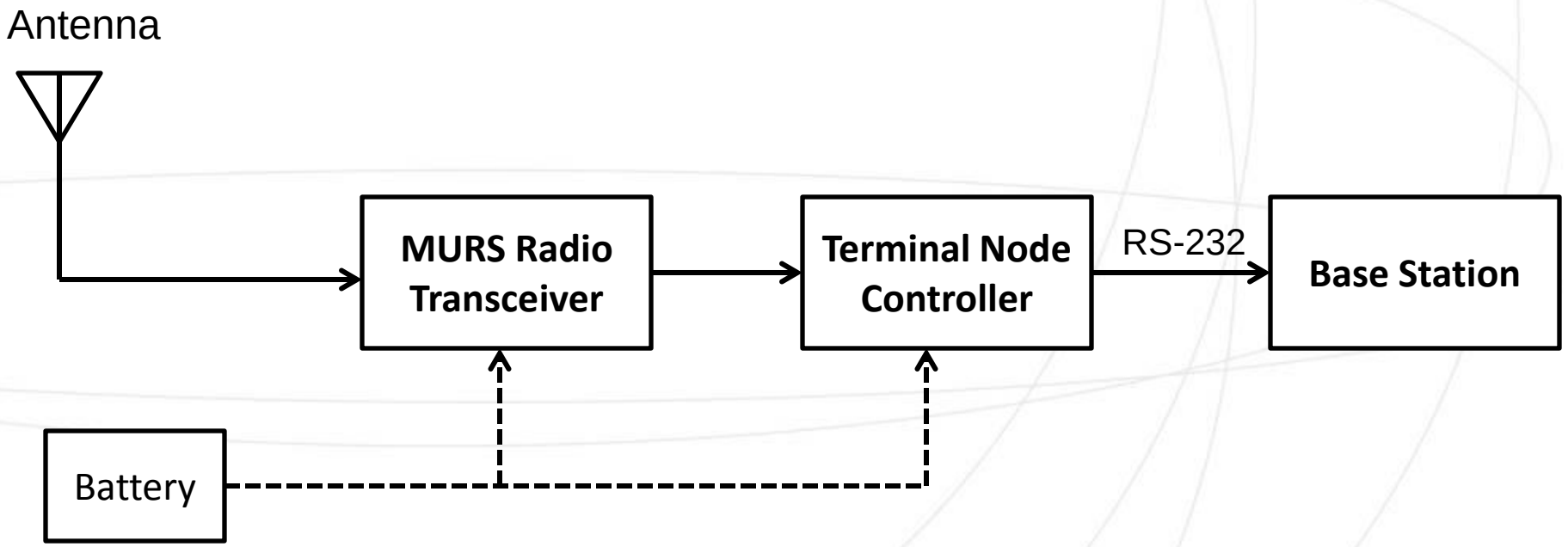
Transmission Integration



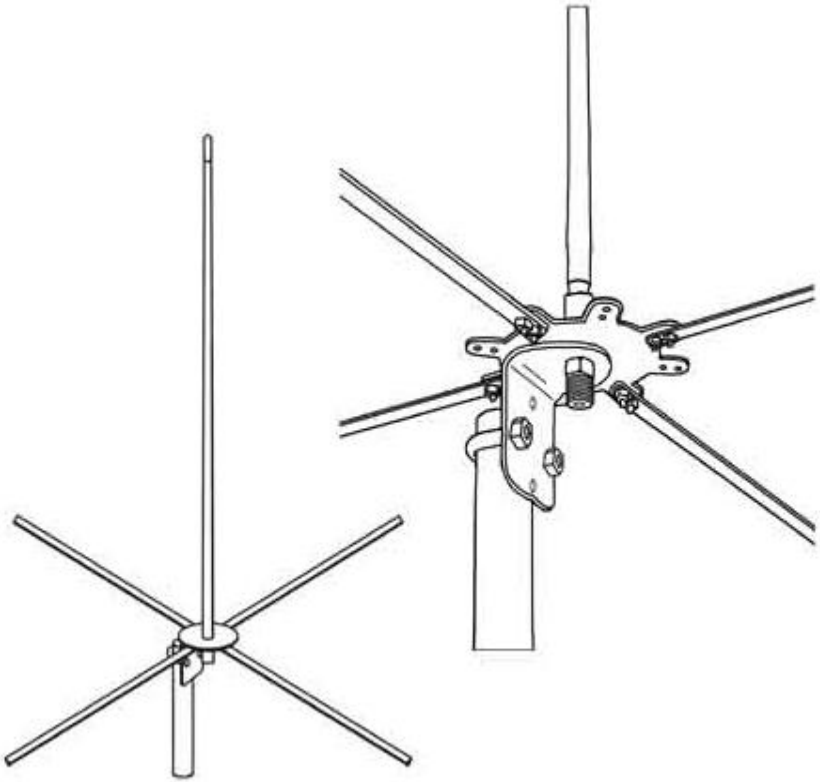
Base Station Receiver

Triesha Fagan

Base Station Unit:
Proposed Design



MURS 5/8” WAVE BASE ANTENNA



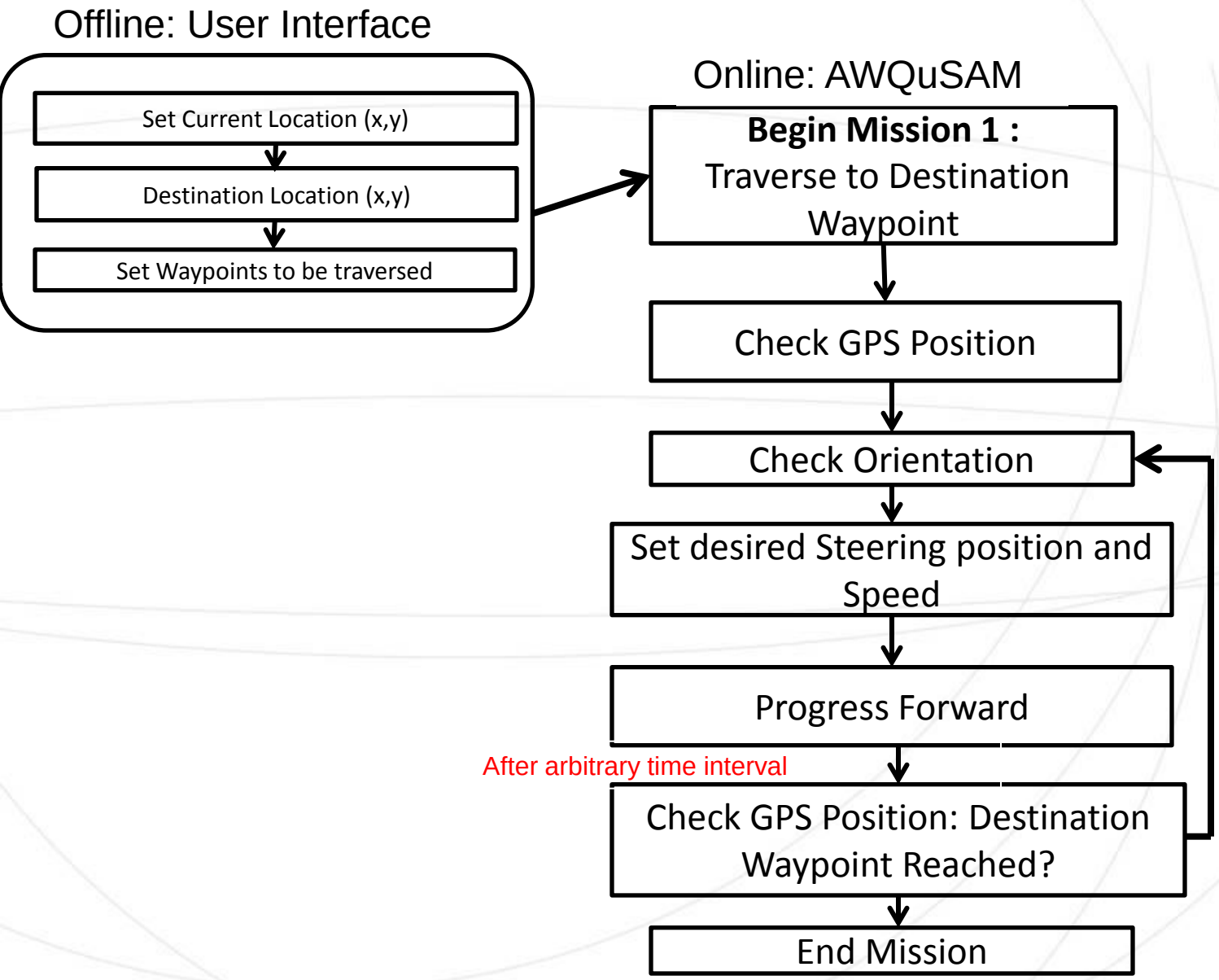
Firestik MURS-BASE

- 5/8 Wave
- Gain: 6dBi
- Assembly: Angle Bracket,
- U-Bolt, Hub plate and Antenna stud for coax cable

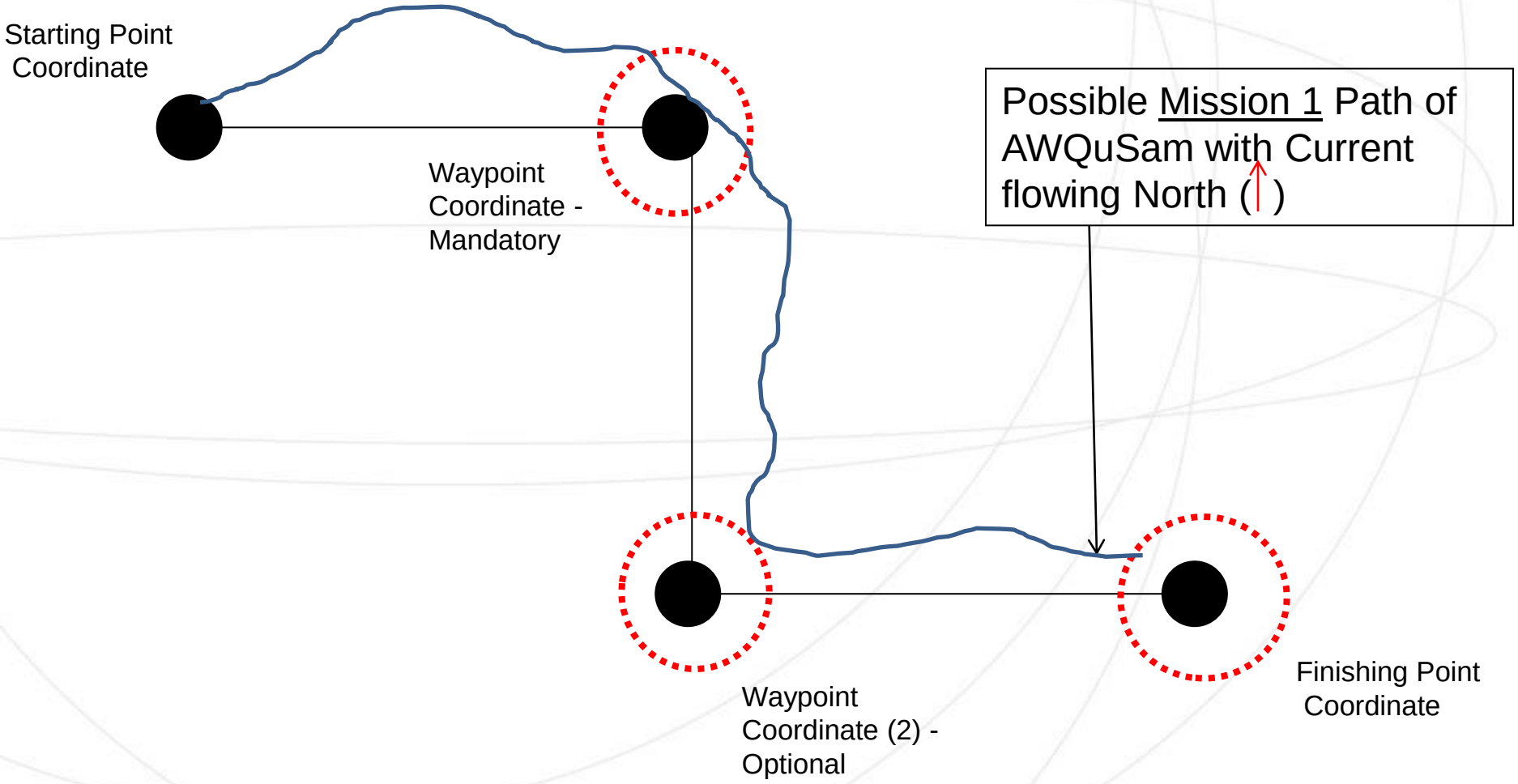
Navigation

Triesha Fagan

Mission and Motion Planning Strategy



Motion Planning



50 Channel D2523T Helical GPS Receiver

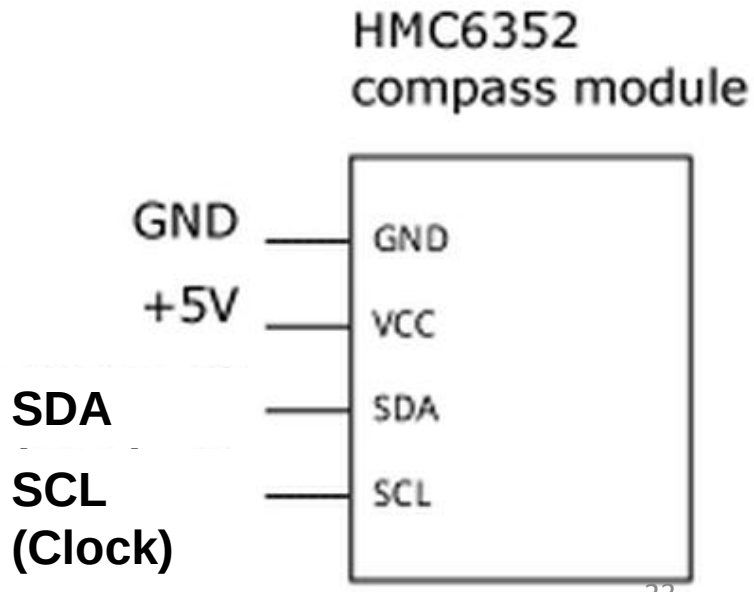
Antenna	26dBi, omni-directional
Max Update Rate	4 Hz
GPS Protocol: Output Format	Standard NMEA sentence: $GPRMC (Time Stamp, Current Latitude, North/South, Current Longitude, Ground Speed in Knots, Ground Course in degrees, Current Date.
Interface	UART
Power Input	3.3 V
Max Velocity	<1000 knots
Max Performance	Acquisition: 74 mA, Tracking: 43 mA

I/O Description

1. RX - Data input (TTL level)
2. TX -Data output (TTL level)
3. GND -Ground
4. VIN - Supply voltage 3.3V
5. VBAT - Backup battery supply voltage
6. GPS LED- LED indicator

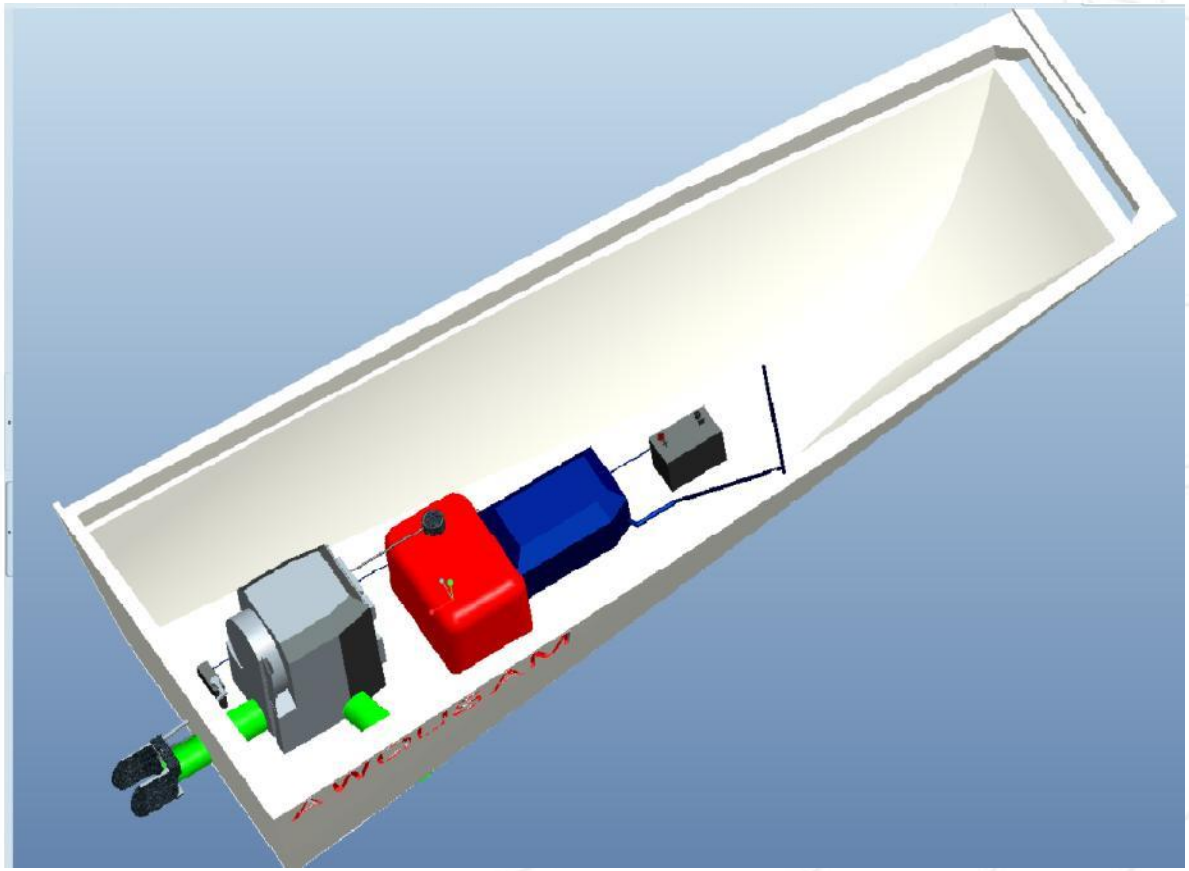
Compass Module - HMC6352

Max Update Rate	20 Hz
Operational Controls	**Operational Mode :** Standby, Query, Continuous options **Output Mode :** Returns binary formatted data in tenths of degrees from 0 to 3599
Interface	I2C 2-Wire Serial Interface
Risks	No tilt compensation,



Propulsion and Steering

Carlos R. Sanchez



Concept Generation & Selection

BATTERIES					
Type	**Price**	**Voltage**	**#needed**	**AmpHours**	**Weight**
Group 35 Lithium Deep Cycle Battery - Intensity i35D AGM Battery Lead Acid Battery Upgrade	2,149	12V	1	192	18.8lbs
Trojan SCS150	169.95	12V	4	100	50lbs

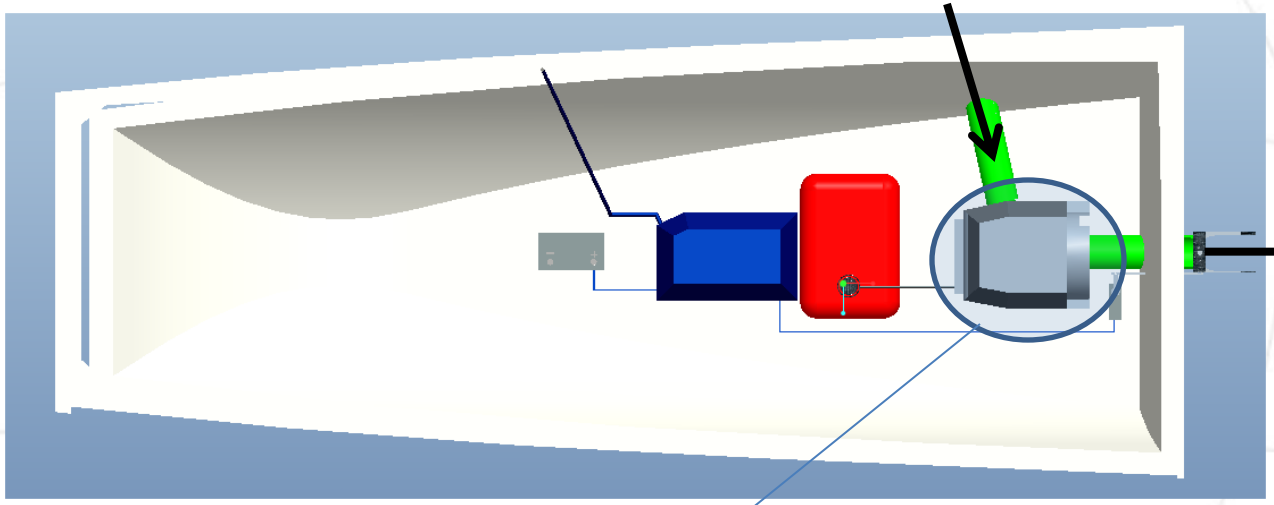
MOTORS					
Type	**Price**	**Voltage**	**Thrust**	**Power Drawn**	**Approximate run time at medium speed**
Sevylor 2000004144 Trolling Motor	90	12	18lb	18	11.1
Sevylor 12V Trolling Boat Motor	200	12	30lb	30	6.7
	100	12	50lb	50	4.0
Minn Kota Endura	99	12	30lb	30	6.7
Minn Kota Endura C2 40 36" Transom-Mount Trolling Motors 1352240	169	12	40lb	40	5.0

WATER PUMP					
Type	**Price**	**Nozzle diameter**	**Thrust**	**Run time**	**Weight**
Pacer Ag Pump	249.99	2in	31lbs	45-1hr per 0.52 gallons	44lbs
Steele Products SP-UG300 3-Inch 4-Cycle Gas Powered Water Pump With Electric Start	608	3in	98lbs	2.4hrs per gallon	73.7lbs
DuroMax XP650WP	259.99	3in	67.9lbs	2.4hrs per gallon	68lbs
PowerHorse Semitrash Water Pump	399.99	3 in	71 lbs	1.2 hrs per gallon	65 lbs
Pacer Self-Priming Transfer Pump	429.99	2in	49 lbs	3hrs per gallon	50 lbs

Concept Generation & Selection

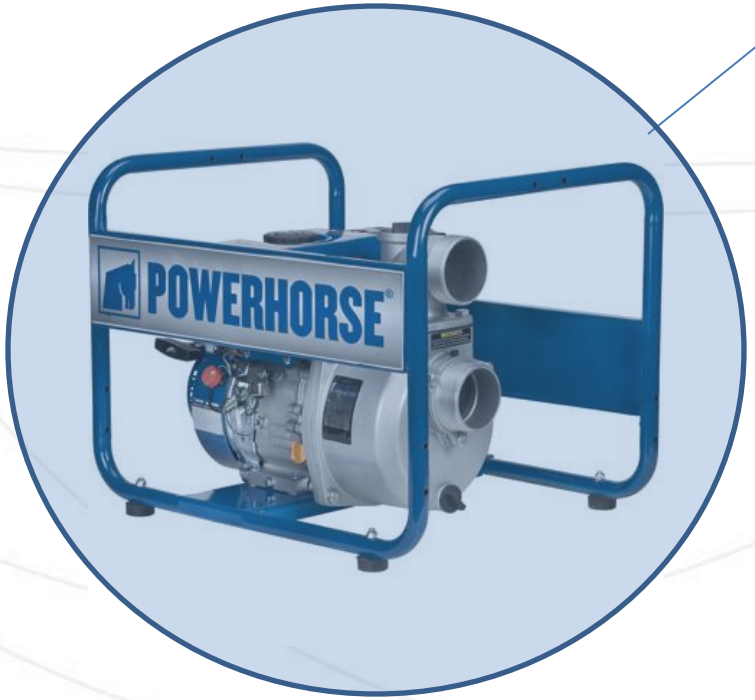
	For 12 hr runs and 50 lbs of thrust		
	Electric motors	**Gas driven water pump**	**Gas driven propeller drive**
WEIGHT	350lbs in batteries ONLY	93 lbs of motor and gas	53 lbs motor and gas
COST	$1319	$500	$350

Propulsion



$399.99

60-65lbs

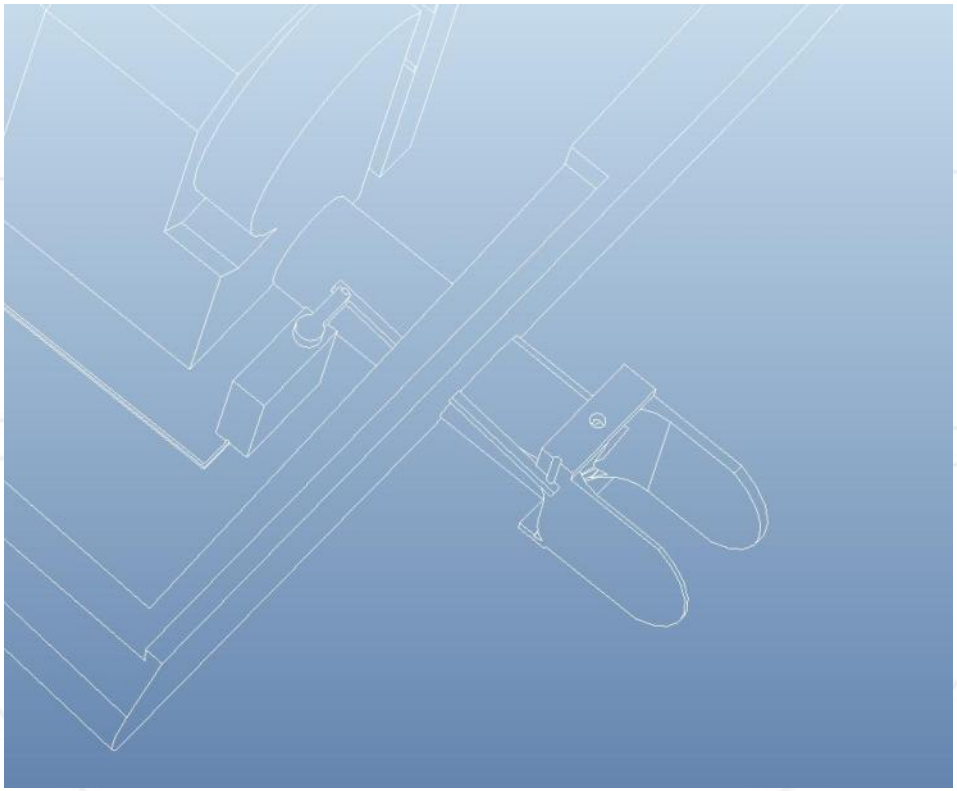


Powerhorse Semi-Trash Water Pump — 3in. Ports, 208cc, 14,160 GPH

Nozzle Pressure = NP psi = $[(gpm)/(29.71 \times D^2)]^2$

The formula for nozzle reaction (NR) for solid bore nozzles is $NR = 1.57\ D^2NP$ therefore: using 30mm nozzle reaction thrust is about 70.14 pounds.

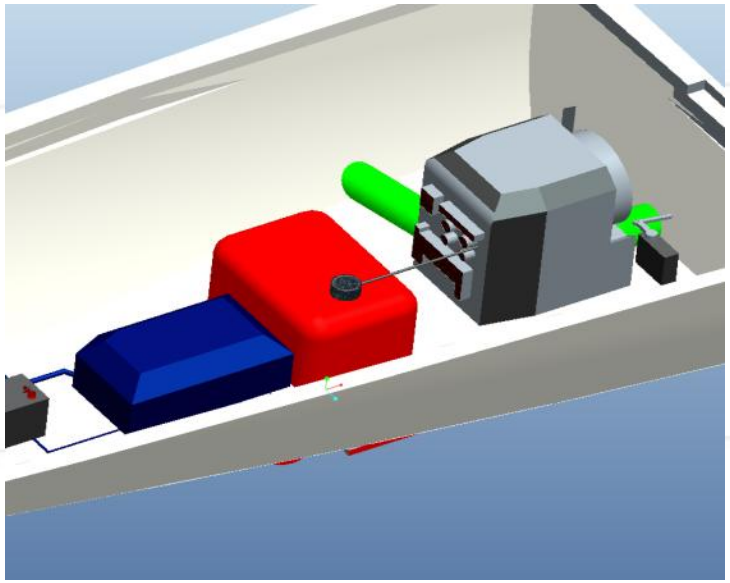
Steering



Traxxas High Torque Servo Motor
80 oz-in

At rest ,current drawn is in 300-500mah
Under command, current may spike to 1-2 amps. Average current draw should be fairly low

Fuel System



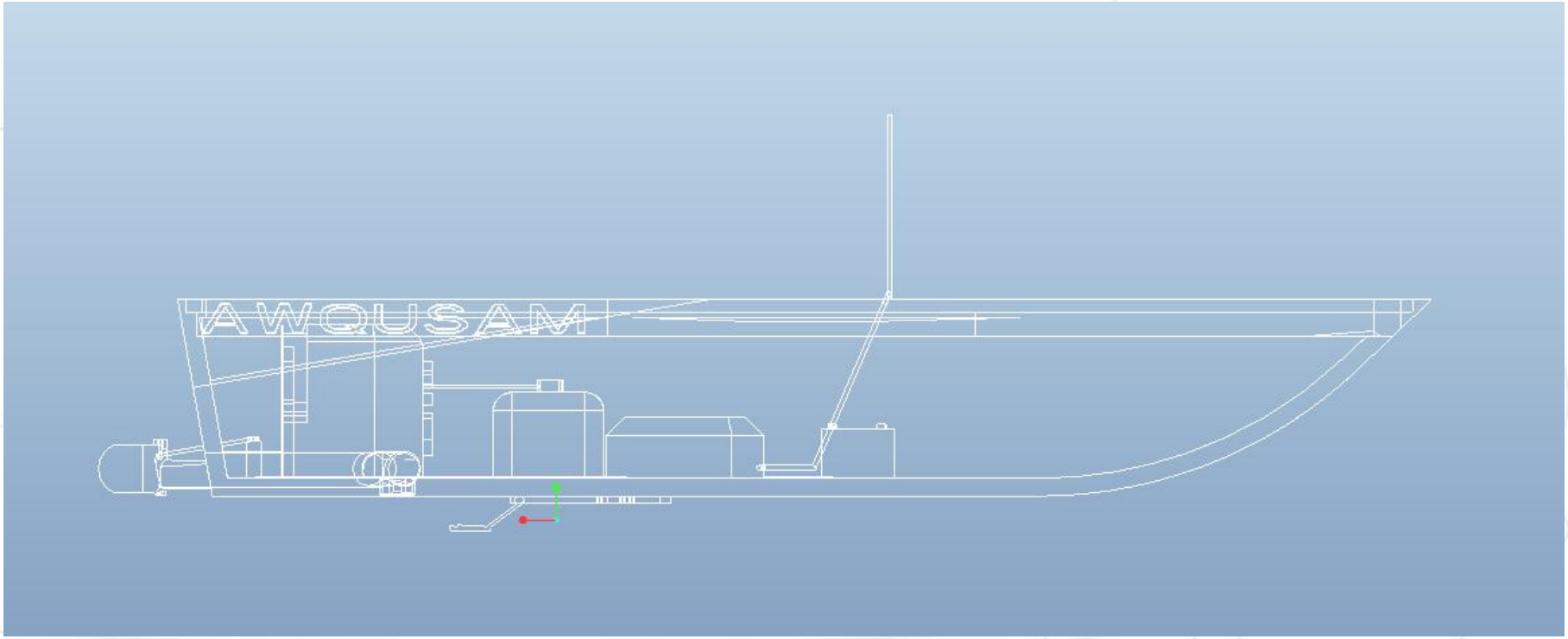
To achieve extended run times of at least 12 hours an external fuel tank is required

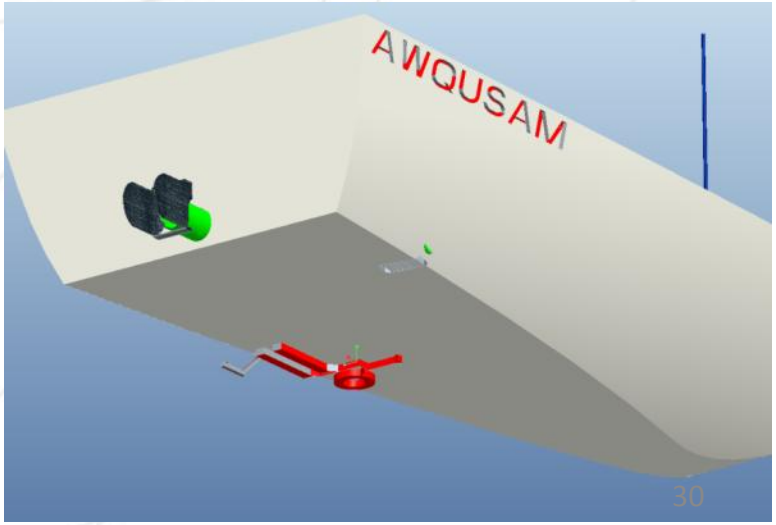
5-6 gallons in size

Connected to water pump fuel tank via fuel hose

Water pump gas tank is gravity fed not vacuum fed so a small 12volt fuel pump may be used at intervals

Sensor Placement





Electronic Housing

All wires and leads coming in or out of the box will be sealed

Box will be watertight yet easily Opened to access vital electronics

Hull

Juan Garcia de Paredes

Approach

Step 1: Design a valid housing that satisfies all engineering needs.

Step 2: Make purchase of components.

Step 3: Assemble housing frame.

Step 4: Assemble covering sheets.

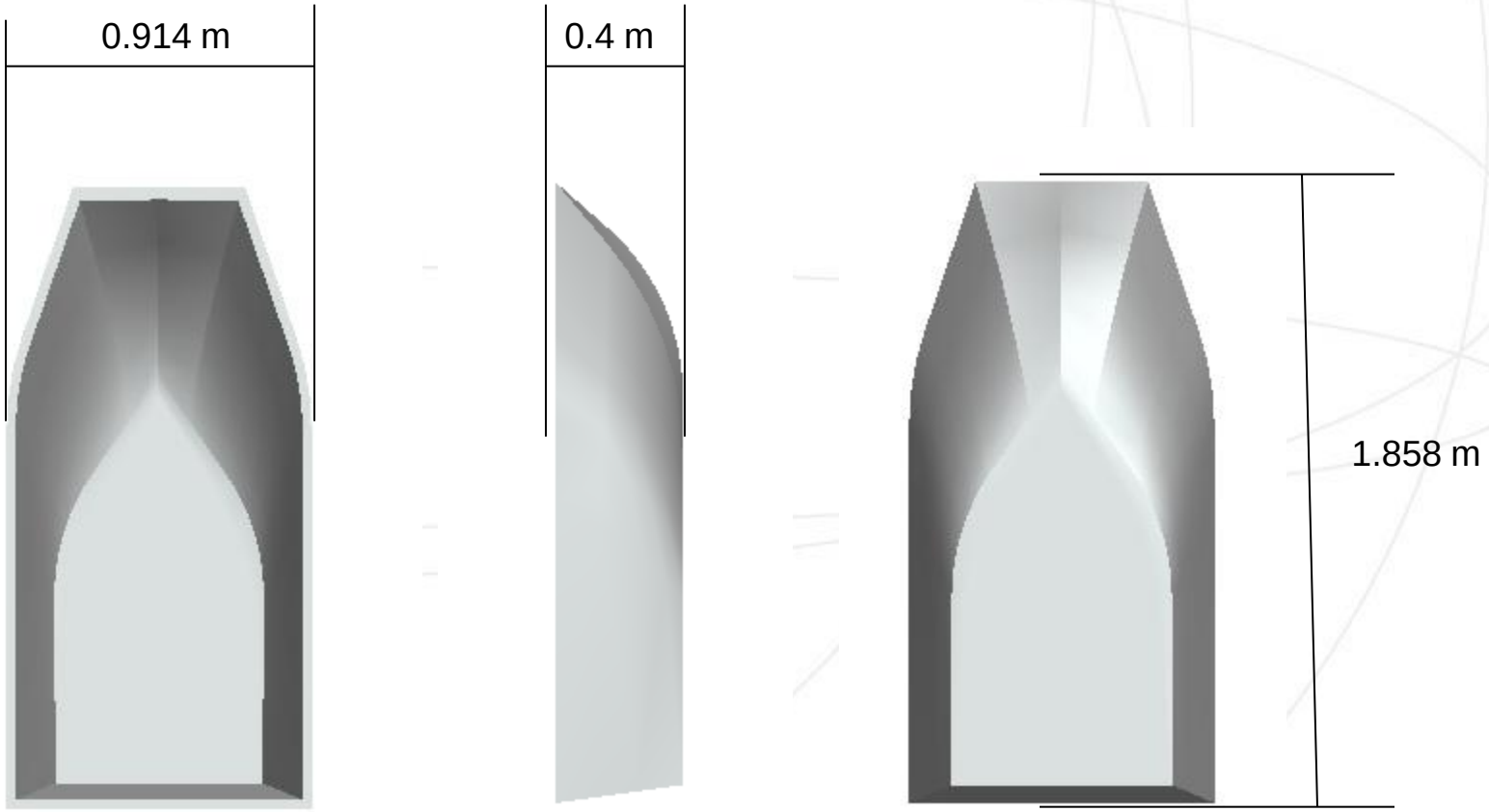
Step 5: Test housing in water and look for leaks.

Step 6: Test buoyancy of housing using placebo weights for all system components.

Step 7: Integrate all mechanical components into system.

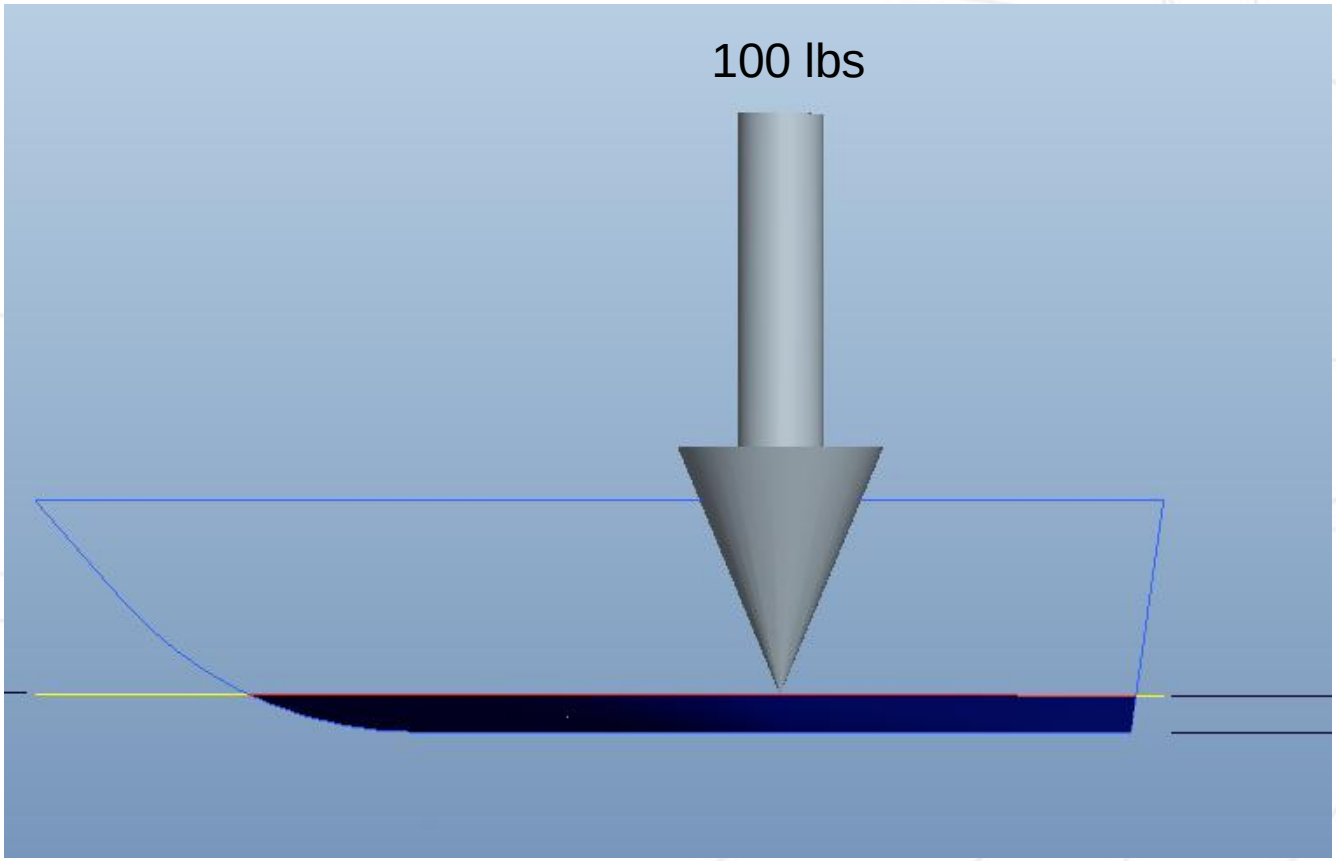
Step 8: Test buoyancy and water-tightness of prototype.

Dimensions



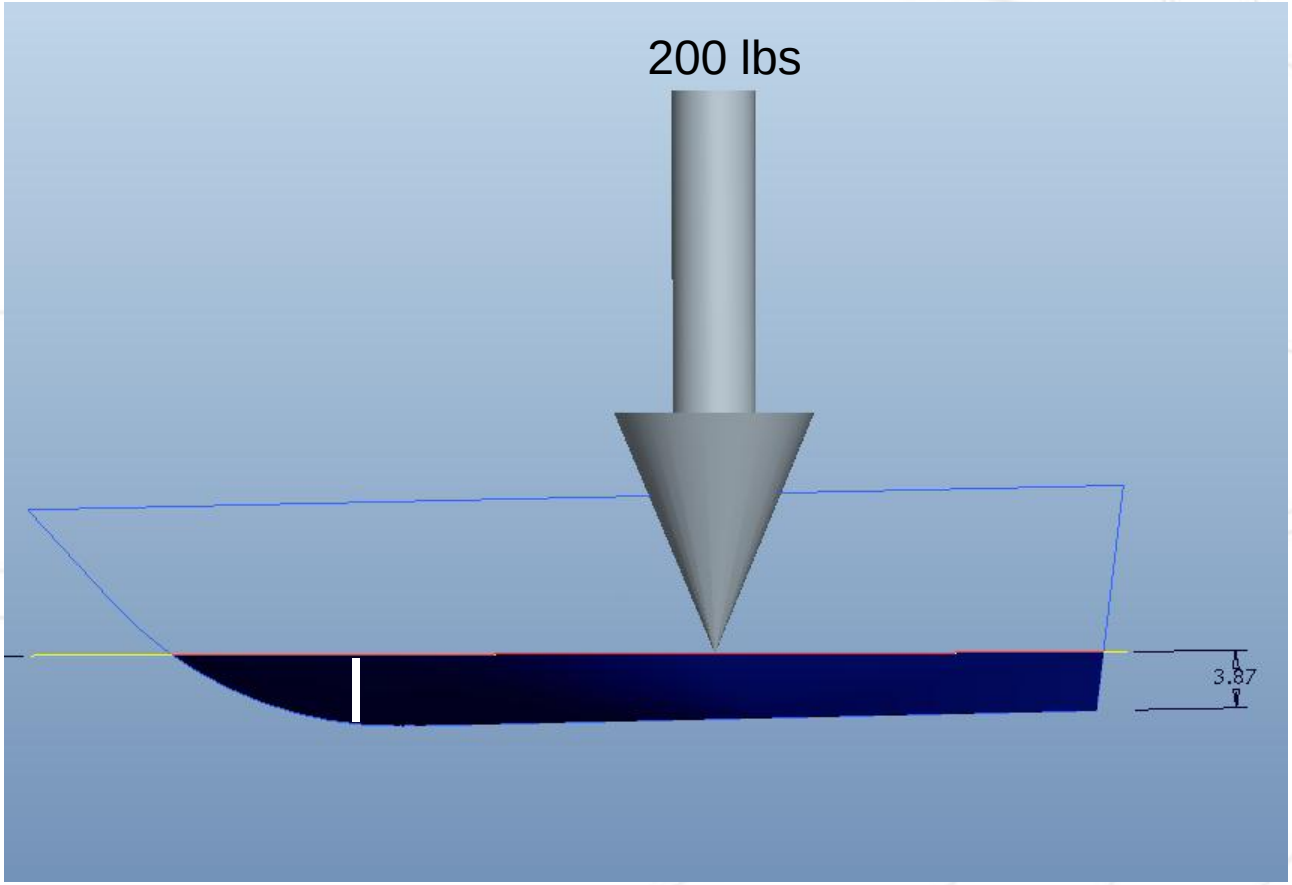
Mass of hull is approximately 30 lbs

Feasibility Analysis



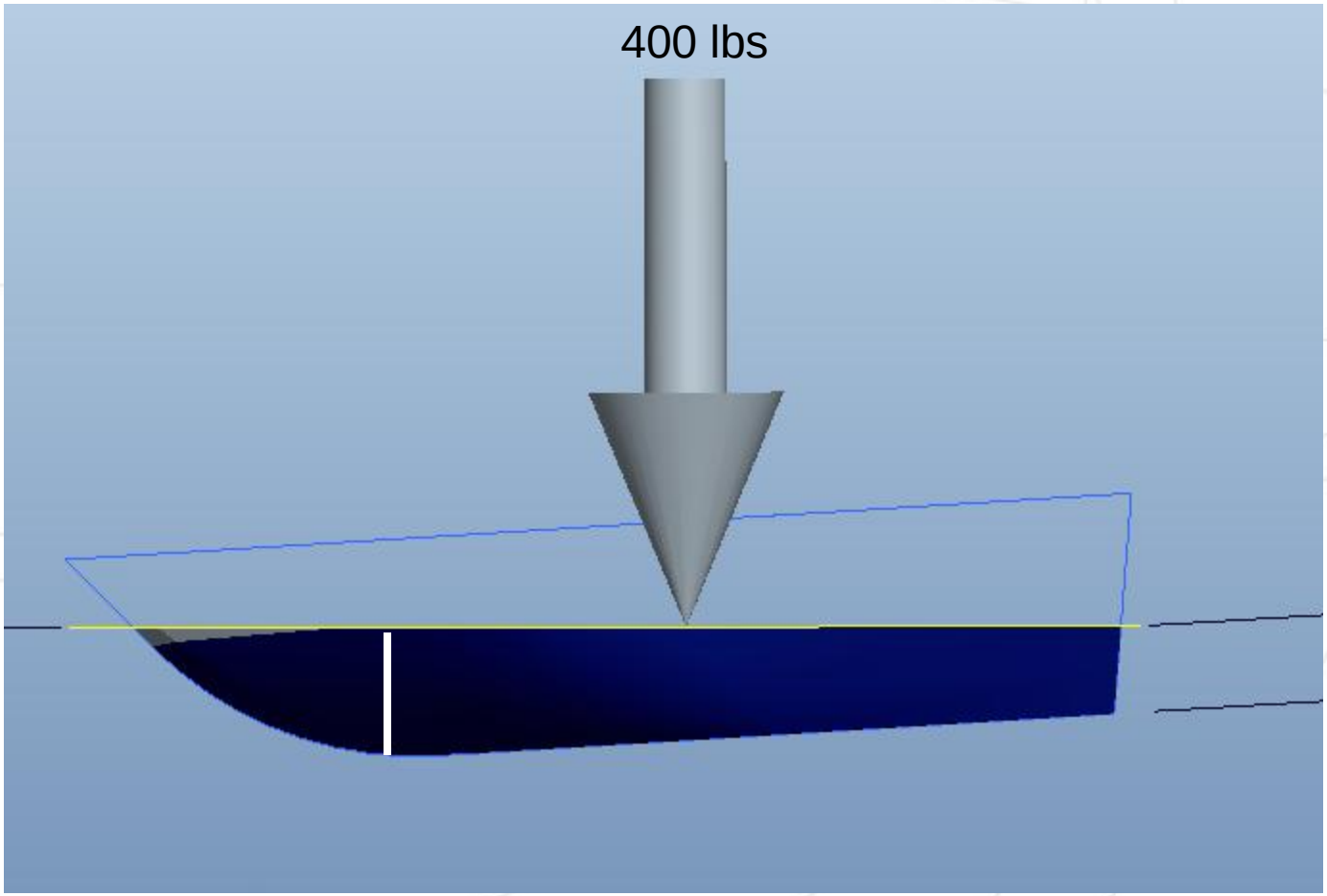
Draft of 2.39 in

Feasibility Analysis



Draft of 4.72 in

Feasibility Analysis



Draft of 8.81 in

Construction

Several aluminum bars make skeleton of housing

Welded together in machine shop

Aluminum sheets are cut to shape

Wrapped around skeleton

Welded together in machine shop

Total cost is approximately $200.00

Including full enclosure, frame, and mounting hardware

Other options

for prototype

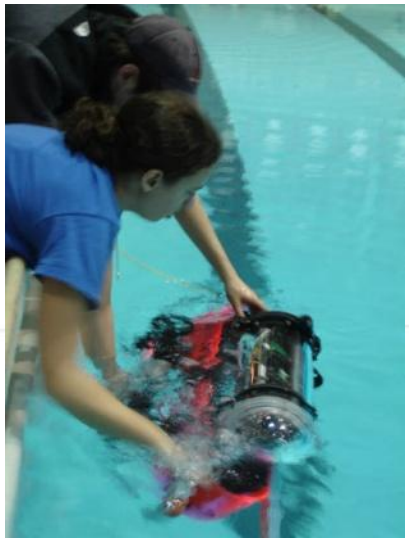
KAYAK

JON BOAT

Benefits:

- Cheaper than building materials and time spent building aluminum haul.
- Lighter – Polyethylene is much lighter than aluminum. (0.92 v. 2.70 g*cm^-3)
- Easier to transport.

Testing



Test for buoyancy and leaks in common pool

Testing in rougher waters

Using Remote Control

User Interface

Steven Golemme

User Interface

AWQuSam user interface will allow for programming of new mission paths using GPS coordinates of waypoints.

Pic Development Board W/ Programmer
- Alpha-numeric 16x2 LCD Display

Interface development board with Keypad and LCD display

Incorporate Key Combination for entering “Program Mode”

Develop Code to facilitate programming AWQuSam using keypad

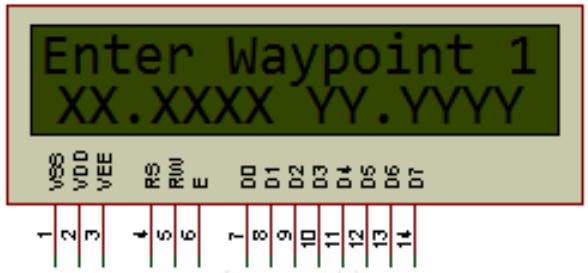
User Interface

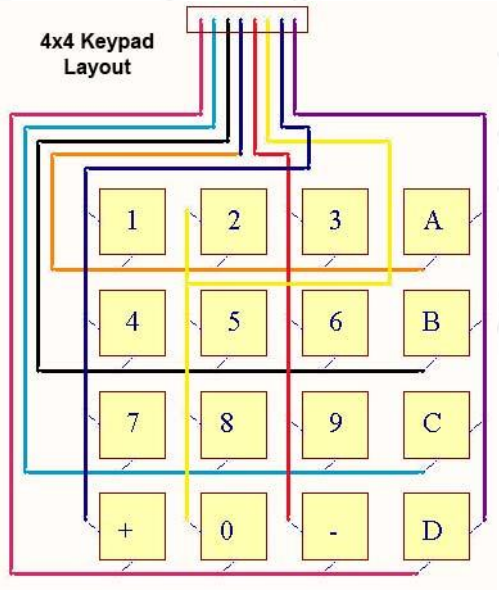
1.) Prompts will be displayed on LCD display as indicated to the right:

2.)Pressing a certain key will allow user to add another waypoint.

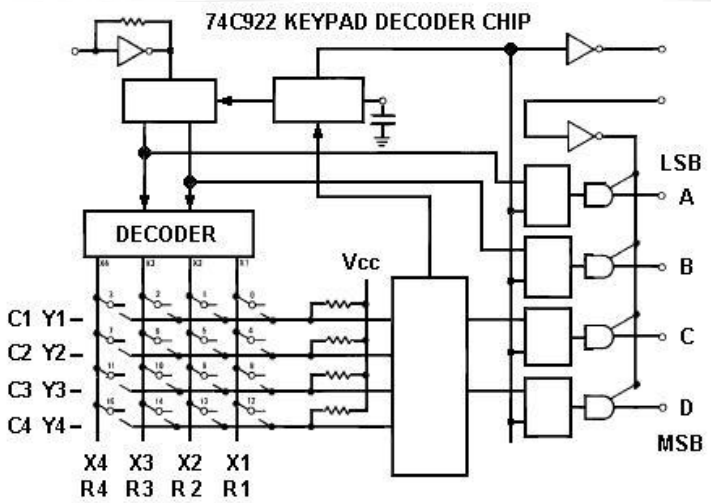
3.)Pressing a different key will allow user to finish adding waypoints.

4.)Documentation shall be developed with instructions for programming AWQuSam





Testing



17KP1604 KEY → BINARY OUTPUT

	A B C D		A B C D
'1' →	0 0 0 0	'7' →	1 0 0 0
'2' →	0 0 0 1	'8' →	1 0 0 1
'3' →	0 0 1 0	'9' →	1 0 1 0
'A' →	0 0 1 1	'C' →	1 0 1 1
'4' →	0 1 0 0	'0' →	1 1 0 0
'5' →	0 1 0 1	'F' →	1 1 0 1
'6' →	0 1 1 0	'E' →	1 1 1 0
'B' →	0 1 1 1	'D' →	1 1 1 1

1.) Verify AWQuSam can be placed in a “Program Mode.”

2.)Verify LCD prompts are clear and concise.

3.)Verify keypad can be used to program AWQuSam.

4.)Utilizing only the instructions developed, ensure an untrained user can program new mission paths into the AWQuSam.

Budget

Budget Increase

Project budget estimate: **$2,038.41**

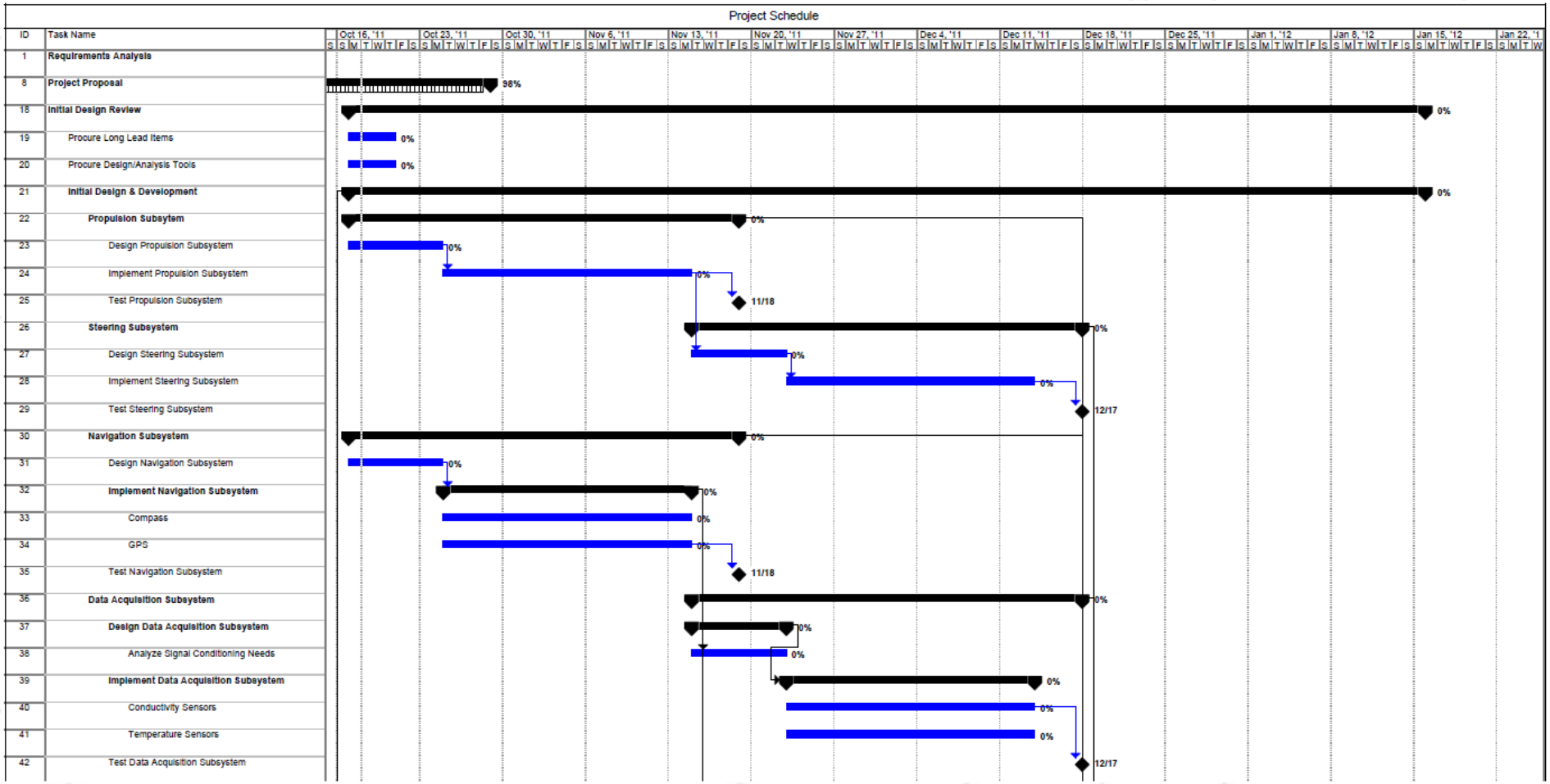
Funding sources:

ECE dept. - **$1,038.41** (FSU robotics money left over from last year)

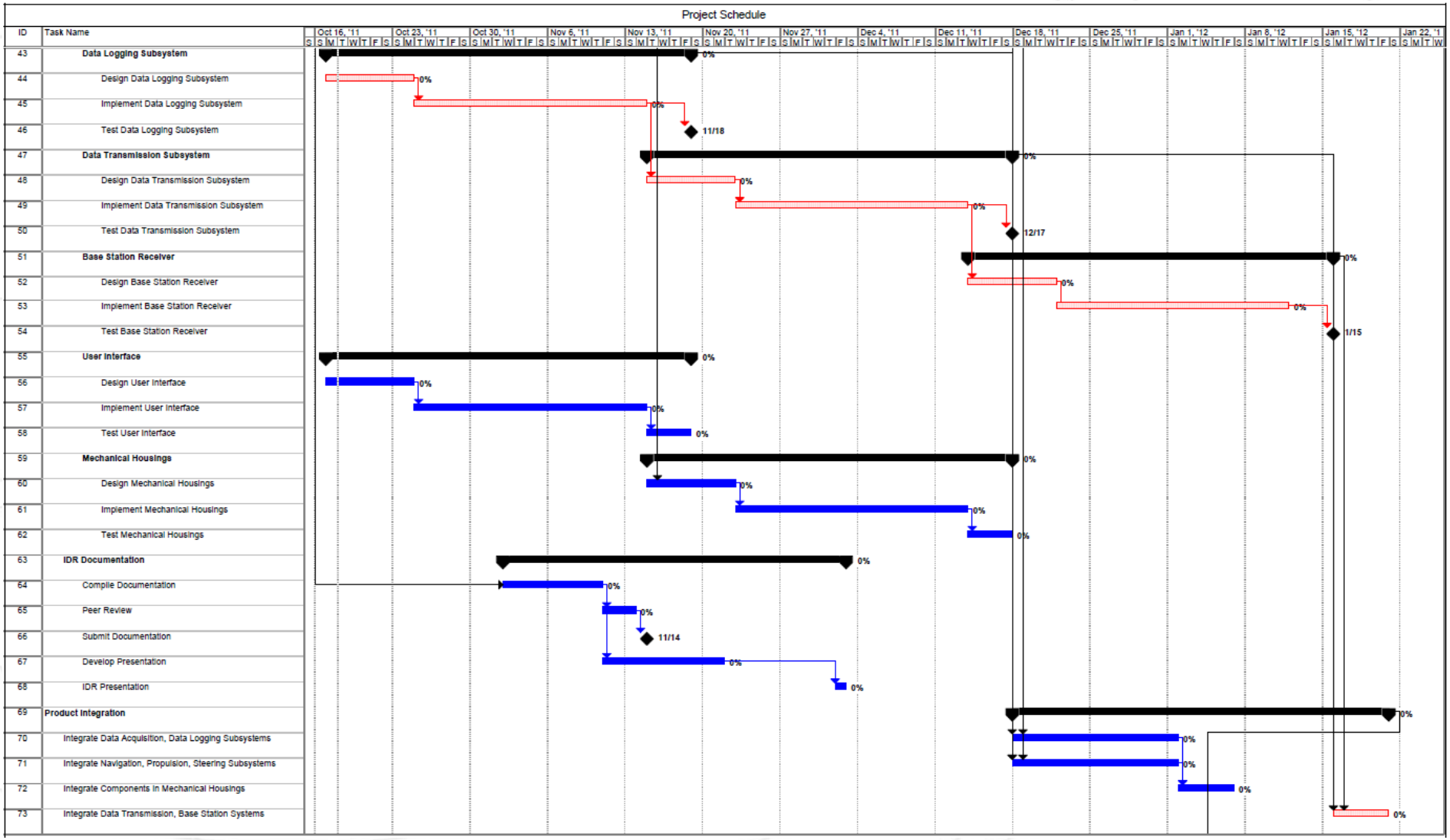
Oceanography Dept - **$1,000** (matching commitment, forthcoming)

Item	P/N	Manufacturer	Distributor	Qty	Price per Unit	Cost
PIC Development Board w/ Programmer	DV164037	Microchip	Microchip	1	$225	$225
SD Daughter Card	AC164122	Microchip	Microchip	1	$28.50	$28.50
Conductivity Sensor	SBE-4	Seabird	In House (FSU Oceanography)	2	-	-
Temperature Sensor	TBD	TBD	TBD	2	$100	$200
Compass Module	SEN-07915	Honeywell	Sparkfun	1	$34.95	$34.95
GPS	GPS-09566	ADH Technology Co. Ltd	Sparkfun	1	$79.95	$79.95
microSD 1GB Memory Card	COM-08163	A-Data	Sparkfun	1	$9.95	$9.95
USB to Serial Converter	USB-232-1	CommFront	CommFront	1	$30	$30
MURS Radio Modem	RV-M3-M	Raveon	Raveon	2	$130	$260
Mobile Antenna	MURS45	Firestik	TBD	1	$24.99	$24.99
Base Station Antenna	MURS-BASE	Firestik	TBD	1	$39.99	$39.99
4x4 Keypad	TBD	Grayhill	TBD	1	$20	$20
Wiring and Accessories					$200	$200
Battery	Lead Acid Battery for UPS and Alarm Systems	Power Sonic	Amazon	2	13.39	26.78
Servo Motor	High Torque Water Proof Servo	Traxxas	TBD	3	27.92	83.76
Propulsion Motor	Semitrash Water Pump	Powerhouse	Northern Tool + Equipment	1	399.99	399.99
Enclosure	Aluminum Roll	Roll Valley	Home Depot	3	12.99	38.97
Frame	N258509 Square Tube	National Mfg.	Amazon	8	12.25	98
Hoses	Discharge and Suction Hoses with couplings	TBD	TBD	1	40	40
Mounting Hardware	Sealants and Bolts	TBD	TBD	N/A	40	40
SubTotal:						1880.83
Shipping & Handling						120
Total Proposed Expenditures:						**2000.83**

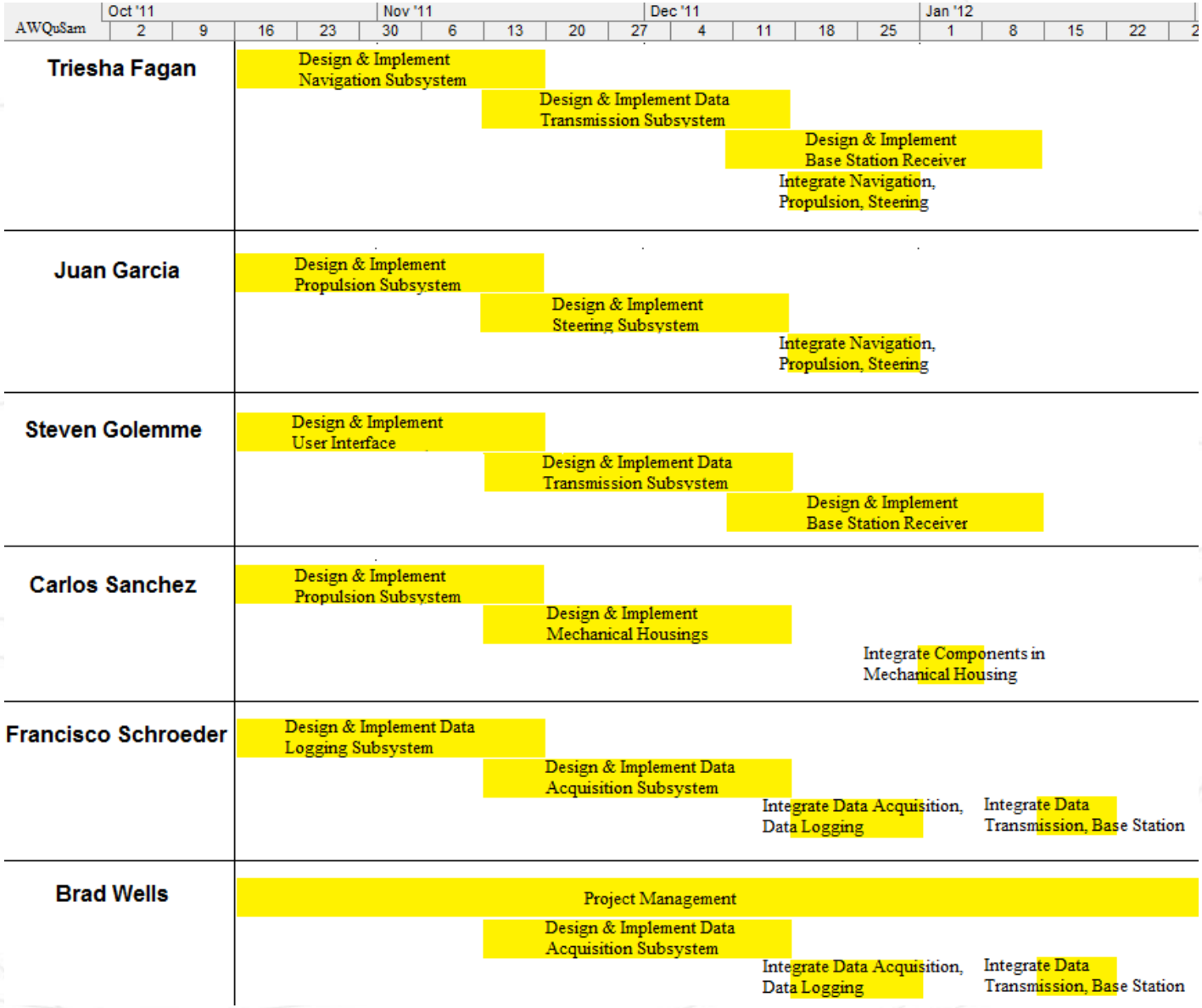
Project Schedule



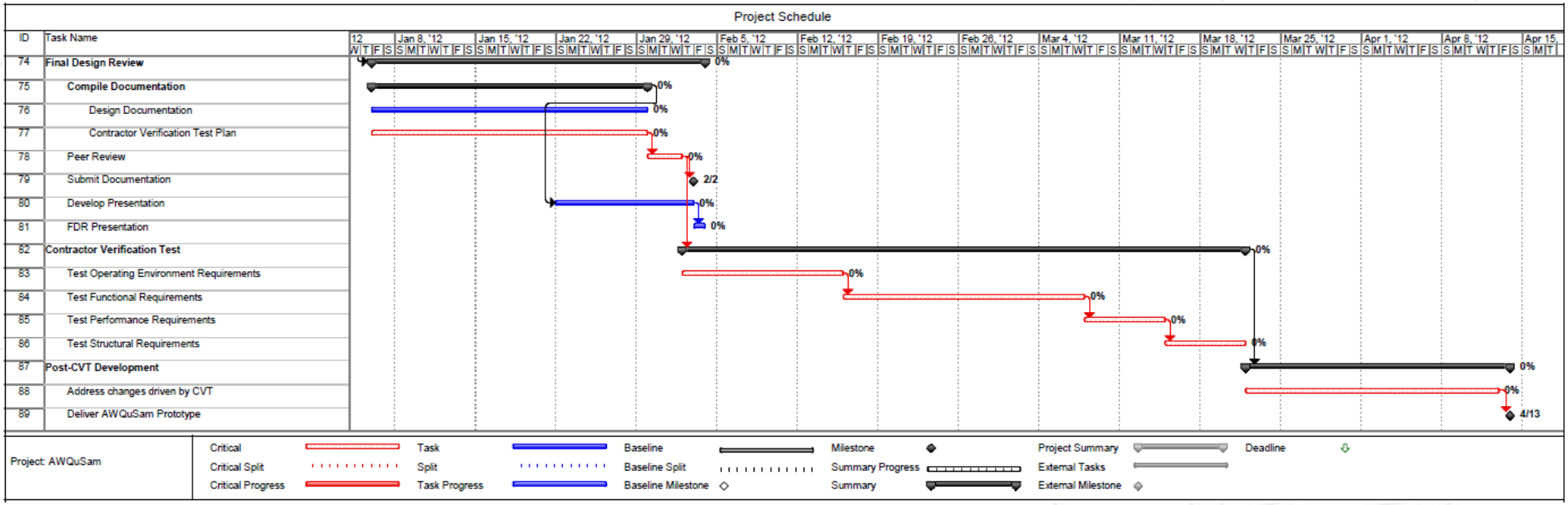
Project Schedule



Team Assignments



Project Schedule



Risk Register

ID	Risk Item	Probability	Impact	Mitigation Plan
1	GPS - Rapid response GPS sensor only outputs 4 sample per second. We are required to log 8 samples/second.	High	Low	We will assume straight-line travel between GPS reports and interpolate intermediary position reports.
2	Power - Combustion of liquid fuel may alter sampled temperature data.	Medium	Low	Sensors will be placed forward of engine to reduce thermal contamination.
3	Hull – Constructing aluminum hull for prototype may introduce delays	Medium	Medium	Team is prepared to implement alternative hull designs (Kayak, Jon Boat) for prototype and deliver design documentation for aluminum hull for final product.
4	Radio - Selected transceiver may only be available to OEM's or in bulk quantities.	High	High	The option outlined in Section 2.4, Paragraph 2 of Project Proposal could be implemented on MURS frequency band.

Questions?

AWQuSam Engineering

Thanks Each of You