FAMU-FSU College of Engineering

NSWC - RoboBoat

Team 521

March 21, 2024 | Virtual Design Review 6

Team Introductions (ME)

Ivanna Caballero
Materials Engineer

Andly Jean
Mechatronic Engineer

Nicholas Norwood
Mechanical Systems Engineer

Makenzie Wiggins
Design Engineer

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Ivanna
Caballero

Team Introductions (EE)

Sophia Barron
Electrical
Systems Engineer

Michael Fitzsimmons
Electronics Engineer

Lucca Meyer
Test Engineer

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Ivanna
Caballero

Sponsor and Mentor

<u>Engineering Mentor/Sponsor</u>
Dr. Damion Dunlap
Naval Surface Warfare Center

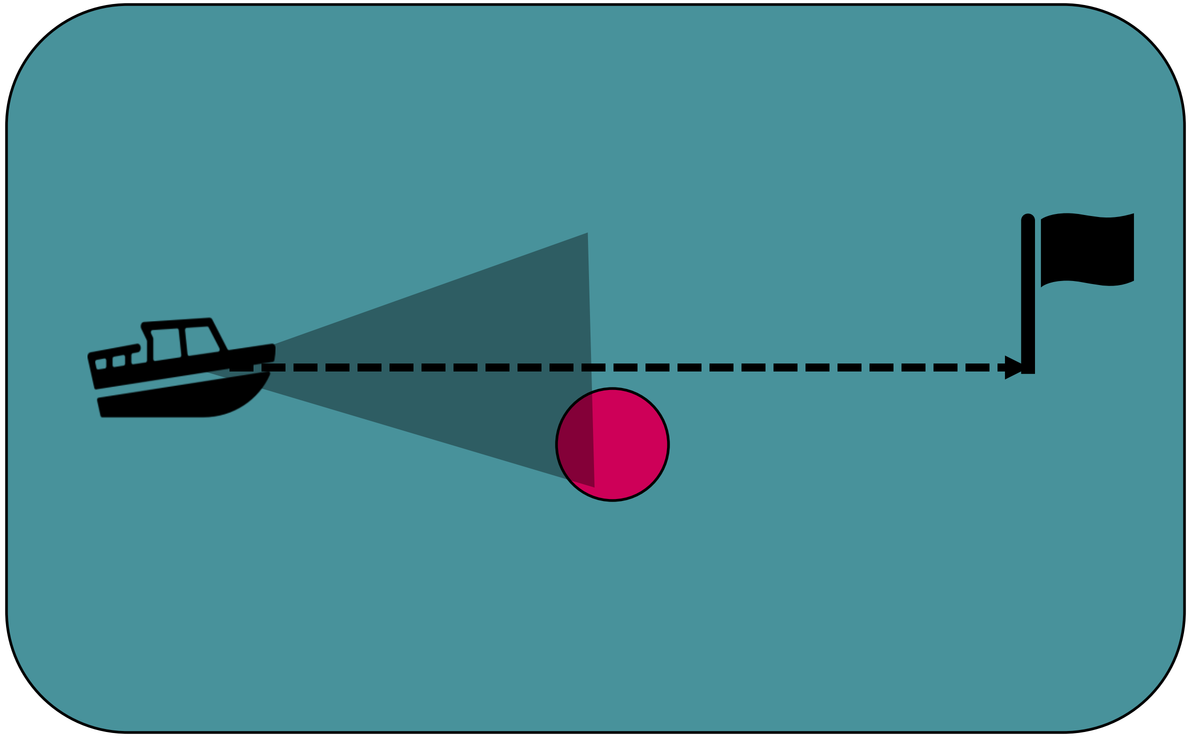
FAMU-FSU College of Engineering

Ivanna
Caballero

Project Objective

The objective of this project is to design, build and program an autonomous surface vehicle capable of completing several tasks in the following categories:

- Navigation
- Detection
- Object avoidance



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Ivanna
Caballero

Background

RoboBoat

- Program at RoboNation
- An international student competition
- Design autonomous, robotic boats to navigate through a challenge course
- Tackle tasks that mimic real-world challenges

Ivanna
Caballero

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Ivanna Caballero

Key Goals

- Reliable Safety System
- Accurate Navigation System
- Modular Code Architecture
- System Designed Around Modular Components

Ivanna
Caballero

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Caballero

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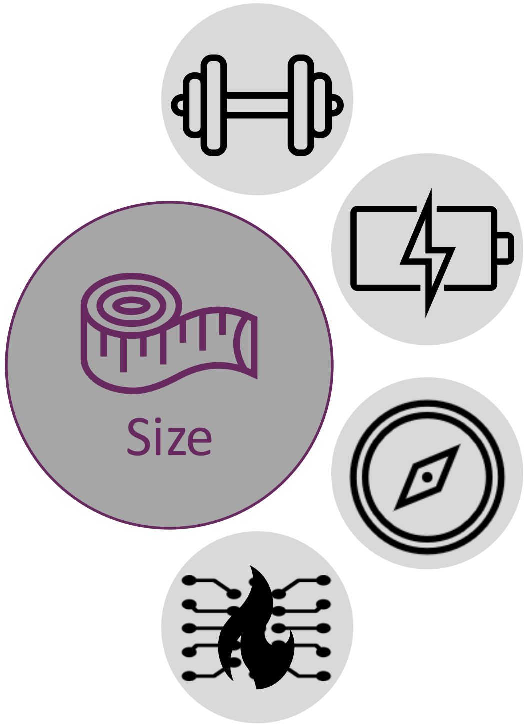
Ivanna
Caballero

Targets and Metrics

The vehicle must fit within a 6 feet x 3 feet x 3 feet box



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Caballero

Targets and Metrics

The entire maritime system must weigh less than 140 lbs

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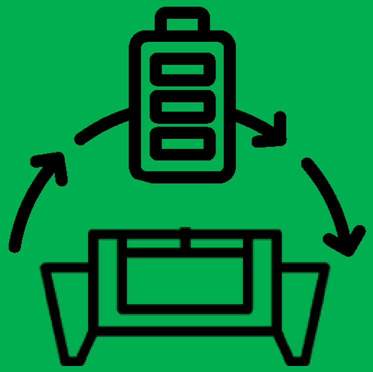
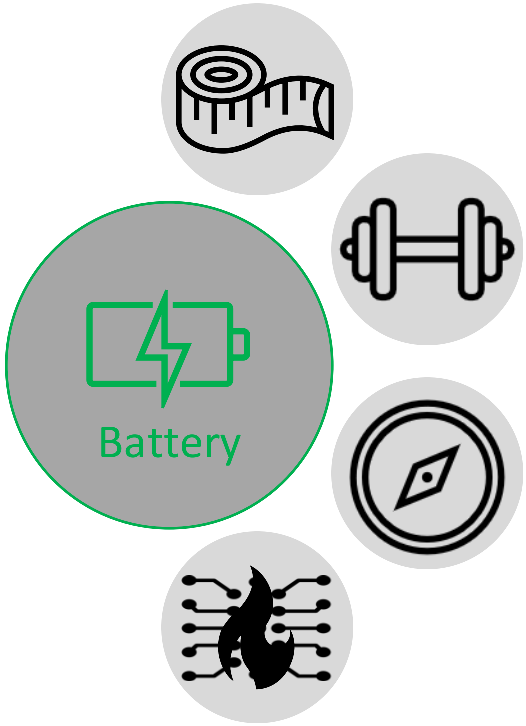
Caballero

Targets and Metrics

The vehicle must be battery powered and have a lifetime of at least 30 minutes





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Caballero

Targets and Metrics

The vehicle must be fully autonomous

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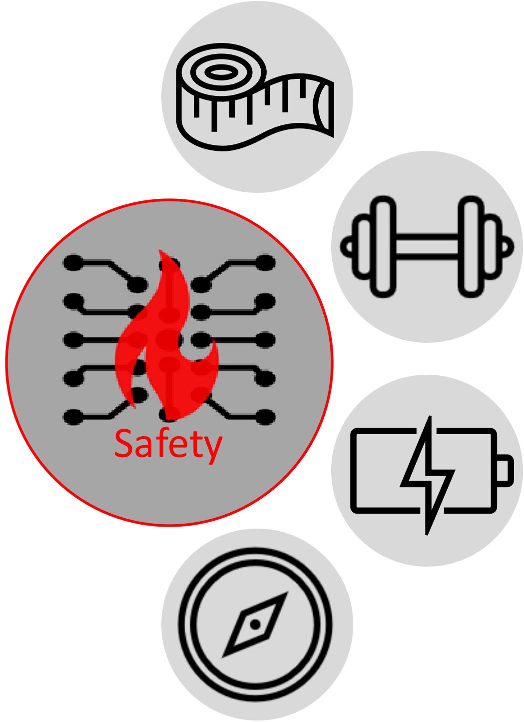
Caballero

Targets and Metrics

The vehicle must have two kill switches: a red stop button and a remote kill switch



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Concept Generation

Michael
Fitzsimmons

Biomimicry

Anti-Problem

Crap Shoot

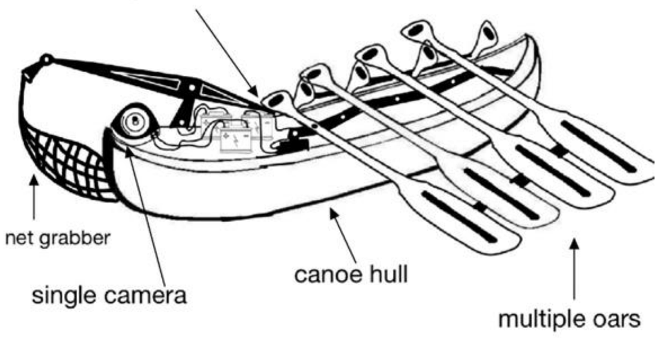
Forced Analogy

Morphological Charts

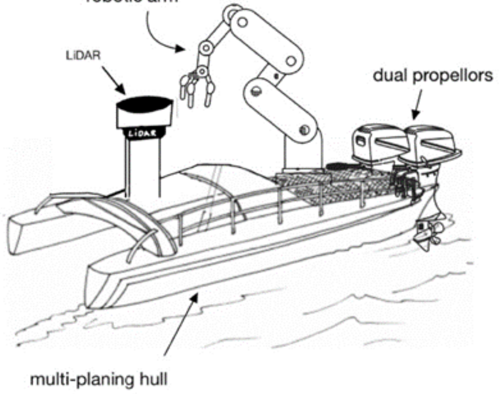
Michael
Fitzsimmons

5 Medium Fidelity Concepts

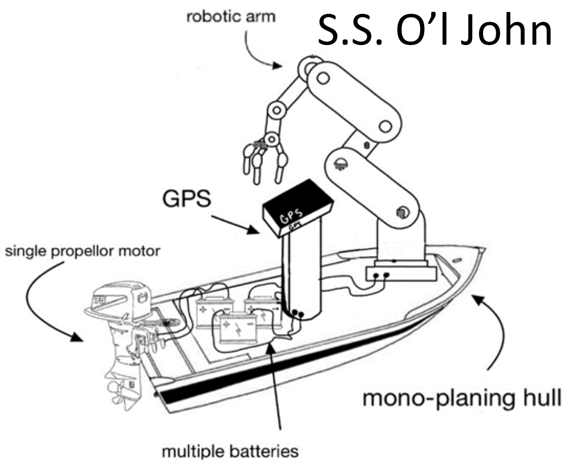
S.S. Galley



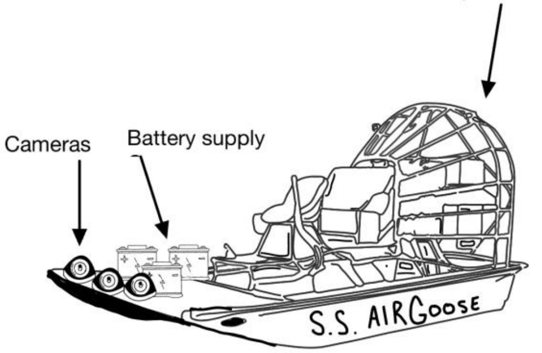
S.S. Hooker



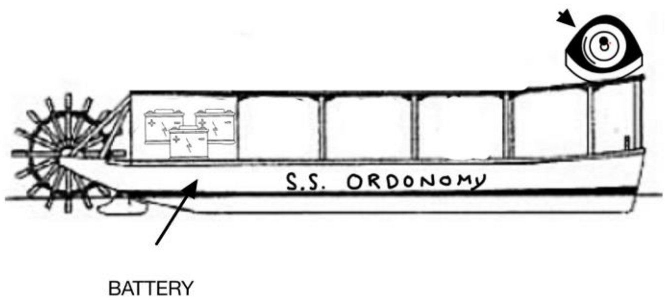
S.S. O'l John



S.S. AIR GOOSE



S.S. ORDONOMY



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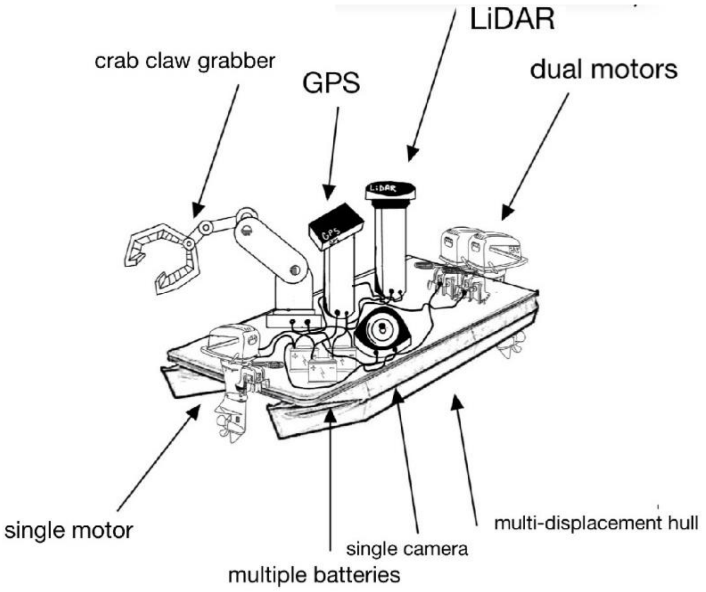
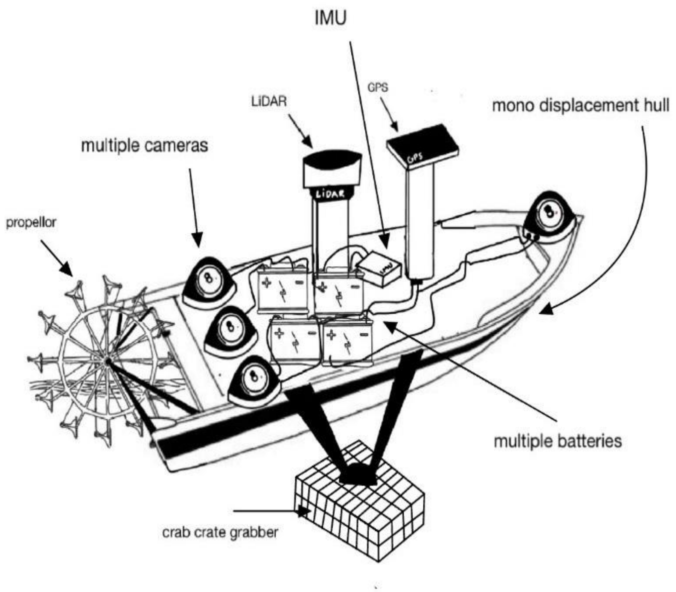
Michael Fitzsimmons

3 High Fidelity Concepts

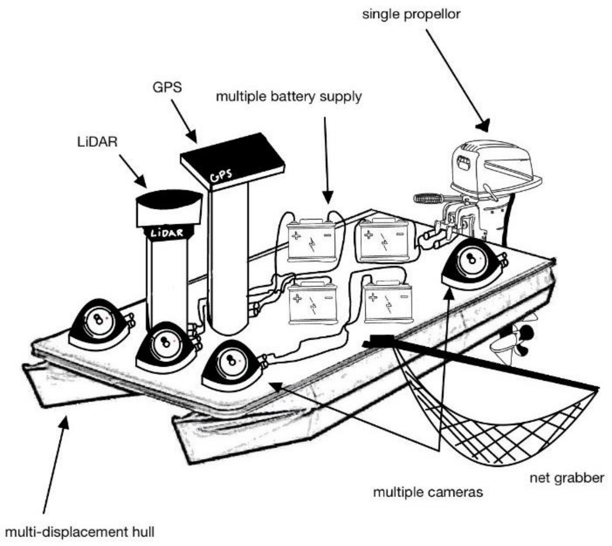
S.S. Shayne 1.0



S.S. Octo



S.S. Slow N' Steady



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Michael
Fitzsimmons

Concept Selection

Pairwise Comparison

House of Quality

Pugh Charts

Analytical Hierarchy

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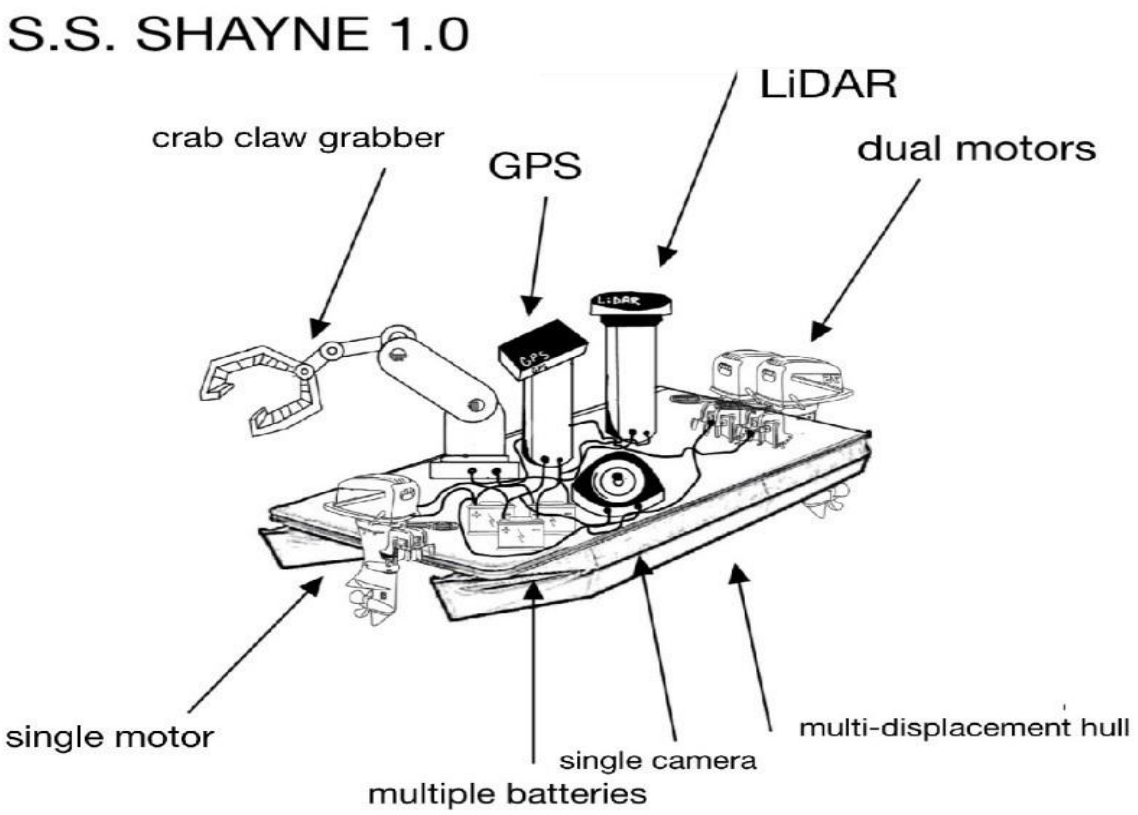
Fitzsimmons

Selected Concept



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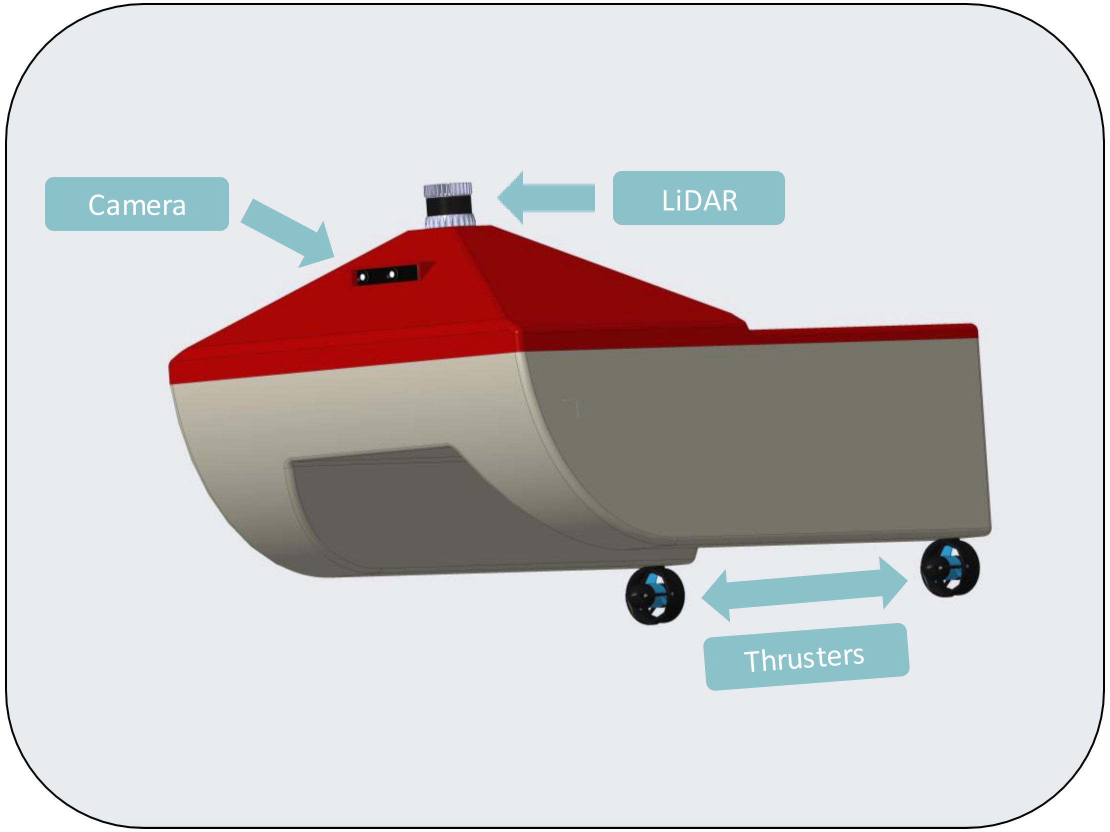
Makenzie
Wiggins

Initial Design



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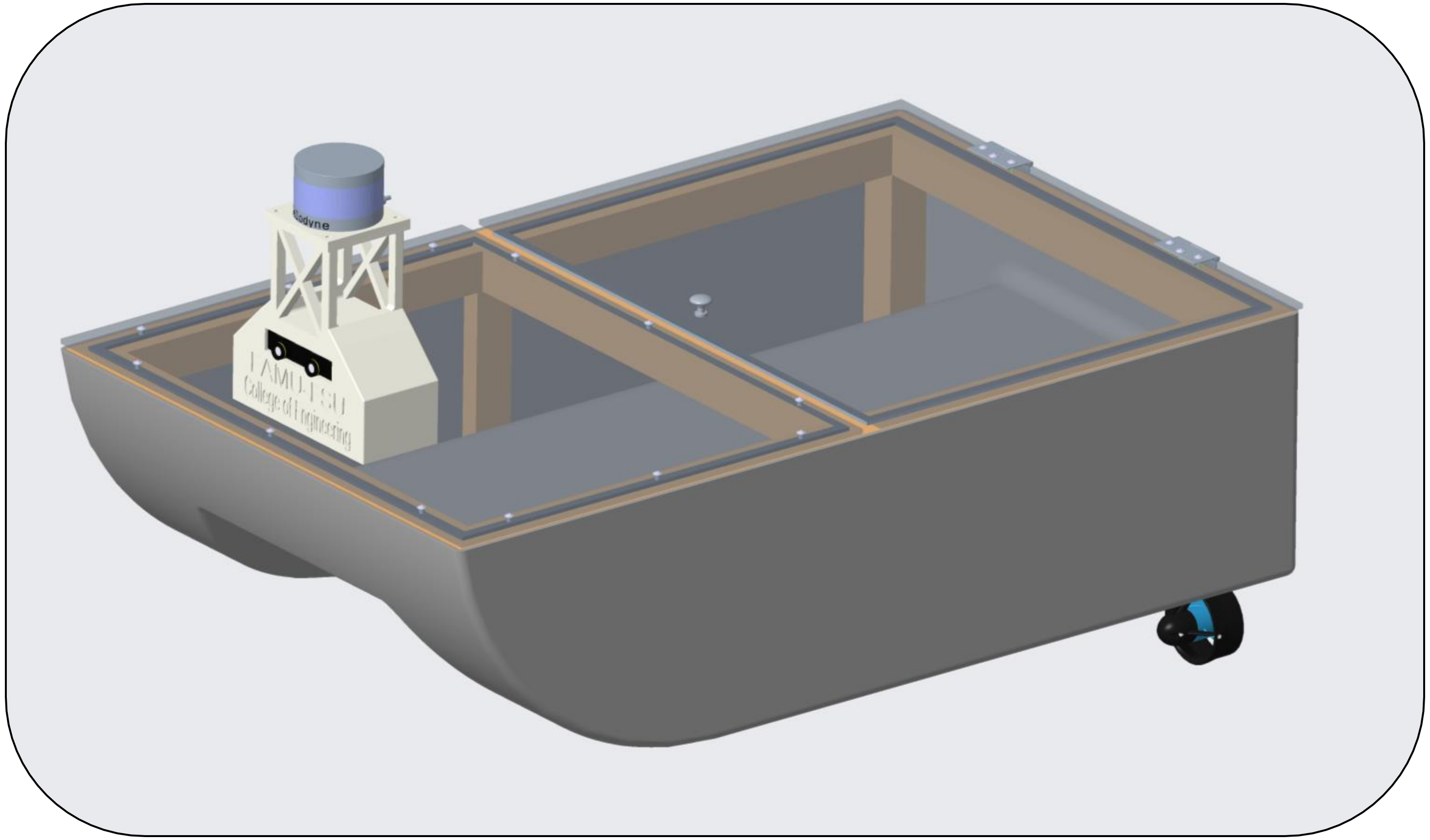
Makenzie
Wiggins

Current Design



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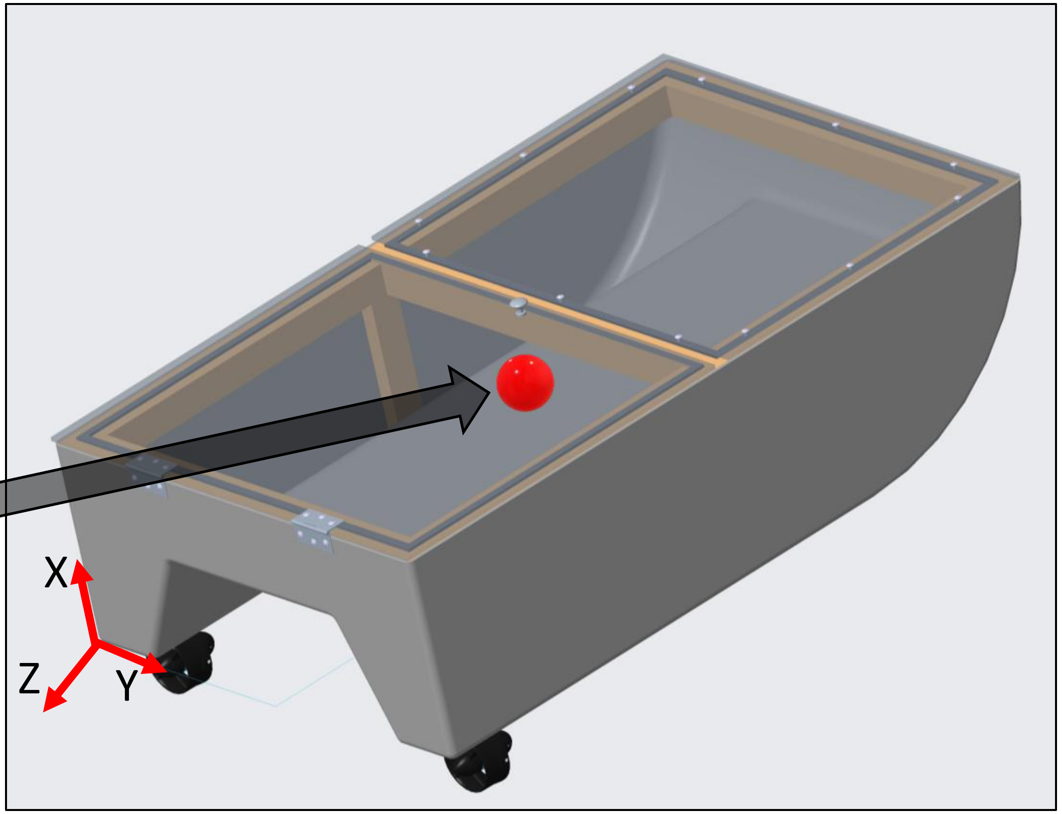
Makenzie
Wiggins

CAD and Center of Mass

- Dynamics
- IMU

Center of mass without components



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Electronics Design

Electrical System

Battery:

- 14.8V battery as main power source

Fuse Panel:

- Delivers power to all components
- Including thrusters, boost converter, and voltage regulator circuit

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Electronics Design

Power Distribution

T200 Thrusters:

- Powered by fuse panel and ESCs

Voltage Regulator Circuit:

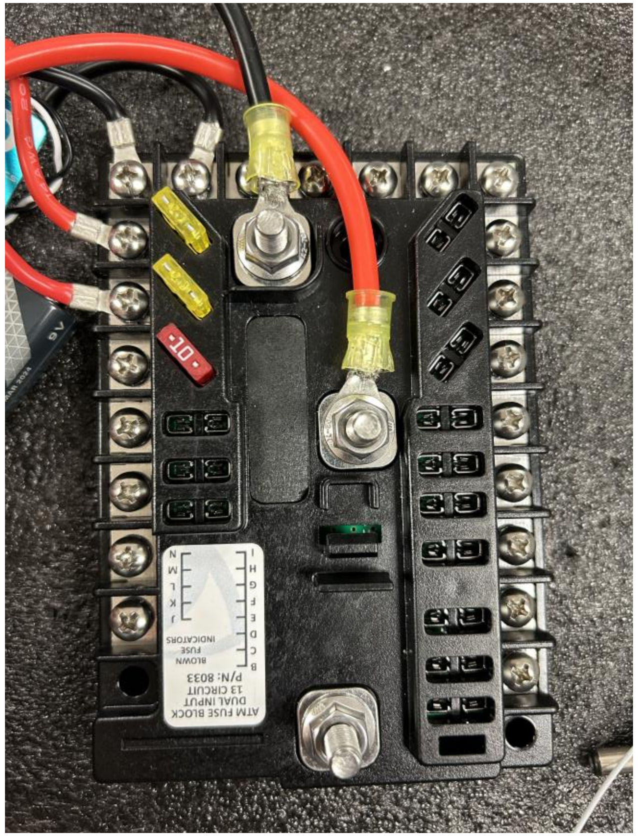
- Arduino microcontrollers receive appropriate voltage level

Boost Converter:

- Steps 14.8V battery up to 19.5V

Velodyne LiDAR:

- Receives 19.5V due to connection with boost converter



Lucca Meyer

Electronics Design

Kill Switch

Emergency Kill Switch Integration:

- Located on the top of the boat for easy access

Fuse Panel in Series with Kill Switch:

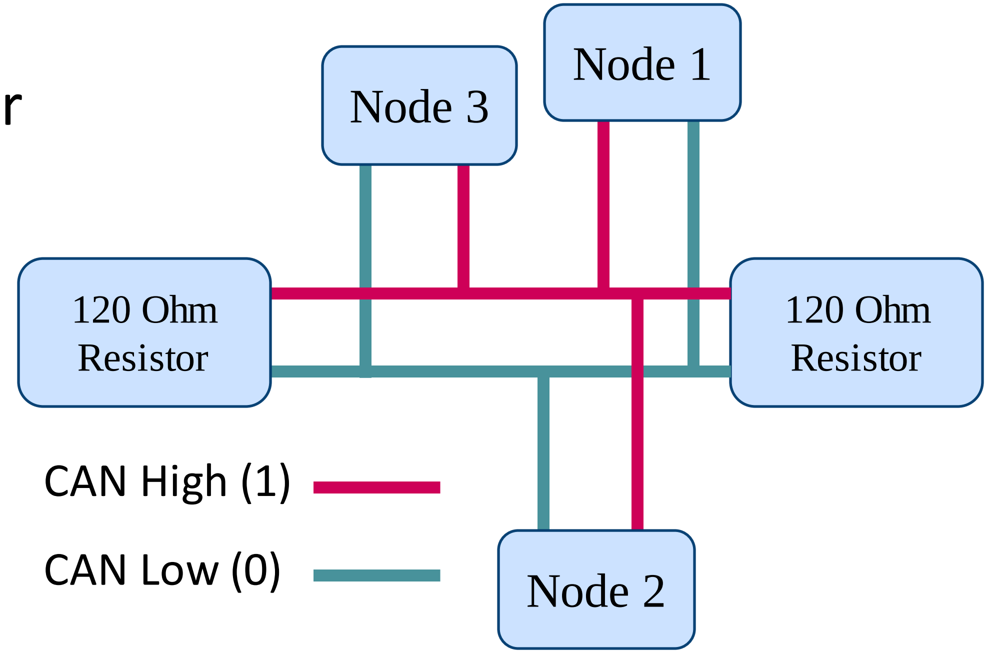
- Wired in series between the battery and the fuse panel
- Immediate power cutoff to fuse panel and all connected components

Andly Jean

Mechatronics Design

CANBUS Design

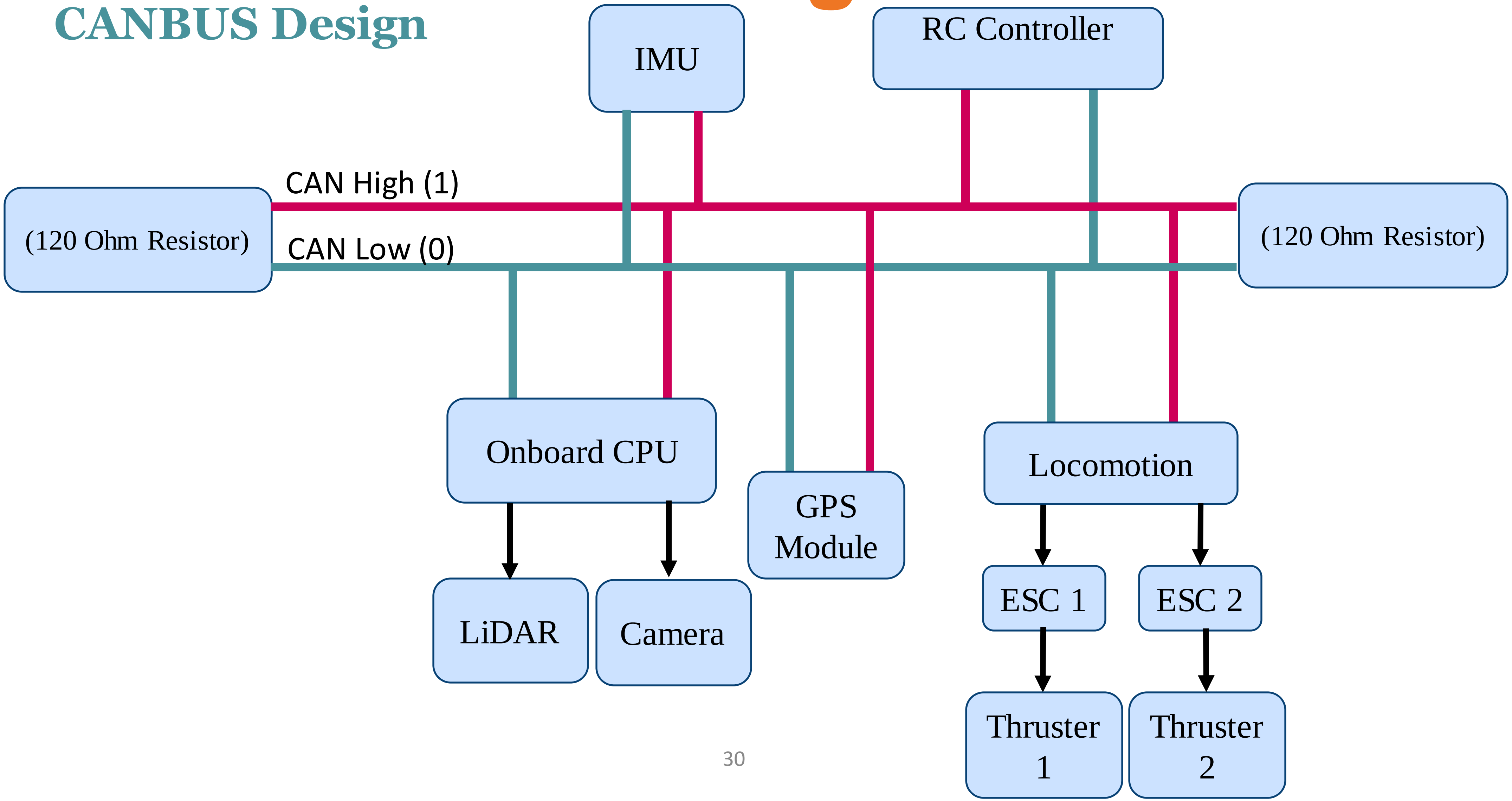
- Controller Area Network (CAN)
- Resistors help pull lines back together
  - Remove noise
- 16 AWG (Gauge)Wires
- CAN ID: 0x02
  - Lower ID = Higher Priority
- CAN DLC: Data Length
- MCP2515 – max 8 bits (0-255)
- Only 1 message on the line at a time



Andly Jean

Mechatronics Design

CANBUS Design



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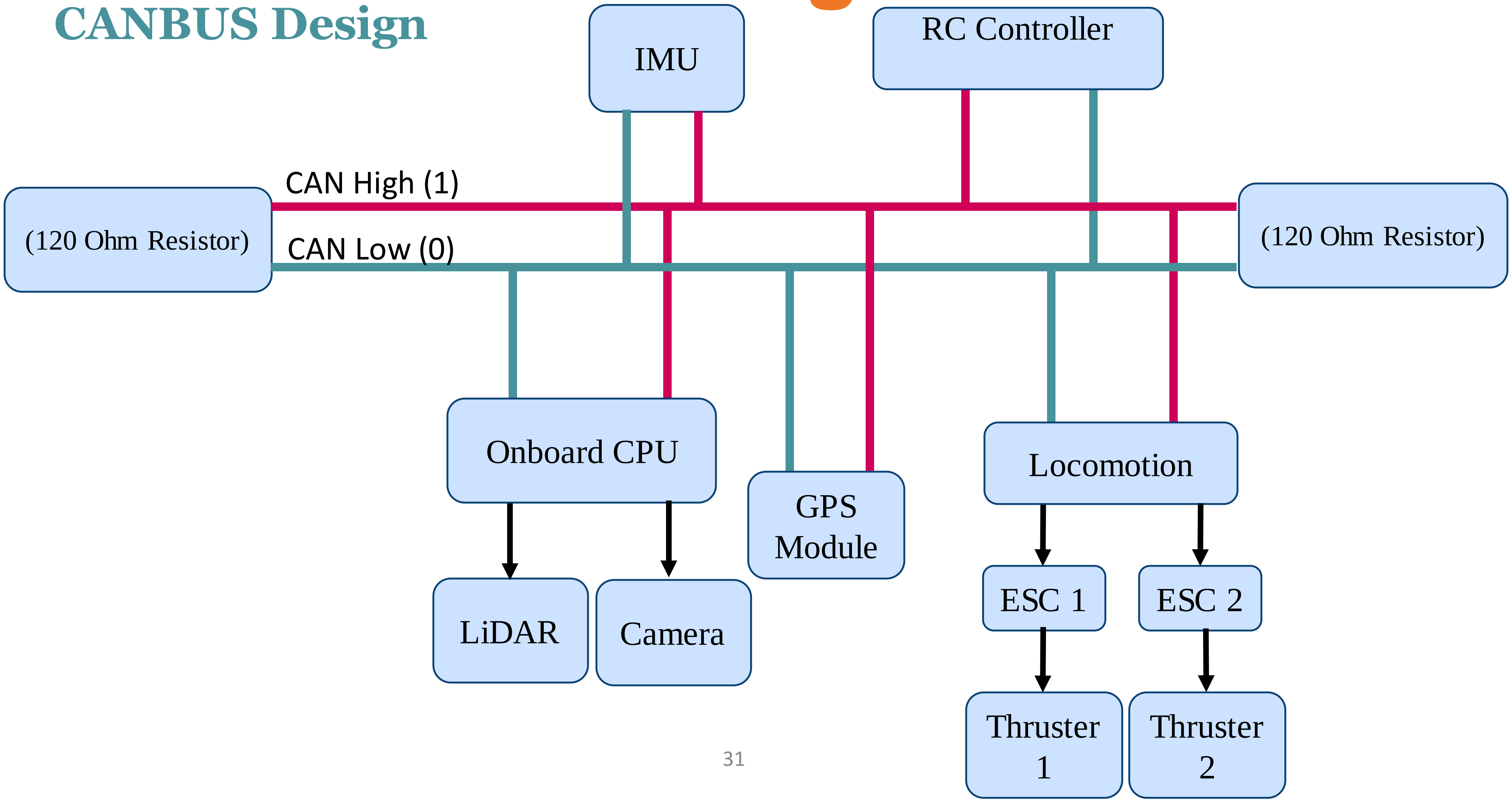
Andly Jean

Mechatronics Design

CANBUS Design



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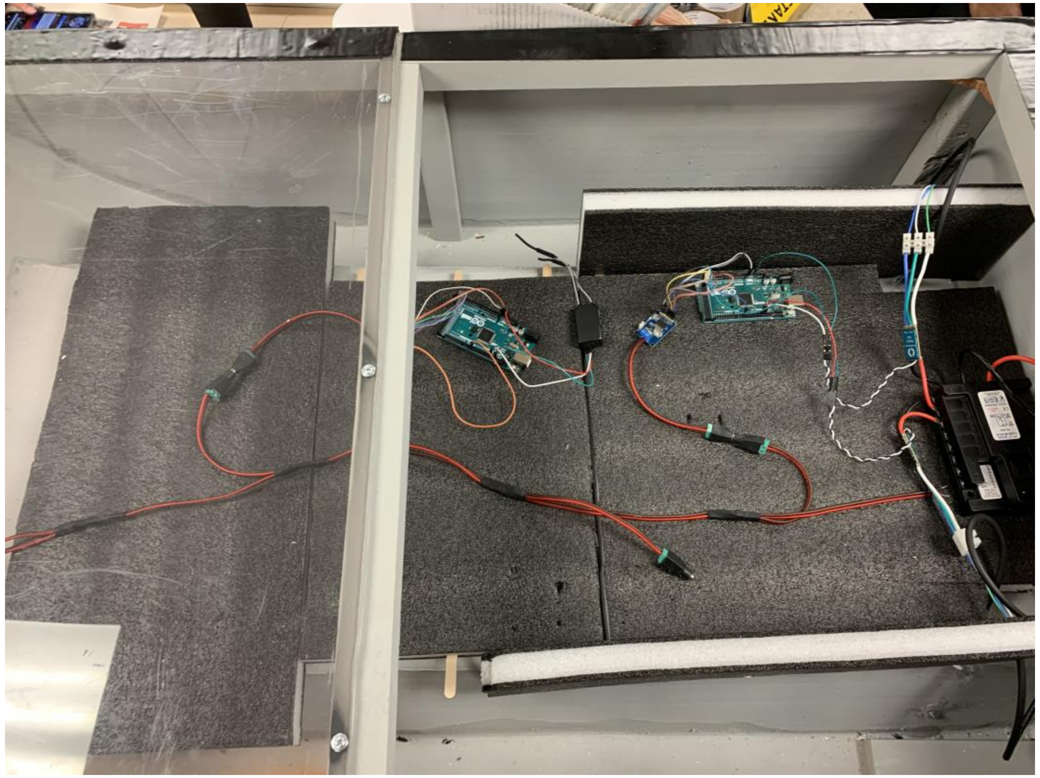
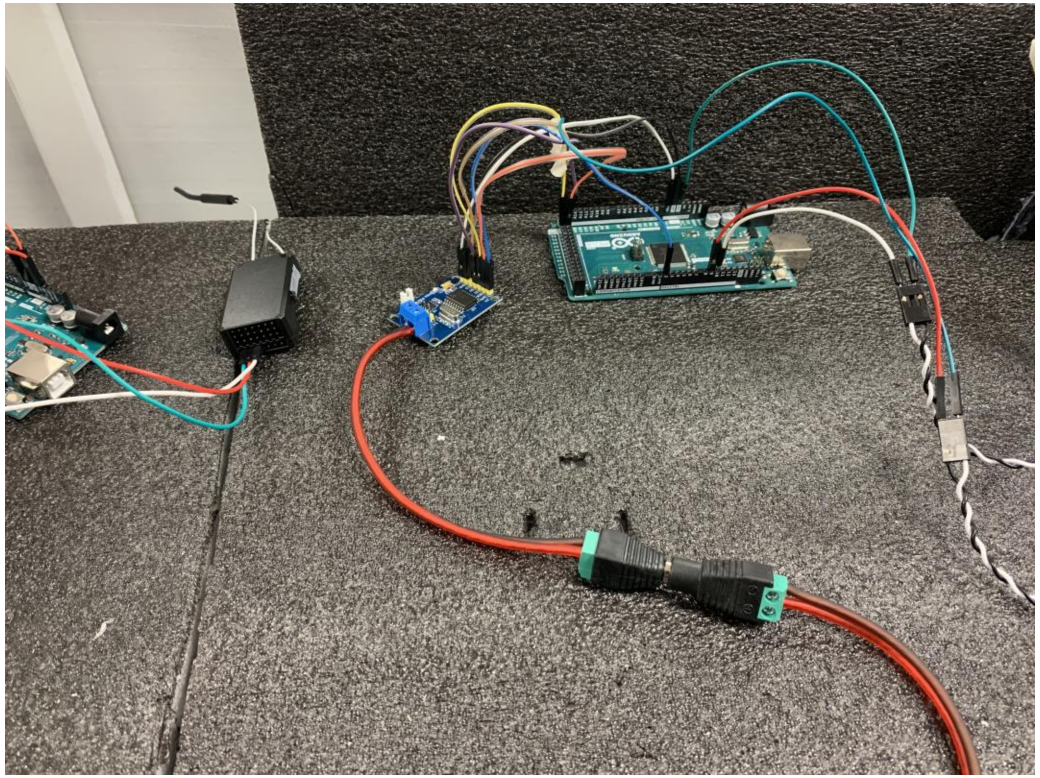
Andly Jean

Mechatronics Design

CANBUS Design





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Andly Jean

Mechatronics Design

Remote Control Is King

- Remote kill switch implementation
  - CAN ID: 0x01 (Highest Priority)
  - Relay >> Transistor
    - 50 Amp requirement


```
//Reads value of a given channel and converts it to set range
int readChannel(byte channelInput, uint16_t min, uint16_t max, byte defaultVal)
{
  uint16_t ch = ibus.readChannel(channelInput);
  if (ch < 1000 || ch > 2000) //if Controller Dead
  {
    pinMode(remote_KSwitch, HIGH)
    return defaultVal;
  }
  return map(ch,1000,2000,min,max);
}
```

- Byte - Range: -128 - 127
- Uint16_t (2 bytes) - Range: 0 – 65,535
- Values outputted from RC: 1000-2000
- Small effort towards memory efficiency

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Nicholas
Norwood

Navigation

- Boat Physics
- Simple Simulation
- Waypoint Following Simulation
- Integration with LiDAR

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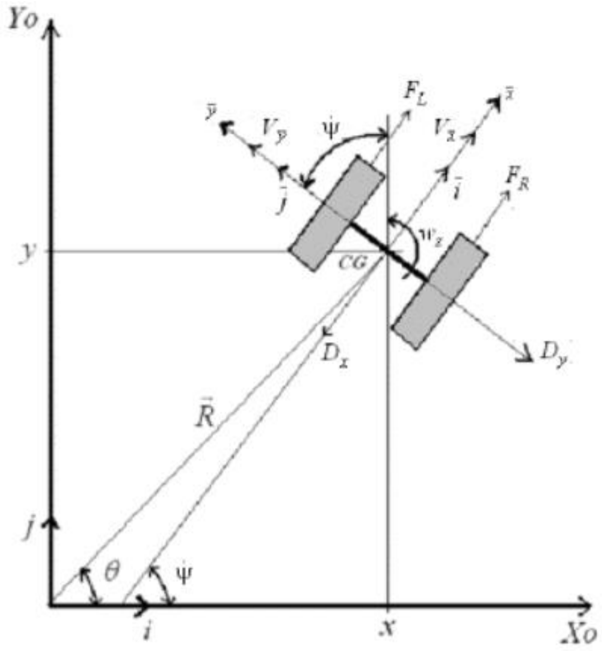
Navigation

Boat Physics

- Free Body Diagram to find forces on the boat
- Use F=ma to create equations that model boat dynamics
- Convert equations into state-space representation
- Constants needed for accurate modeling
  - Mass
  - Moment of Inertia
  - Drag Coefficients



$$\begin{bmatrix} \dot{V}_x \\ \dot{V}_y \\ \dot{p}_x \\ \dot{p}_y \\ \dot{\psi} \\ \dot{w}_Z \end{bmatrix} = \begin{bmatrix} \omega_z V_{\bar{y}} + (F_R + F_L - sign(V_{\bar{x}}) K_x V_{\bar{x}}^2))/m \\ -w_z V_{\bar{x}} - sign(V_{\bar{y}}) K_y V_{\bar{y}}^2/m \\ V_{\bar{x}} \cos\psi - V_{\bar{y}} \sin\psi \\ V_{\bar{x}} \sin\psi + V_{\bar{y}} \cos\psi \\ w_z \\ ((F_R - F_L)d - sign(w_Z) K_Z w_Z^2)/J \end{bmatrix}$$

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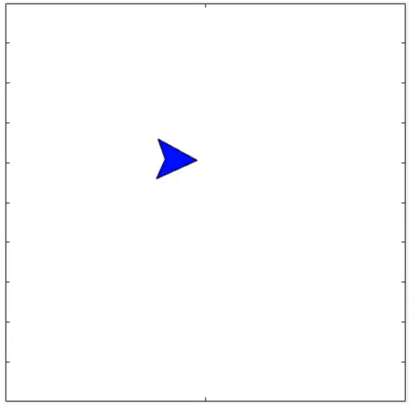
Nicholas
Norwood

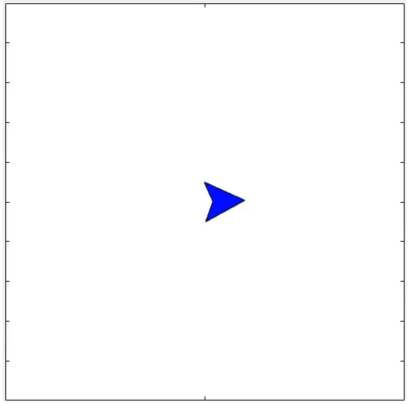
Navigation

Basic Matlab Simulation

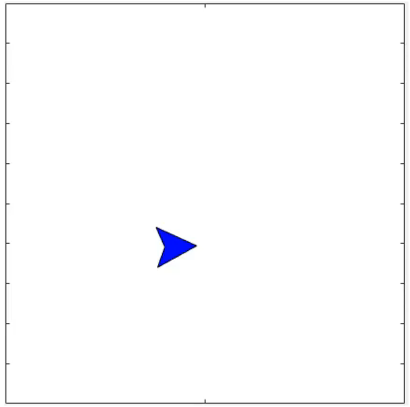
Right Turn



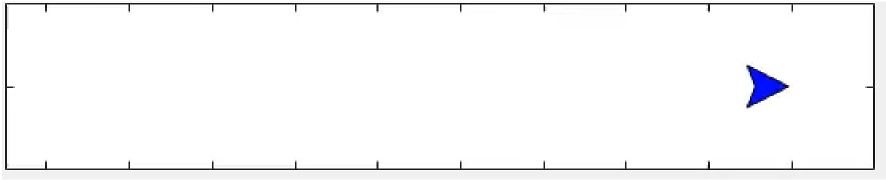
Point Turn



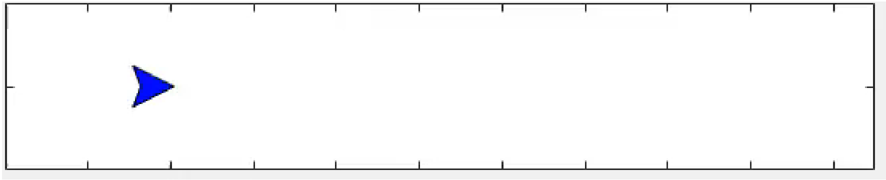
Left Turn



Forwards



Backwards



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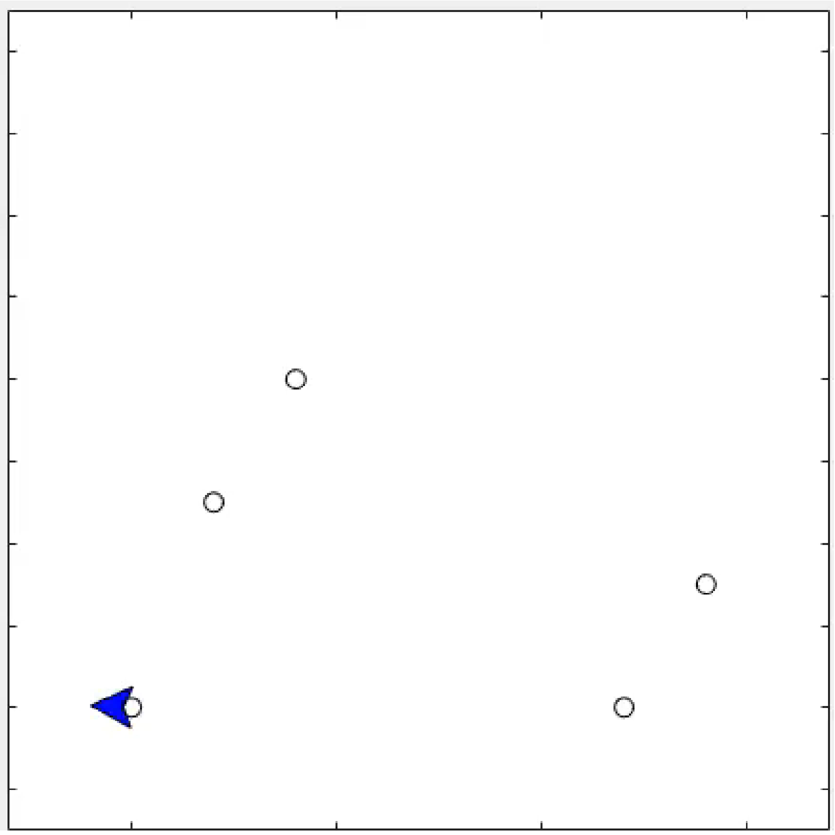
Norwood

Navigation

Waypoint Following Simulation



- Inputs
  - Waypoints
  - Initial guess of motor commands
- Outputs
  - List of commands for motors
  - Time interval for between each waypoint
- List of commands converted from force inputs to motor signals

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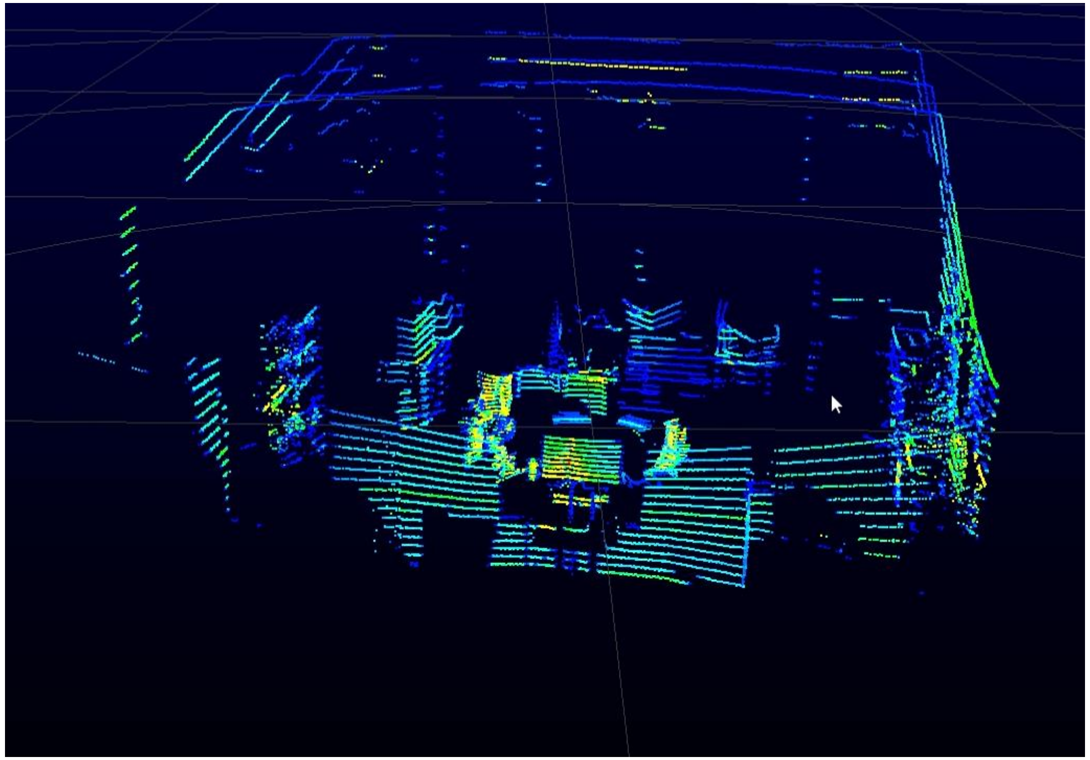
Nicholas
Norwood

Navigation

Integration with LiDAR

- Map challenge course with LiDAR
- Select waypoints using LiDAR map
- Feed waypoints into Matlab Simulation
- Transfer motor commands to Microcontrollers

LiDAR Map



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Sophia Barron

Testing and Validation

- Hull taking on water at the bottom of boat
  - Tested by spray painting the inside
- RC Controls & Waypoint following
  - Tested in COE lake
- Main battery power control
  - Tested by multimeter & power getting to individual parts

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Sophia Barron

Improvements

Hull

- Flex seal
- Spray painted inside
- Reinforced by wood planks

Electronics

- Mounted thrusters
- Fuse panel
- DC-to-DC boost converter & 5 V Voltage Regulator

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Sophia Barron

Lessons Learned

Aspirations to compete this year seemed too large

More research & testing on LiDAR and Jetson done earlier

- More troubleshooting than we originally planned for
- Prepared for more backup solutions

Adaptiveness in earlier assignments

- Losing sight of the bigger picture

It might have been better to start from scratch rather than trying to fix and navigate through problems

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Sophia Barron

Budget

Total spent: $584.32

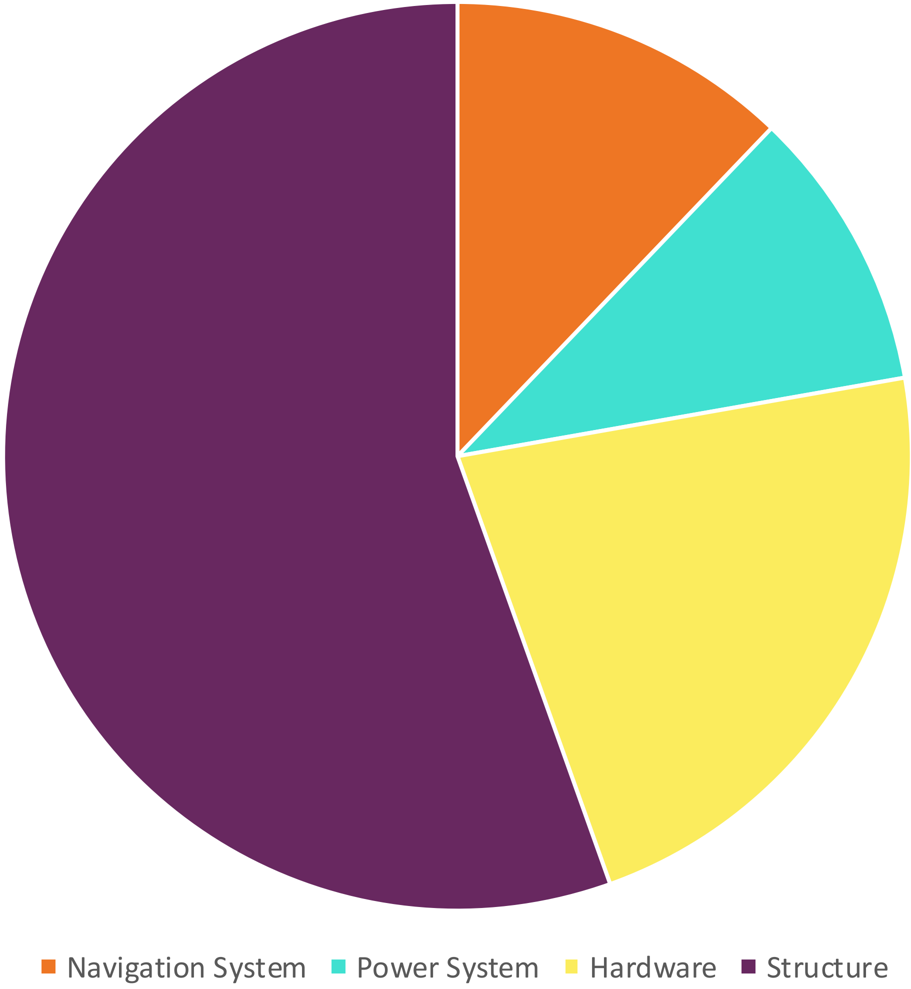
Navigation System:$71.00

Power System:$58.90

Hardware:$130.38

Structure:$324.04

Remaining: $1415.68



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References

About. RoboBoat. (2021, March 13). https://roboboat.org/about/

Past programs. RoboBoat. (2019, September 27). https://roboboat.org/past-programs/

RoboBoat 2024. RoboBoat. (2023, October 13). https://roboboat.org/programs/2024/

Tel Aviv Competition Strategy Video. (2022, May 16). https://www.youtube.com/watch?v=qss0lyN3KJ8

Thank You

Thank You

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Backup Slides

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Michael
Fitzsimmons

Critical Targets

Size:
≤ 6 ft x 3 ft x 3ft

Weight:
≤ 140 lbs

Battery Life:
> 30 min

Autonomous Navigation:
True

Kill Switch Integration:
True

Contact Us!

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Michael Fitzsimmons

Concept Selection

Pairwise Comparison

Binary Pairwise Comparison	1	2	3	4	5	6	7	8	9	10	Total
1. Navigation	-	1	0	0	1	0	1	1	1	0	5
2. Retrieving objects	0	-	0	0	0	0	0	0	0	0	0
3. Size within 3 ft wide x 3 ft high x 6 ft long	1	1	-	0	1	0	1	0	1	0	5
4. Weight less than 140 lbs	1	1	1	-	1	0	1	0	1	0	6
5. Enough power for 30 minute minimum run time	0	1	0	0	-	0	1	0	1	0	3
6. Stability	1	1	1	1	1	-	1	1	1	1	9
7. Autonomy	0	1	0	0	0	0	-	0	0	0	1
8. Modular components	0	1	1	1	1	0	1	-	1	0	6
9. Object detection	0	1	0	0	0	0	1	0	-	0	2
10. Costs under $2000	1	1	1	1	1	0	1	1	1	-	8
Total	4	9	4	3	6	0	8	3	7	1	n-1 =9
Check	9	9	9	9	9	9	9	9	9	9	

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Michael Fitzsimmons

Concept Selection

Pairwise Comparison → House of Quality

House Of Quality														
	Engineering Characteristics													
	Improvement Direction													
	Units	m	lbs.	Newtons	degrees	m	m/s	m	mAh	ft	grams	pixels	milliseconds	
Customer Needs	Priority	Size	Weight	Buoyancy	Deflection Angle	Turn Radius	Velocity	Calculate distance from objects	Battery Power	Cross-track error	Arm Capacity	Sensor Resolution	Response time	
1. Navigation	5				3	9	9	9	3	9		9	3	
2. Retrieving objects	0	3						9	3		9	3	1	
3. Size within 3 ft wide x 3 ft high x 6 ft long	5	9	3	9	3	3	3		1					
4. Weight less than 140 lbs	6	3	9	9	3		3		9		1			
5. Enough power for 30 minute minimum run time	3	9	9				1		9			3	1	
6. Stability	9	3	3	9	9	3	3	1		1	3	1		
7. Autonomy	1				3	3	3	9	9	9	1	9	3	
8. Modular components	6	3	1						9		1	3	3	
9. Object detection	2				3	1	3	9	3	1		9	3	
10. Costs under $2000	8	3	3	1			3	3	9		1	9	3	
Raw Score		159	153	188	138	92	141	105	242	65	48	180	69	Average
Relative Weight Percent		10.06%	9.68%	11.90%	8.73%	5.82%	8.92%	6.65%	15.32%	4.11%	3.04%	11.39%	4.37%	8.33%
Rank Order		4	5	2	7	9	6	8	1	11	12	3	10	

Michael Fitzsimmons

Concept Selection

Pairwise Comparison → House of Quality → Pugh Charts

			Concepts							
Selection Criteria	Criteria Weight	Tel Aviv 2022 RoboBoat Team	S.S. Galley	S.S. OrdoNomy	S.S. Hooker V1	S.S. Air Goose	S.S. Ol' John	S.S. Shayne 1.0	S.S. Octo	S.S. Slow N' Steady
Battery Power	15.32%	Datum	S	S	S	-	S	S	S	S
Buoyancy	11.90%		-	-	S	+	-	S	-	+
Sensor resolution	11.39%		-	S	-	-	-	S	S	+
Size	10.06%		-	+	-	-	S	S	-	-
Weight	9.68%		+	S	-	-	+	-	-	-
Velocity	8.92%		-	-	+	+	-	+	-	-
Deflection Angle	8.73%		-	-	-	+	-	-	-	+
# of pluses			1	1	1	3	1	1	0	3
# of minuses			5	3	4	4	4	2	5	3

			Concepts			
Selection Criteria	Criteria Weight	S.S. Slow N' Steady	S.S. Air Goose	S.S. Ol' John	S.S. Shayne 1.0	S.S. Ordonomy
Battery Power	15.32%	Datum	-	S	S	S
Buoyancy	11.90%		-	-	S	-
Sensor resolution	11.39%		-	-	-	S
Size	10.06%		+	+	S	-
Weight	9.68%		+	+	+	-
Velocity	8.92%		+	+	+	-
Deflection Angle	8.73%		-	-	S	S
# of pluses			3	3	2	0
# of minuses			4	3	1	4

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Michael Fitzsimmons

Concept Selection

Pairwise Comparison → House of Quality → Pugh Charts → Analytical Hierarchy

Final Rating Matrix			
Selection Criteria	S.S. Air Goose	S.S Ol' John	S.S Shayne 1.0
Batter Power	0.091	0.455	0.455
Buoyancy	0.633	0.106	0.260
Sensor Resolution	0.261	0.106	0.633
Size	0.106	0.633	0.260
Velocity	0.261	0.106	0.633
Deflection Angle	0.200	0.200	0.600

Concept	Alternative Value
S.S. Air Goose	0.241
S.S. Ol' John	0.255
S.S. Shayne 1.0	0.504

FAMU-FSU College of Engineering

Lucca Meyer

Current Work
Purchasing

- Receiving list
  - Thrusters (x4)
  - Electronic Speed Controlling ESCs (x4)
  - Velodyne LiDAR (x1)
- Established Source of Funding
  - Derived priority order list

FAMU-FSU College of Engineering

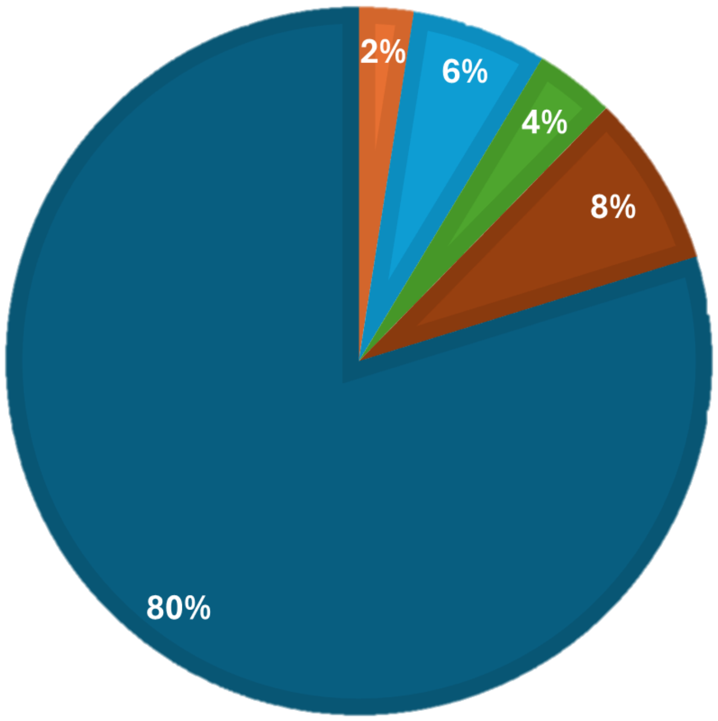
Lucca Meyer

Current Work
Budget Breakdown

Total spent: $404.62

Remaining: $1595.48

- Navigation System:$50.05
- Power System:$123.57
- Hardware:$73.00
- Structure:$158.00



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Lucca Meyer

Current Work
Budget Breakdown

- Lidar: $4600.00
- GPS Module: $32.00
- Camera: $399.00
- Jetson: $3,000.00
- USB Port Hub: $19.99
- SD Card: $12.99
- Batteries: $169.99
- Voltage Regulators (9V): $49.98

Total
Amount Saved: **$8,284.94**

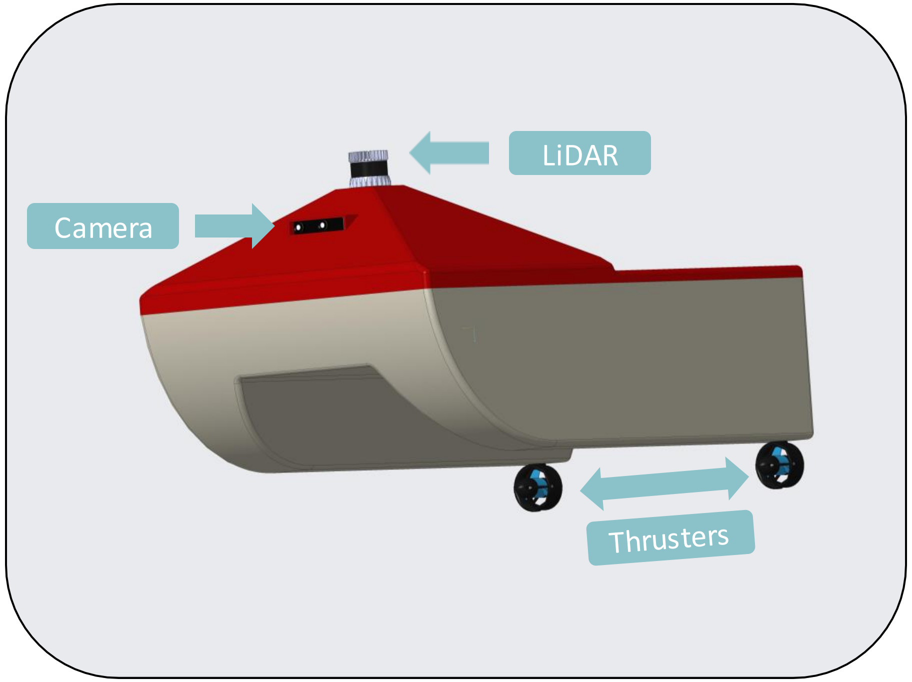
Current Work
Structure

- Tested hull with 30 lbs. weight in water
  - Leaks
- Began reinforcing structure
- Selected Material
  - 1/10 inch Plexiglass

Lucca Meyer

Current Work
Structure

- Designing mounts for LiDAR, thruster, and camera
- Cutting plexiglass lid to size
- Hinged lid



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Lucca Meyer

Current Work

Structure

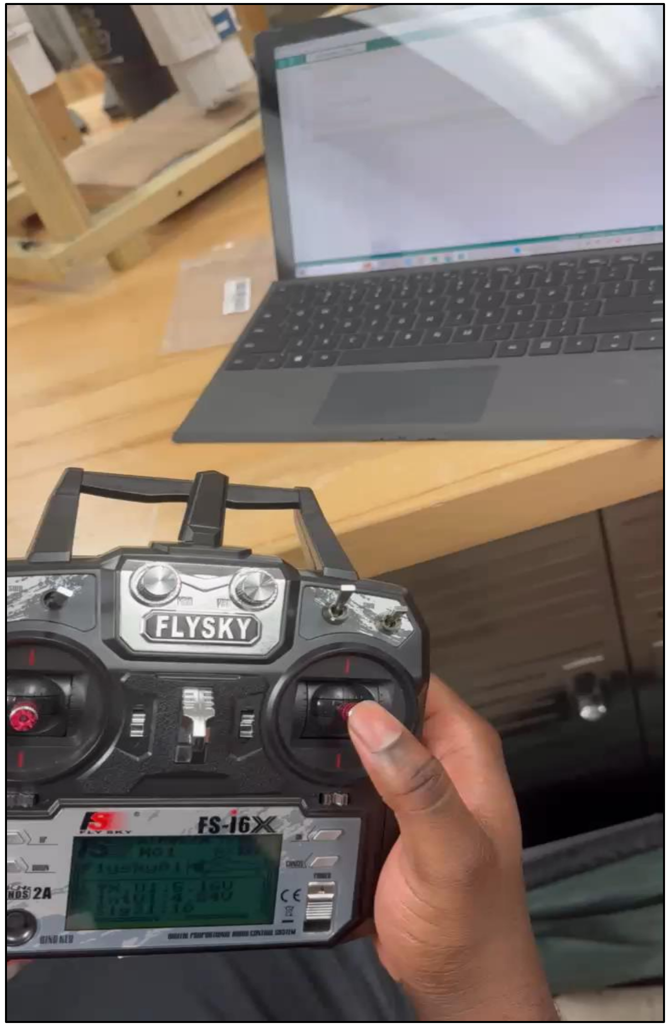
- Mount Thrusters to hull
- Finish reinforcing Hull
- Fiberglass
- Leak prevention

FAMU-FSU College of Engineering

Andly Jean

Current Work
Locomotion

- Thrusters
  - Repaired broken ESC
  - 2 Thrusters connected and paired to RC Controller
- Can Bus Line
  - Communication logic written and formatted
  - Work out can line layout within boat



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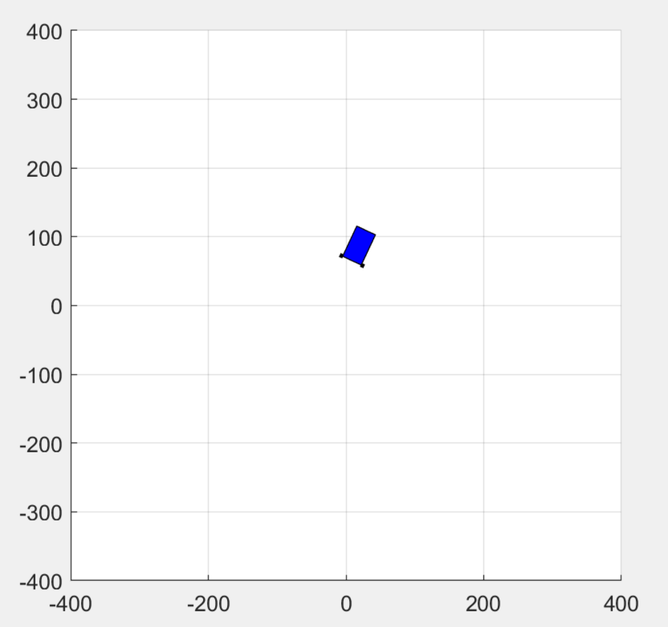
Andly Jean

Current Work
Locomotion

- Controls
  - Matlab Simulation
    - Boat Kinematics
    - Waypoint following in progress
- Relationship between PWM signal and RPM
  - Equation provided by manufacturer
    - 12 and 16 Volts
    - 14 Volts*



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Andly Jean

Current Work
Navigation

- Velodyne LiDAR
  - Panama City Campus
  - Internal IMU
  - Output example on next page
- Nvidia Xavier
  - Figured out and stored device password
  - Began software installs/upgrades
    - Error with update from Ubuntu 18.04 to Ubuntu 20.04

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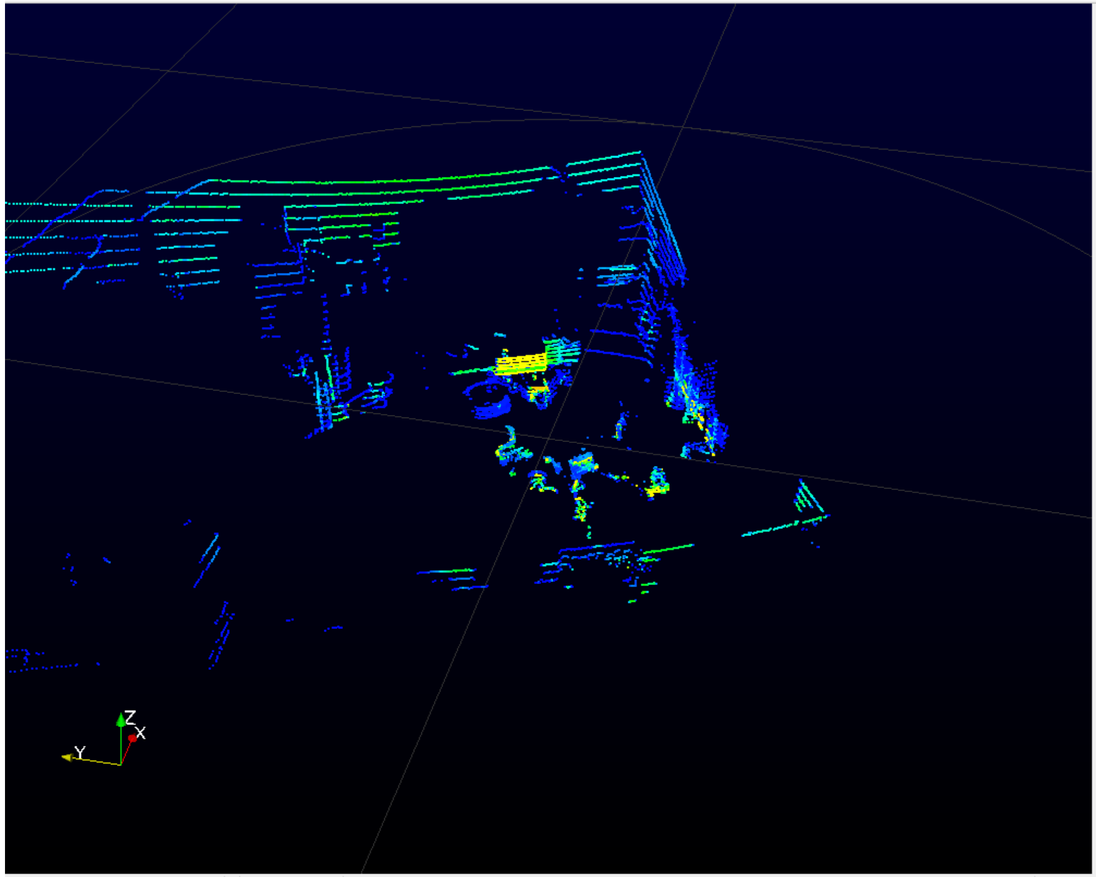
Andly Jean

Current Work
Navigation



Showing: Data | Attribute: Point Data | Precision: 3

	Point ID	X	Y	Z
976	976	1.587	6.596	1.818
977	977	0.854	3.528	-0.973
978	978	0.946	3.908	0.070
979	979	0.838	3.460	-0.822
980	980	1.790	7.384	0.398
981	981	0.716	2.952	-0.590
982	982	1.983	8.173	0.736
983	983	0.718	2.958	-0.482
984	984	1.987	8.175	1.033
985	985	0.894	3.676	-0.465
986	986	1.985	8.161	1.330
987	987	0.899	3.694	-0.333
988	988	1.986	8.154	1.631
989	989	0.899	3.689	-0.199
990	990	1.838	7.533	1.790
991	991	0.846	3.464	-0.062
992	992	1.606	6.580	1.815
993	993	0.853	3.471	-0.958
994	994	0.946	3.849	0.069
995	995	0.846	3.438	-0.817
996	996	2.003	8.136	0.439
997	997	0.722	2.934	-0.587
998	998	2.004	8.135	0.733
999	999	0.728	2.952	-0.482
1000	1000	2.008	8.139	1.029
1001	1001	0.911	3.689	-0.467

Live sensor stream (Port:2368) | Frame: 7533 Factory Field 1: 55 (hex: 0x37) STRONGEST RETURN | Factory Field 2: 34 (hex: 0x22) VLP-16

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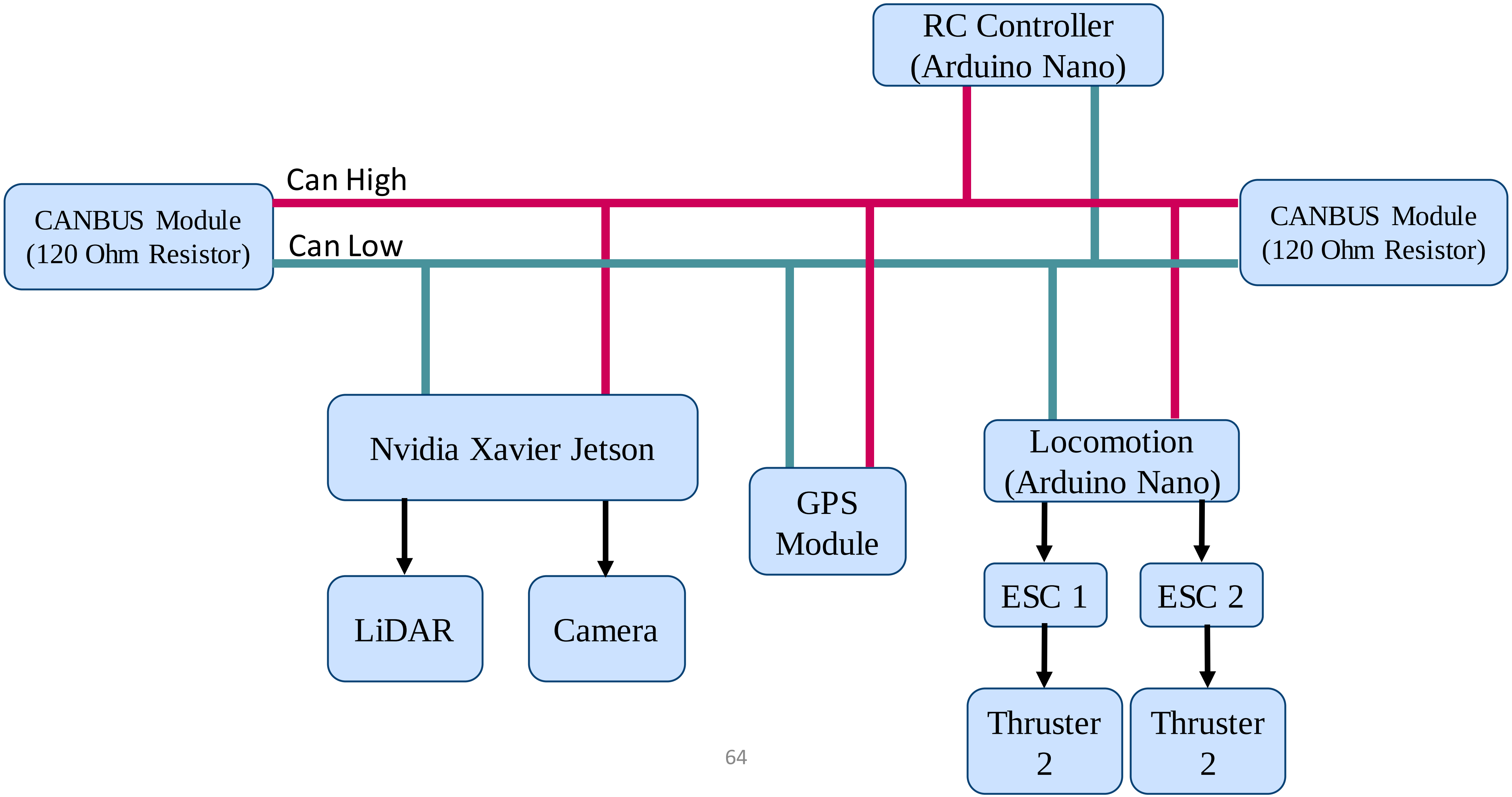
Andly Jean

Future Work and Timeline

- **Mar. 4th** — Waypoint following sim completed and ready for testing
- **Mar. 10th** — Thrusters, Xavier, and LiDAR mounted and ready for testing
- **Mar. 18th-22nd** — Ordered parts received and integrated into system
- **Mar. 22nd** — PID Controls, object avoidance implemented and tested
- **Mar. 31st** — Achieve a 90-92% navigation accuracy
- **Apr. 1st** — Results analyzed & all work documented and organized
- **Apr. 4th** — Senior Design Day Video complete

Andly Jean

Workflow



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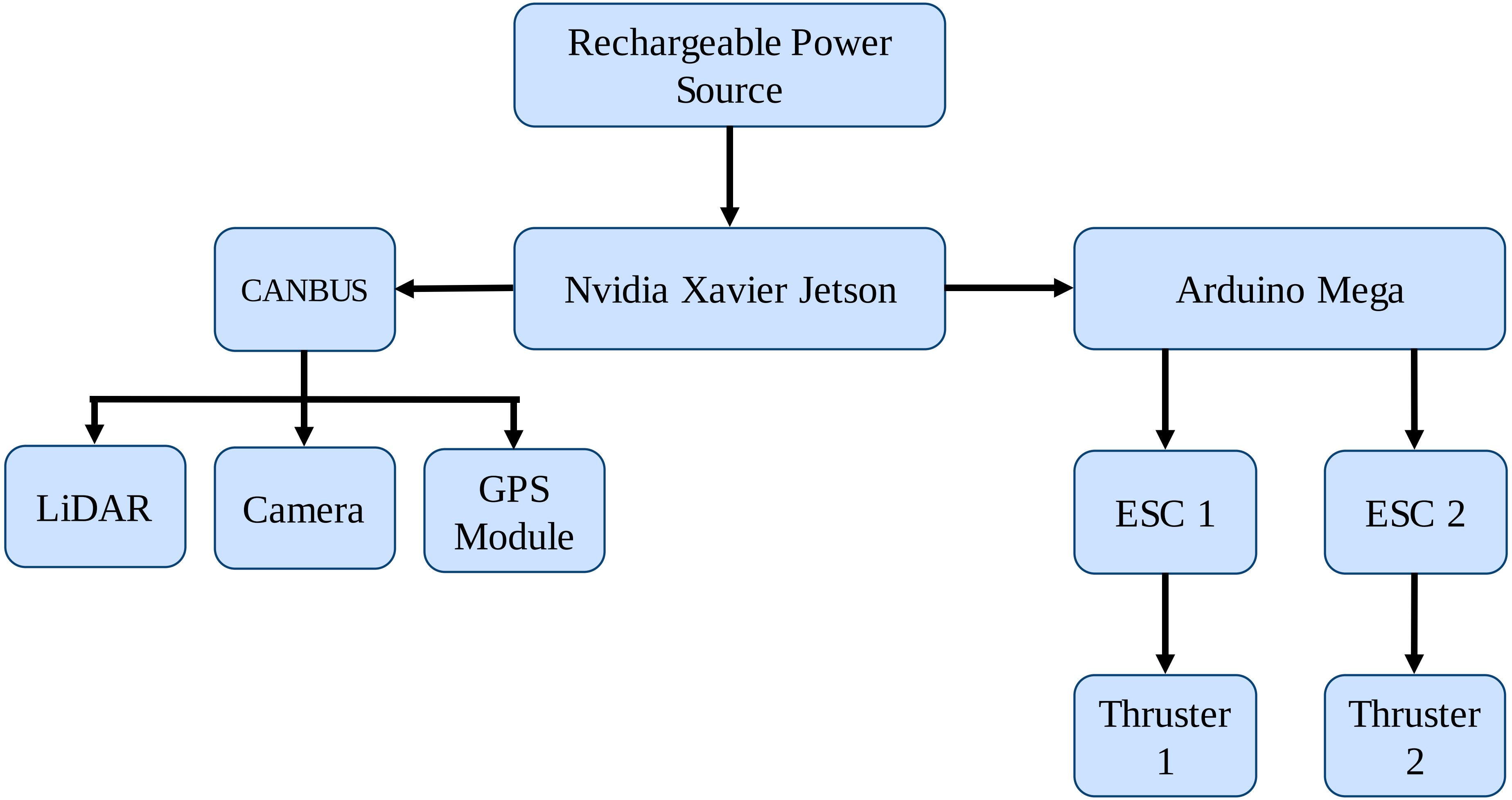
Andly Jean

Workflow Chart



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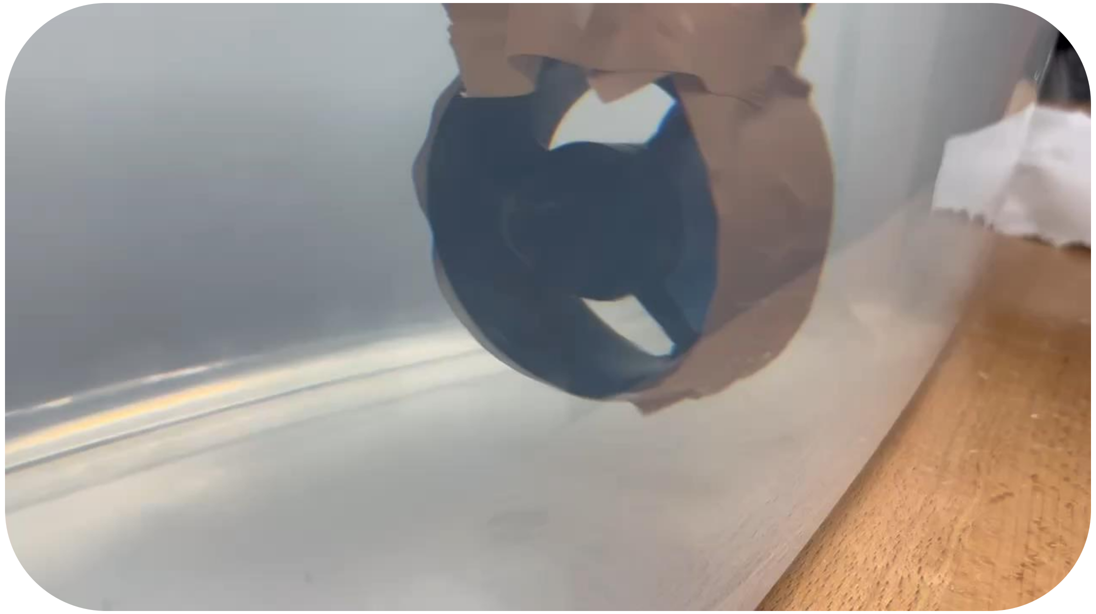
Makenzie
Wiggins

Current Work
Locomotion

- One fully functional thruster with ESC
  - Need new ESC (speed controller)
  - Thruster for rear of the boat



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Ivanna
Caballero

Customer Needs

Navigation System

Safety System

Power/Battery System

Weight/Size Restraint

One Major Task

Thruster Code

Michael Fitzsimmons

Boat_prototype §

```
#include <Servo.h>
#include <IBusBM.h>

const int xPin = A0;  //Analog Pin
const int yPin = A1;//Analog Pin

/****** RC Remote ********/
void joyS();        // Function for Joystick implementation
int potPin = A2;  // Analog pin for potentiometer
int buttPin = 50; // Digital pin for speed button
int revPin = 49;  // Digital pin for reverse button
int Thruster;     // Variable to control thruster speed
Servo servo;      // Thruster servo variable
byte servoPin = 9; // Pin to connect thruster to Arduino
int xAxis;        // variable for joystick axis
int State1 = 0;   //variable for reading Speed button
int State2 = 0;   //variable for Direction button
int state = 0;    // Variable for controlling thruster speed
int reverse = 0;  // Variable for controlling thruster Direction

int readChannel(int chanInput, int minLimit, int maxLimit, int defaultVal);

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);  // Intialization for printing to Serial Monitor
  pinMode(xPin, INPUT);  // Initializing joystick pin
  pinMode(yPin, INPUT);  // Initializing joystick pin
  pinMode(potPin,INPUT);  // Intializing Potentiomemter pin
  pinMode(buttPin, INPUT); // Intializing speed button pin
  pinMode(revPin, INPUT);  // Intializing direction button pin

  servo.attach(servoPin);        // Intialize Thruster
  servo.writeMicroseconds(1500); // Send signal to Initialize thruster
  delay(700);                    // Delay before starting loop to ensure thruster recognizes signal
}
```

Boat_prototype §

```
  delay(700);                    // Delay before starting loop to ensure thruster recognizes signal
}

void loop() {
//
//  Thruster = analogRead(potPin);
//  Thruster = map(Thruster, 0, 1023, 1100, 1900);

  State1 = digitalRead(revPin);   // read signal from button controlling direction
  if (State1 == HIGH)             // If button is pressed
    reverse = reverse + 1;        // Increase state of the direction
    reverse = reverse % 2;        // Mod 2, keeps direction between 0 and 1
                                  // 0 = forward, 1 = reverse

  State2 = digitalRead(buttPin); // read signal from button controlling speed
  if (State2 == HIGH) {          // If button is pressed
    state = state + 1;           // Increase state of the speed
    state = state%3;             // Mod 3, Keeps speed state 0, 1 or 2
                                 // 0 = off, 1 = slow, 2 = fast

  }
  Serial.print("reverse: ");     // Prints state of the direction variable to Serial monitor
  Serial.println(reverse);

  switch (state) {                       // Switch statement to control the speed of the thruster
    case 0: Serial.println("Off");         // Print state of speed to Serial monitor
            servo.writeMicroseconds(1500);   // 1500 microsends is the neutral value for the ESC thru
      break;
    case 1: Serial.println("Slow");        // Print state of speed to Serial monitor, SLOW setting
            if ( reverse == 0)              // If the direction state is 0 (Forward)
              servo.writeMicroseconds(1550);  // Set the ESC speed to 1550   (1500 + 50)
            else                            // If the direction state is 1 (Reverse)
              servo.writeMicroseconds(1450);  // Set the ESC speed to 1450   (1500 - 50)
      break;
    case 2: Serial.println("Fast");        // Print state of speed to Serial monitor, FAST setting
```

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Thruster Code

Michael
Fitzsimmons

Boat_prototype §

```
    case 2: Serial.println("Fast");              // Print state of speed to Serial monitor, FAST setting
            if ( reverse == 0)                   // If the direction is 0 (Forward)
              servo.writeMicroseconds(1575);     // Set the ESC speed to 1575      (1500 + 75)
            else                                 // If the direction is 1 (Reverse)
              servo.writeMicroseconds(1425);     // Set the ESC speed to 1425      (1500 - 75)
      break;
  }

  delay(400);
}

void joyS() {
  xAxis = analogRead(xPin);
  int yAxis = analogRead(yPin);

  static int range = 1900;
  static int center = 1500;
  static int thresh = range / 633   ;
  int x_Dist = xAxis - center;
  int y_Dist = yAxis - center;


  xAxis = map(xAxis, 0, 1023, 1100, 1900);
  yAxis = map(yAxis, 0, 1023, 1100, 1900);

  if (xAxis > 1495 && xAxis < 1505)
    xAxis = 1500;
}

int readChannel(int chanInput, int minLimit, int maxLimit, int defaultVal)
{
  int ch = pulseIn(chanInput, HIGH, 2500);
  if (ch < 100)
  {
    return defaultVal;
```

Nicholas
Norwood

Project Objective

The objective of this project is to design, build and program an autonomous surface vehicle capable of completing several tasks in the following categories:

- Navigation
- Detection
- Object avoidance
- Conduct two-step behavior

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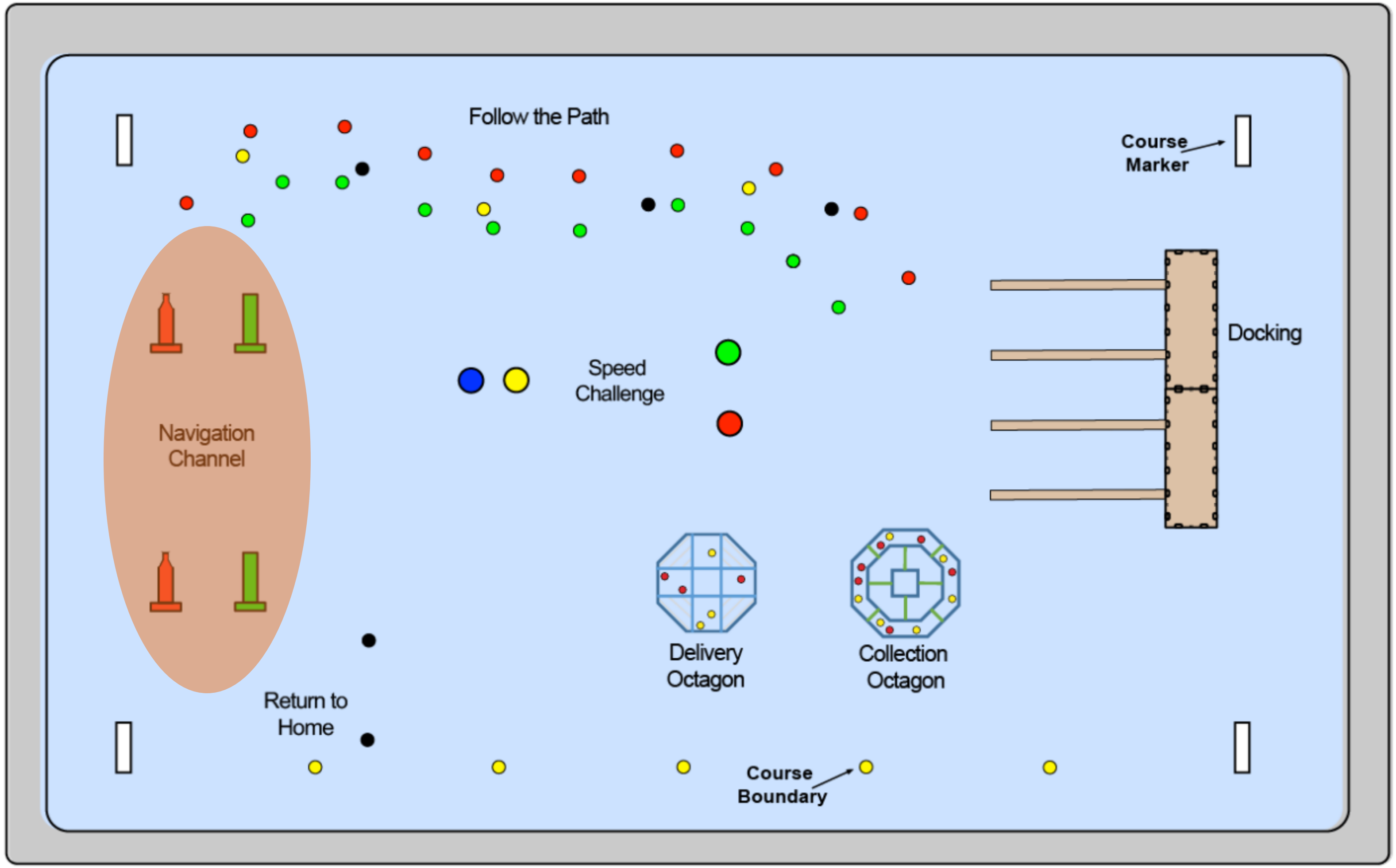
Makenzie
Wiggins

RoboBoat 2024 Course



Task 1:
Navigation Channel

Task 2:
Follow the Path

Task 3:
Docking

Task 4:
Duck Wash

Task 5:
Speed Challenge

Task 6:
Collection Octagon

Task 7:
Delivery Octagon

Task 8:
Return to Home

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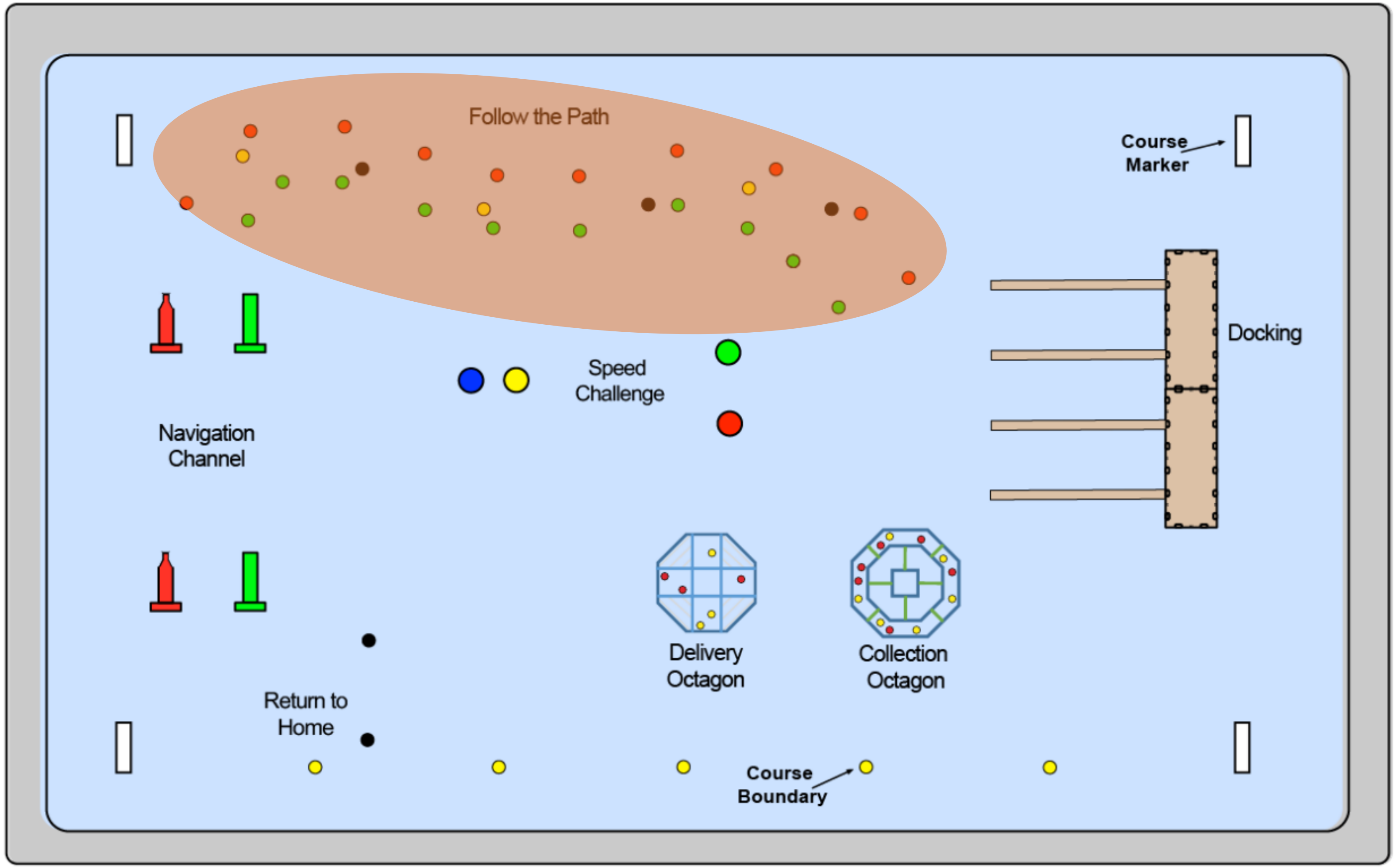
Makenzie Wiggins

RoboBoat 2024 Course



Task 1:
Navigation Channel

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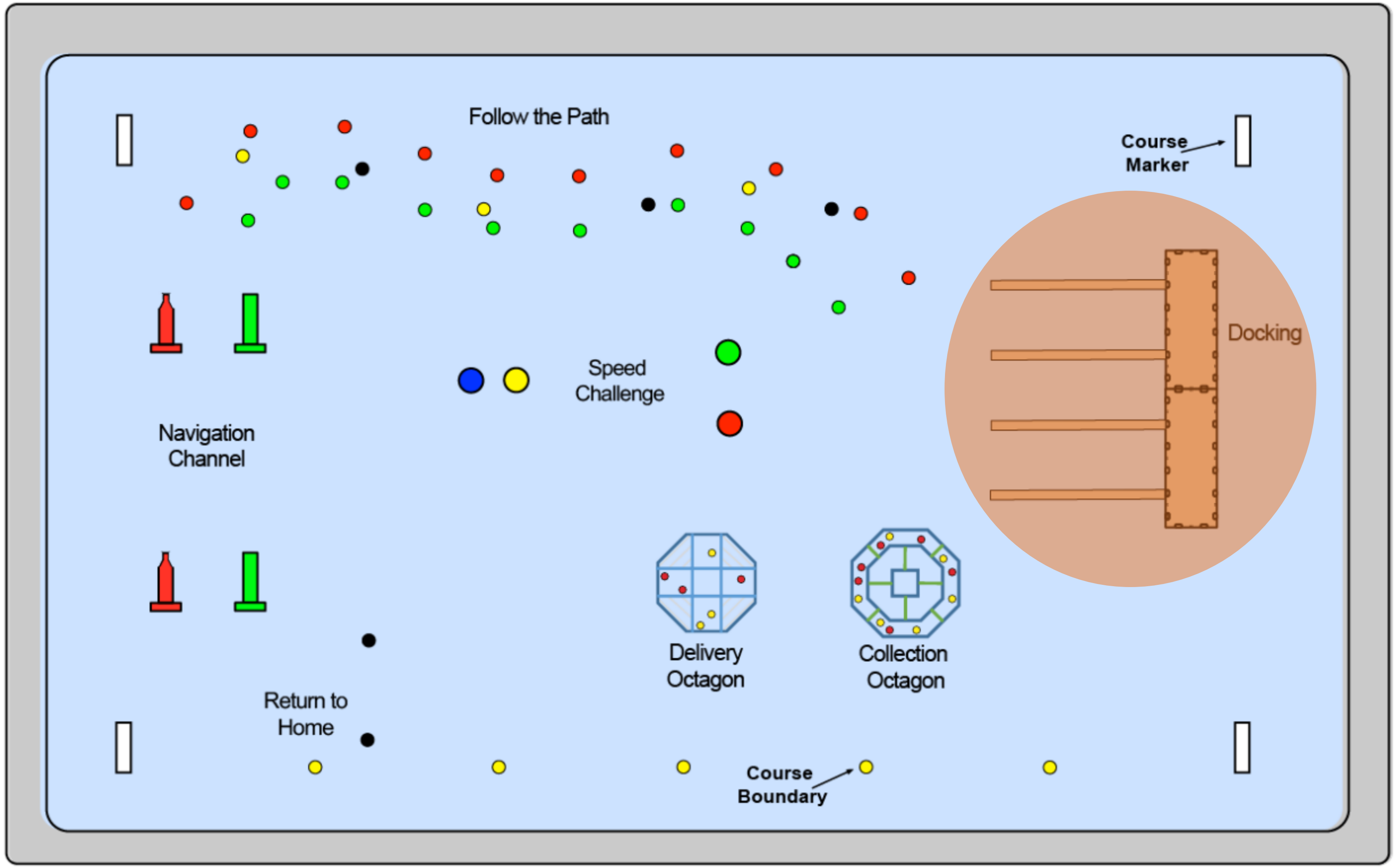
Makenzie
Wiggins

RoboBoat 2024 Course



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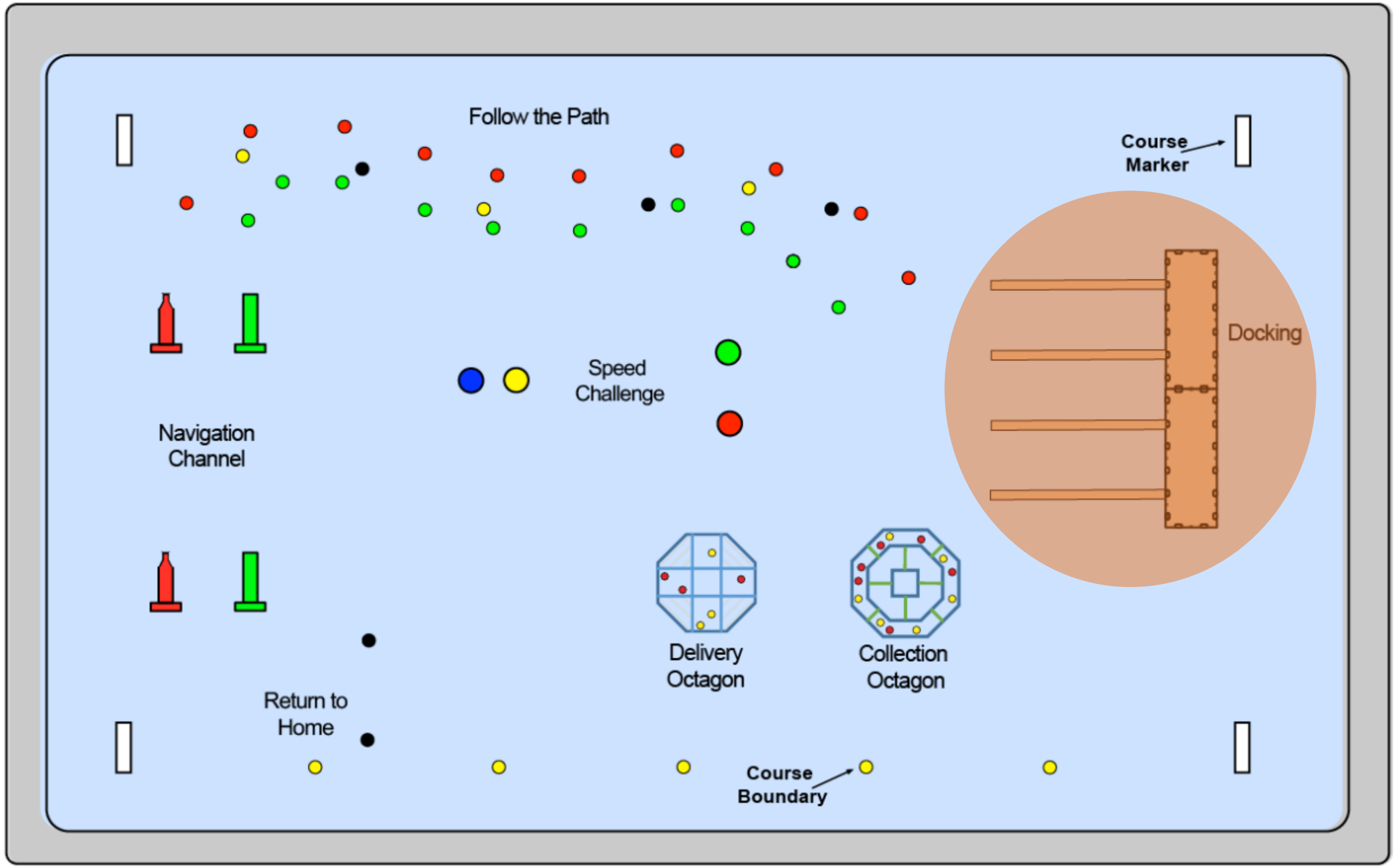
Makenzie
Wiggins

RoboBoat 2024 Course



Task 1:
Navigation Channel
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Task 3:
Docking
**Task 4:
Duck Wash**
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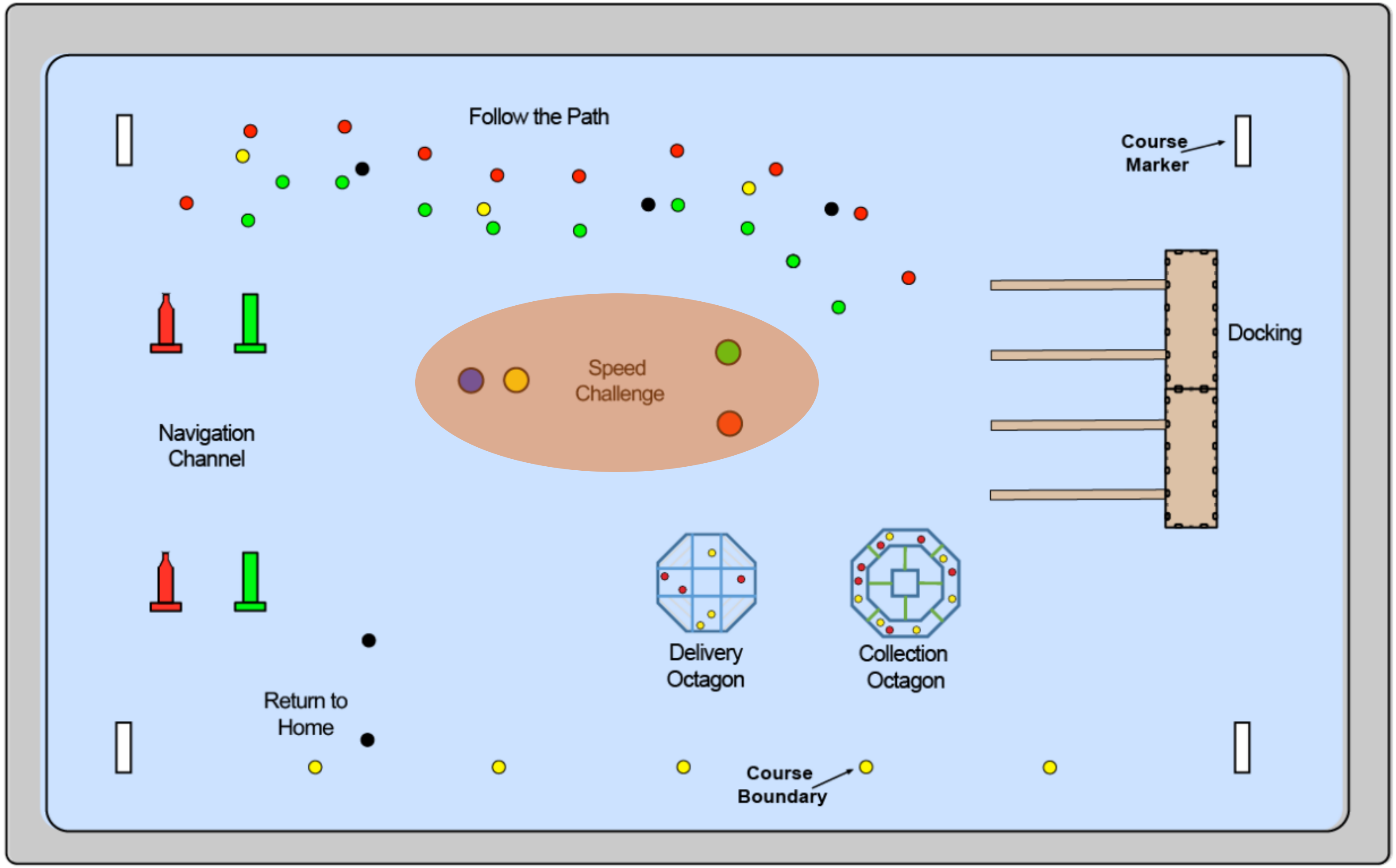
Makenzie
Wiggins

RoboBoat 2024 Course



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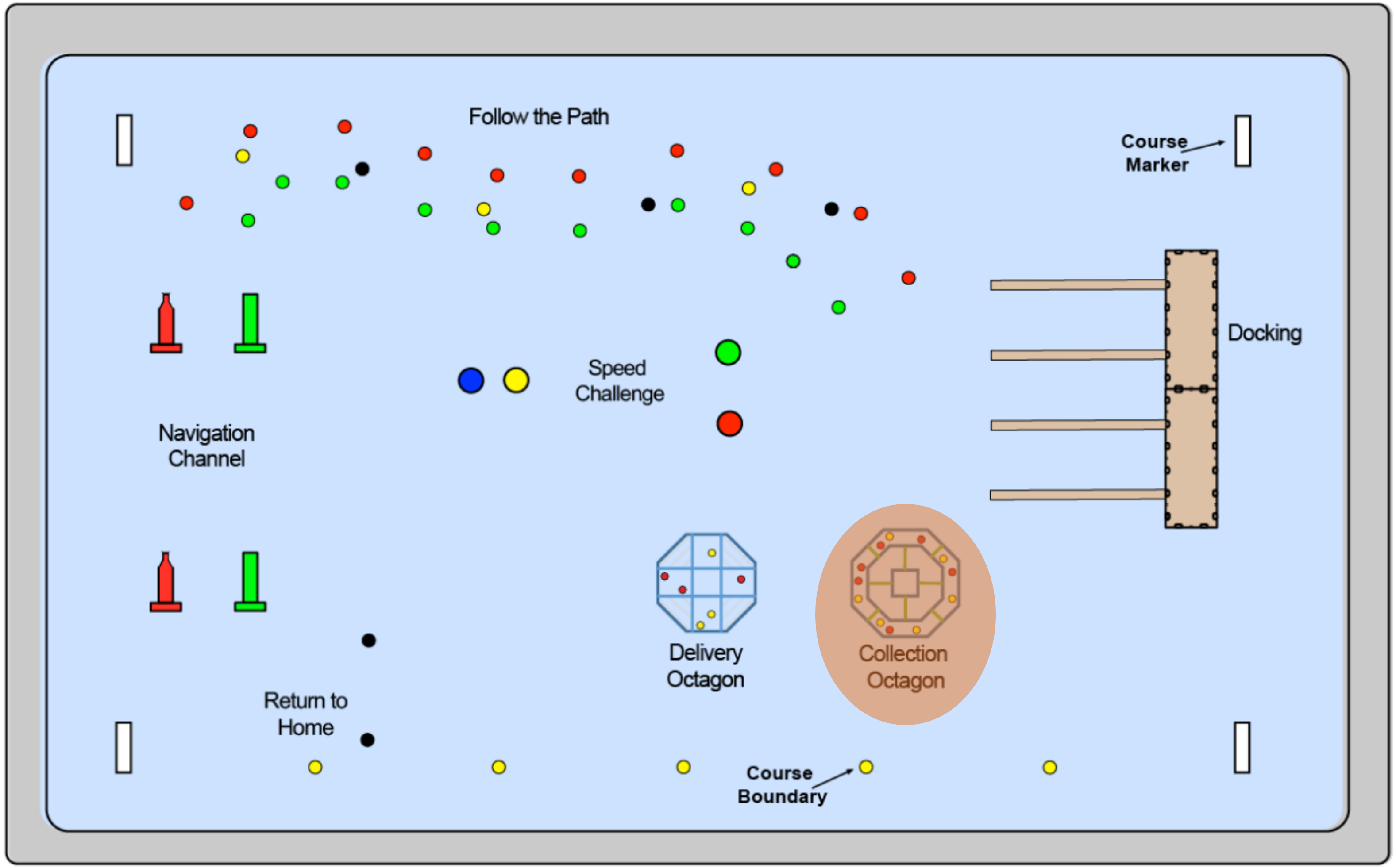
Wiggins

RoboBoat 2024 Course



Task 1: Navigation Channel
Task 2: Follow the Path
Task 3: Docking
Task 4: Duck Wash
Task 5: Speed Challenge
Task 6: Collection Octagon
Task 7: Delivery Octagon
Task 8: Return to Home

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Makenzie
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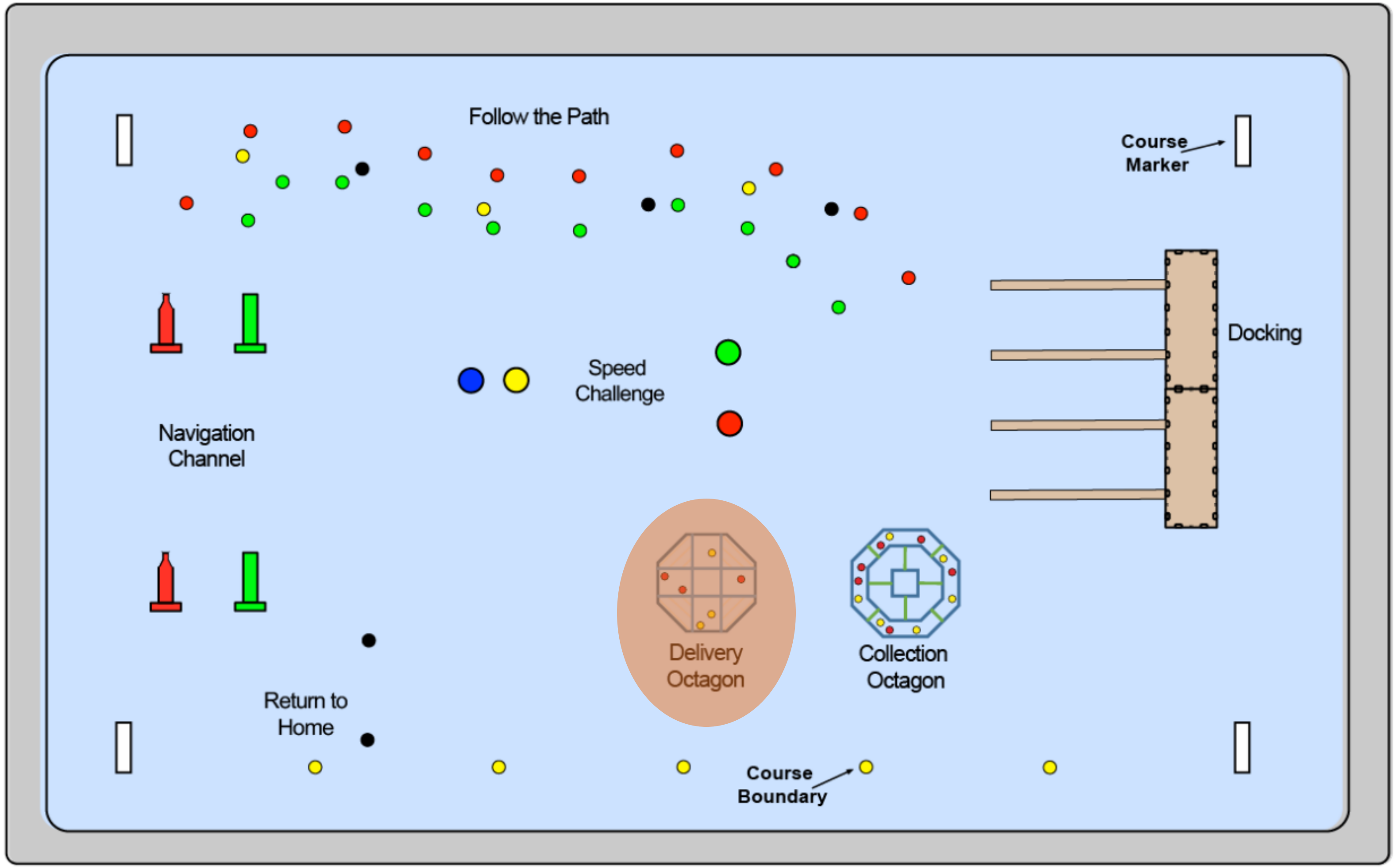
RoboBoat 2024 Course



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Makenzie Wiggins

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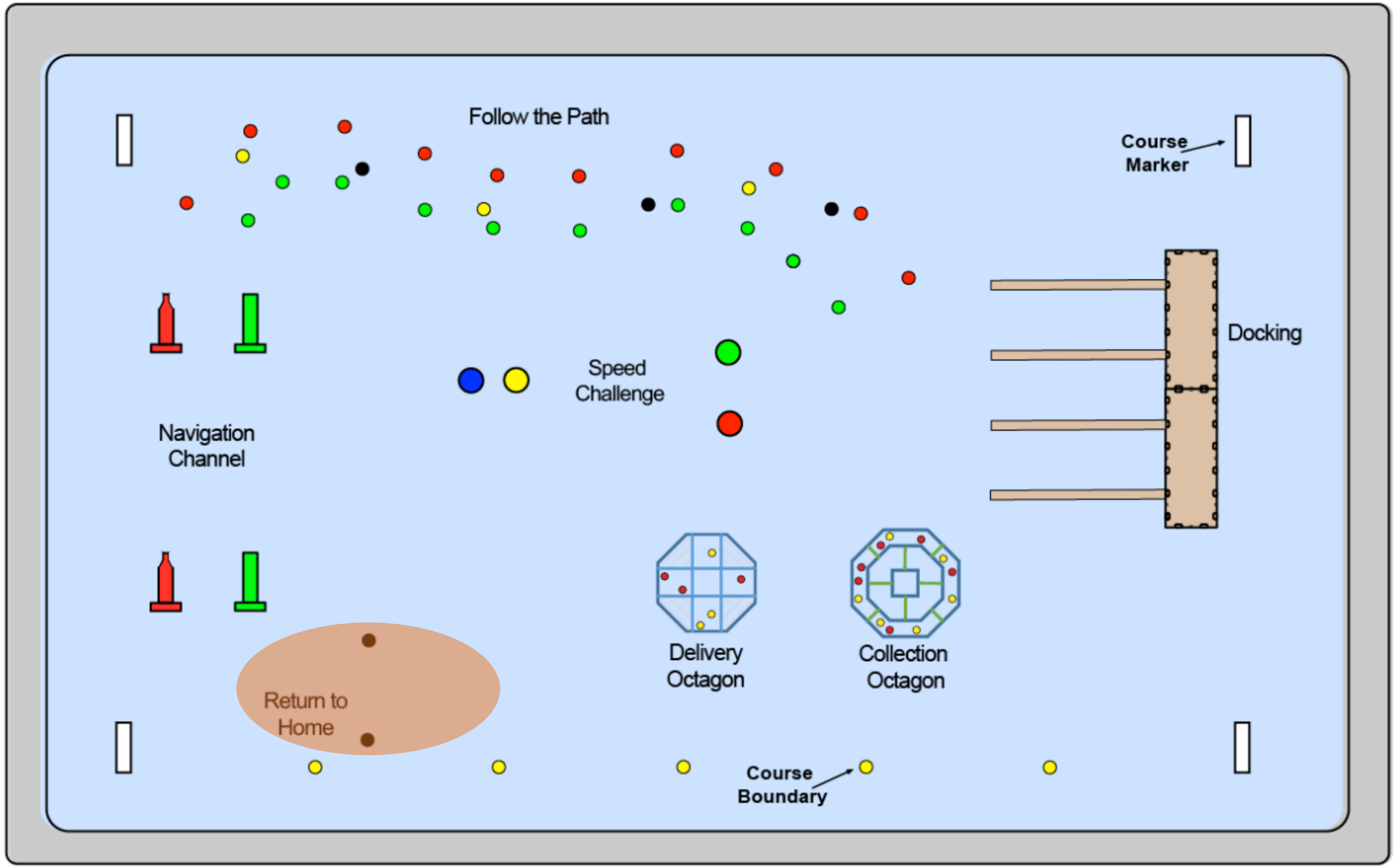

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Ivanna
Caballero

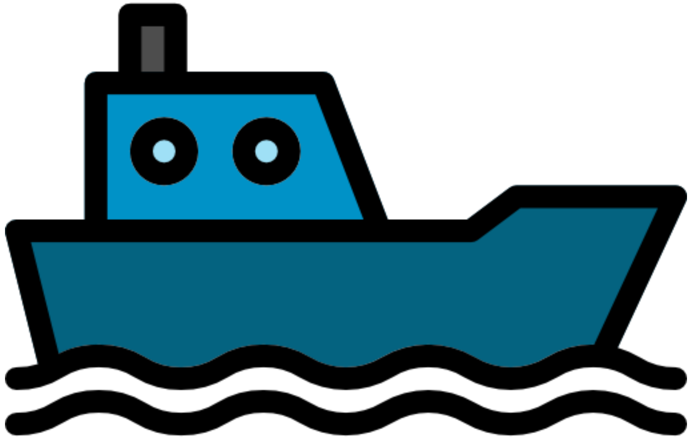
System: Structure

Function	Target	Metric
Length	3.94(ft)	size
Width	2.58(ft)	size
Height	2.445(ft)	size
Weight	63.25(lbs)	weight
Buoyancy	300N	force
Deflection Angle	15 degrees	angle

Ivanna Caballero

System: Locomotion

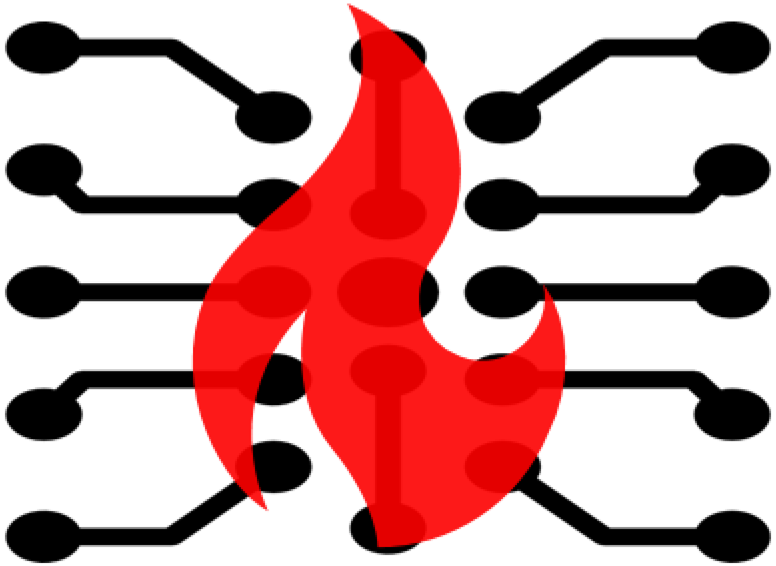
Function	Target	Metric
Speed	>=1.515 (m/s)	velocity
Acceleration	0.25 (m/s)	acceleration
Thrust	14.6 (lbs)	force



Ivanna
Caballero

System: Safety

Function	Target	Metric
Kill switch response time	0.25(s)	time
Manual-Remote kill switch integration	True	Boolean



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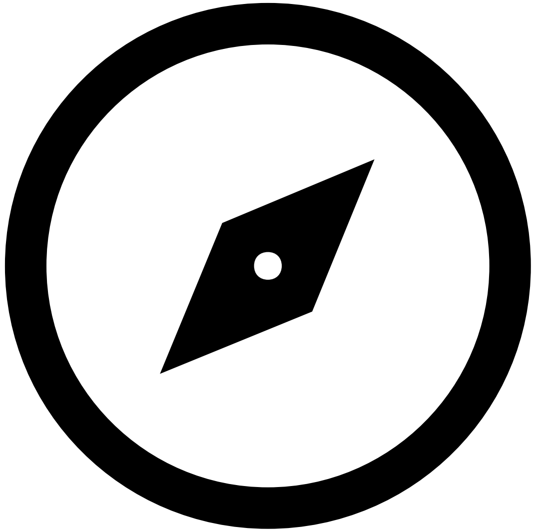
Ivanna
Caballero

System: Navigation

Function	Target	Metric
Cross-track error of navigating to a destination	2(m)	length
Boat localization error	< 5(m)	length



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Ivanna
Caballero

System: Power Systems

Function	Target	Metric
Battery size	22000(mAh)	Charge capacity
Battery life	1 (hr)	Time
Capability of tracking battery life	True	Boolean

Ivanna
Caballero

System: Object Detection

Function	Target	Metric
Camera Resolution	1920x1080 (pixels)	Number of Pixels
Range of object detection	25(m)	Length
Accuracy of detecting color	95%	Percent Error
Capability of identifying different objects	Min. Of 6 objects	Number of objects

Ivanna
Caballero

System: Object Detection

Function	Target	Metric
Camera Resolution	1920x1080 (pixels)	Number of Pixels
Range of object detection	25(m)	Length
Accuracy of detecting color	95%	Percent Error
Capability of identifying different objects	Min. Of 6 objects	Number of objects

Sophia Barron

Functional Decomposition

Locomotion	Navigation	Structure	Power Systems
Safety	Object Retrieval	Water Spraying	Object Detection

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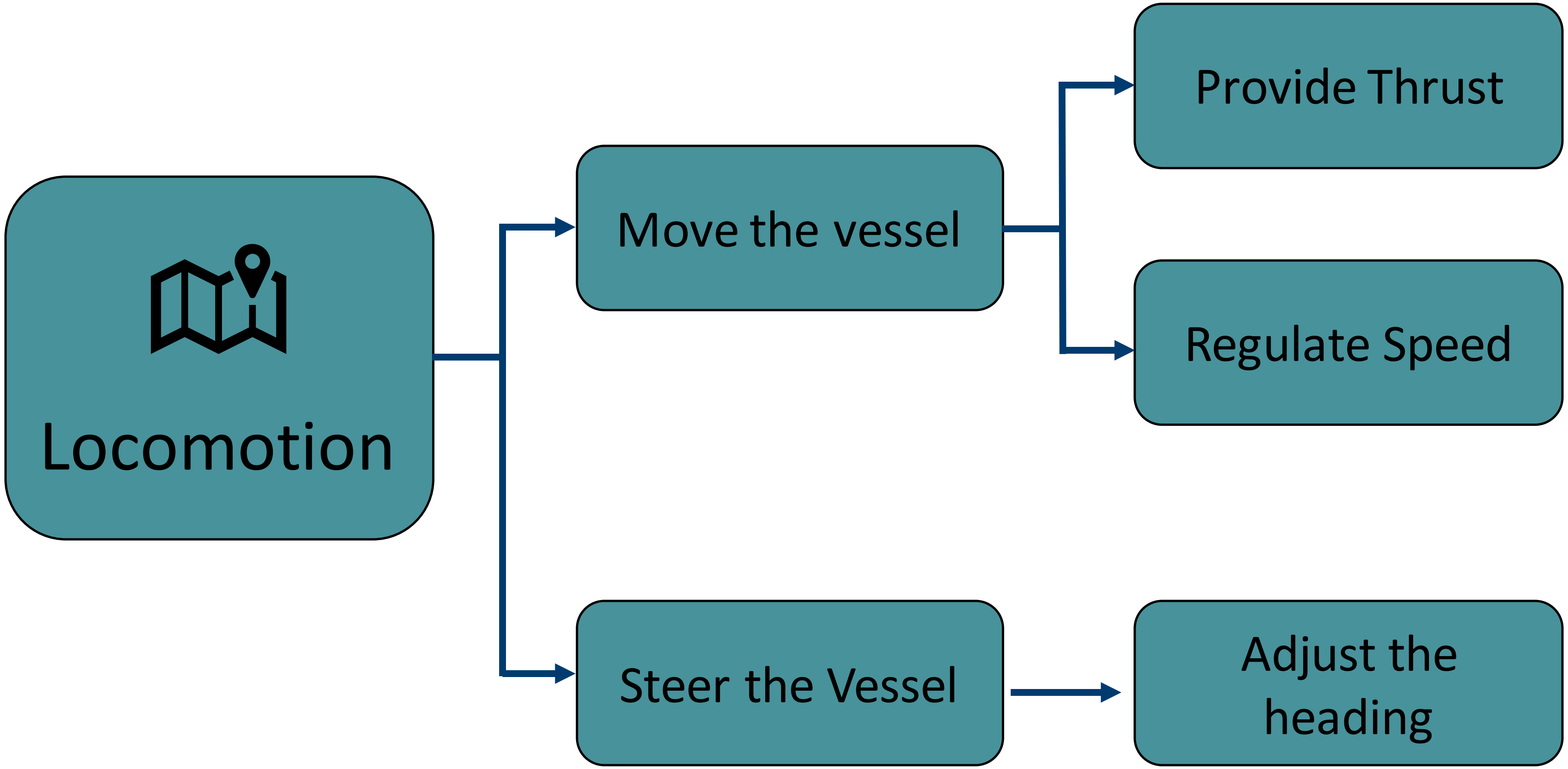
Sophia Barron

Functional Decomposition



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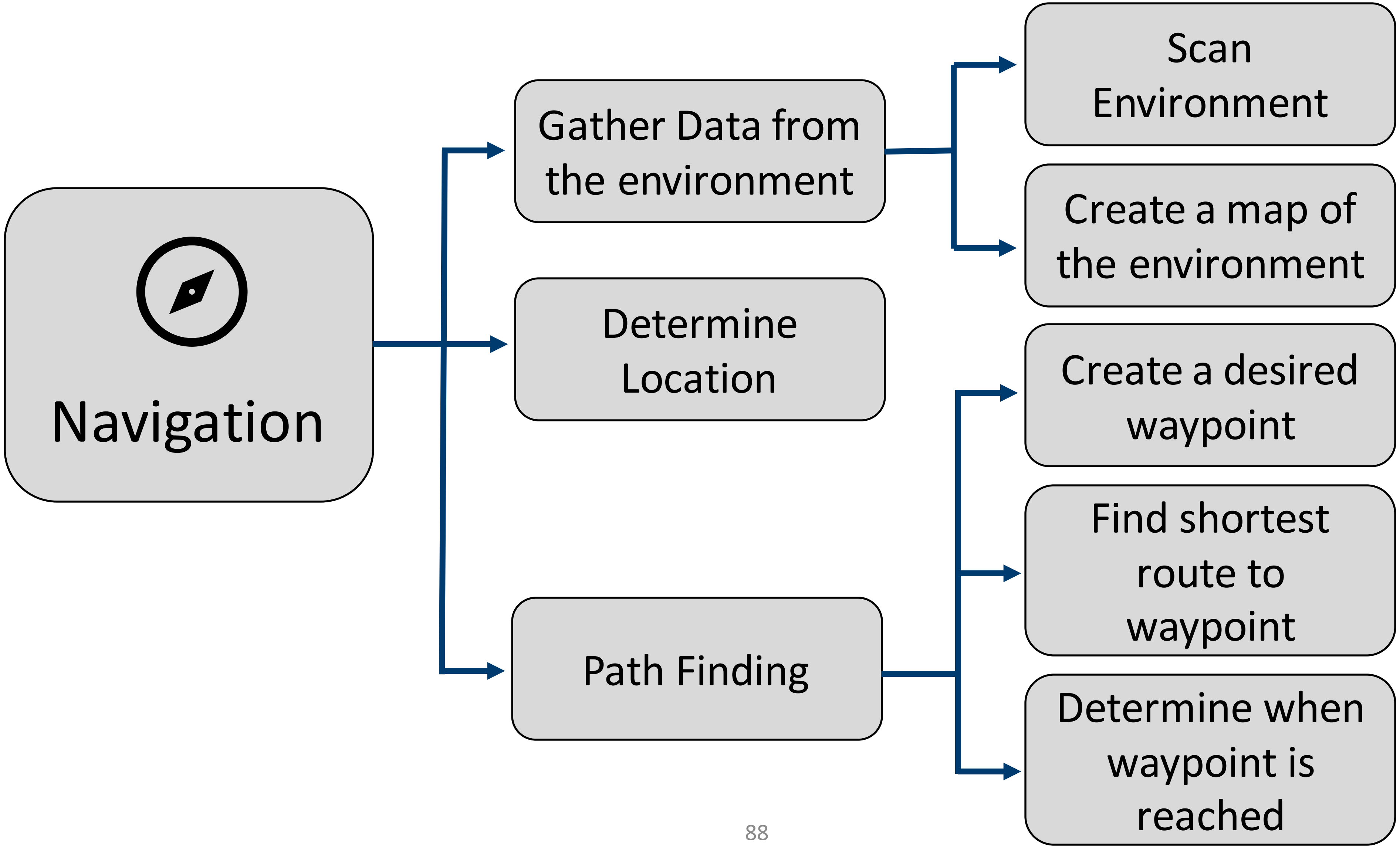
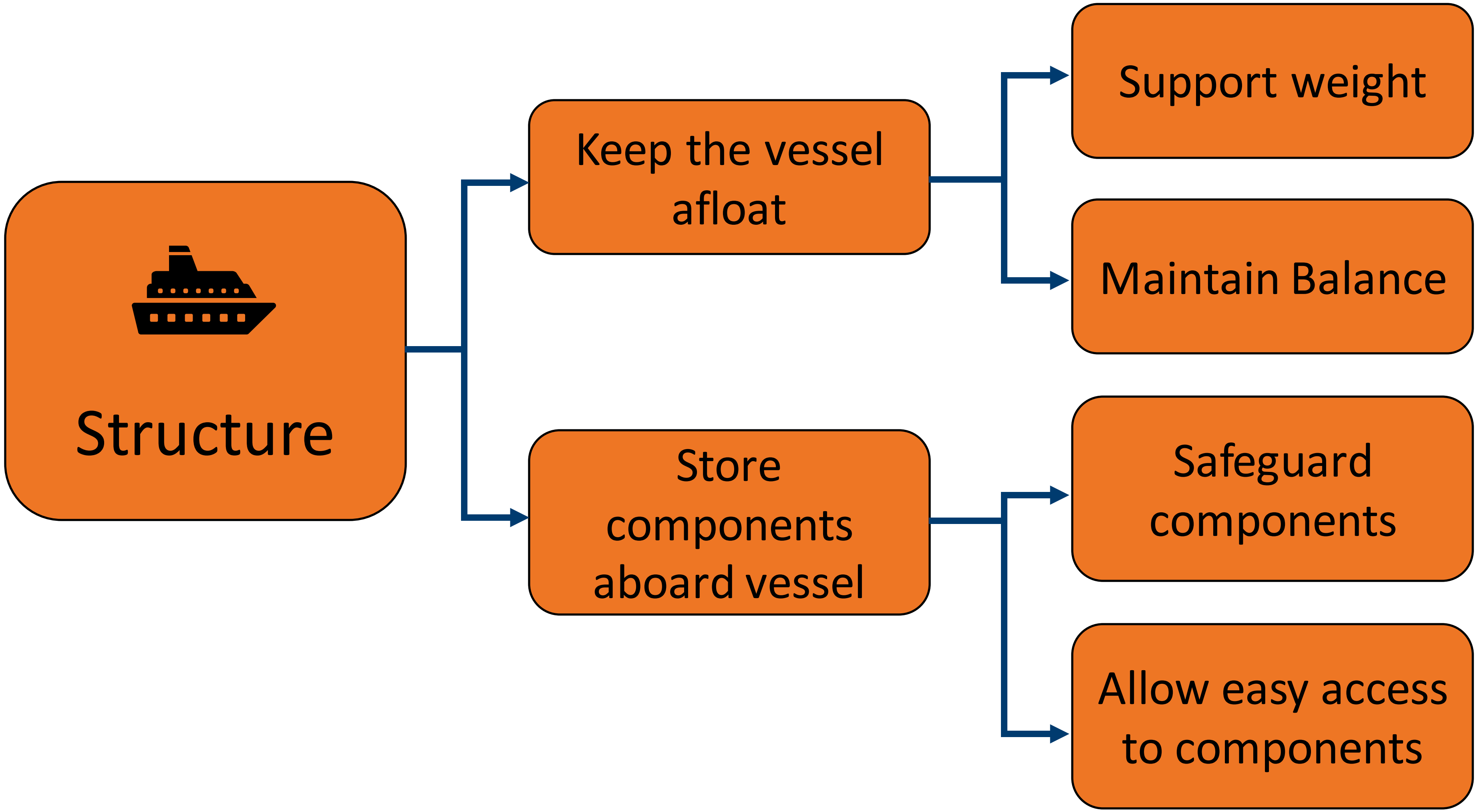
Sophia Barron

Functional Decomposition



Sophia
Barron

Functional Decomposition



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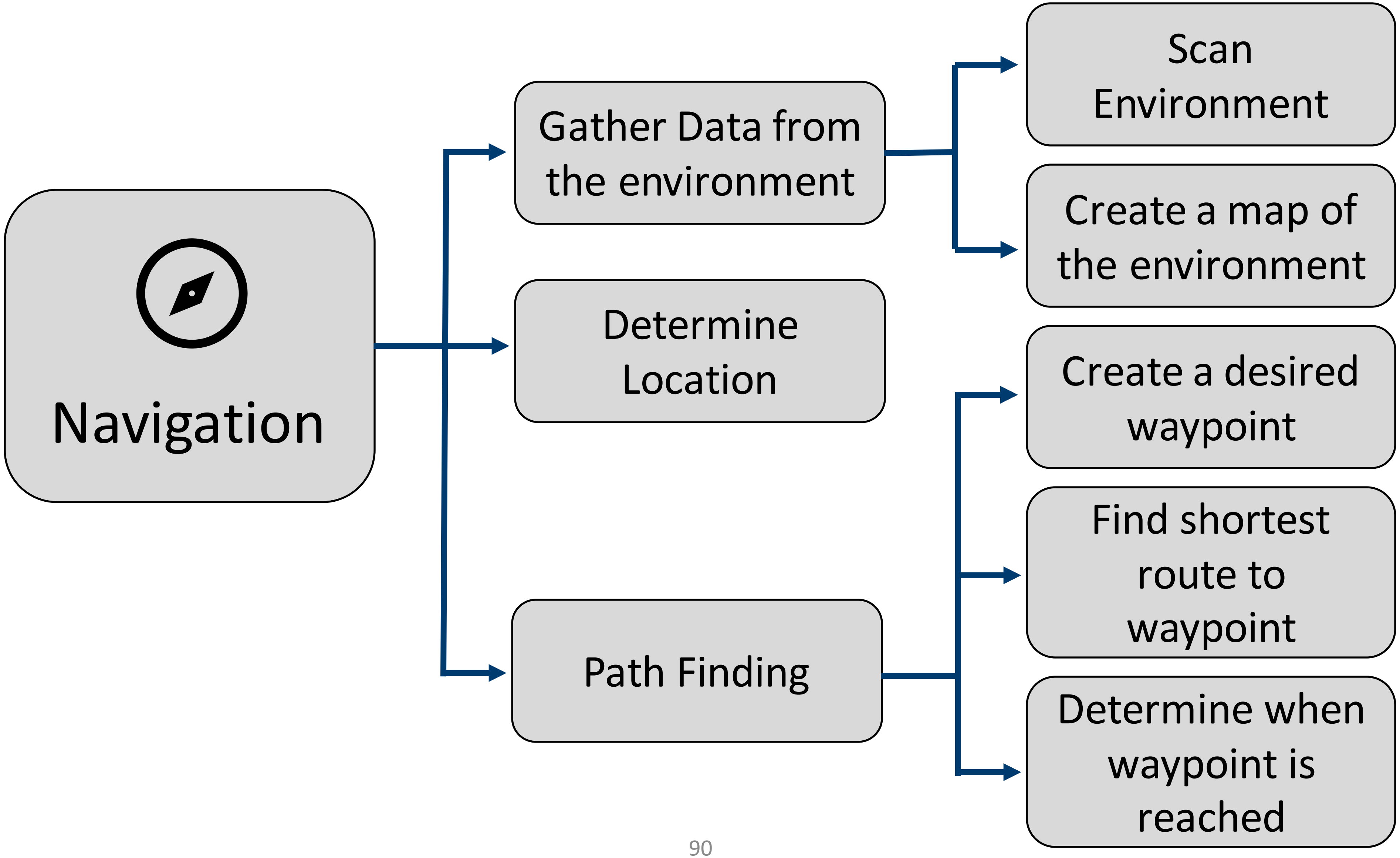
Sophia Barron

Functional Decomposition



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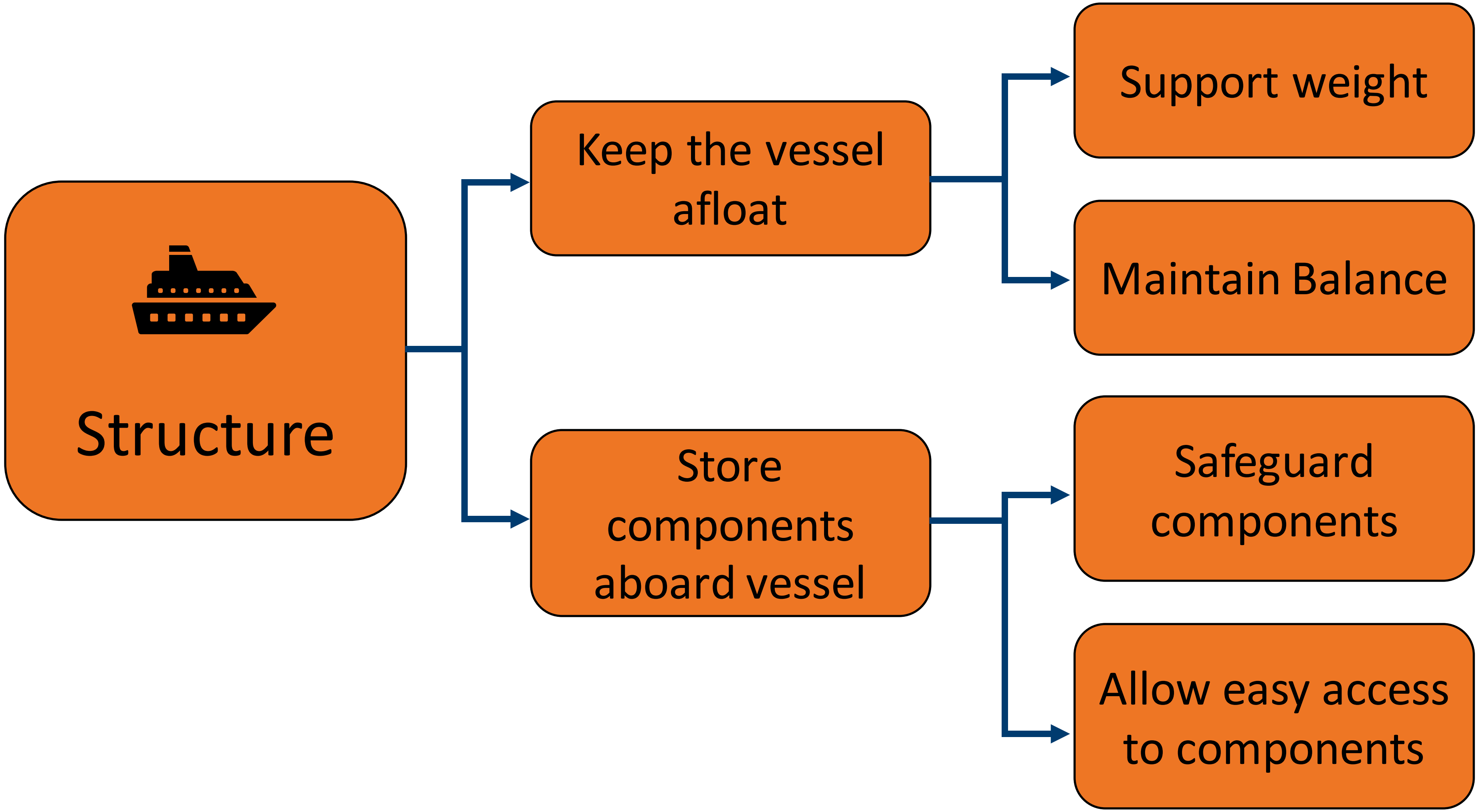
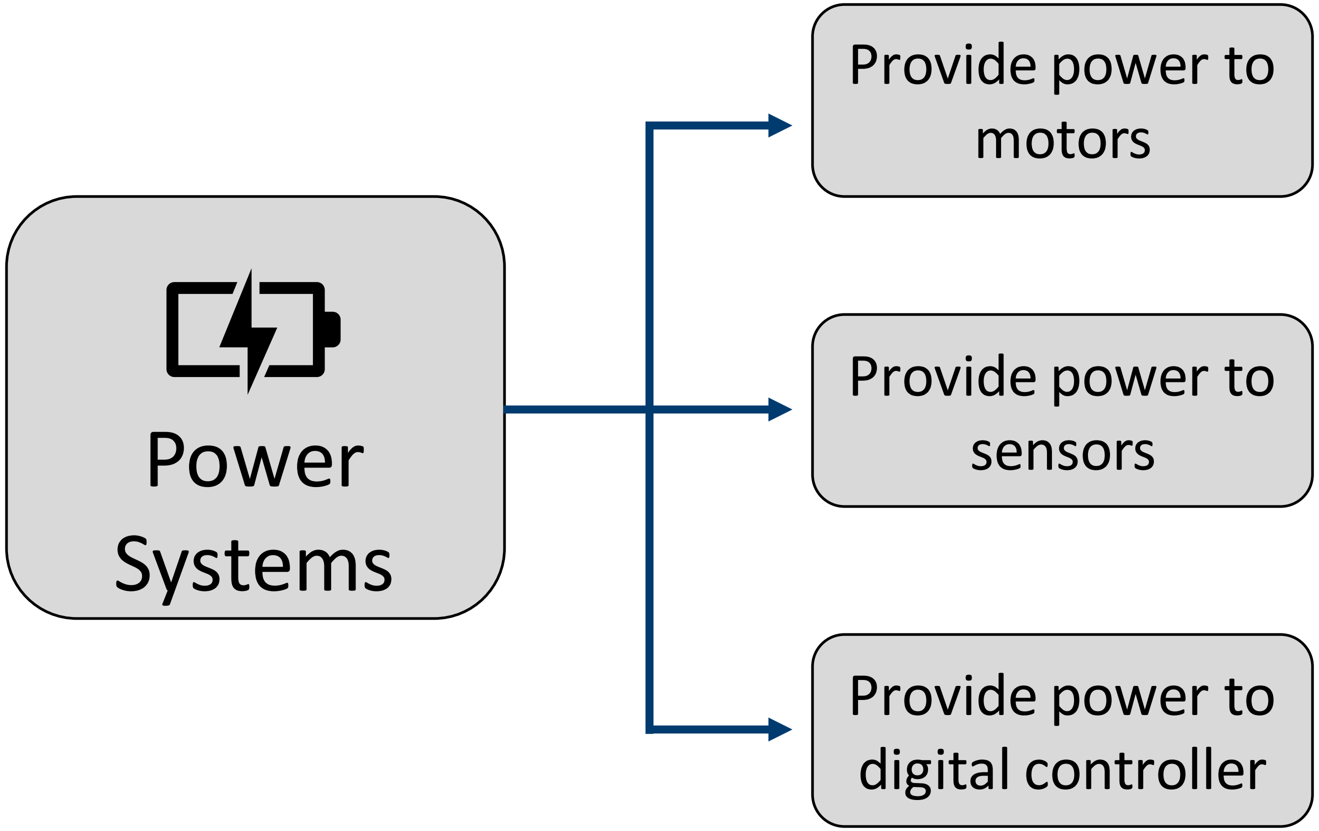
Functional Decomposition



Sophia Barron

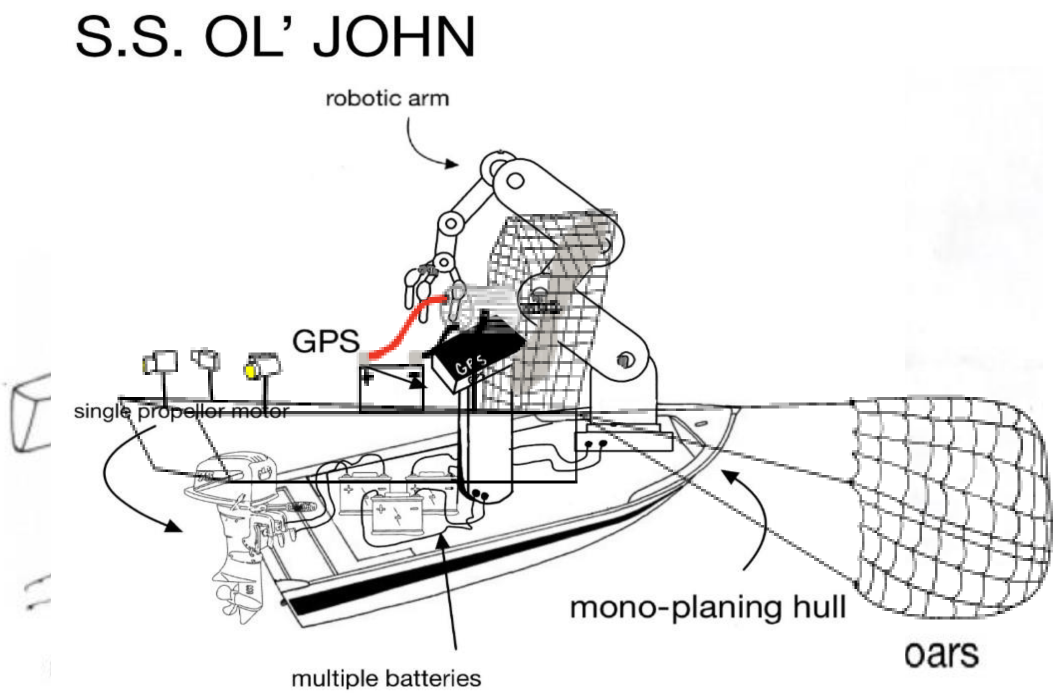
Functional Decomposition



Michael
Fitzsimmons

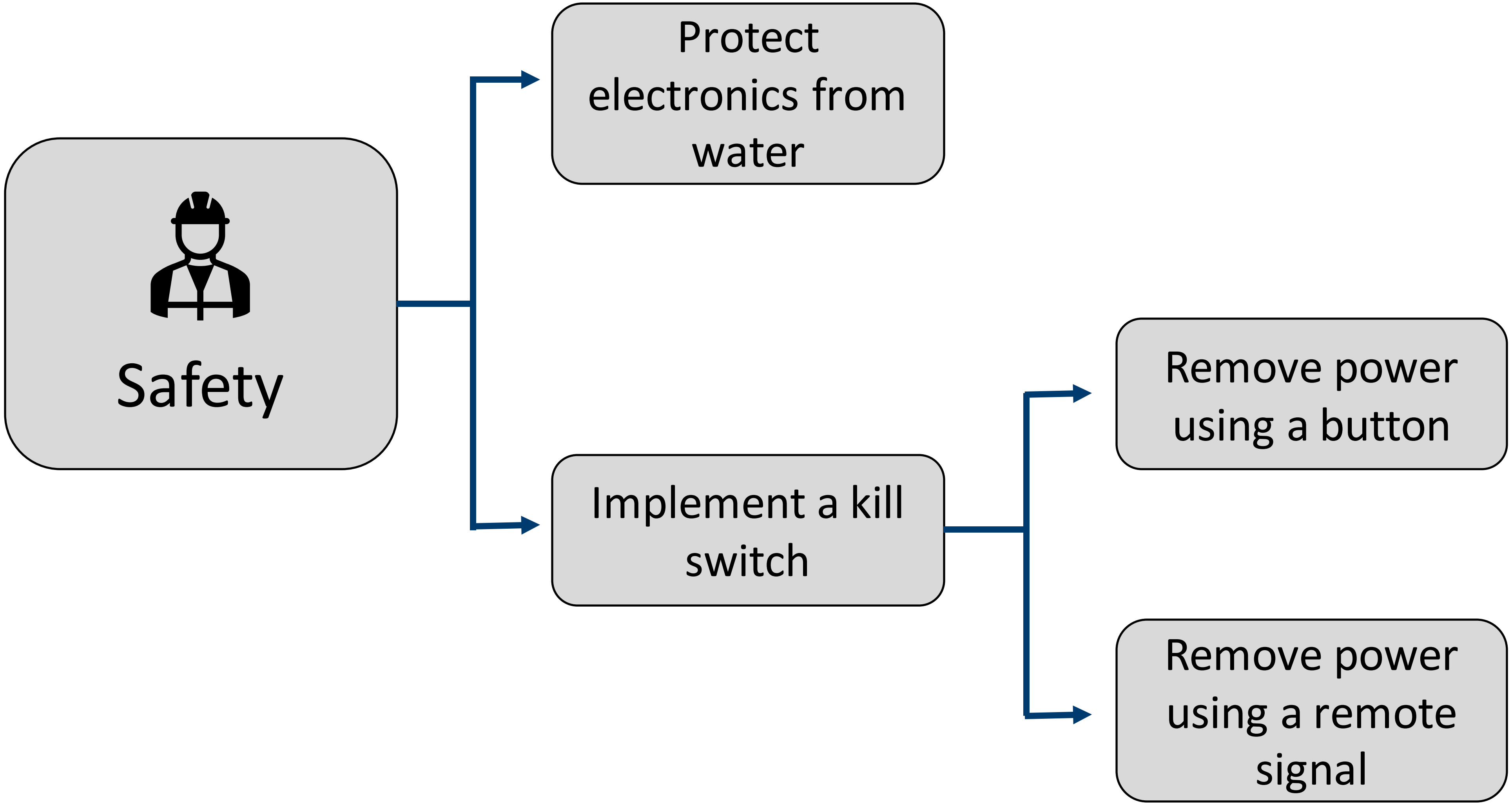
Medium Fidelity Concepts

- S.S. Galley
- S.S. Ordonomy
- S.S. Hooker V1
- S.S. Air Goose
- S.S. Ol' John



Sophia Barron

Functional Decomposition



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Sophia Barron

Functional Decomposition

- Object Retrieval
  - Retrieve the object
    - Capture object in environment
    - Transfer object to chassis
  - Release the object
    - Move object to release location
    - Remove object from the chassis

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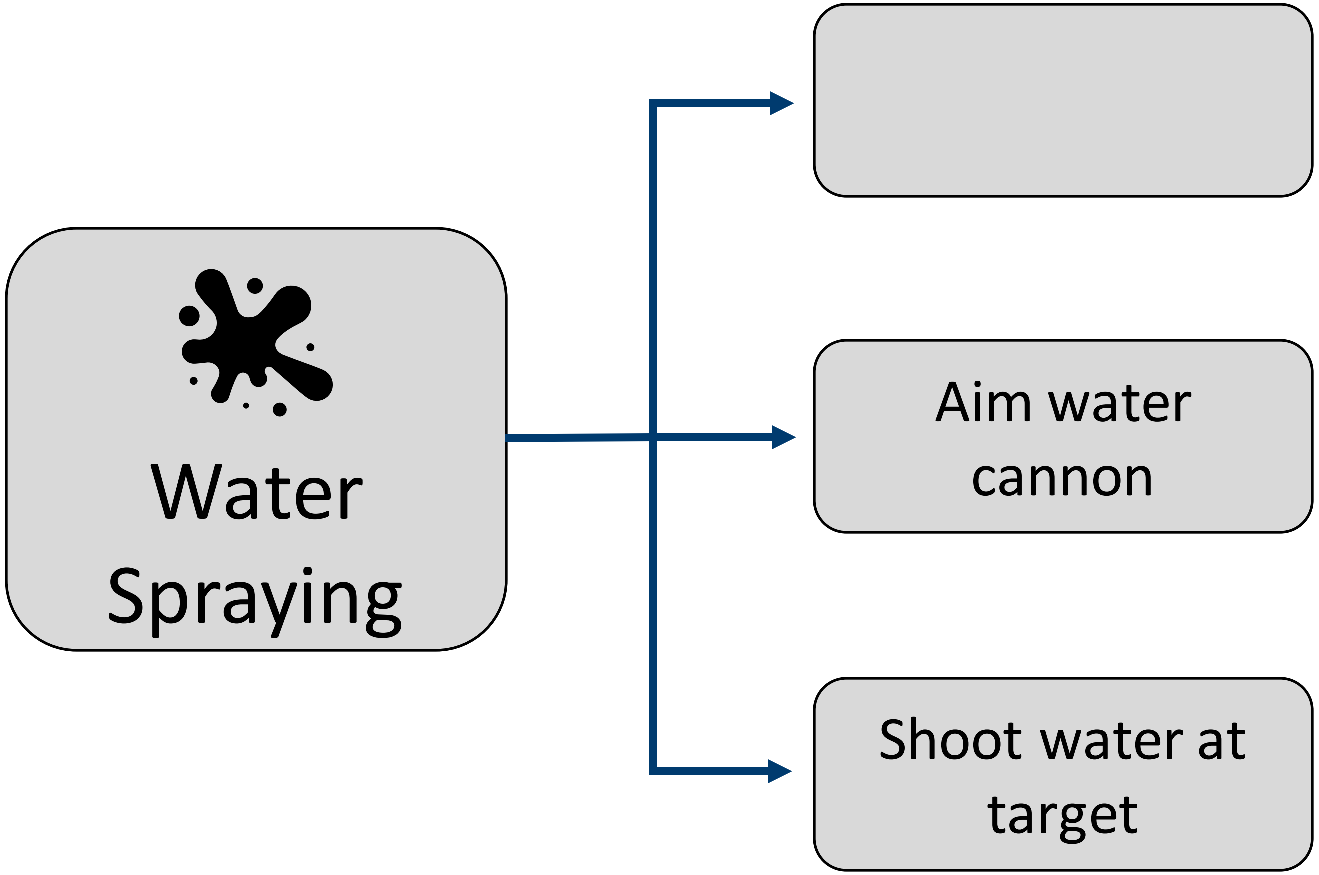
Sophia Barron

Functional Decomposition



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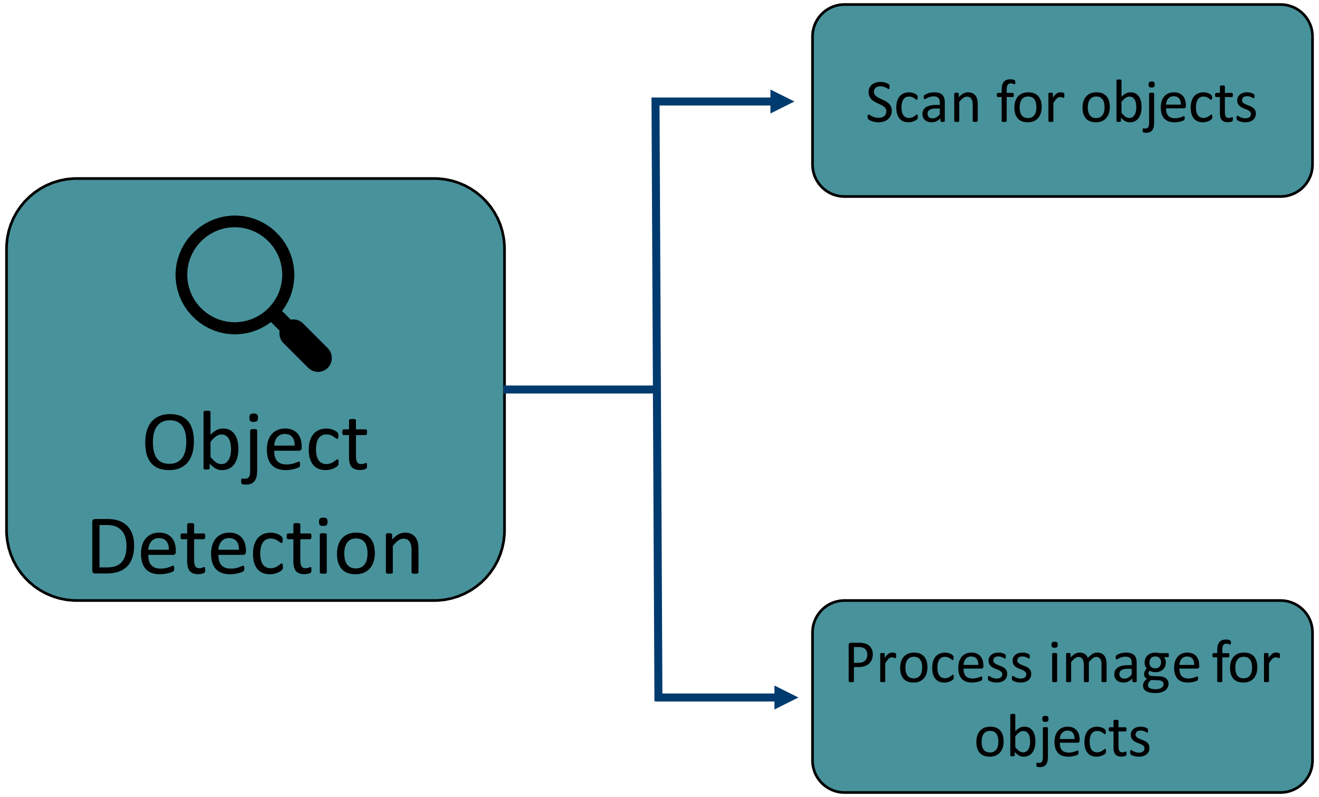
Functional Decomposition



Sophia Barron

Near Future Work

- Start working on robot localization
  - Test different GPS module (found in Senior design room)
  - Draft navigation code diagram
  - Test different obstacle aversion methods on prototype
- Test given thrusters (PCB Campus)
- Start drafting and testing kill switches
  - Remote with RC transmitter
  - Physical with push button

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Sophia Barron

Future Work

- Start working on materializing chosen structural design
- Start working on camera object detection
  - Geometric segmentation: Recognizing shapes
  - Semantic segmentation: Object class (Ducks, buoy, etc)
- Integrate different functional systems
  - I.e navigation w/ locomotion and object detection
- Preliminary electrical calculations/schematics
  - Power supply calculations
  - Overall block diagrams
- Finalize first draft of test code for the Autonomous navigation portion of ASV

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Ivanna Caballero

Primary Markets

FAMU-FSU College of Engineering

Ivanna
Caballero

Secondary Markets

INSANE BOATS

UNITED STATES COAST GUARD 1790

RoyalCaribbean

BOSTON WHALER ®

Stakeholders

NAVSEA
NAVAL SEA SYSTEMS COMMAND

FAMU-FSU
College of
Engineering

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College of
Engineering

Markets

FAMU-FSU College of Engineering

Michael
Fitzsimmons

Medium Fidelity Concepts

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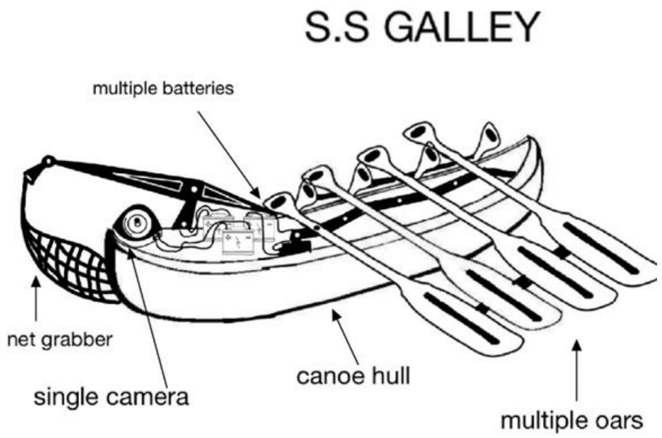
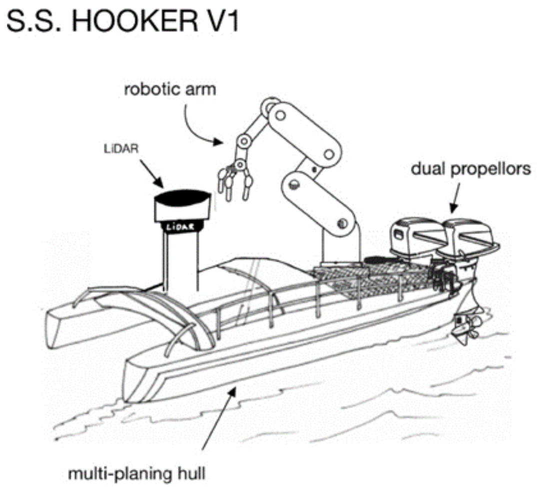
College of
Engineering

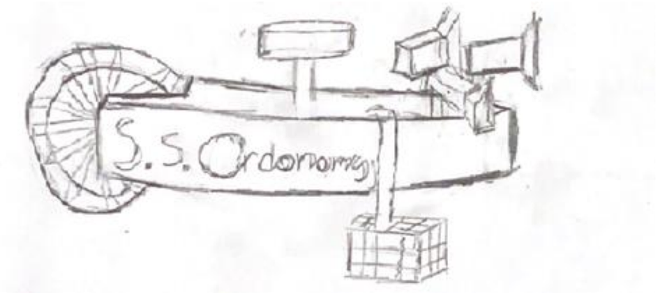
S.S Galley



S.S Hooker V1



S.S Ordonomy



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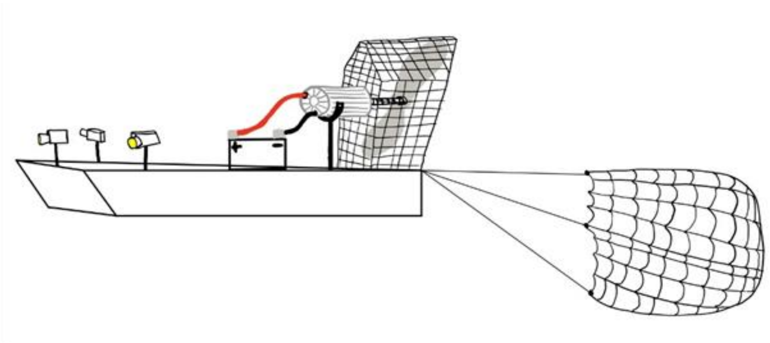
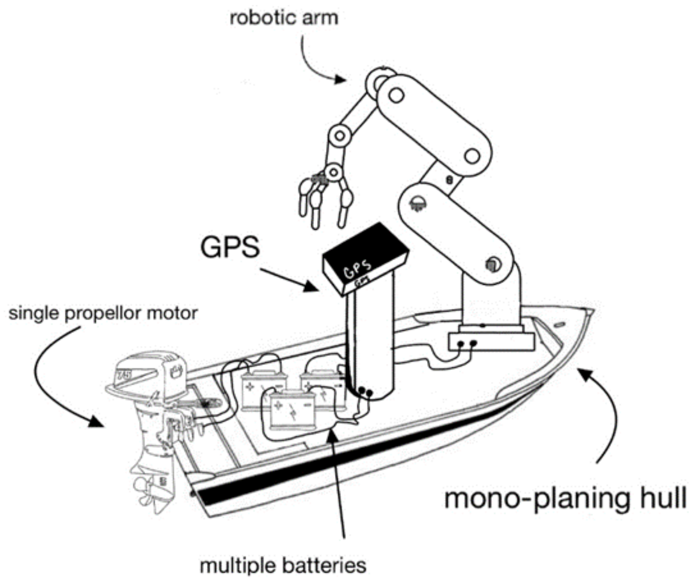
S.S Air Goose

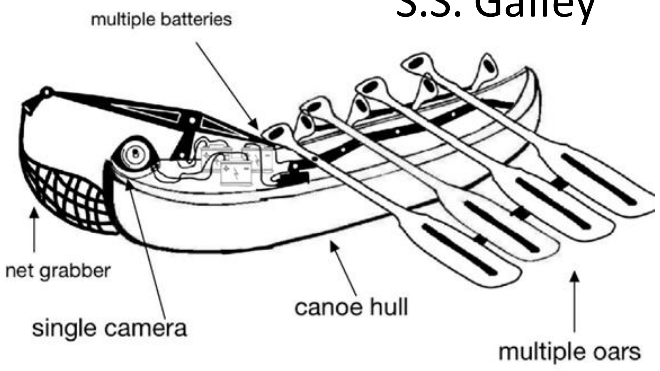


S.S Ol' John



5 Medium Fidelity Concepts

S.S. Galley



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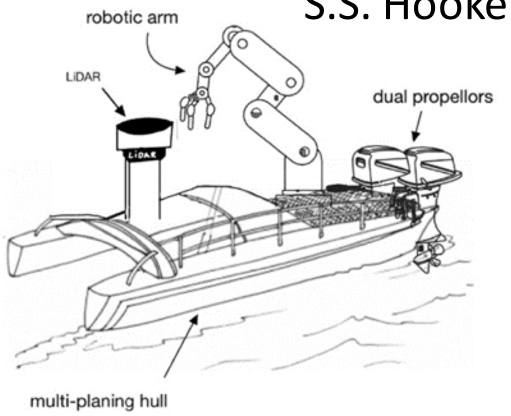

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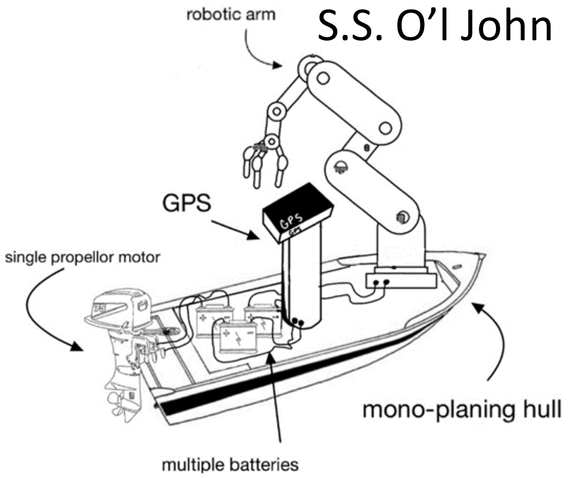

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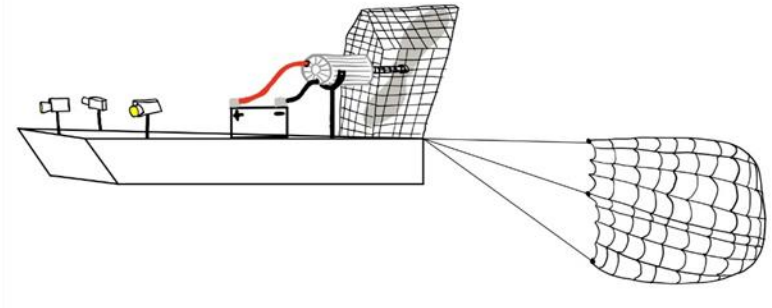

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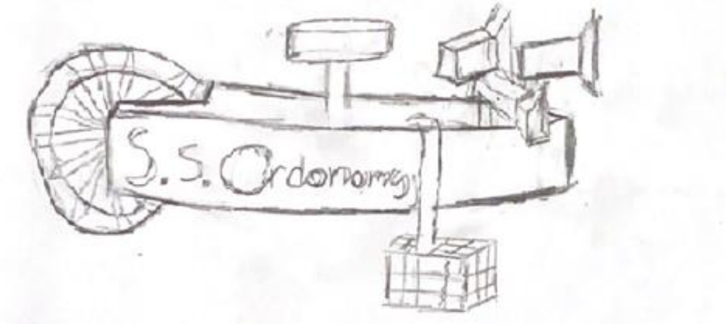

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Michael Fitzsimmons

High Fidelity Concepts

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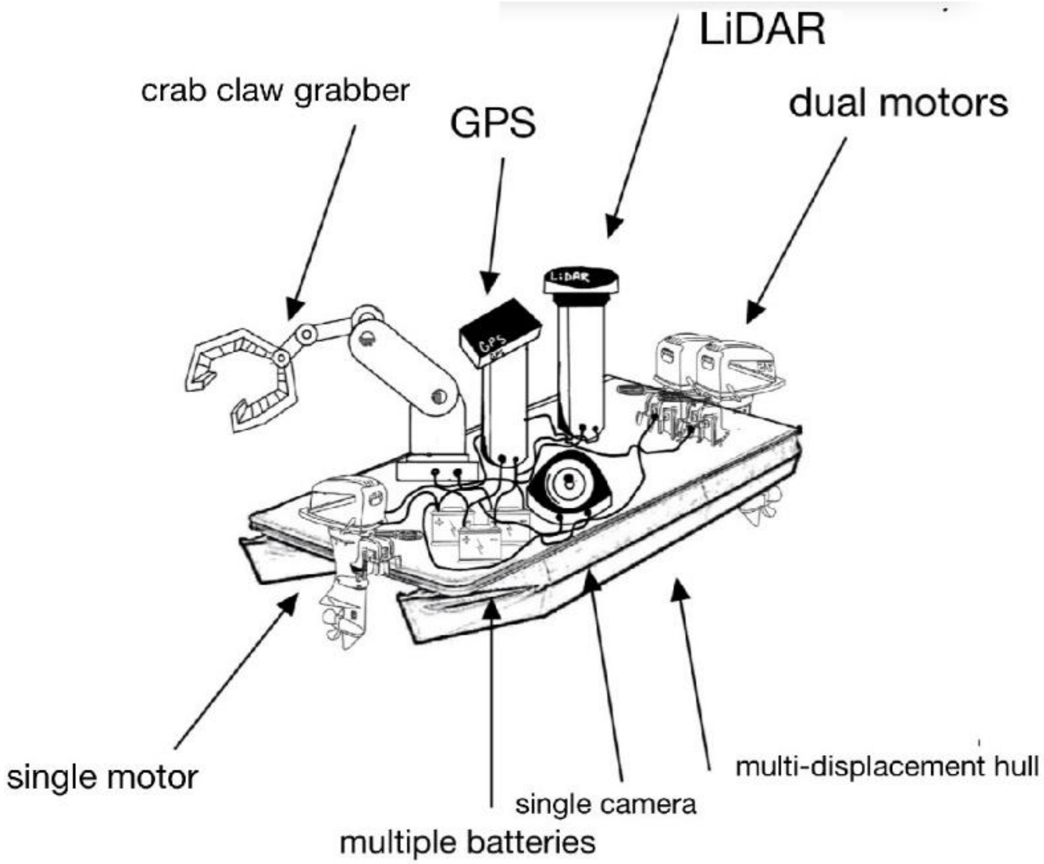
Michael Fitzsimmons

S.S. Shayne 1.0

- Multi-displacement hull
- Dual rear propellers
- Single front propeller
- GPS, camera, and Lidar
- Crab claw grabber
- Multiple batteries



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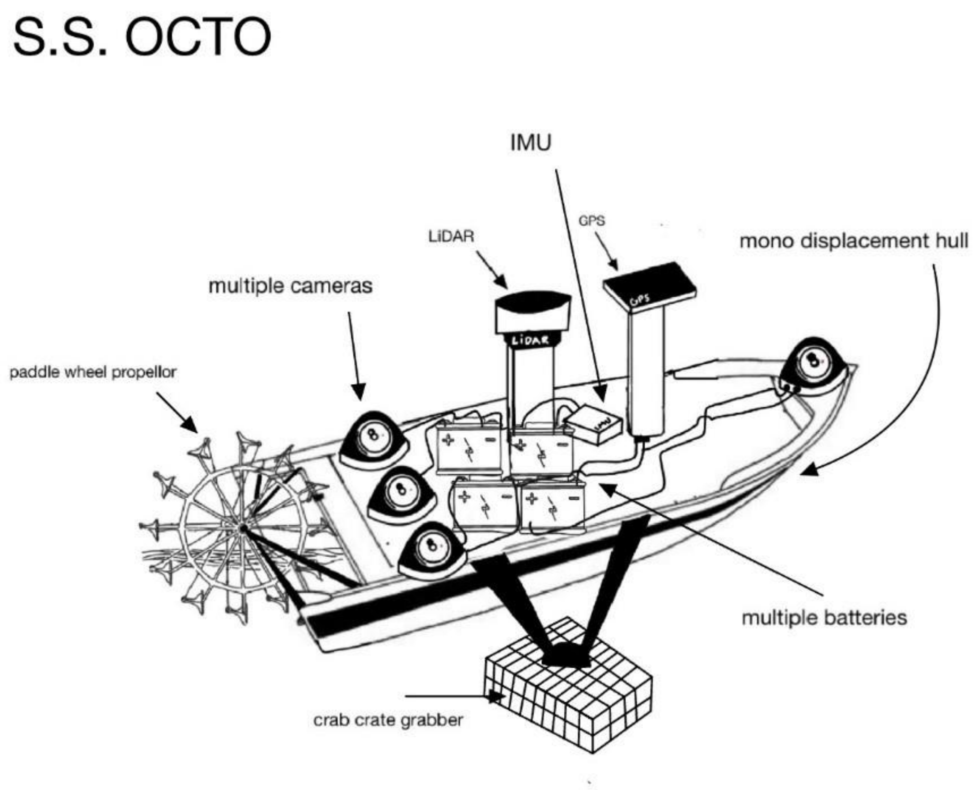
Fitzsimmons

S.S. Octo

- Mono-displacement Hull
- Paddle wheel propeller
- Multiple cameras
- GPS, Lidar, IMU
- Crab crate
- Multiple batteries



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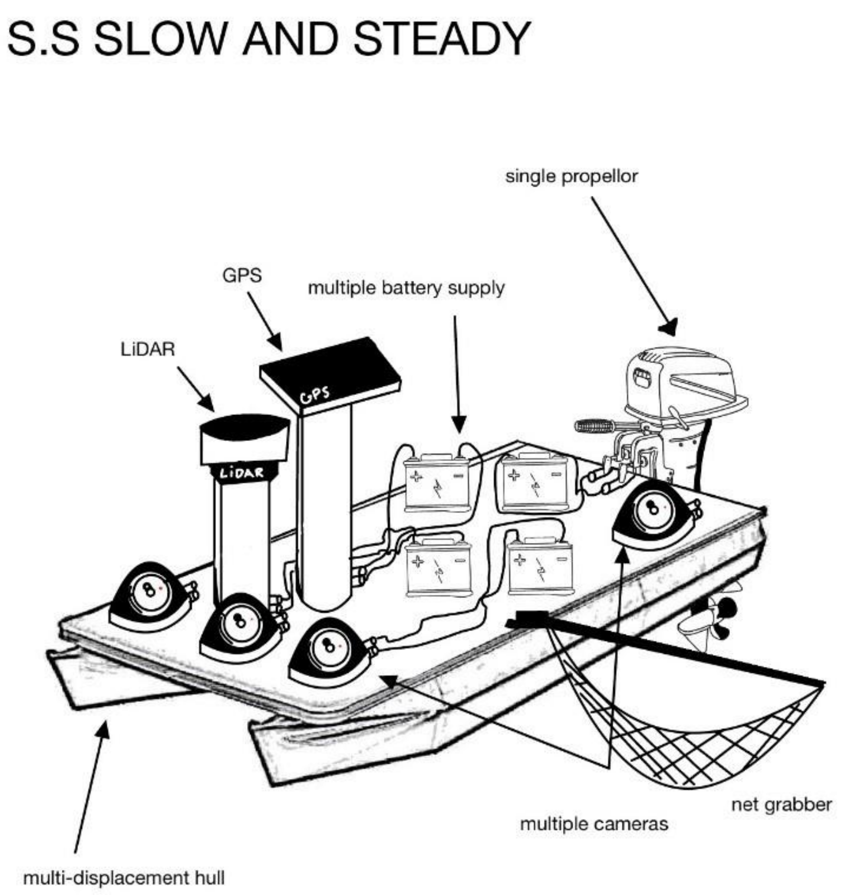
Fitzsimmons

S.S. Slow N' Steady

- Multi-displacement hull
- Single propeller
- GPS & Lidar
- Multiple batteries
- Multiple Cameras
- Net Grabber



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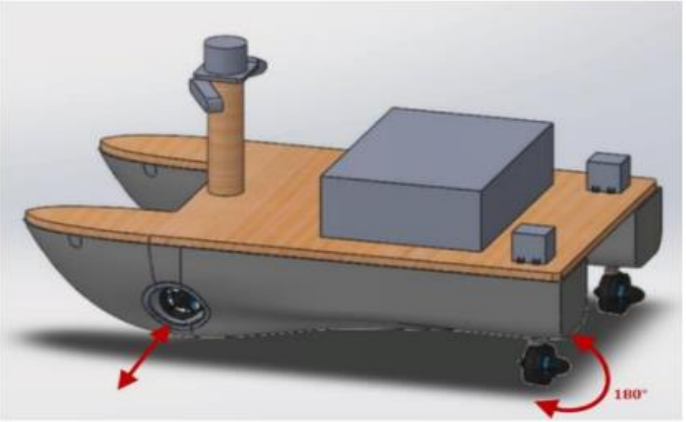
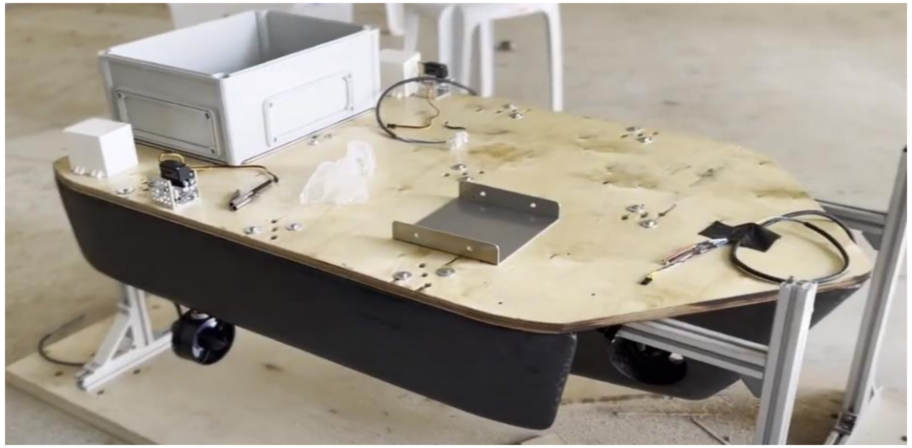
Nicholas
Norwood

Pugh Charts – Tel Aviv

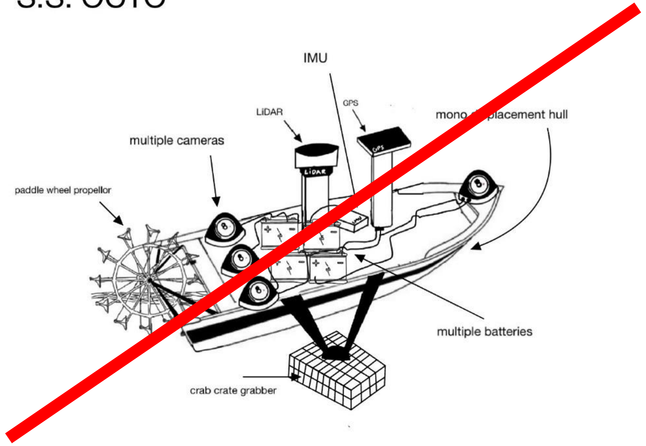




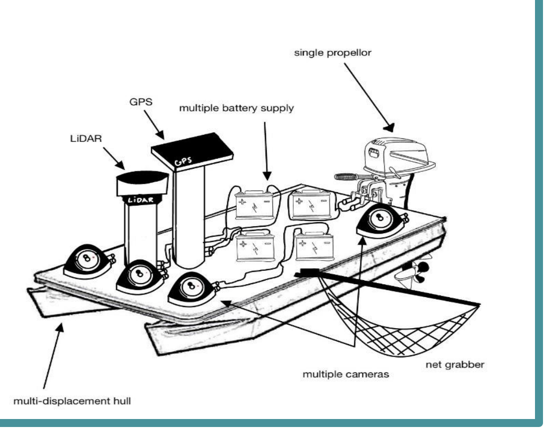
Nicholas Norwood

Pugh Charts – 1st Iteration

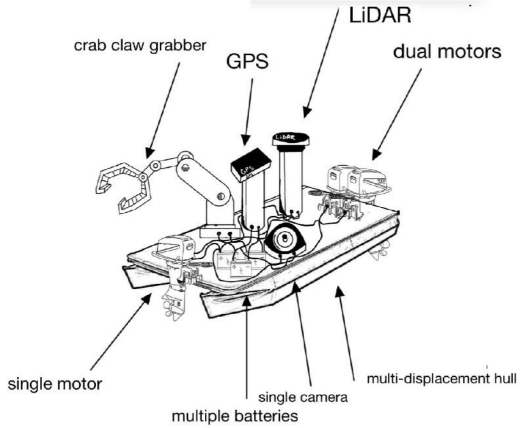
S.S. OCTO



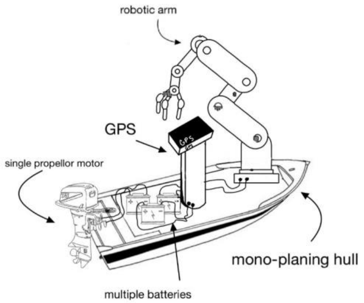
S.S SLOW AND STEADY



S.S. SHAYNE 1.0



S.S. OL' JOHN



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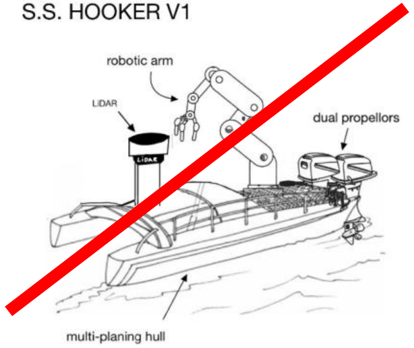
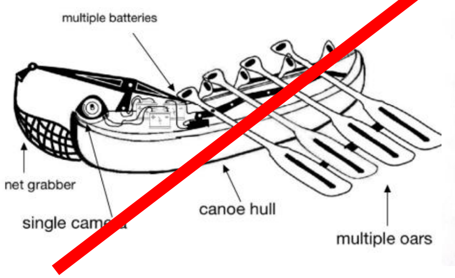
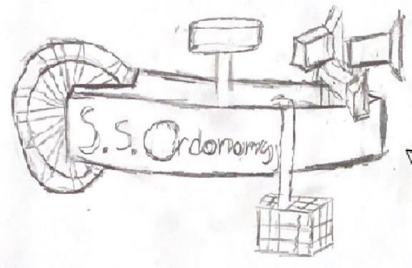


S.S GALLEY

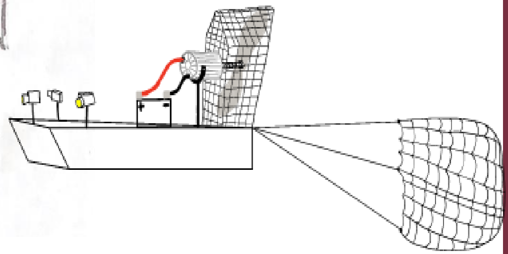


S.S. Ordonomy



113

S.S. Air Goose



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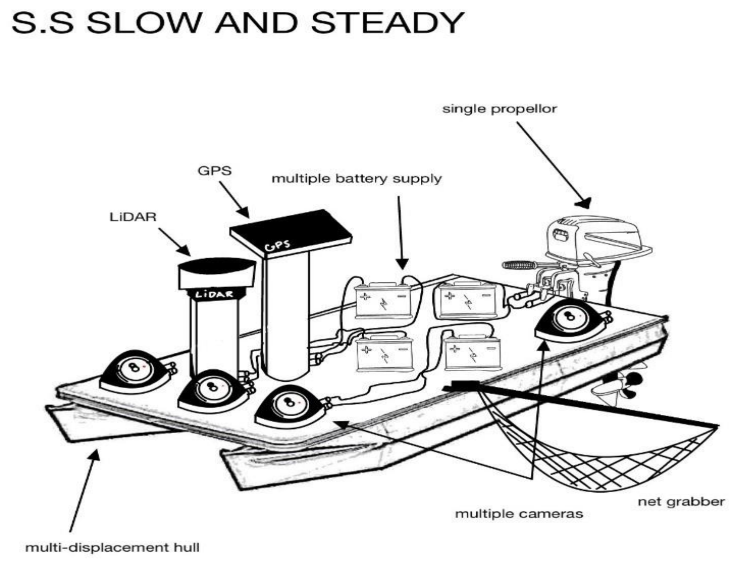
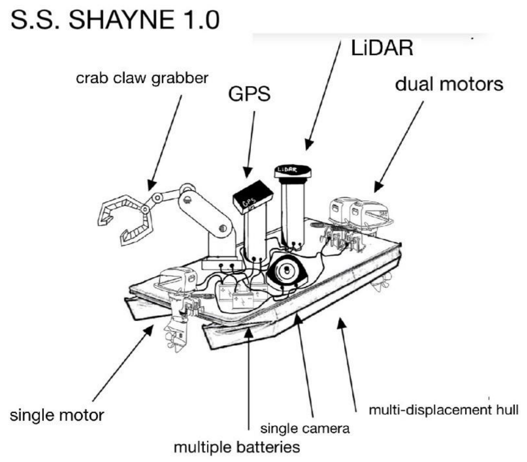
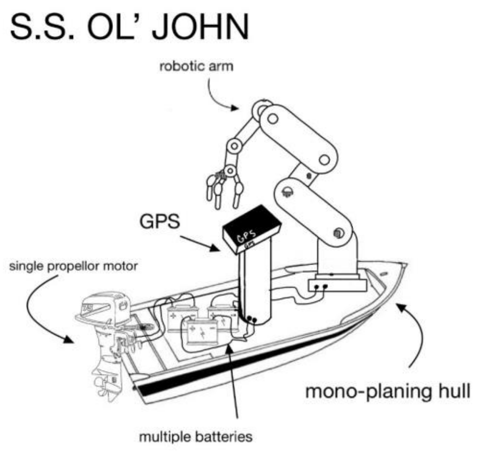
Nicholas Norwood

Pugh Charts – 2nd Iteration

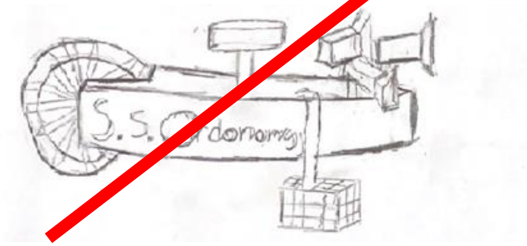
New Datum







S.S. Ordonomy



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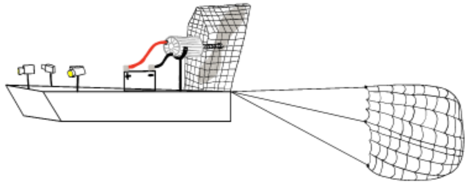

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Andly Jean

Functional Decomposition

Locomotion	Navigation	Structure	Power Systems
Safety	Object Retrieval	Water Spraying	Object Detection

Andly Jean

Functional Decomposition

Locomotion	Navigation	Structure	Power Systems
Safety	Object Retrieval	Water Spraying	Object Detection

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Andly Jean

Functional Decomposition

Locomotion	Navigation	Structure	Power Systems
Safety	Object Retrieval	Water Spraying	Object Detection

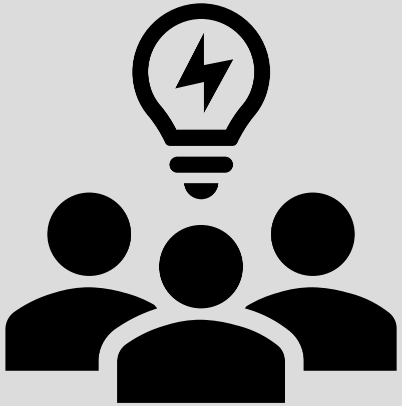
Andly Jean

Functional Decomposition

- Locomotion
- Navigation
- Structure
- Power Systems
- Safety
- Object Retrieval
- Water Spraying
- Object Detection

Michael Fitzsimmons

Concept Generation



100 Concepts

5 Medium Fidelity

3 High Fidelity

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Lucca Meyer

Critical Targets and Metrics

Nicholas Norwood

Concept Selection

Customer Need Priority

↓

Target Priority and Weight

↓

Narrow Down Concepts

↓

Select the Best Design

Nicholas Norwood

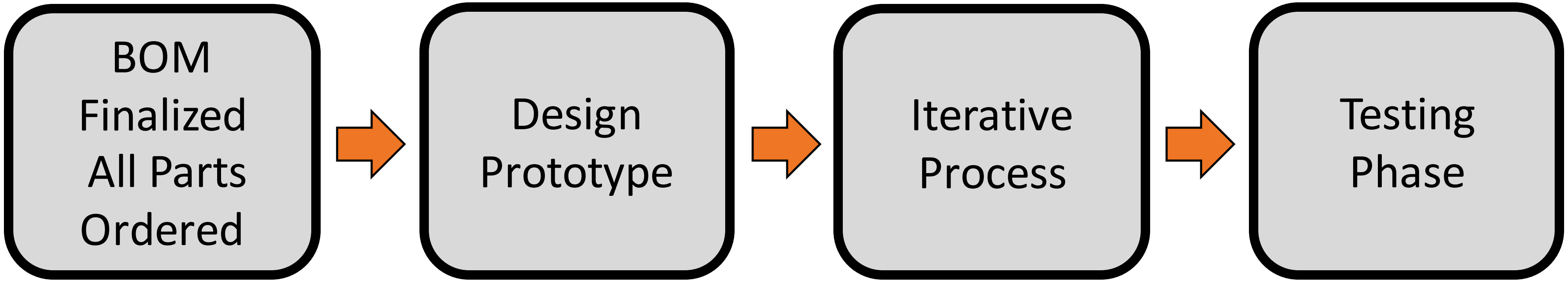
Concept Selection

Customer Needs	Weight
Stability	9
Cost Stays Within Budget	8
Modular Components	6
Weight	6
Size Within Competition Rules	5
Navigation	5
Run Time	3
Object Detection	2
Autonomy	1
Object Retrieval	0

Target	Priority
Battery Power	1
Buoyancy	2
Sensor Resolution	3
Size	4
Weight	5
Navigation	6
Deflection Angle	7

Sophia Barron

Future Work and Timeline



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- This is 10-point
- This is 15–point Times
- This is 20–point
- This is 25–point
- This is 30–point
- This is 35–point
- This is 40–point
- This is 50–point
- This is 60–point

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