DATA EXTRACTION

MILESTONE 1

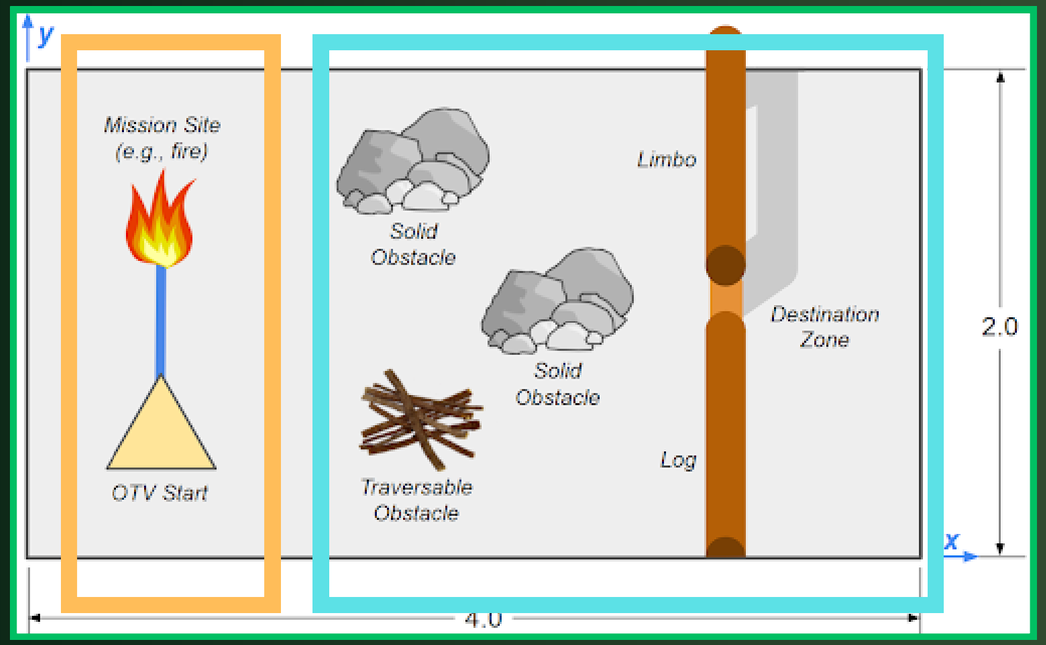
"OSCAR THE GROUCH"

Team 2: Ella Bierly, Ariana Butterworth, Phillip Chen, Jacquelyn Eng, Thomas Kimberlin, Vihaan Le, Ryan Tran, Steven Vilcheck

OBJECTIVES FOR OSCAR'S GARBAGE TRUCK

GENERAL

- Navigate *OTV* through Payload
- Navigate *OTV* through Arena



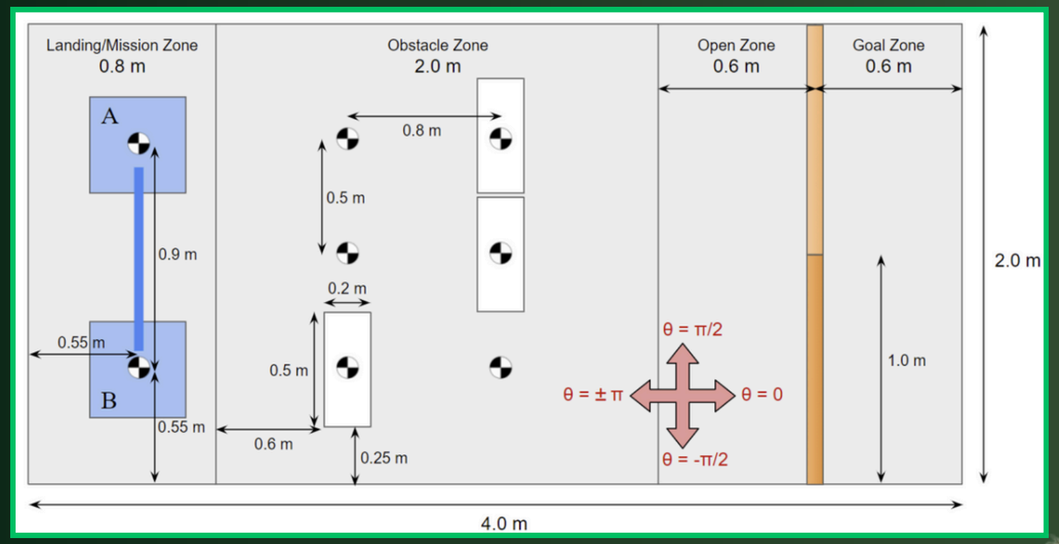
SPECIFIC

- Transmit Duty Cycle in Silo
- Collect Data inside Silo

HOW OSCAR WILL APPROACH THE TASK

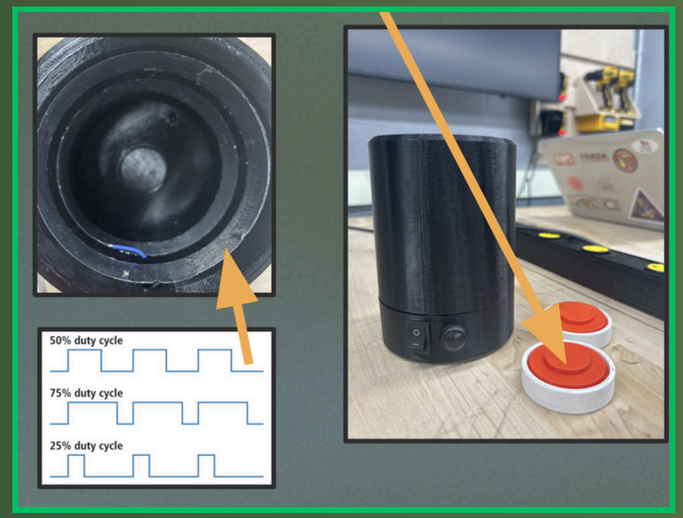
NAVIGATE ARENA

- The *OTV* will use sensors to determine position, obstacle orientation, and speed



DATA EXTRACTION

- Pick up silo and empty contents by using a claw
- Electrodes to transmit duty cycle



CONSTRAINTS

LOCOMOTIVE

- Motors can handle >3kg and 0.7 coefficient of rolling resistance
- Coefficient of friction of the tires vs. the arena floor

CHASSIS

- Overall OTV under $320 and 3kg
- Must have 115mm x 115mm space for Aruco tracker on top

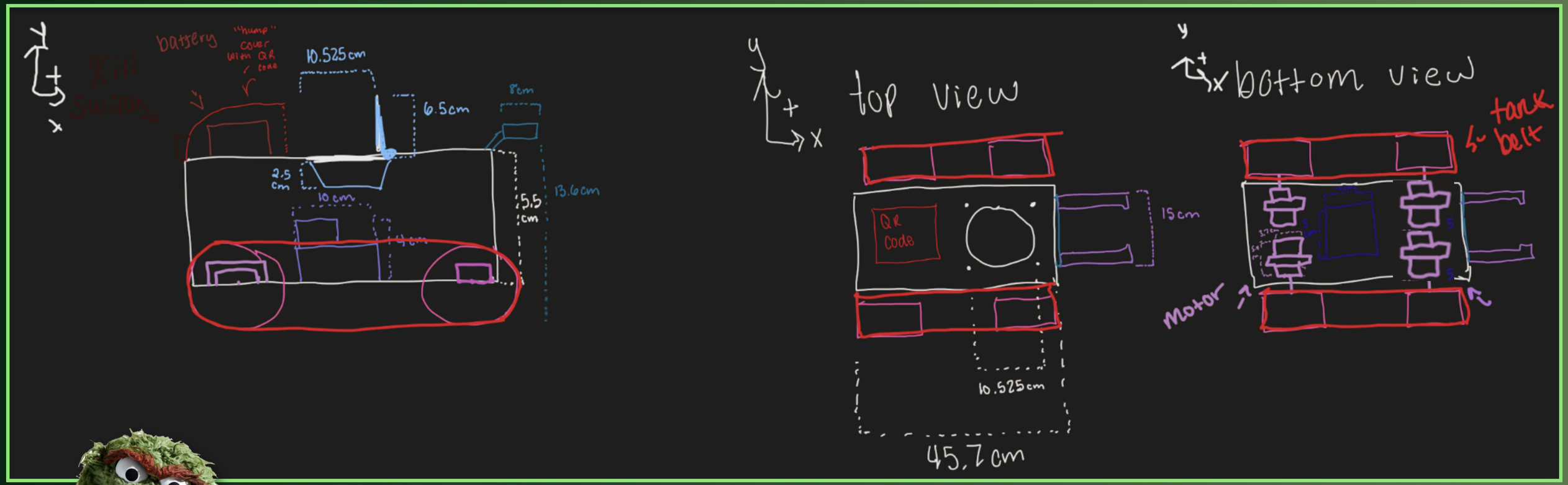
ELECTRICAL

- OTV must be able to operate for 10 minutes with non-lithium rechargable batteries
- Must consider power, current draw, and voltage of all electrical components

ARDUINO

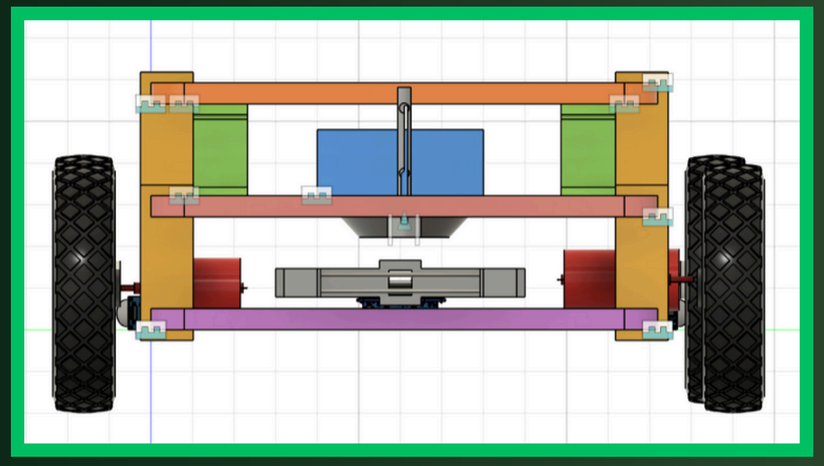
- Autonomous
- Functionality of sensors used to navigate and complete mission objectives
- 3 Obstacles and Log/Limbo

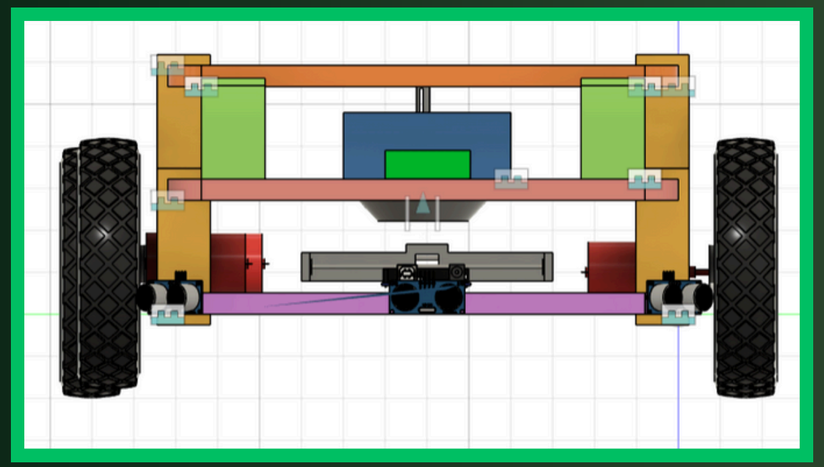
INITIAL DESIGN DIAGRAM



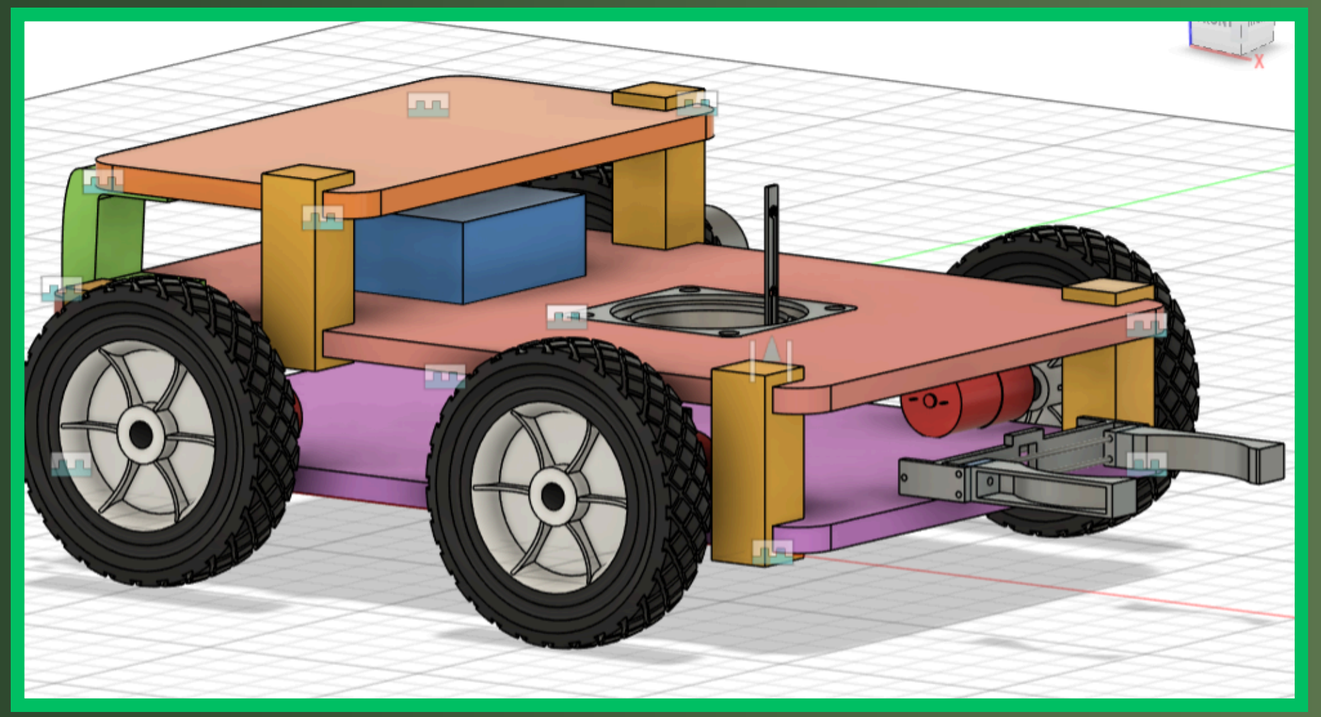
OTV CAD

Front View

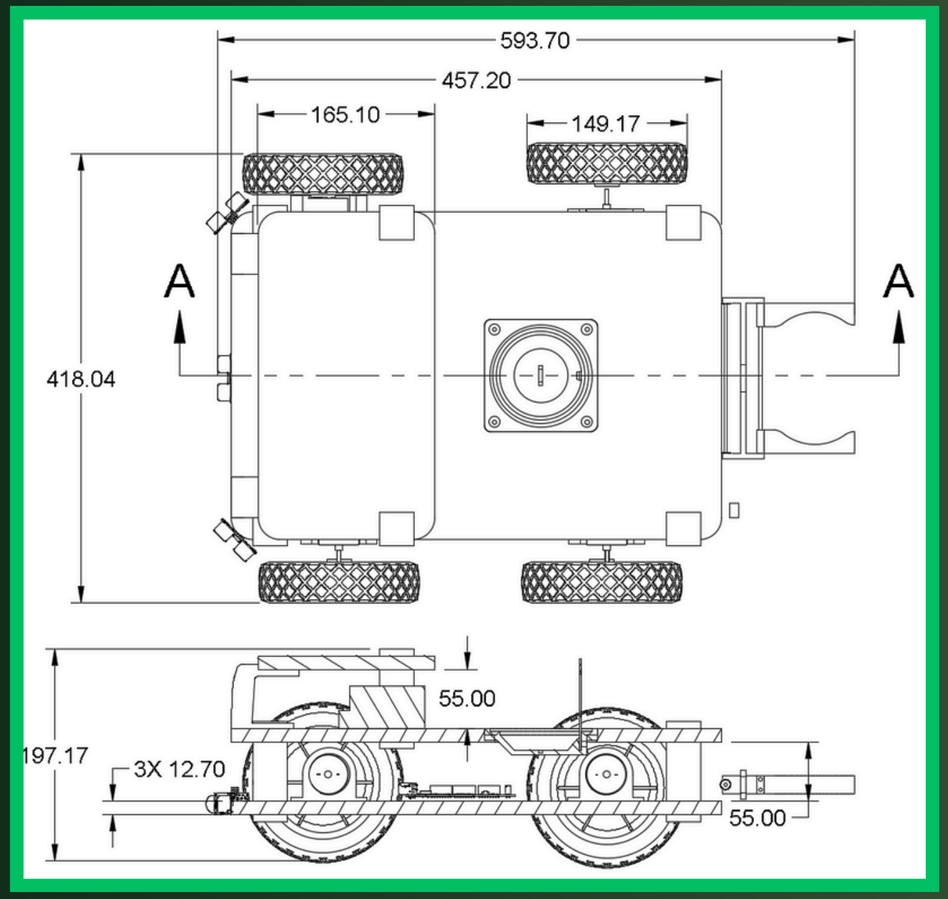




Back View



OTV CAD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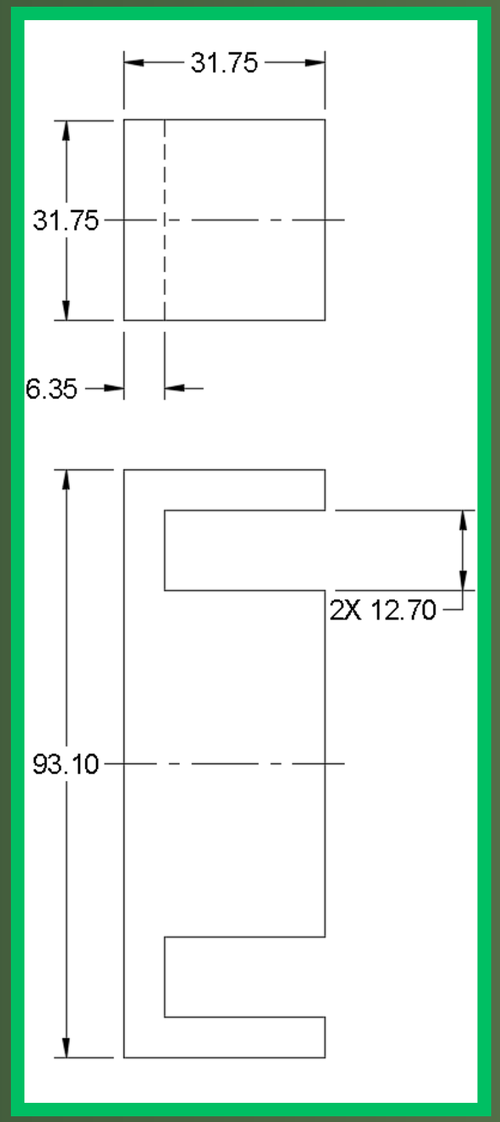
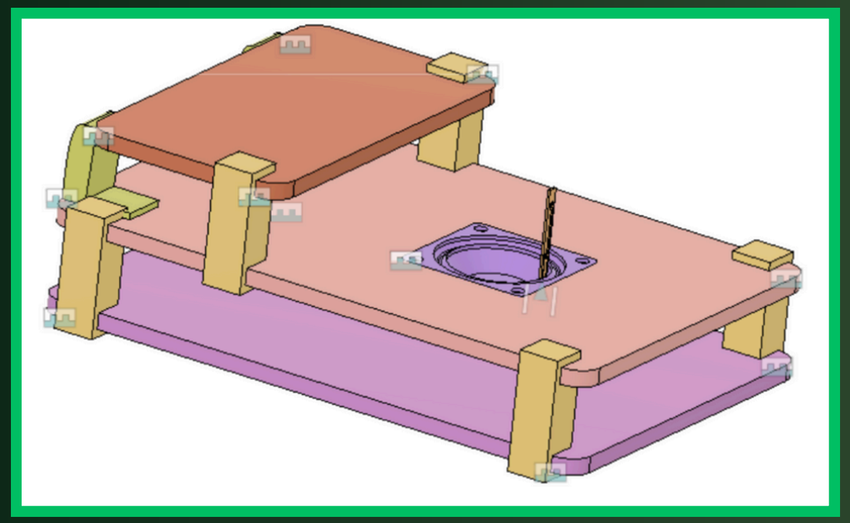
457.20
165.10
149.17
A
A
418.04
55.00
197.17
3X 12.70
55.00


31.75
31.75
6.35
2X 12.70
93.10

CHASSIS DEVELOPMENT



ARRANGEMENTS

- Electronics housed between two layers
- Missions systems mounted on top layer

MATERIALS

- 3 layers of cut wood/PLA
- 3D-printed spacers

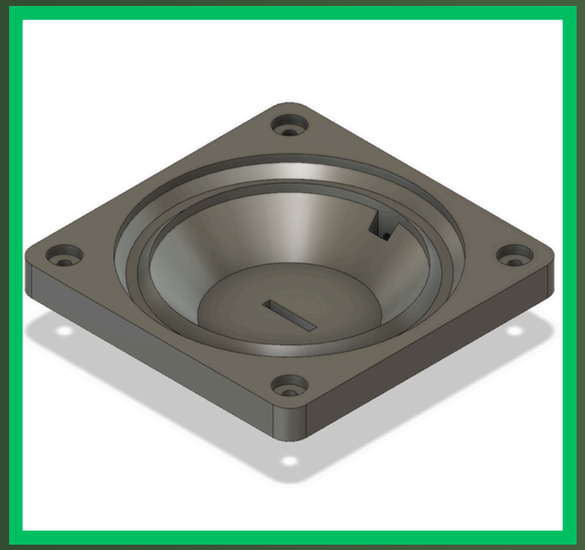
CAVEATS

- Final dimensions dependent on subteams
- Final dimensions also dependent on specific goals

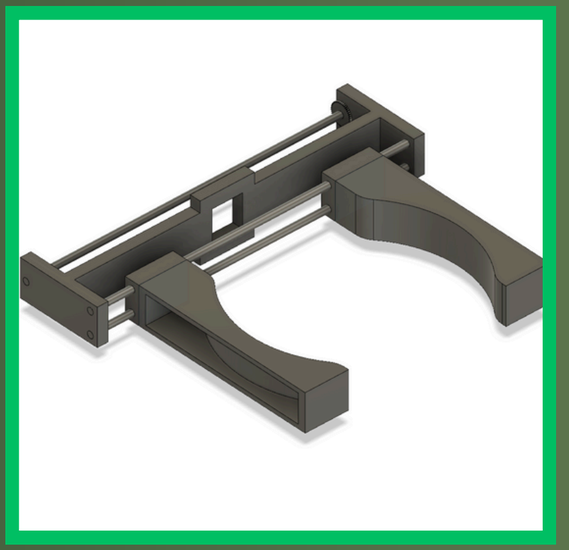
MISSION SYSTEMS

SUBSYSTEMS

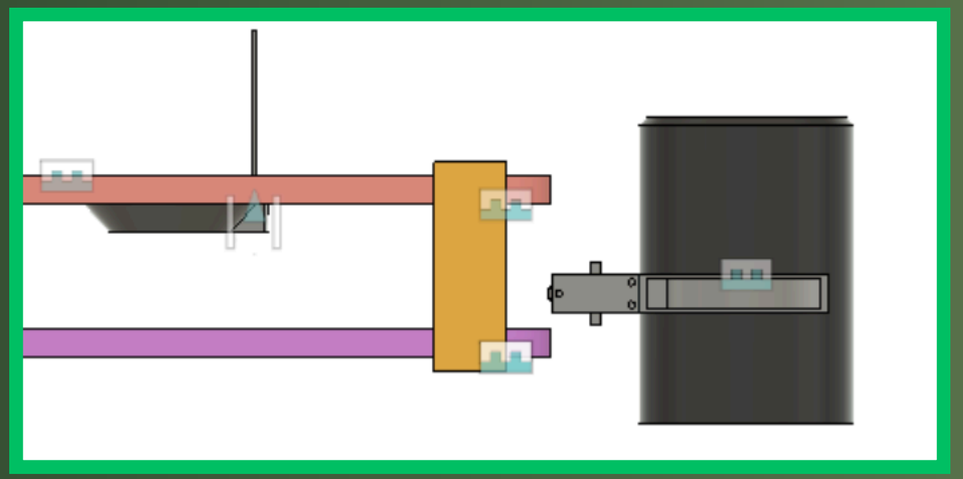
- Claw - grab and rotate silo 180 degrees onto interface plate
- Silo Interface Plate - houses all sensors necessary for data extraction
- Sensors - determines silo contents and positions of silo and obstacles



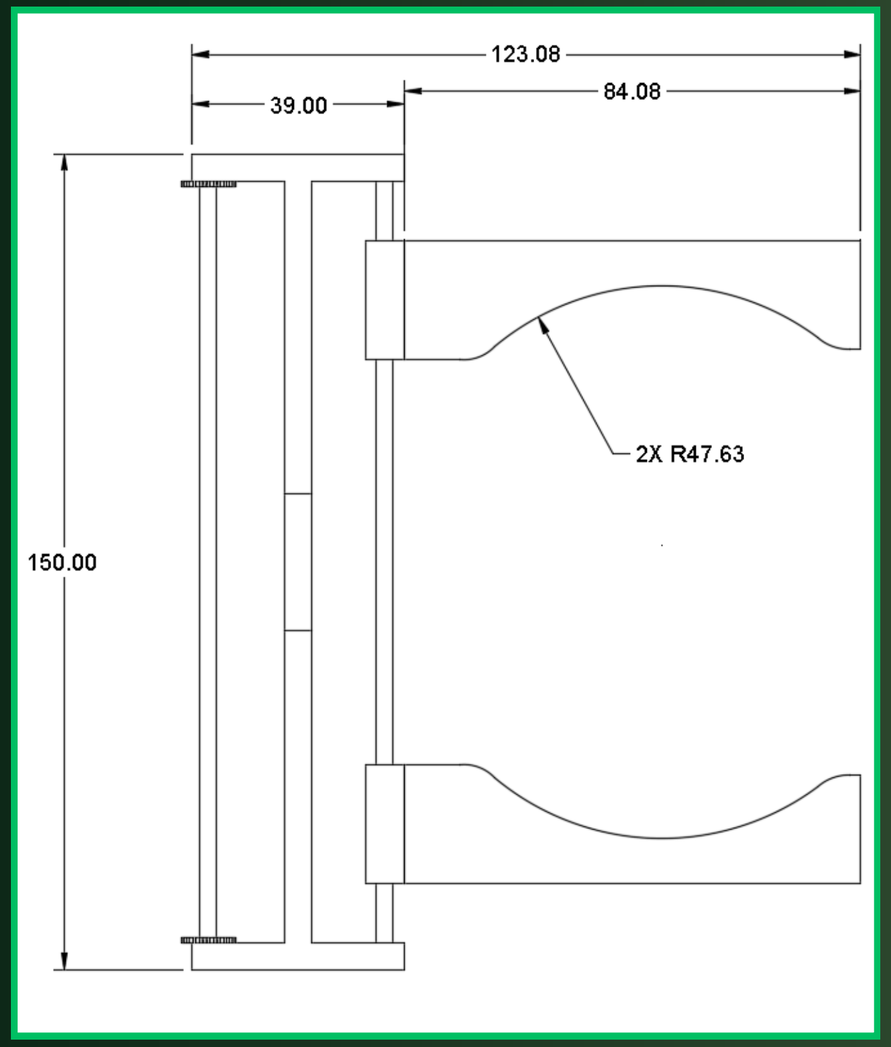
Silo Interface Plate

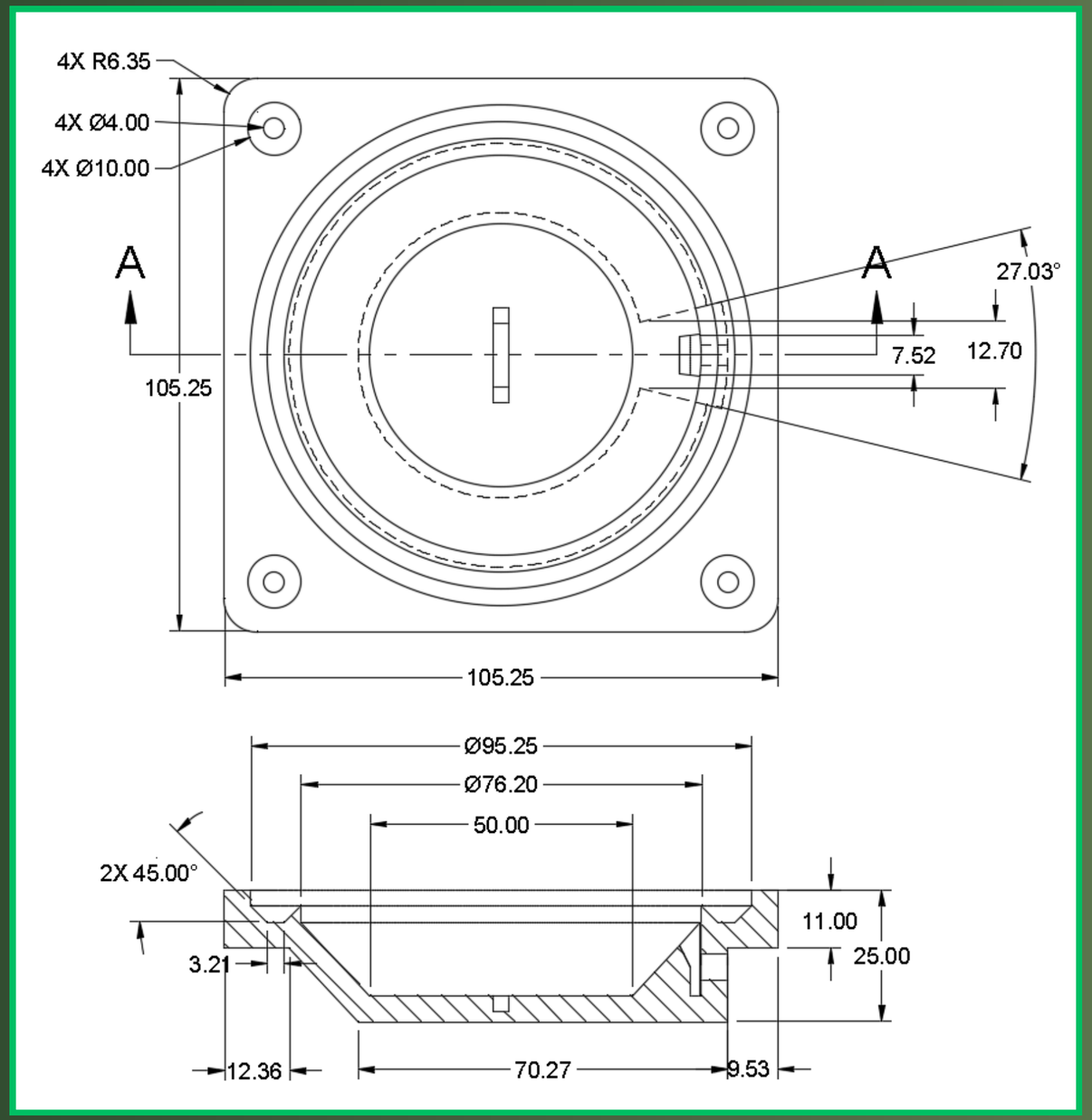


Claw

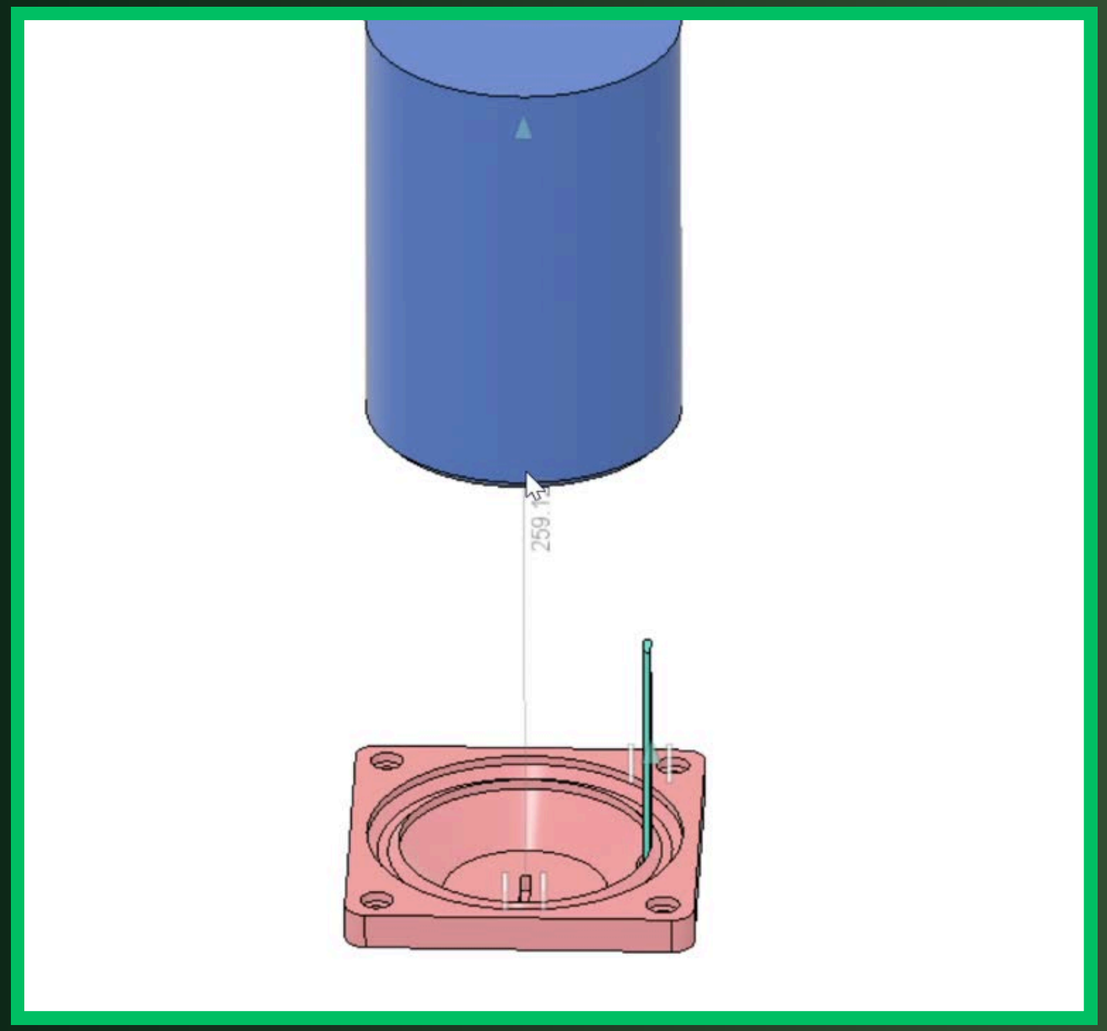


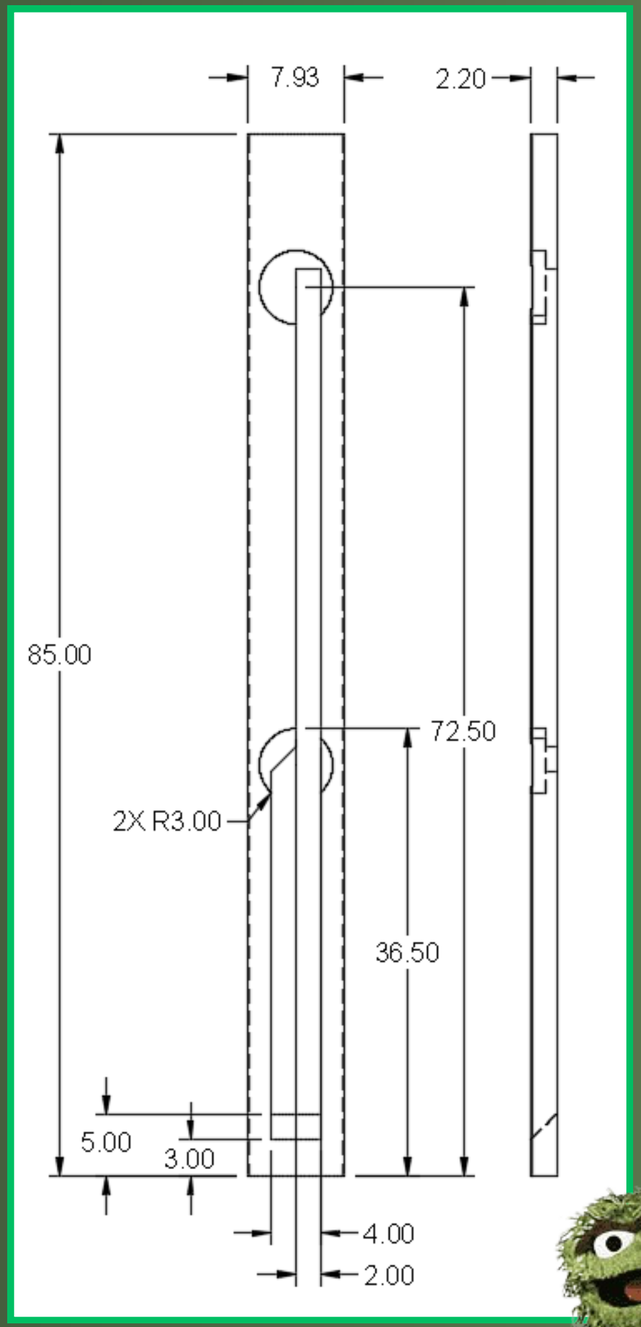
MISSION SYSTEMS



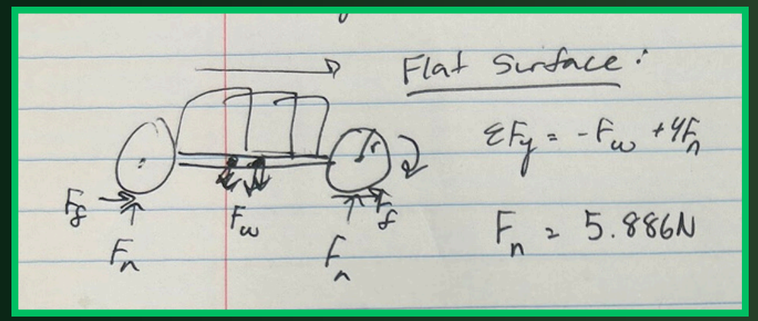


MISSION SYSTEMS

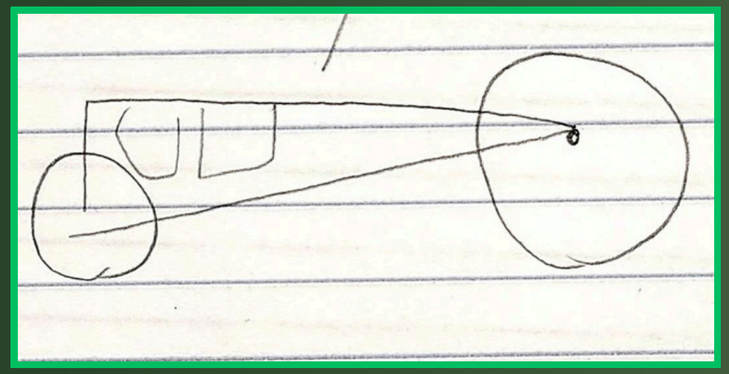




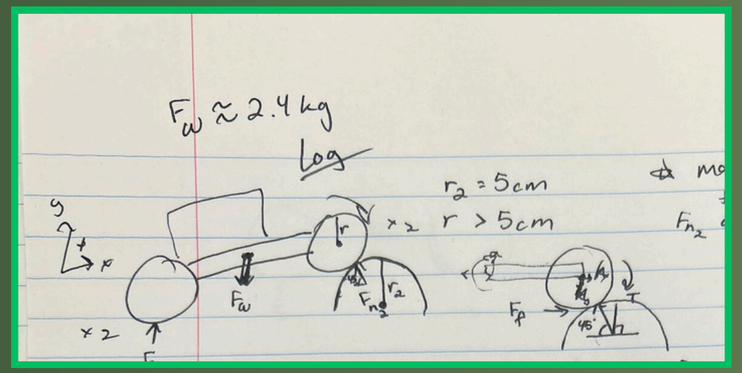
INITIAL SKETCHES AND CALCULATIONS



Initial FBD and equilibrium equation to find the normal force acting on each tire.

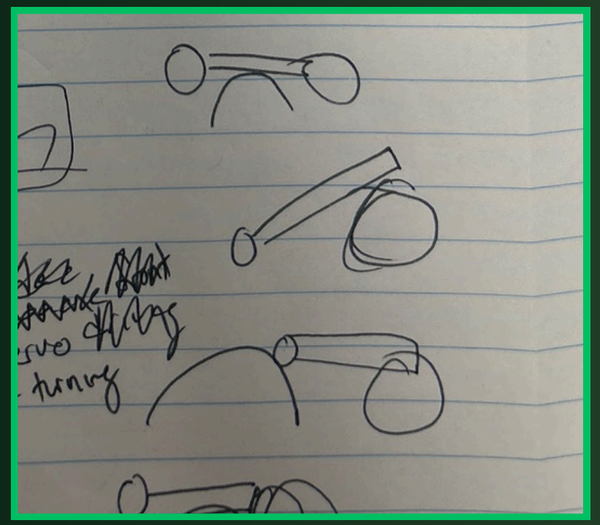


Option with different sized wheels and a bottom to protect the motors.

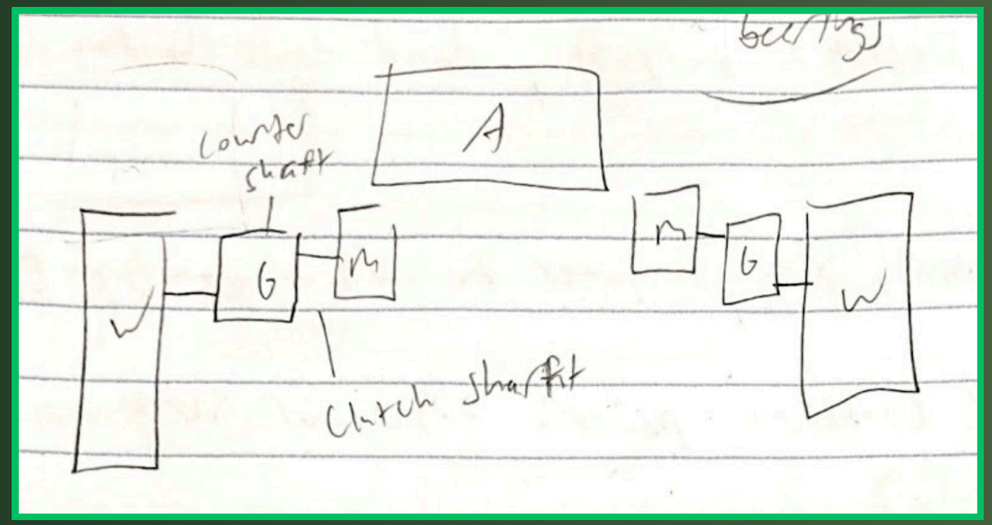


Initial sketches concerning the how large the radius of the tires should be.

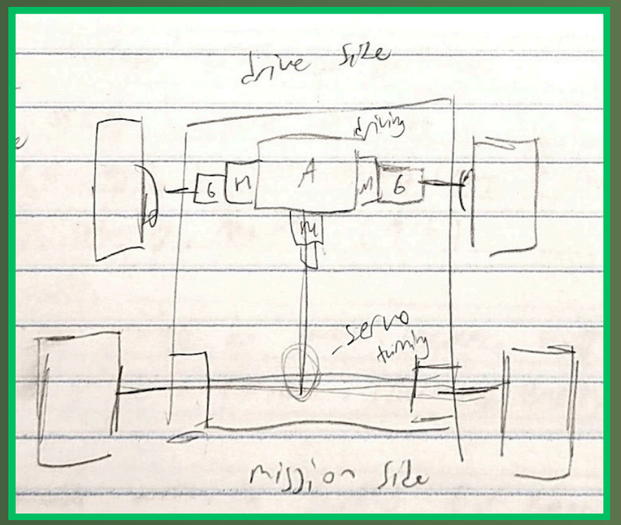
INITIAL SKETCHES AND CALCULATIONS (CONT.)



Initial chassis designs with going over log in mind



Initial sketch of how the motors will be connected to the wheels.

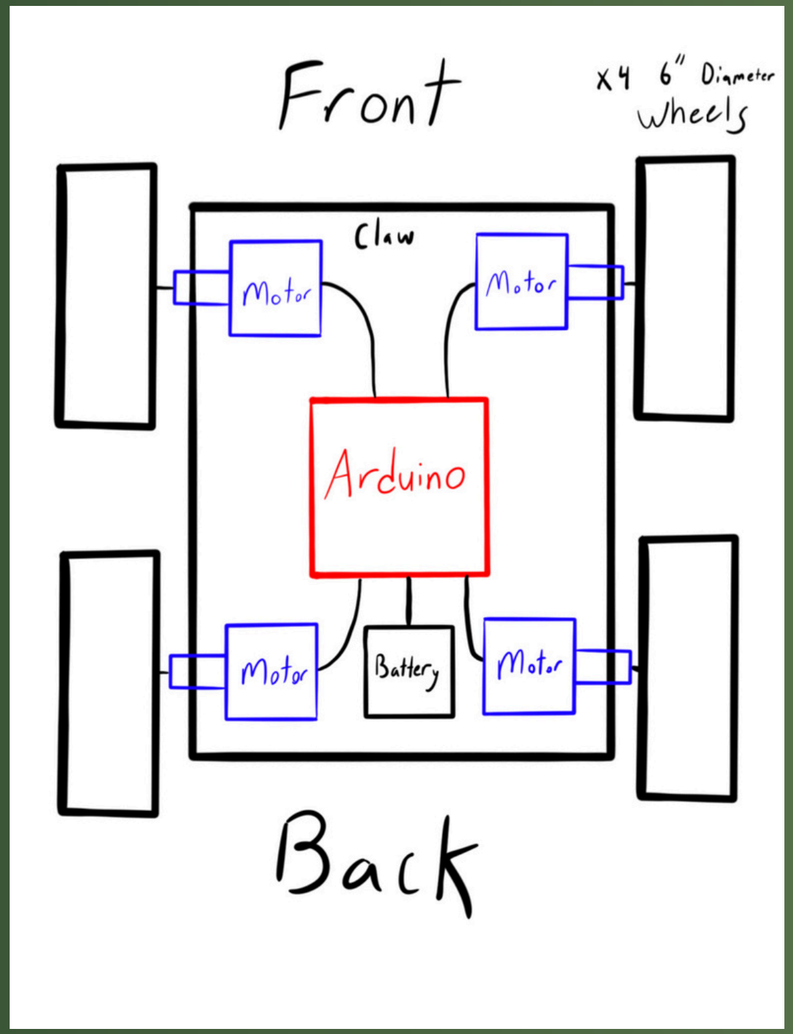


Bird's eye view the initial method plan for locomotion where the front tires drive the OTV while the back wheels steer.

PROPULSION METHOD

METHOD: TANK DRIVE

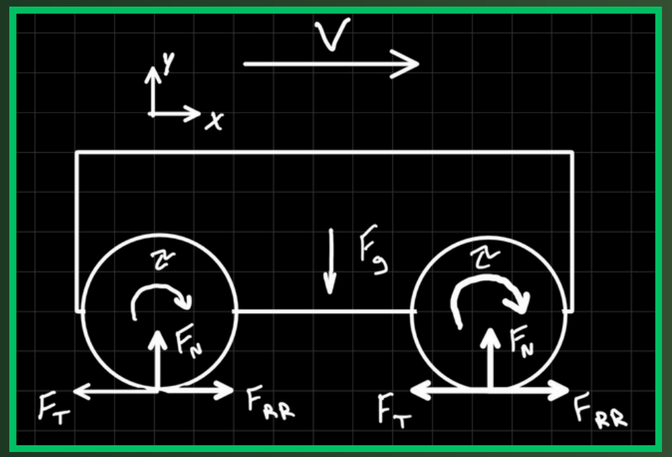
- Four wheels, left side and right side connected to separate motors
- 4 motors, one controlling each wheel



GENERAL TORQUE EQUATION

METHOD: TANK DRIVE

- Four wheels, left side and right side connected to seperate pwm pins
- 4 motors, one controlling each wheel



EQUATIONS

m = Mass of OTV
g = Gravitational Acceleration
$\mu_{f,s}$ = Coefficient of Static Friction
τ = Torque of Individual Motor

p = Points of Contact
r = Radius of Drive Wheels
n = Number of Drive Wheels

$$\Sigma F_y = ma_y = 0$$

$$F_g = pF_N$$

$$F_N = \frac{mg}{p}$$

$$F_T = \frac{\tau}{r}$$

$$\Sigma F_x = ma_x = 0$$

$$nF_T = pF_{RR}$$

$$\frac{n\tau}{r} = \mu_{f,s}mg$$

$$\tau = \frac{\mu_{f,s}mgr}{n}$$

CALCULATIONS AND MOTOR SELECTION (CONT.)

ASSUMED VALUE

Coefficient of Static Friction (μ_{f,s})	0.70
OTV Mass (m) [kg]	4.00
Gravitational Acceleration (g) [m/s^2]	9.81
Radius of Wheels (r) [m]	0.06
Number of Drive Wheels (n)	4
Number of Motors	4
Torque of Individual Motor (τ) [kg-cm]	4.20

MOTOR SPECIFICATIONS

Rated Voltage [V]	12.00
Rated Current [mA]	90.00
Speed [rpm]	15.00
Rated Torque [kg-cm]	15.00

GREARTISAN 15 RPM 12V MOTOR

15.00 >> 4.20 [kg-cm]

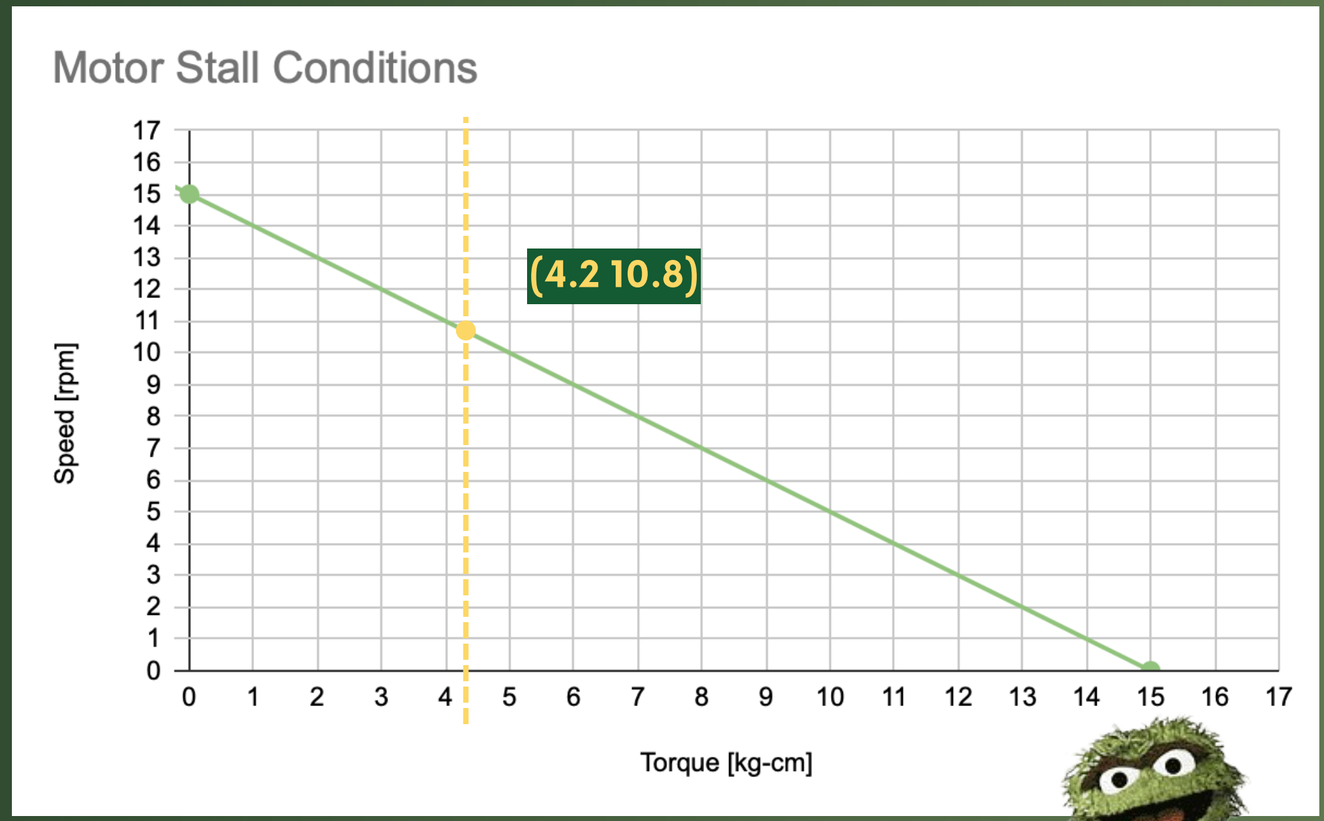
CALCULATIONS AND MOTOR SELECTION (CONT.)

MOTOR DATA

Rated Voltage [V]	12.00
Rated Current [mA]	90.00
Speed [rpm]	15.00
Rated Torque [kg-cm]	15.00

OTV DATA

Required Torque [kg-cm]	4.20
Possible Speeds [rpm]	0 to 10.80



OTV VELOCITY CALCULATIONS

WHEEL OF CHOICE

EQUATIONS

ω = Angular Speed of Wheels

v = Velocity of OTV

$$v = \omega r$$

$$v = \omega(2\pi \text{ rad/rev})(1\text{m}/60\text{s})r = \text{Velocity in m/s}$$

SPECIFICATIONS

Radius [cm]	6
Possible Speeds [rpm]	0 to 10.80
Max OTV Velocity [m/s]	0.07

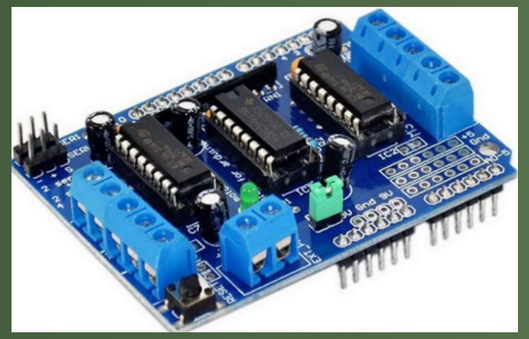
MOTOR OPTIONS

OPTION 1 :

15 RPM

90 mA

+



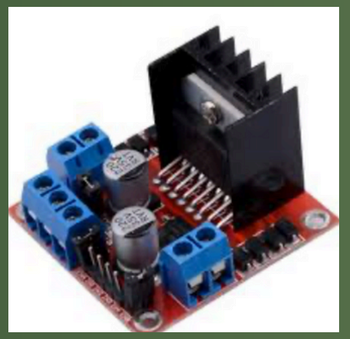
600 mA

OPTION 2 :

20 RPM

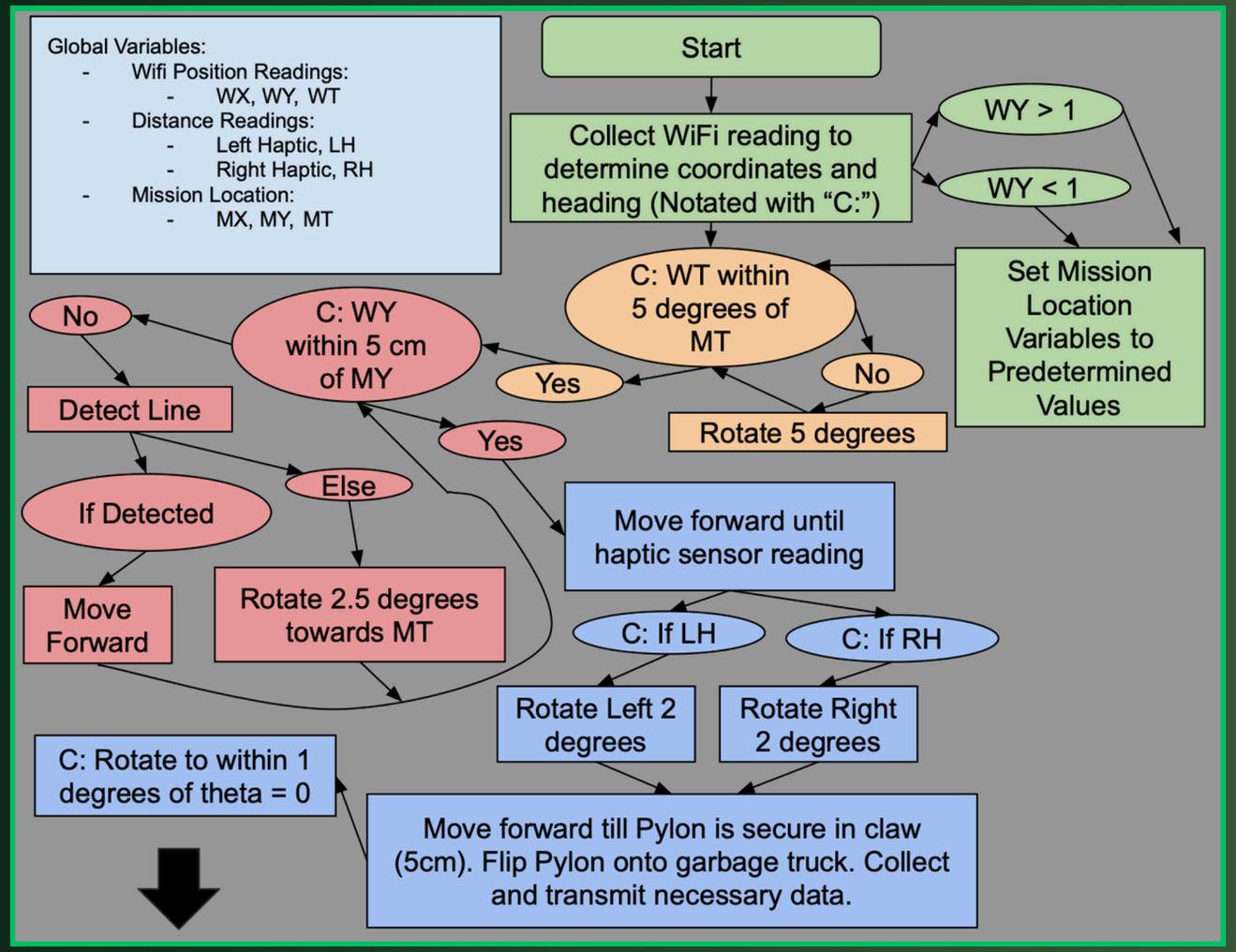
920 mA

+



2000 mA

NAVIGATION FLOW CHART



Coordinate:
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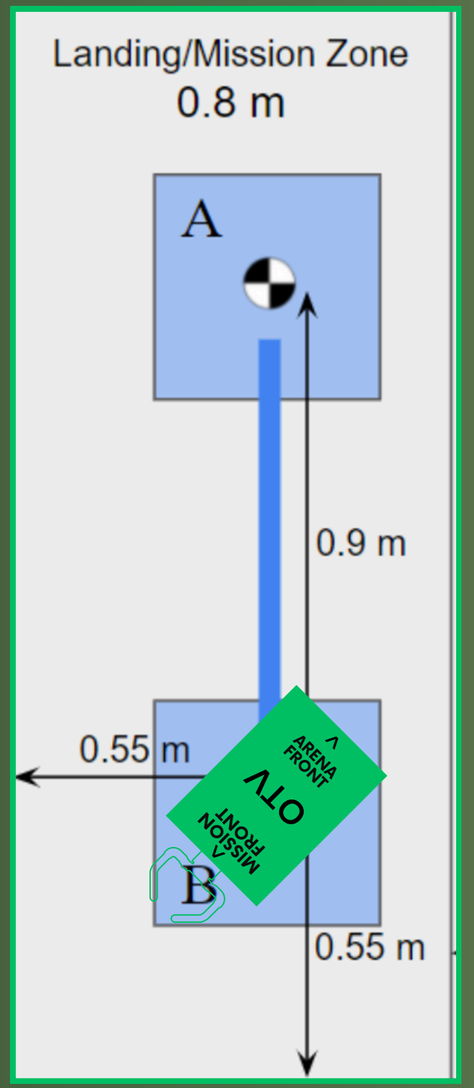
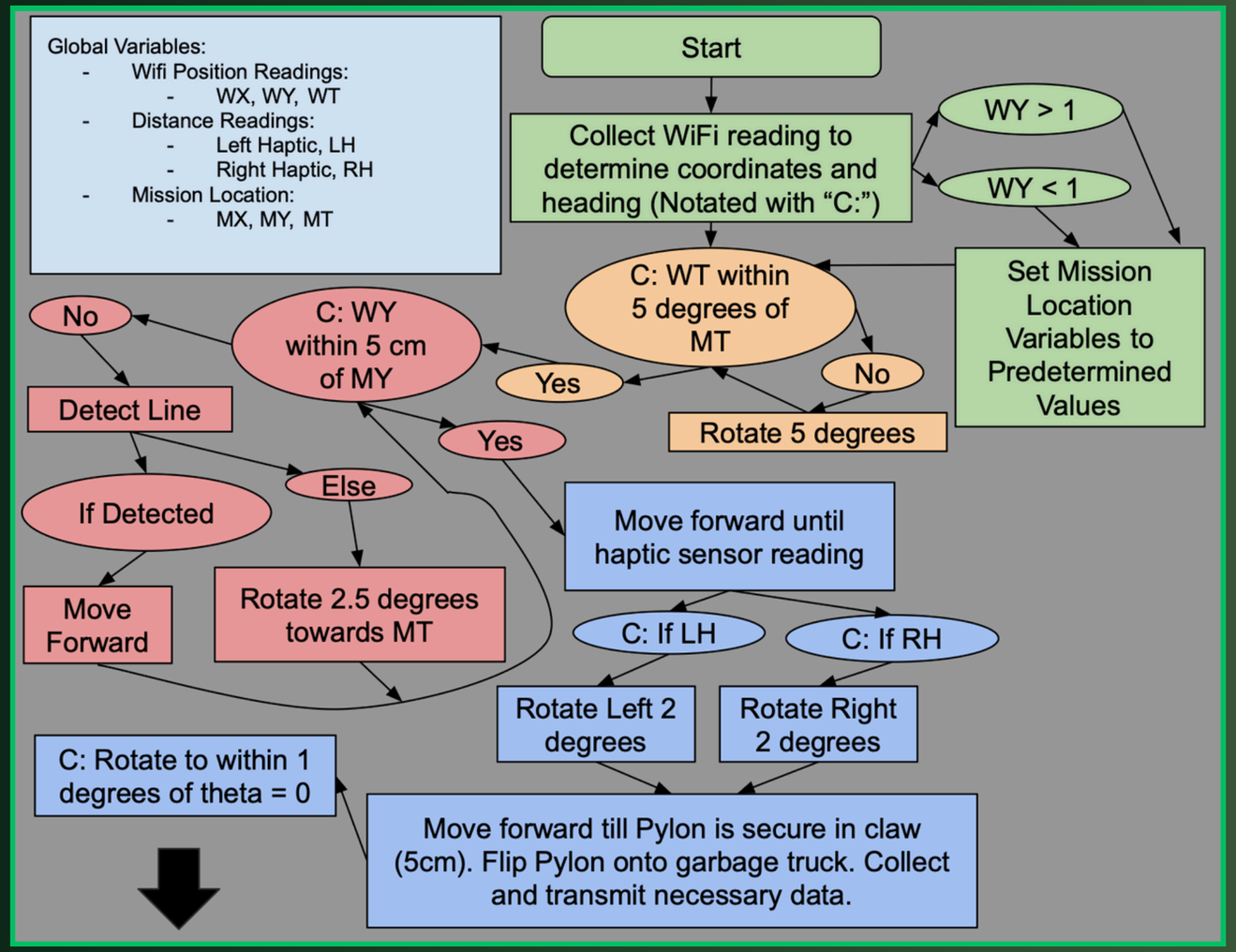
Angle:
Theta = 135



NAVIGATION FLOW CHART



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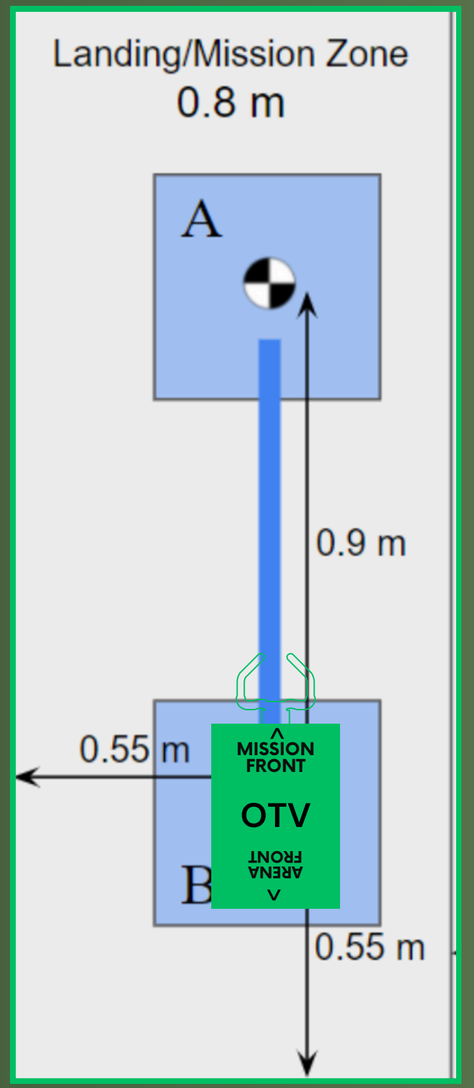

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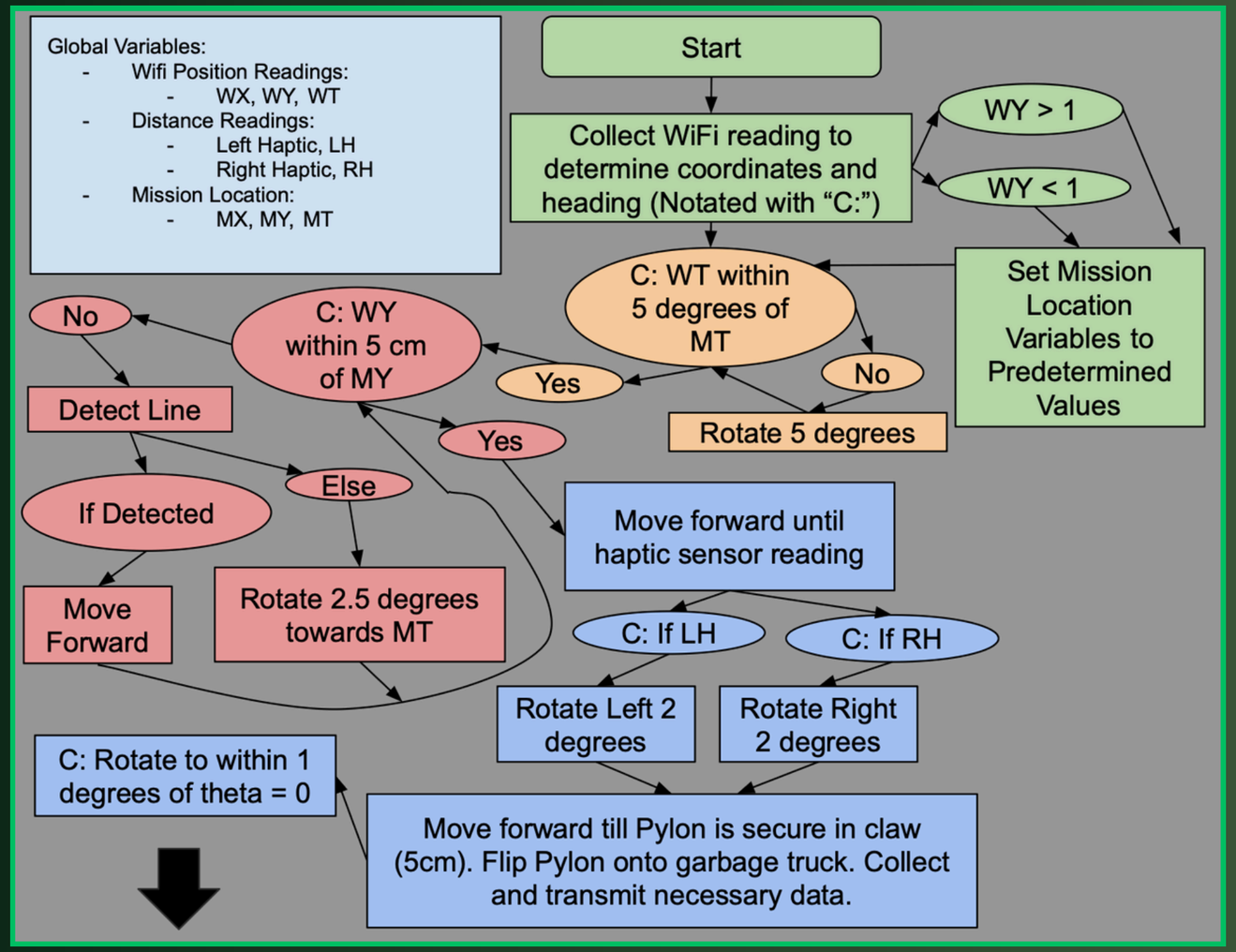

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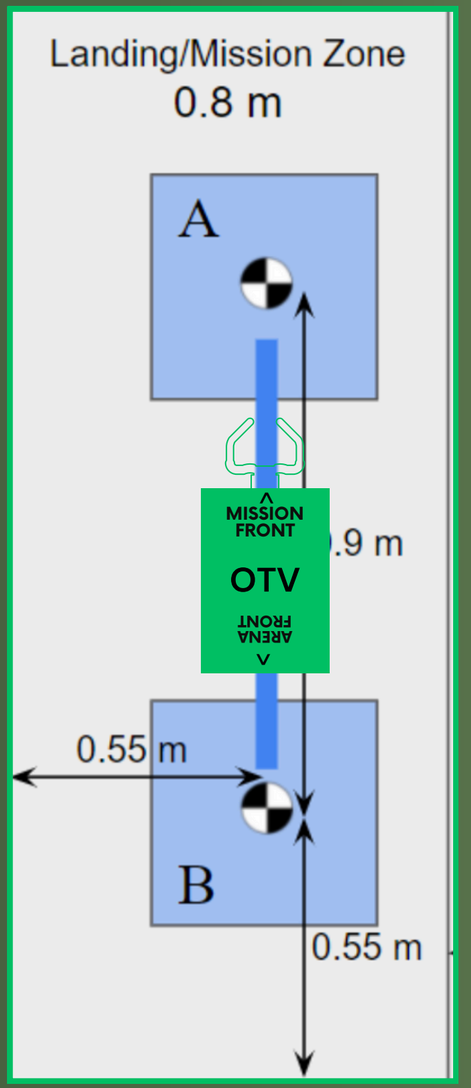

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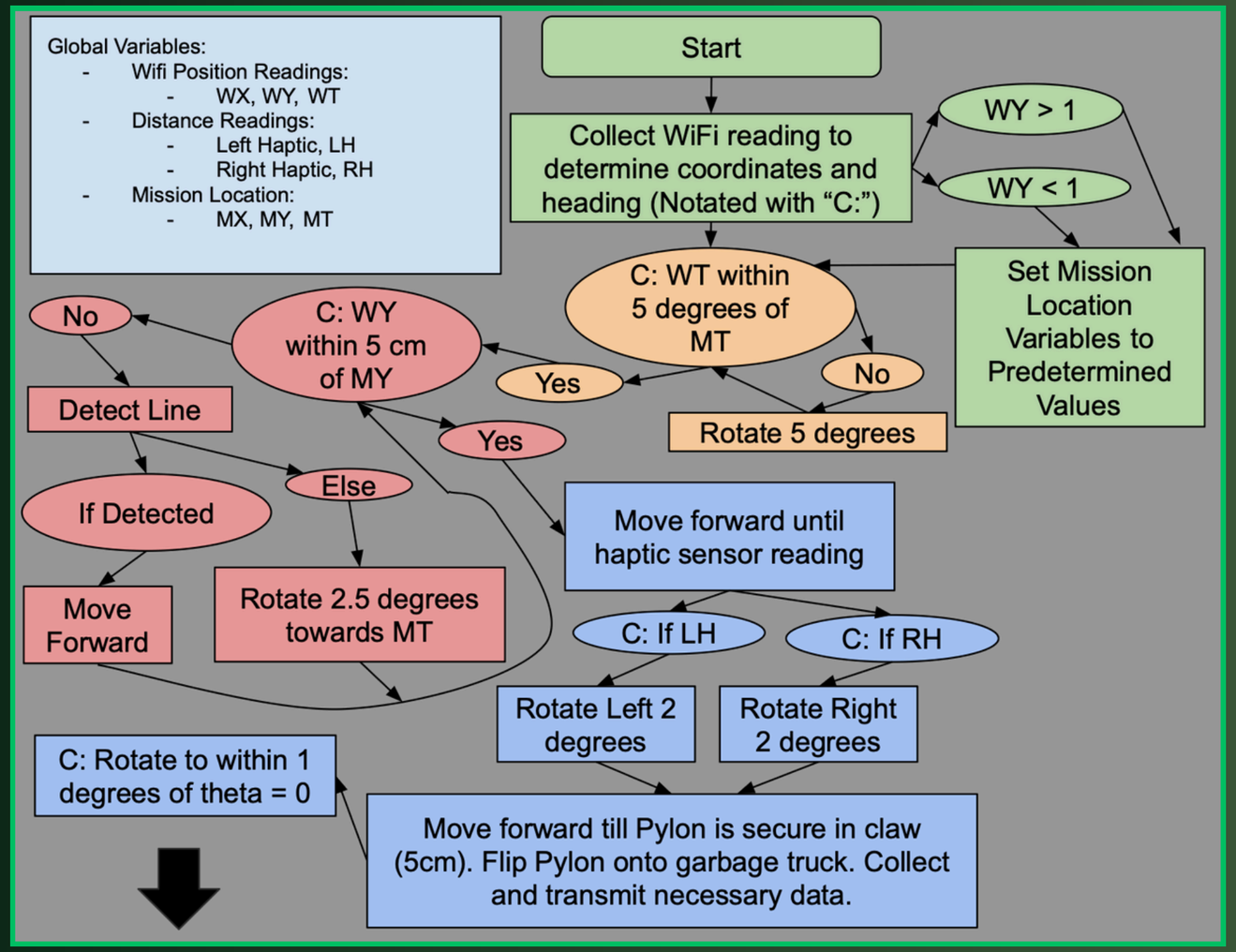

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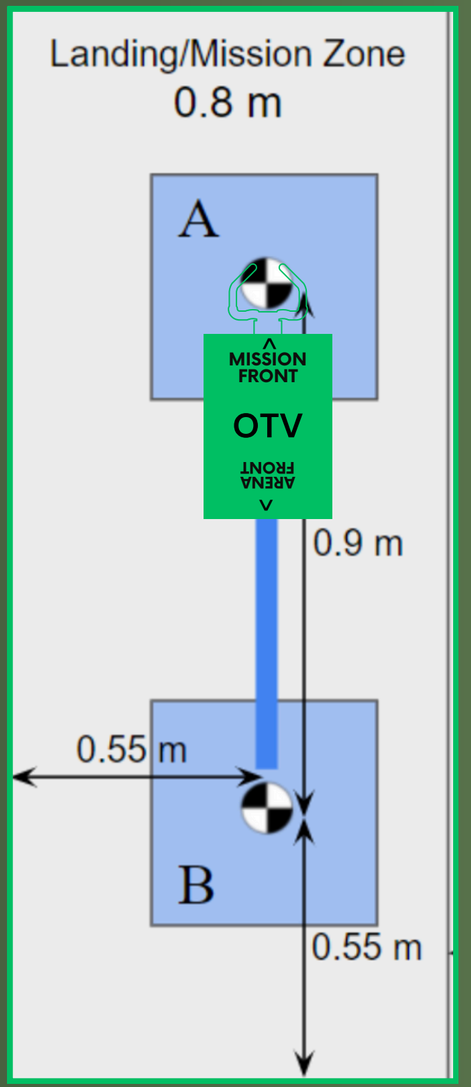

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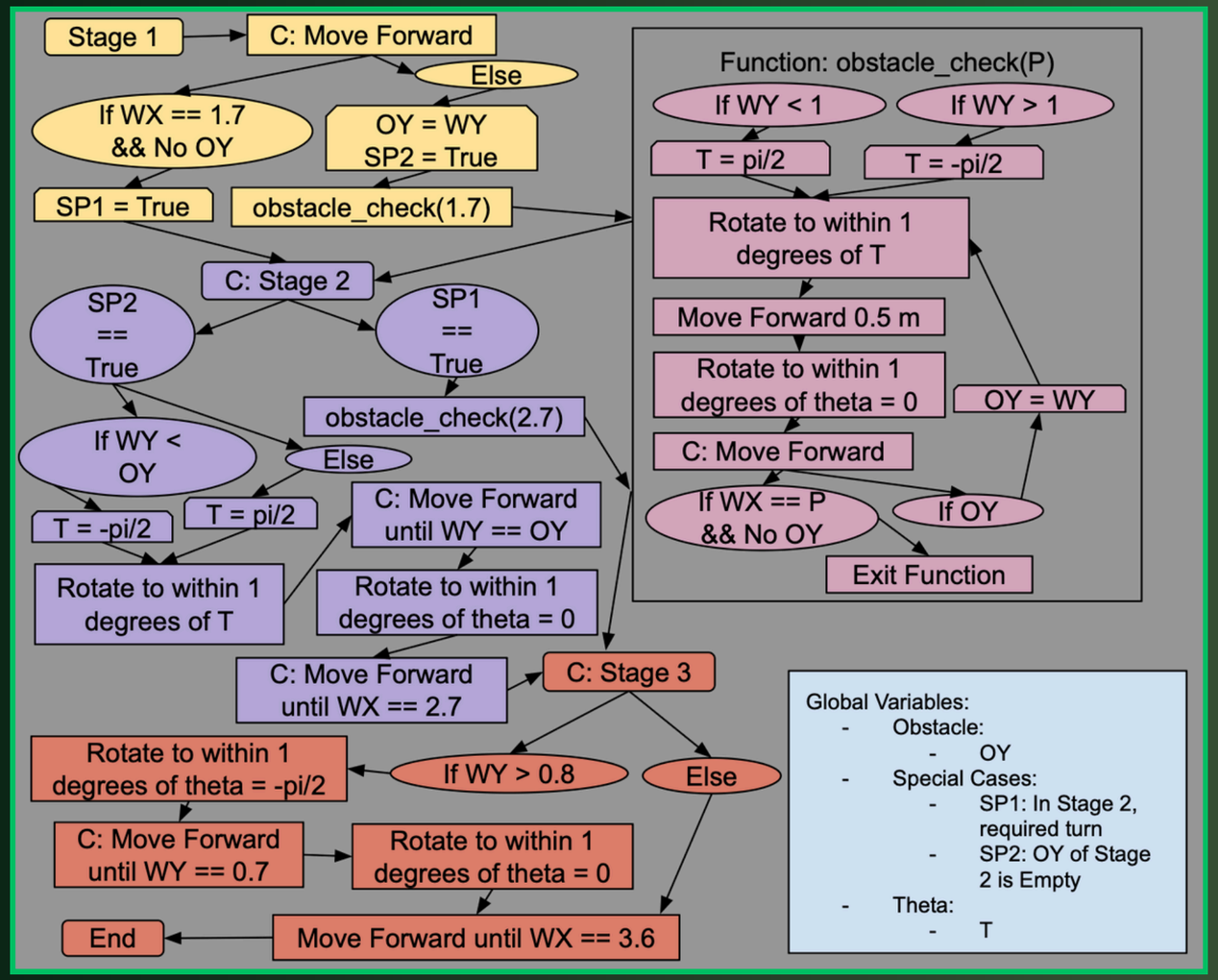
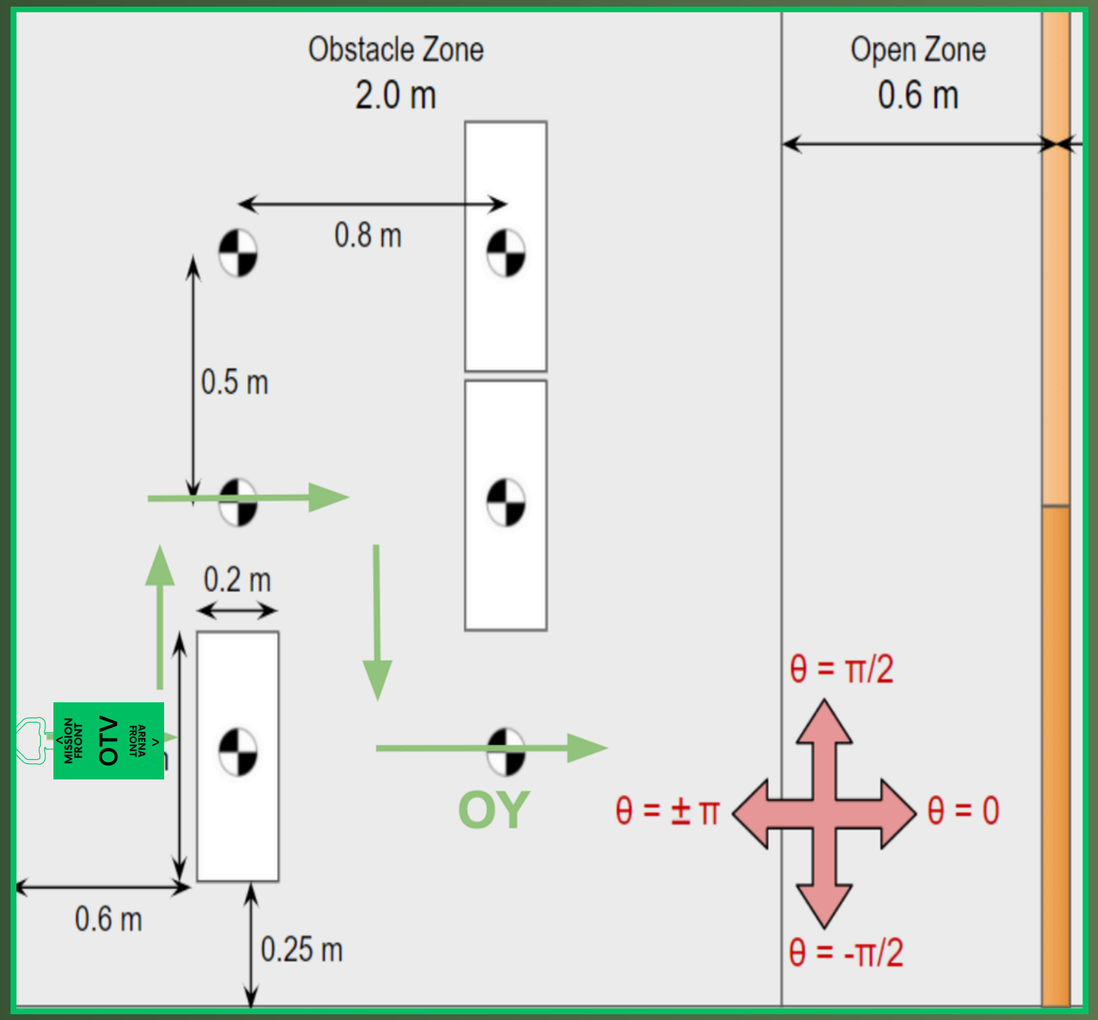
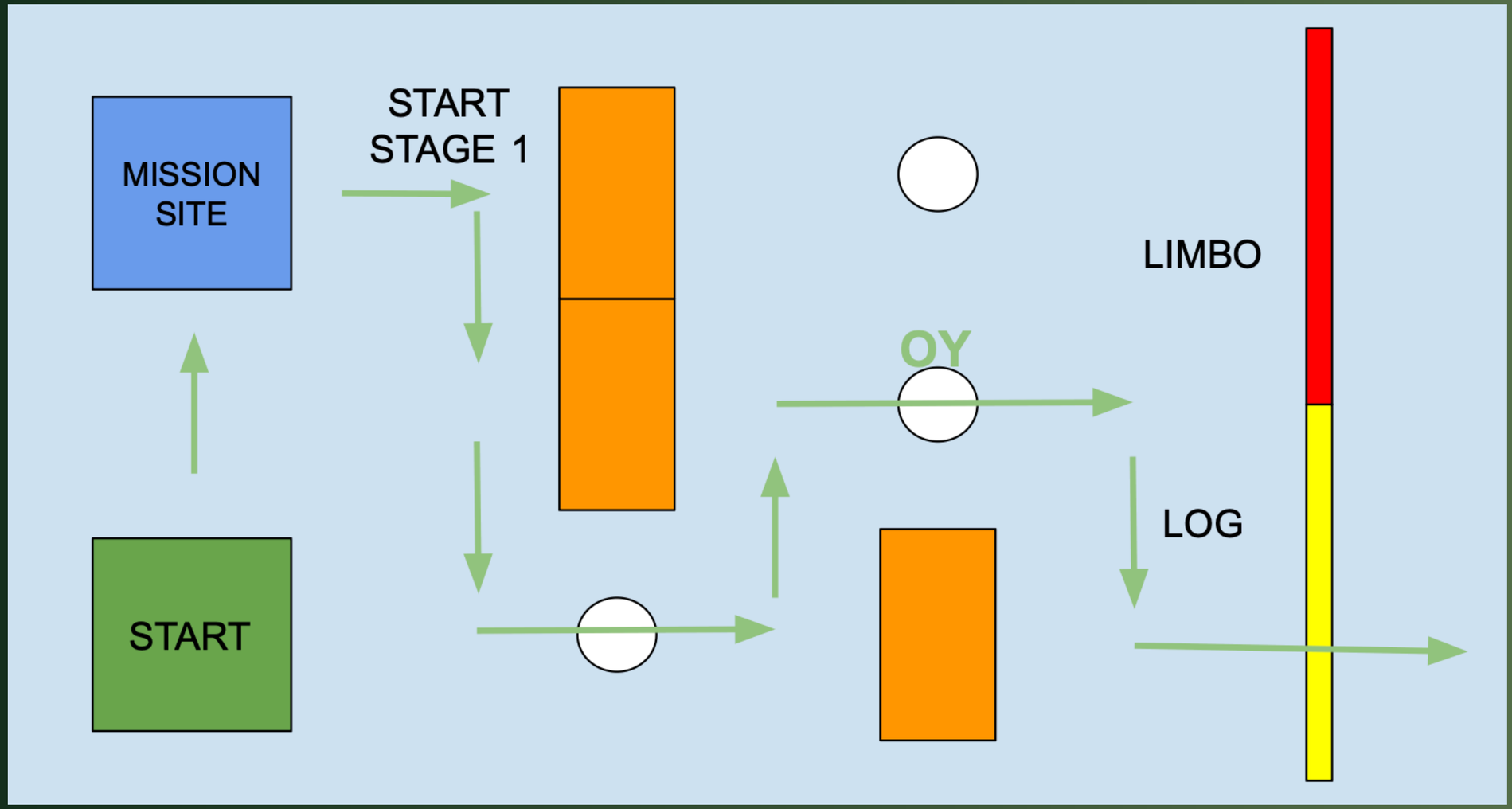




NAVIGATION EXAMPLE



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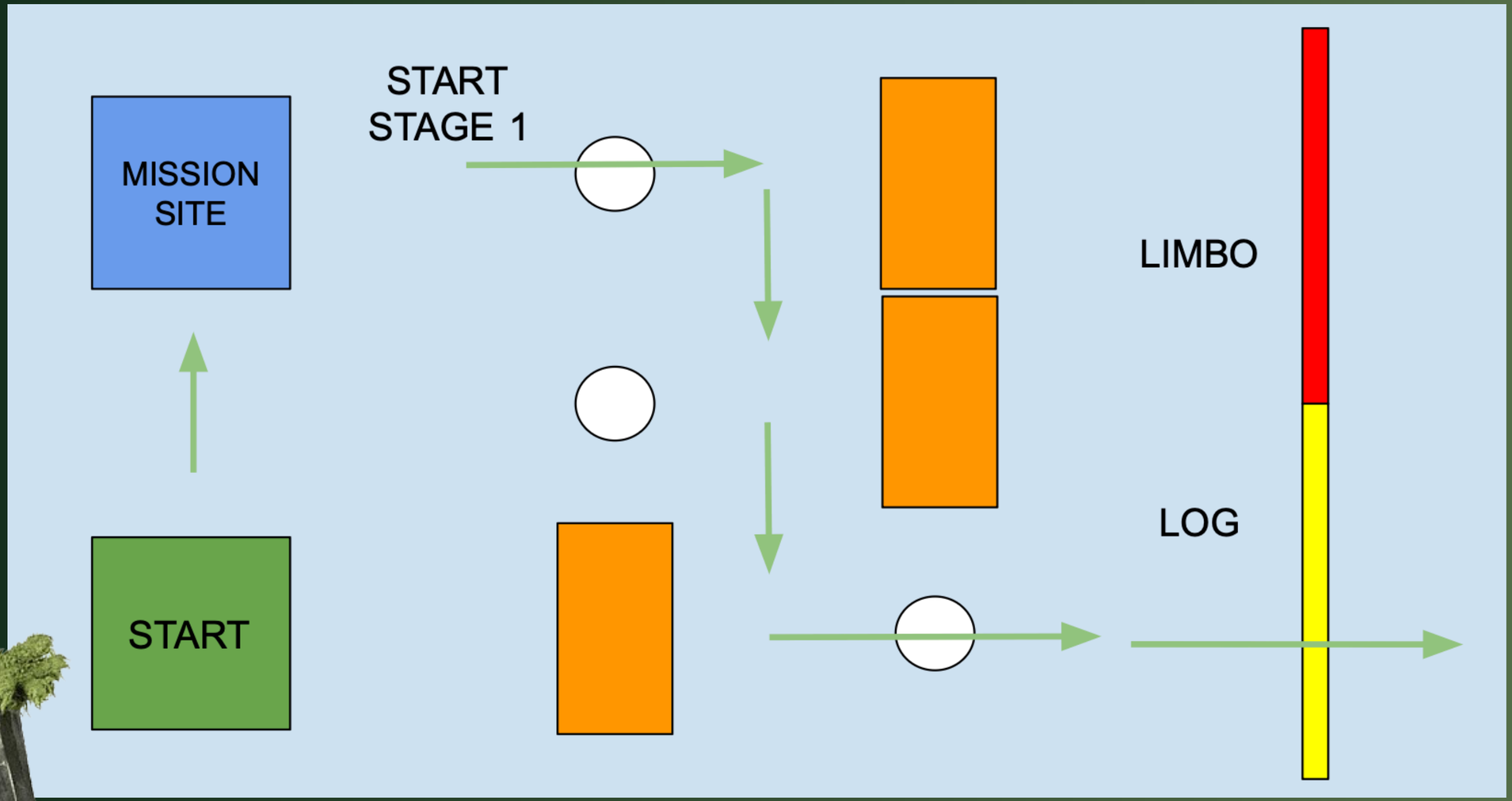

LINGERING QUESTIONS?

- Would haptic sensors be more accurate than distance sensors?
- Do you recommend using 2 motors for tank drive and connecting with chain rather than 4 individual motors?
- Could we use 2 motors and connect without a chain, and if so, how?
- Any recommendations for batteries?
- Would you recommend 3D printing wheels or buying them?
- Any tips on our approach for the mission task?

THANKS FOR LISTENING

BUDGET SHEET

Product	Amount	Cost [$]	Mass [kg]
Elegoo MEGA R3 ATmega 2560	1	$22.99	0.064
L293D DC Motor Drive Shield	1	$6.99	0.040
Electrical Components (Non-Battery)	N/A	$10.00	0.005
Batteries	4	$40.00	0.150
Greartisan DC 12V 15RPM Motors	4	$60.00	0.888
3D Print Wheels	4	$20.00	0.200
3D Print Spacers	8	$12.00	0.120
Recycled PLA	N/A	$100.00	1.000
3D Print Mission Task Components	N/A	$20.00	0.200

Total	
Cost	$301.93
Mass [kg]	2.687