

# Project 3

## Team 39

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# Abstract

- The MACRO must:
  - Navigate to specific sites
  - Recognize and avoid hazards
  - Deliver cargo in a timely manner
  - Transport cargo without dropping or tipping
- Must require little to no human interaction
- Efficient use of resources and safe operation

# Project Management - Metrics

Customer Need	Technical Need
Precise navigation to specific sites	Distance from target site
Recognition and handling hazards	Proportion of hazardous conditions that are avoided/otherwise successfully managed
Timely delivery of mission hardware	Time of delivery
Transporting cargo from location to location without dropping or tipping	Proportion of cargo that is successfully delivered
Speed restriction	Maximum speed

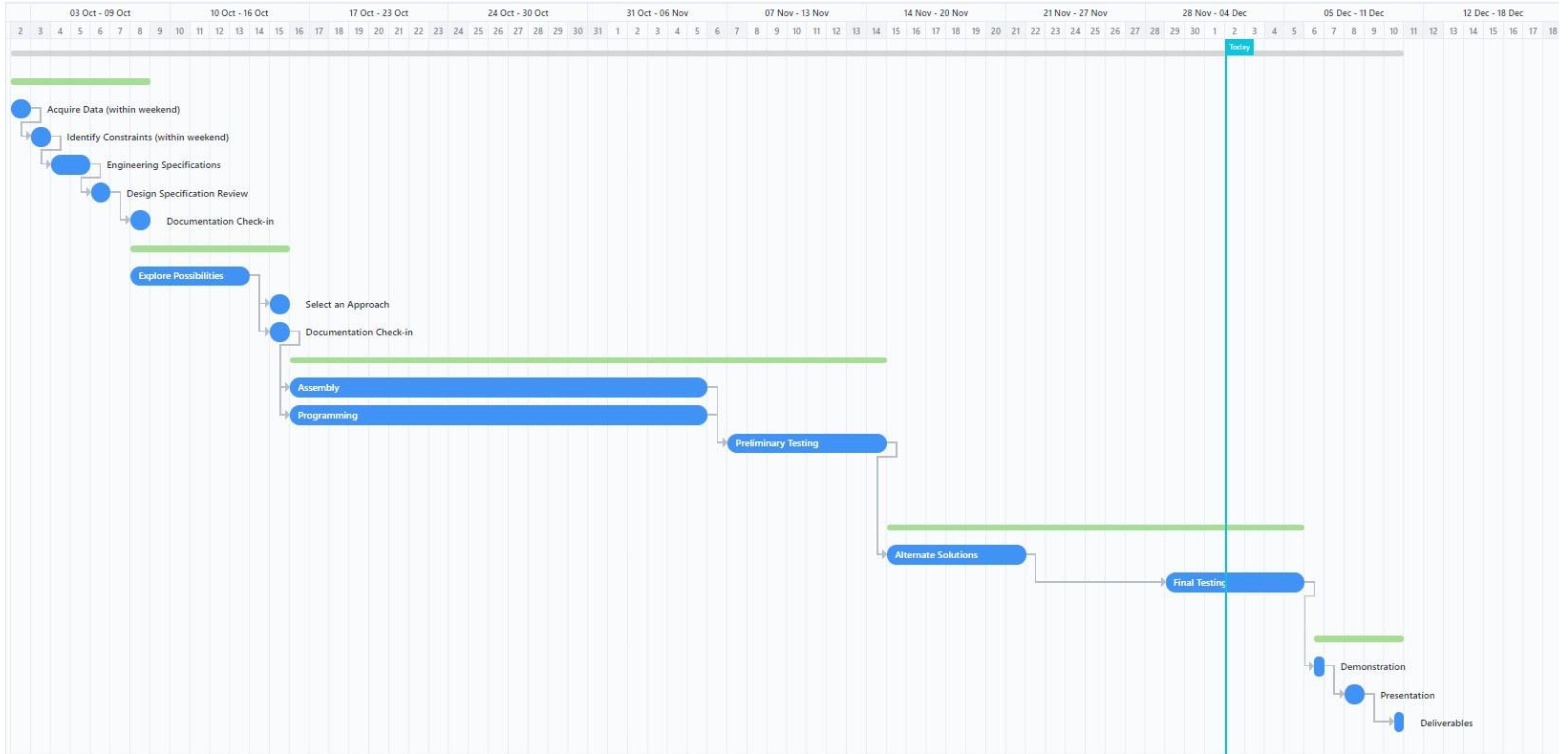
# Project Management - Metrics

Customer Need	Technical Need	Technical Requirement	Target Value
Does not drop cargo inappropriately	Proximity to target zone	Less than 6 cm	0 cm
Powerful motor	Maximum Axial Torque Output	20N*cm or greater	20 N*cm
Is able to make different size turns when necessary	Turning Radius	1.5 inches to 2.5 inches (3.81 cm to 6.35 cm)	2.0 inches (5.08 cm)
Transporting cargo from location to location without dropping or tipping	Max cargo dimensions (Area of base)	45.01 cm <sup>2</sup> to 127.68 cm <sup>2</sup>	127.68 cm <sup>2</sup>
Speed restriction	Maximum speed	15 cm/s to 30 cm/s	22.5 cm/s

# Project Management - Coordinating Work

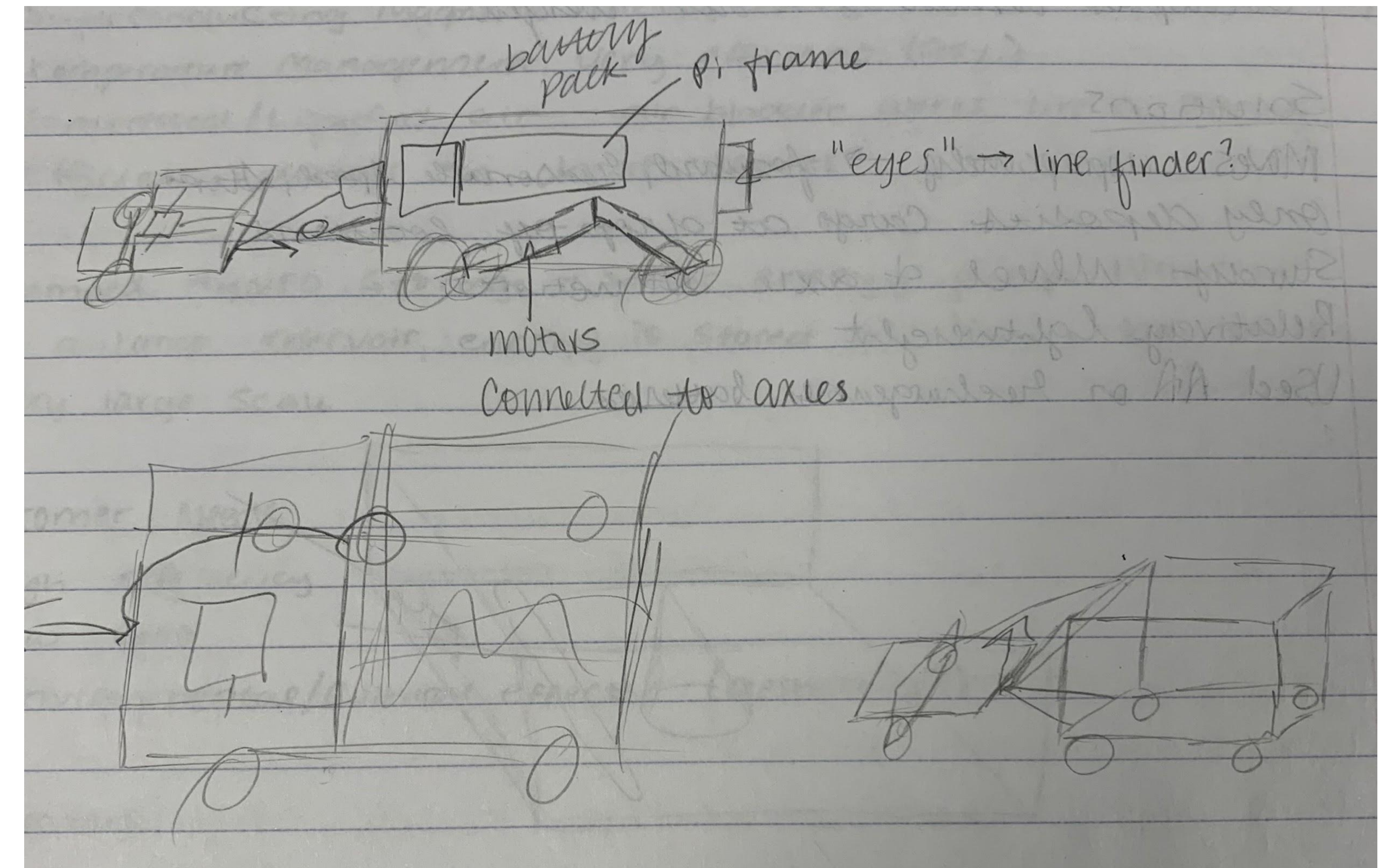
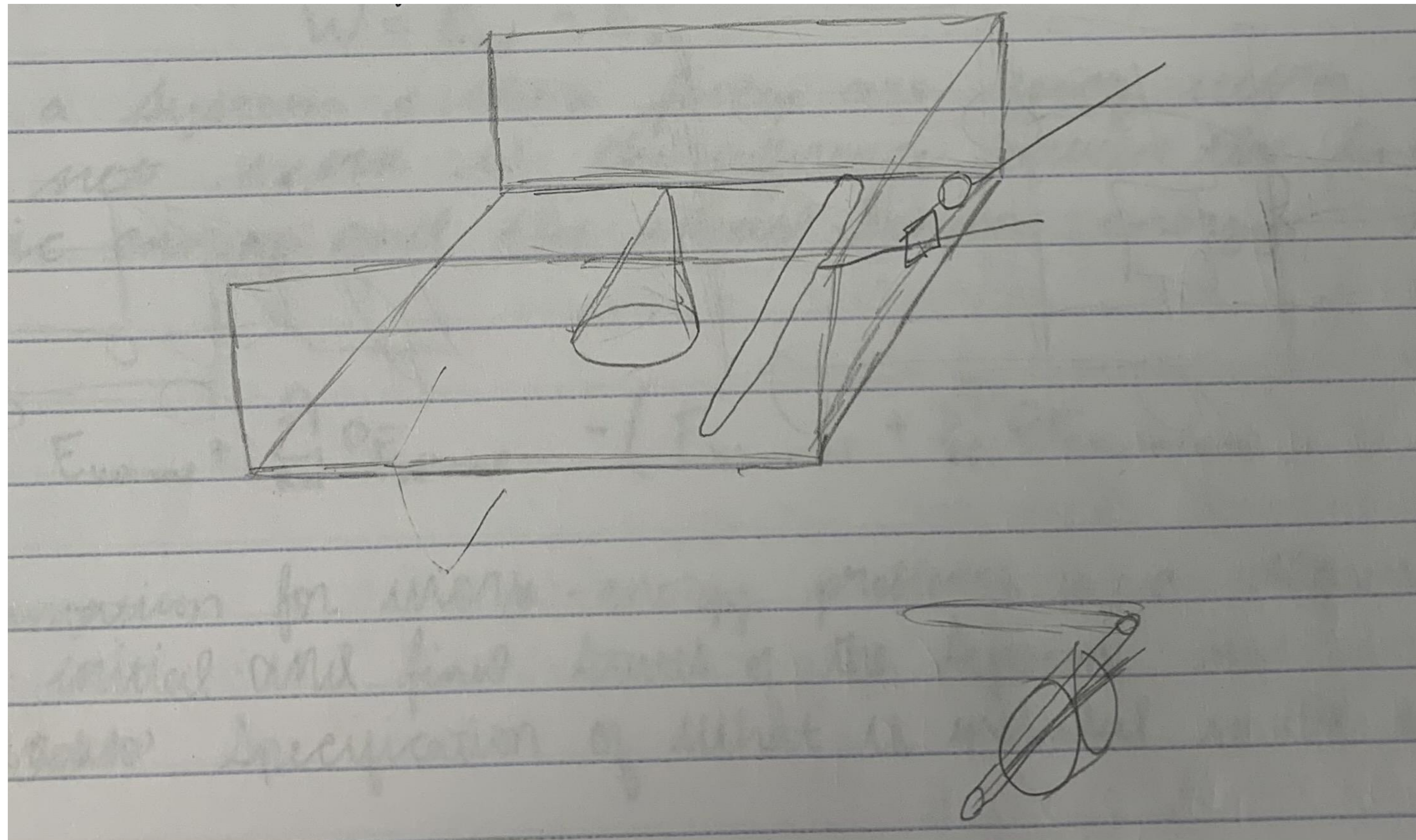
- Divided the group into two smaller teams
  - One was responsible for coding and testing
  - The other was responsible for building and documentation

# Project Management - Time Management

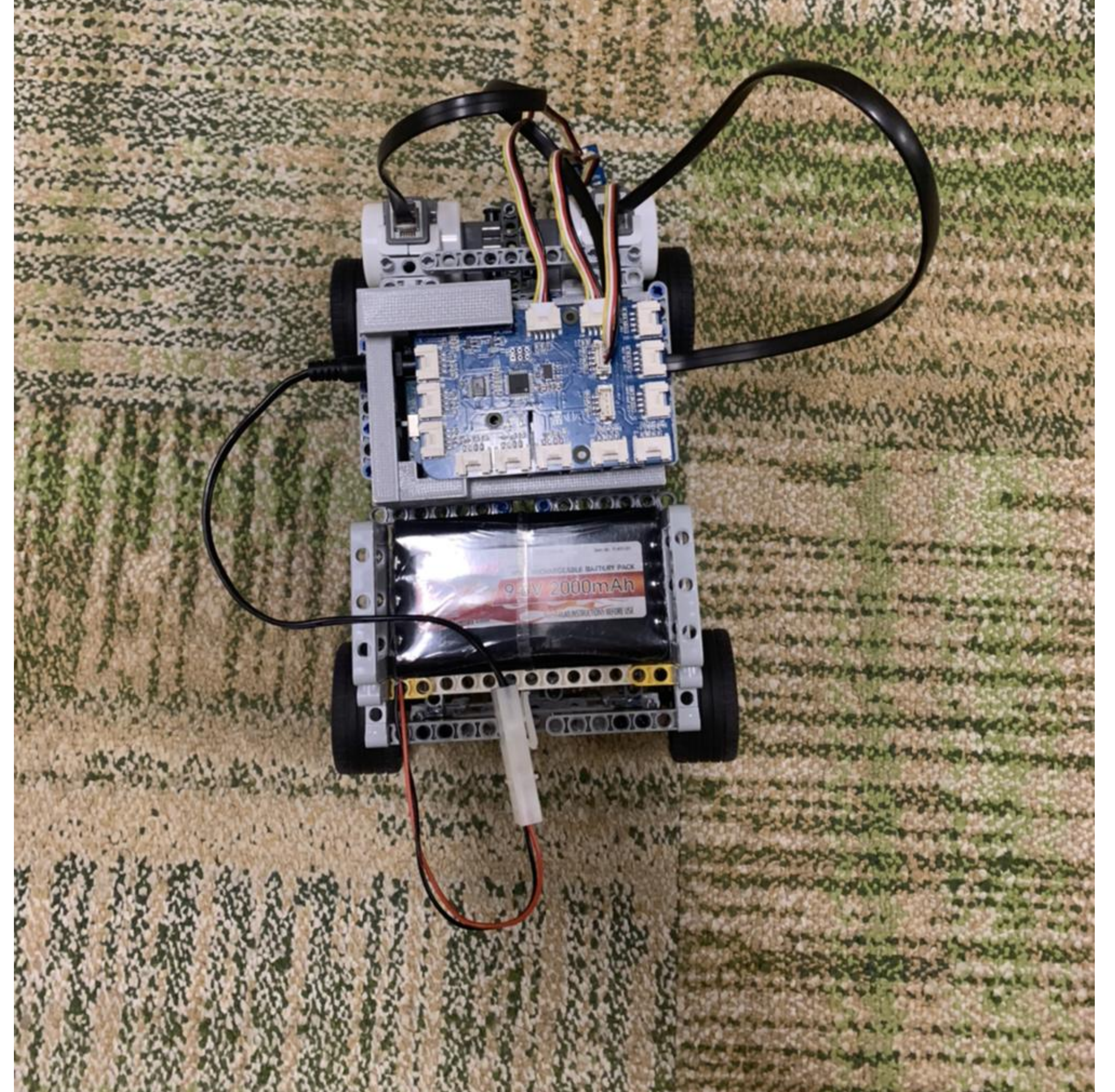
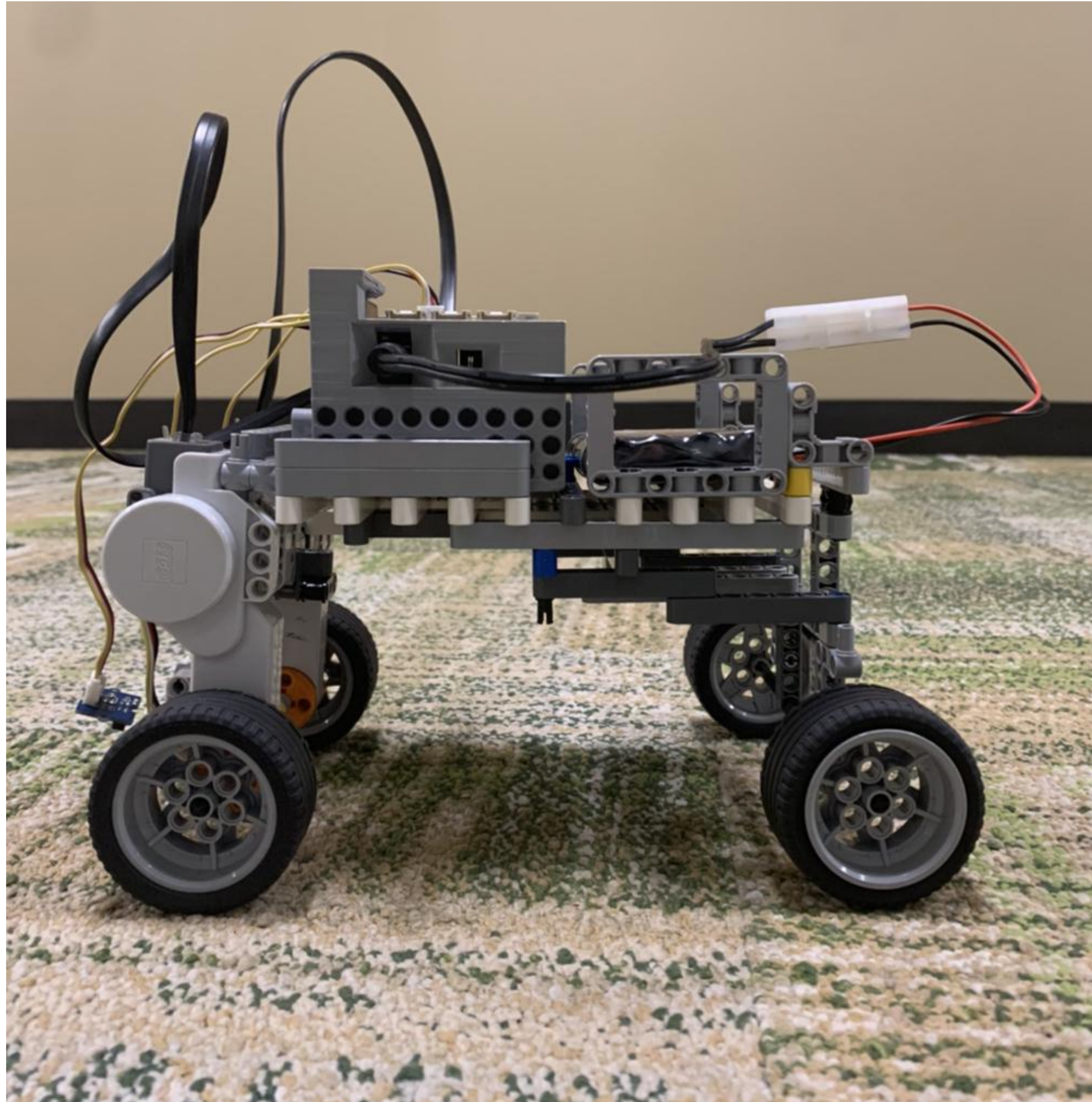


# Design Philosophy - Hardware

- The team began with basic sketches of our early ideas but transitioned quickly to hands-on building so we could begin testing code as soon as possible
- Four iterations of the trailer, two iterations of the main body



# First Iteration MACRO



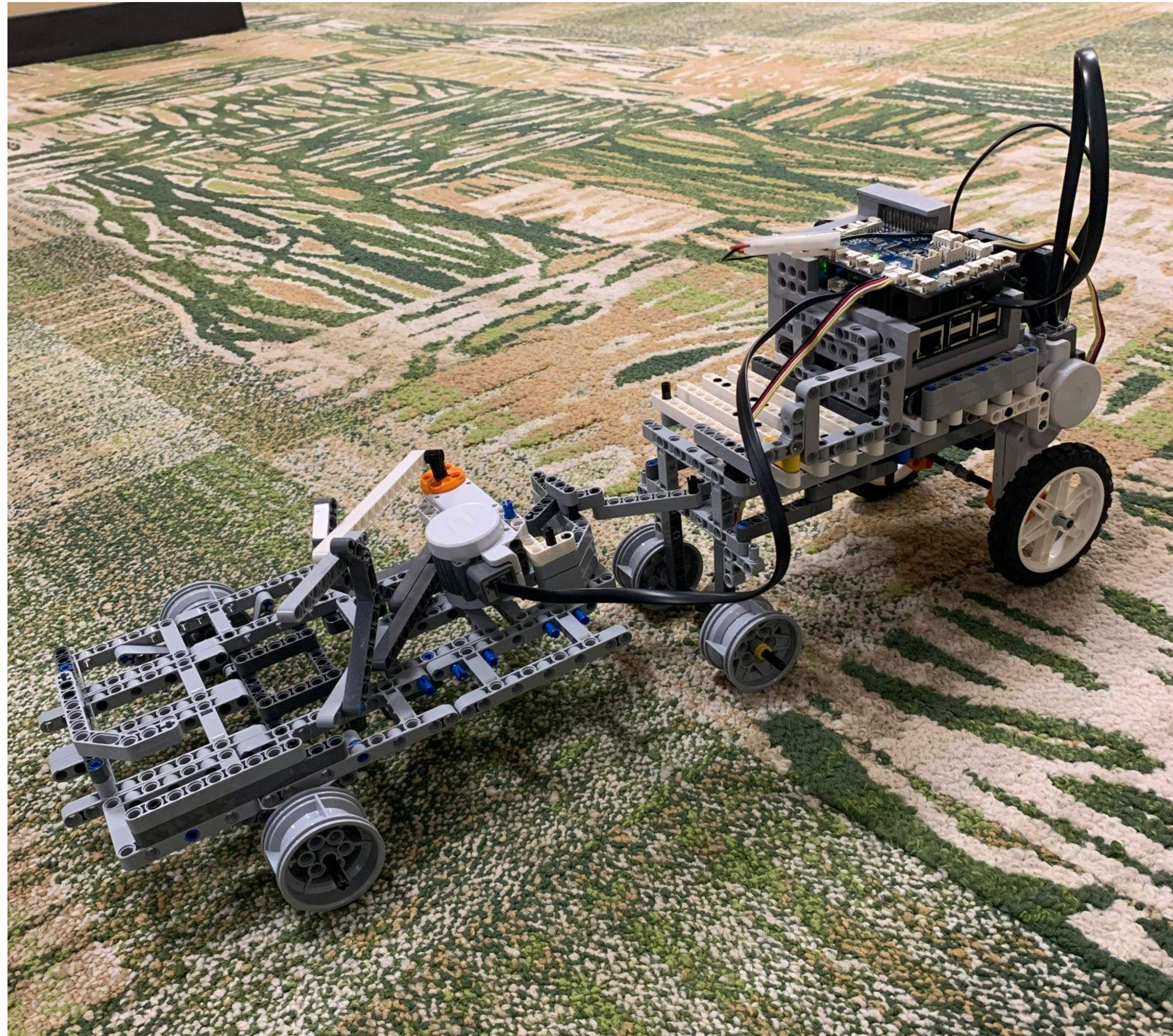


# Trailer

- First iteration trailer was far too small for any cargo and could not move smoothly through turns
  - The team had to redesign the trailer several times to fit the cargo

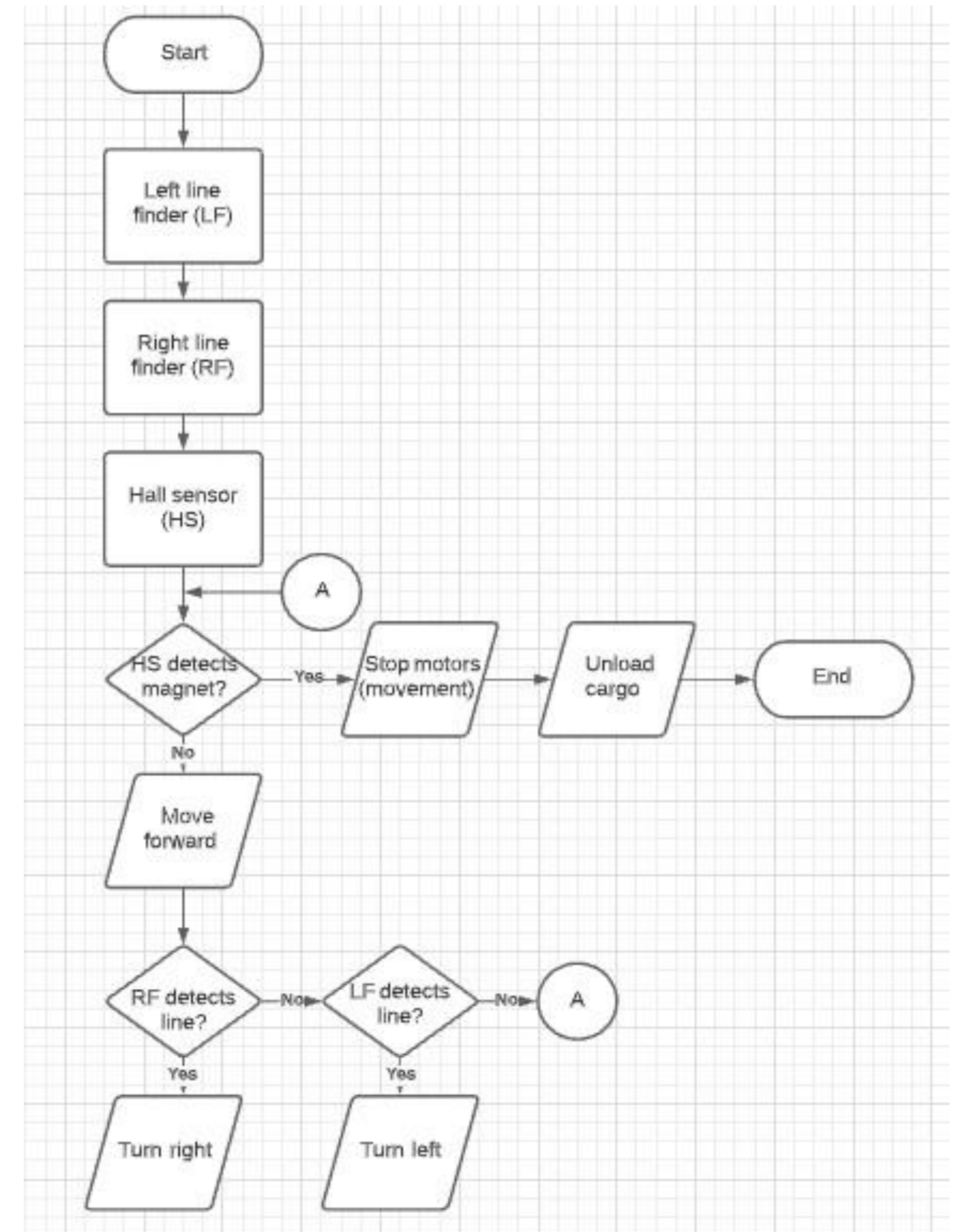


# Final MACRO



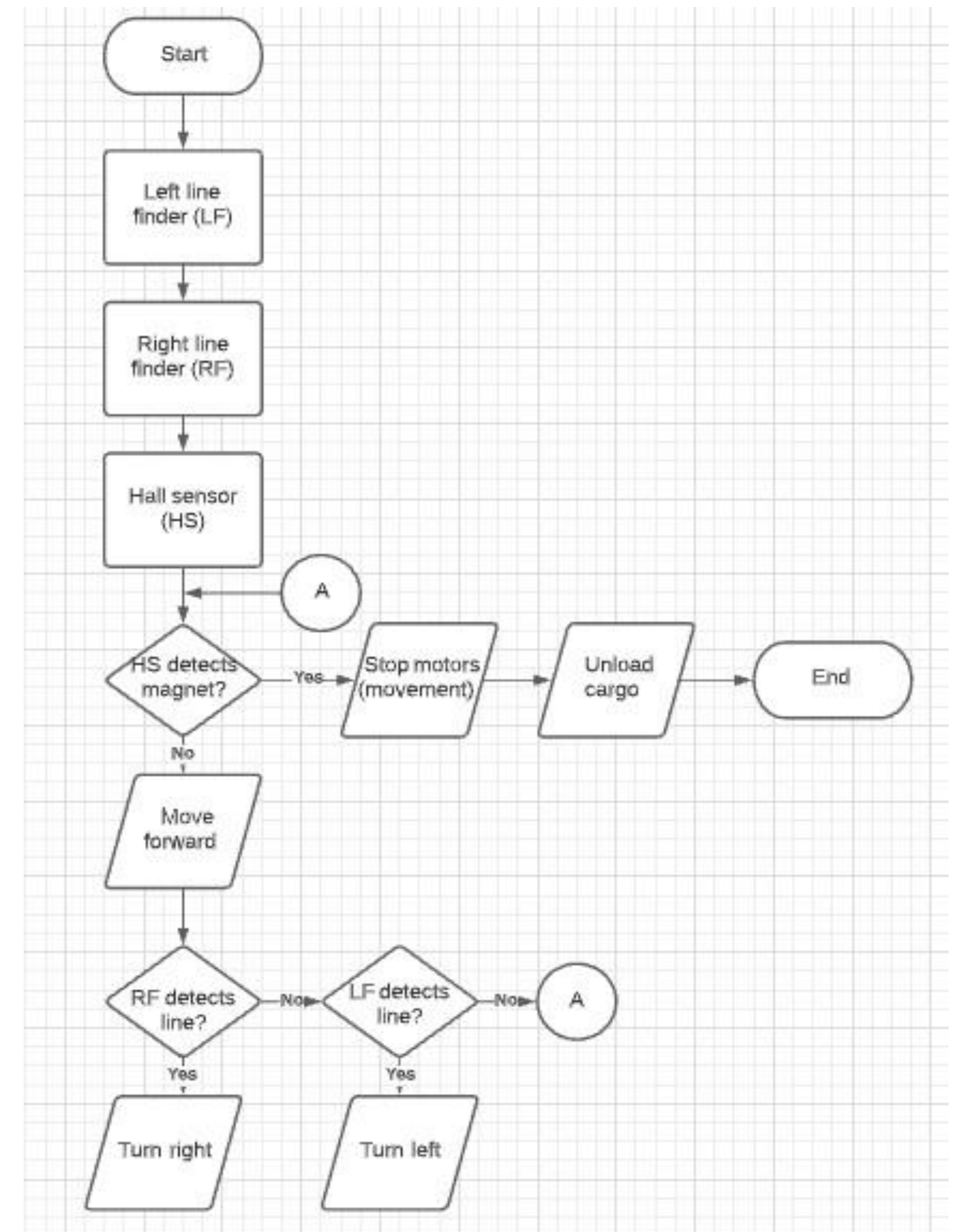
# Design Philosophy - Software

- Turning
  - Dual line finder setup
  - Contra-rotating wheels
  - Reversing before turn
  - Slow-speed turn loop
- Hill
  - High motor speed



# Design Philosophy - Software (Cont.)

- Obstacles
  - High motor speed
- Drop Off
  - Hall sensor
  - Trailer arm motor



```
while True:
    try:
        t_end = time.time() + 10
        if (grovepi.digitalRead(line_finder_r) == 1) and (grovepi.digitalRead(line_finder_l) == 0) or (grovepi.digitalRead(line_finder_r) == 0) and (grovepi.digitalRead(line_finder_l) == 1):
            while time.time() < t_end:
                if (grovepi.digitalRead(line_finder_r) == 1) and (grovepi.digitalRead(line_finder_l) == 1):
                    BP.set_motor_power(BP.PORT_A, 30)#50
                    BP.set_motor_power(BP.PORT_B, 30)#50

                if (grovepi.digitalRead(line_finder_r) == 1) and (grovepi.digitalRead(line_finder_l) == 0):
                    BP.set_motor_power(BP.PORT_A , -10)#-30
                    BP.set_motor_power(BP.PORT_B, -10)#-30
                    time.sleep(.3)
                    BP.set_motor_power(BP.PORT_A, 50)#50,40
                    BP.set_motor_power(BP.PORT_B, -20)#-20
                    time.sleep(.5)

                if (grovepi.digitalRead(line_finder_r) == 0) and (grovepi.digitalRead(line_finder_l) == 1):
                    BP.set_motor_power(BP.PORT_A , -10)#-30
                    BP.set_motor_power(BP.PORT_B, -10)#-30
                    time.sleep(.3)
                    BP.set_motor_power(BP.PORT_A, -20)#-20
                    BP.set_motor_power(BP.PORT_B, 50)#50,40
                    time.sleep(.5)

                if (grovepi.digitalRead(line_finder_r) == 0) and (grovepi.digitalRead(line_finder_l) == 0):
                    BP.set_motor_power(BP.PORT_A, 30)#50
                    BP.set_motor_power(BP.PORT_B, 30)#50
                    #time.sleep(.1)

                if (grovepi.digitalRead(hall) == 1):
                    #print(grovepi.analogRead(hall))
                    BP.set_motor_power(BP.PORT_A, 0)
                    BP.set_motor_power(BP.PORT_B, 0)
                    time.sleep(3)
                    BP.set_motor_power(BP.PORT_D, 50)
                    time.sleep(.35)
                    BP.set_motor_power(BP.PORT_D, 0)
                    time.sleep(600)
```

# Positive Attributes

- Taller wheels, allows for easier navigation over small obstacles instead of needing to go around
- Relatively lightweight, making turning easier
- Front wheel drive keeps the macro from tipping when navigating hills
- Trailer design allows for easy adaptation to different shapes of cargo (through testing)

# Negative Attributes

- Trailer is bulky and hinders turning over hills and obstacles
- Wheels are not the ideal size
  - Rubber on wheels tends to slide off and slip, causing the macro to get stuck
- Hall sensor dangles underneath main frame
- Cart length is unnecessarily long
  - Unused space at the back of the main body





# Areas for Improvement

- Trailer is bulky and hinders turning
  - Include wheels that pivot rather than dragging the trailer or have one body
- Wheels are not the ideal size
  - Use different wheels on the front
- Hall sensor dangles underneath main frame
  - Mount a sensor frame beneath the main body of the MACRO
- Too long
  - Remove unused space at the back of the main body