Automated Driveway Salt Dispenser

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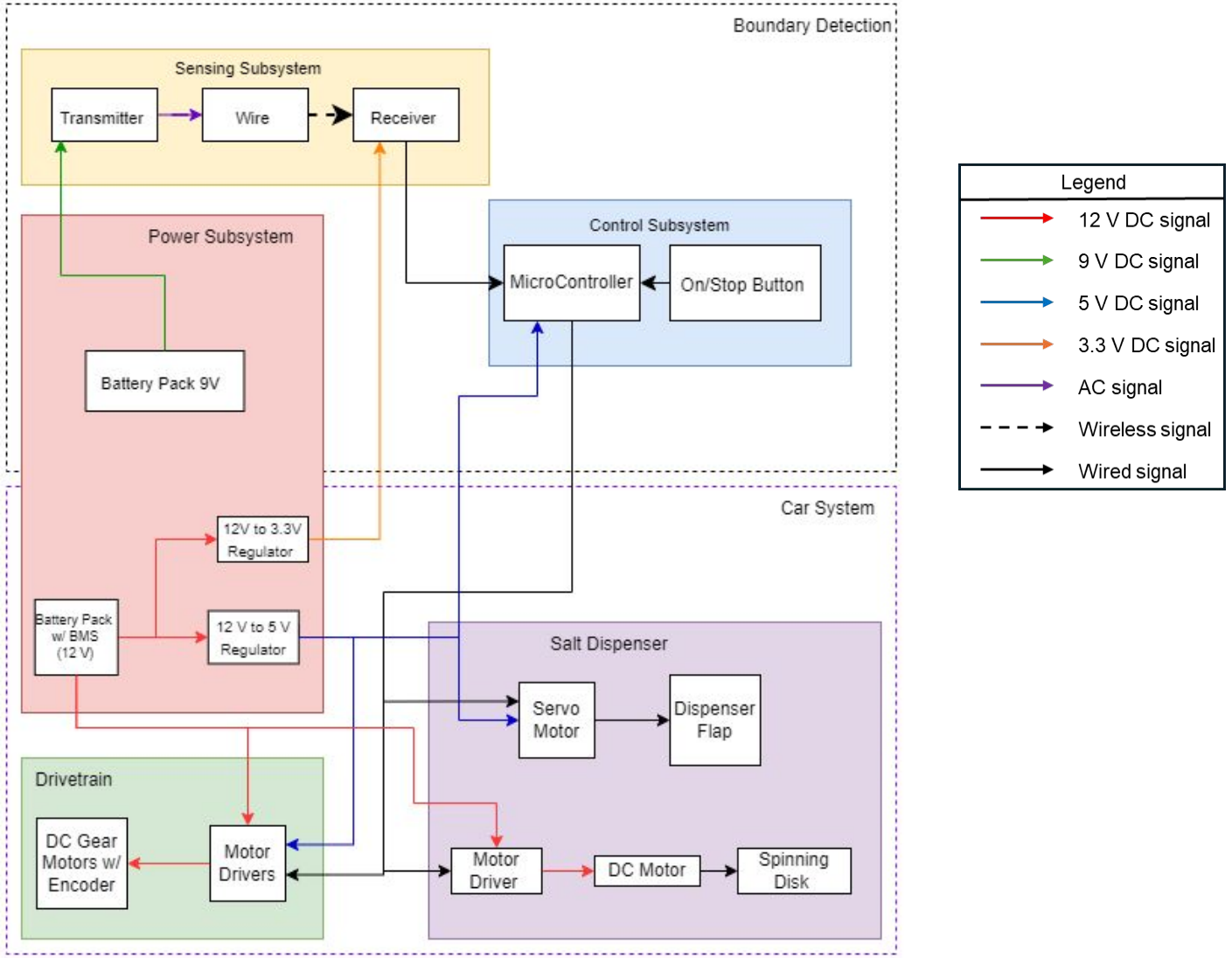
Objective

- Fully autonomous salt dispenser car that would distribute salt evenly across a driveway.

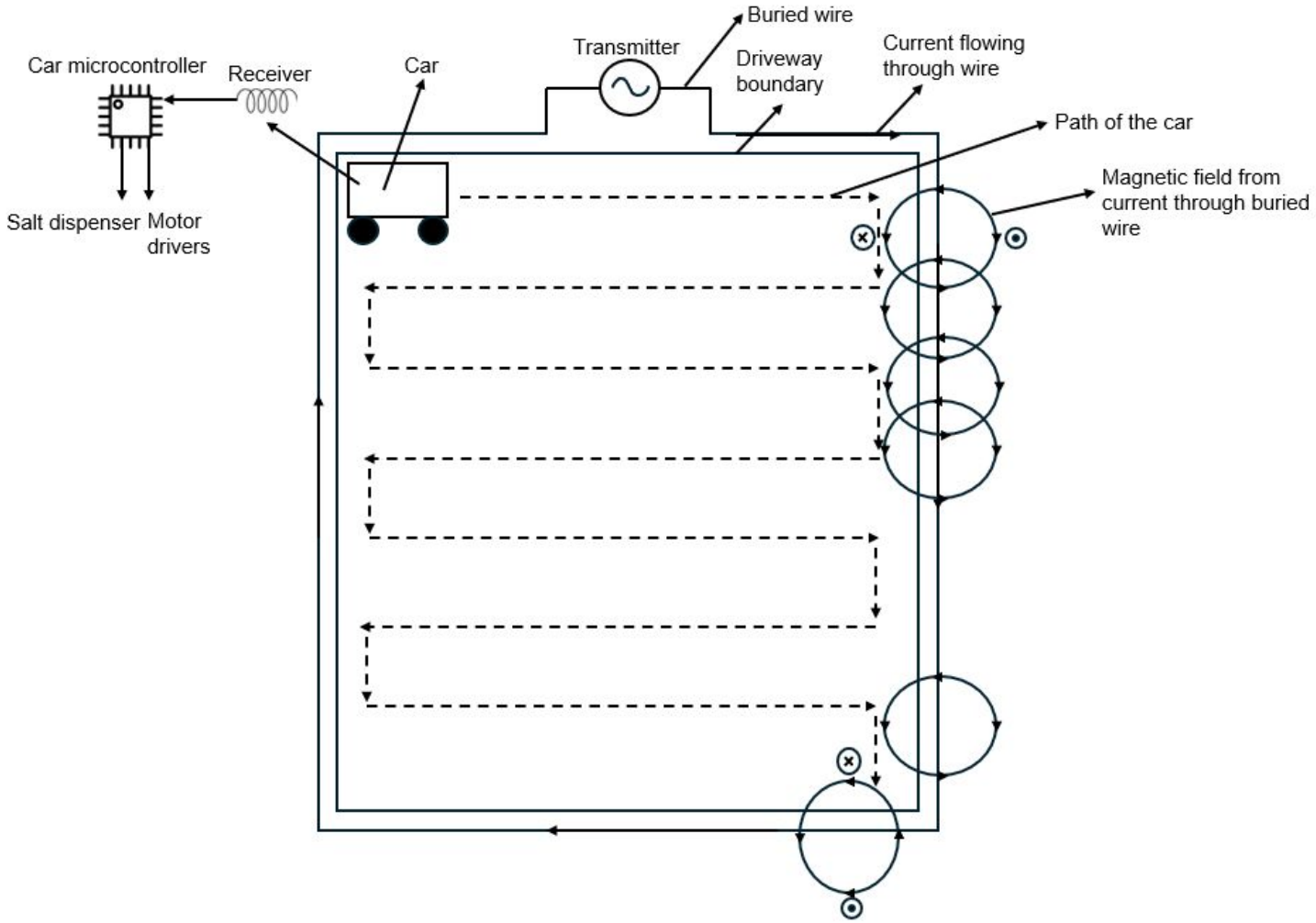
- High Level Requirements:

    1. The robot is able to distribute the salt onto a 2m x 2m driveway in under 10 minutes.
    2. The robot is able to detect the edge of the driveway within 10 inches of the edge.
    3. The robot is able to come to a complete stop once it has reached the end of the driveway in under 10 seconds.

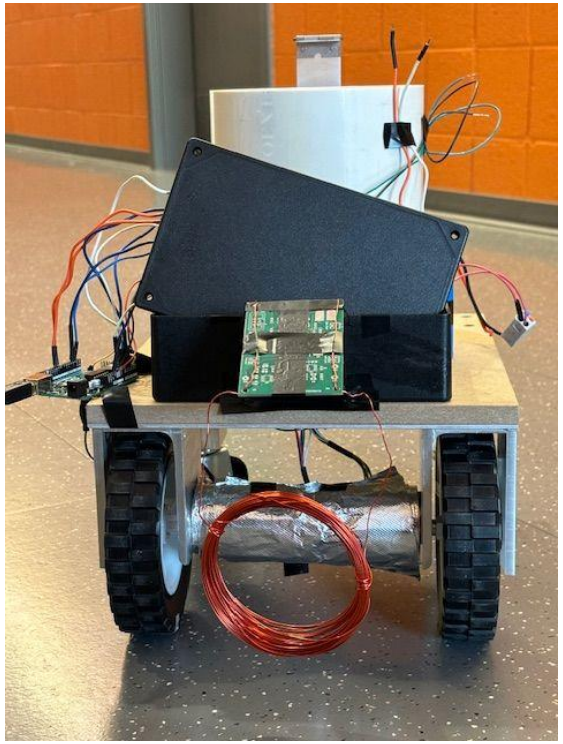
Original Design

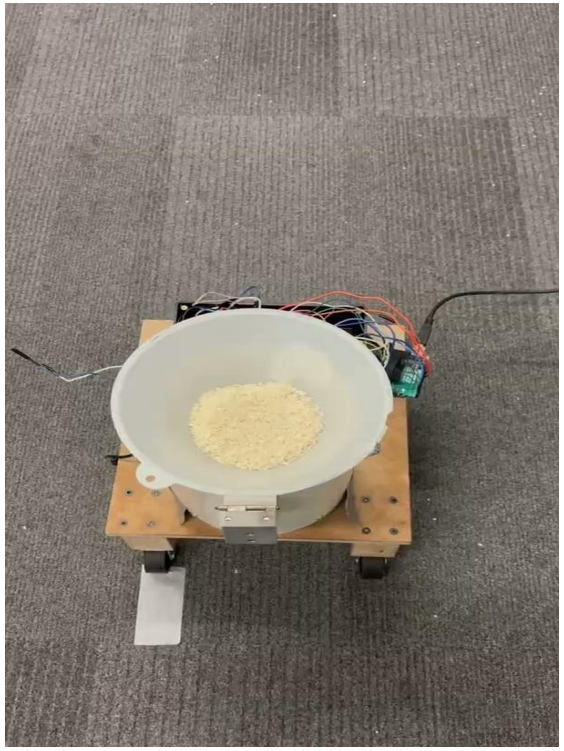


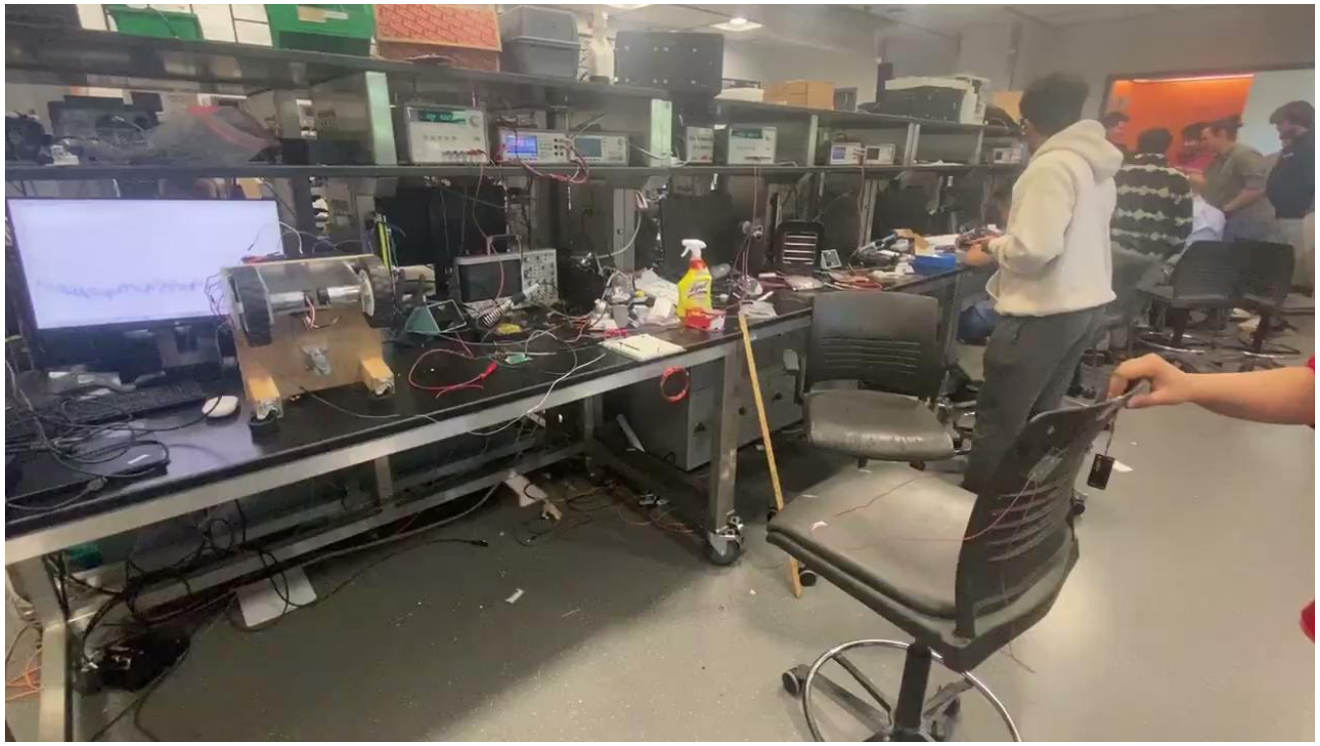
Original Design



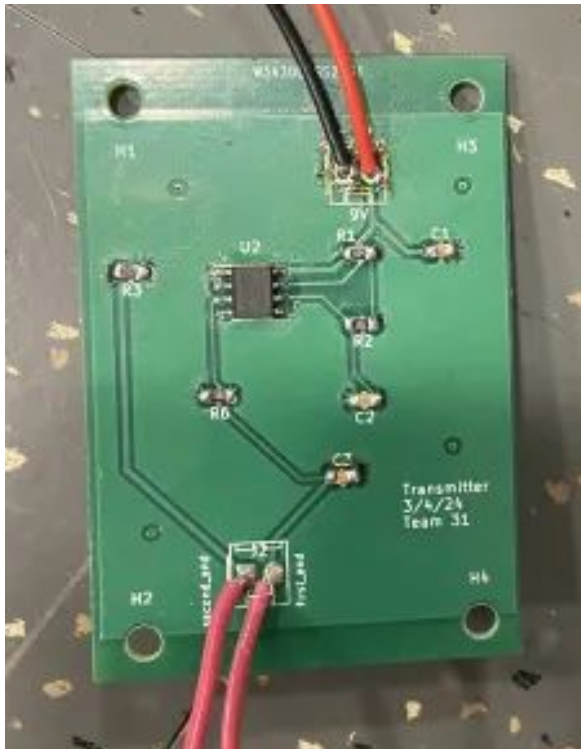
Project Build







PCB Design



Transmitter Board used in the sensing demo

Receiver Board used in the sensing demo

Final Receiver Board

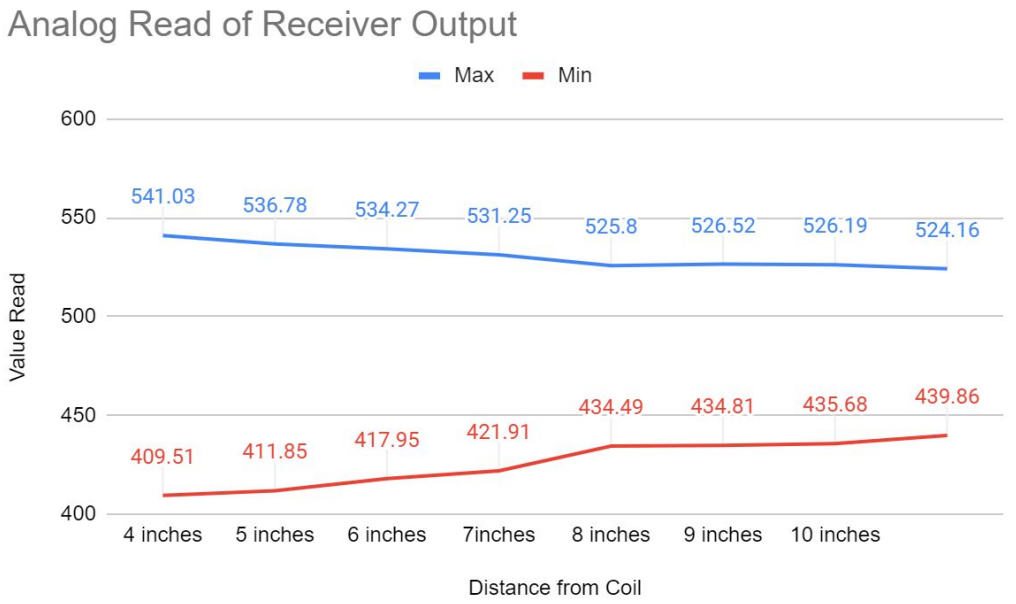
Sensing R&V

Requirements:

1. Transmitter is able to output a sinusoidal wave between 9V and 0V
2. Receiver is able to output a sinusoidal signal between 0V and 3.3V to the microcontroller

Yellow: Receiver output with Pk-Pk of 1.51V

Green: Transmitter output with Pk-Pk of 7.0 V



Arduino analog reading of the receiver output

Challenges/ Successes: Sensing

Challenges:

- Induced voltage from the receiver was very low.
- Interference from the DC wheel motors.

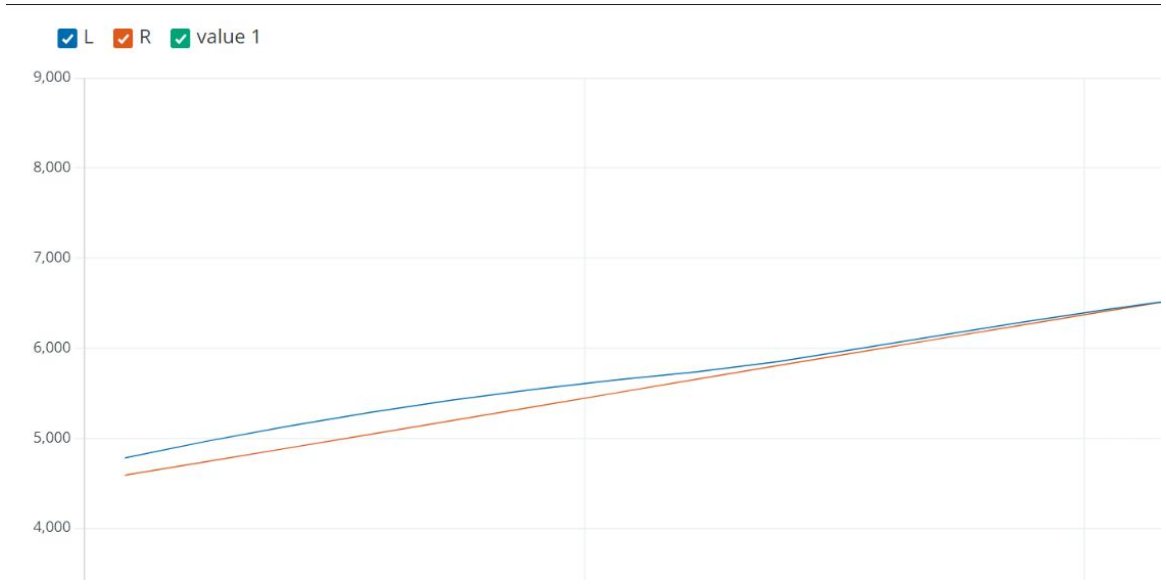
Successes:

- Increased amplification of induced voltage by increasing gain and using 12V battery to power transmitter instead of 9V.
- Detection of the transmitter by the receiver about 6 to 8 inches away resulted in wheel motors to stop moving.

DriveTrain R&V

Requirements:

1. The DC gear motors for the front two wheels will travel at the same rpm.
2. Car should turn 90 +/- 5 degrees once it reaches the edge of the driveway.
3. Car should move 6+/- 2 inches forward before turning again.



Blue: Left wheel encoder pulse count Orange: Right wheel encoder pulse count

Right Turning Sequence: Straight -> 90 degree Right -> Straight -> 90 Degree Right ->Straight

Challenges/ Successes: DriveTrain

Challenges:

- PID on Atmega
  - Servo Library
- Connected STBY pin on Dual motor driver to GND
- Making turns be exactly 90 degrees
- Turns/ straights looked different when power was at a different level

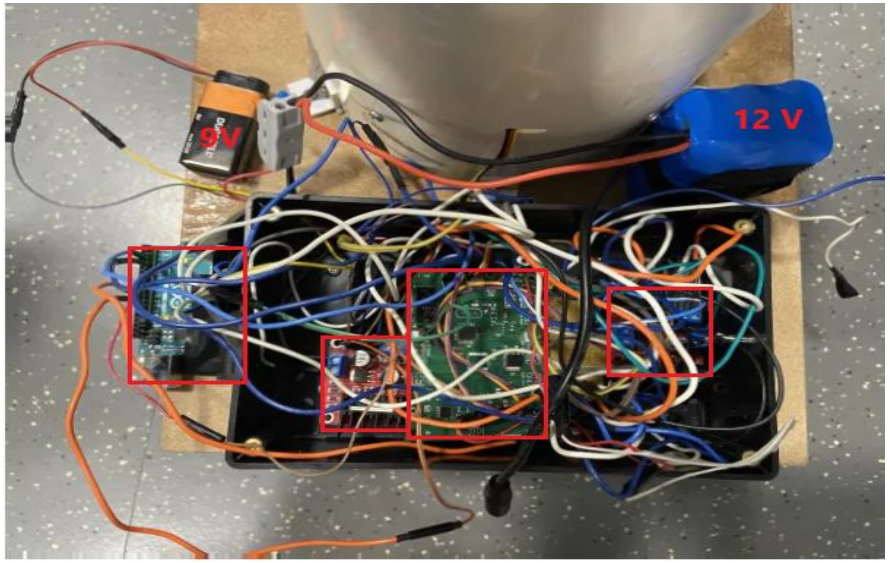
Successes:

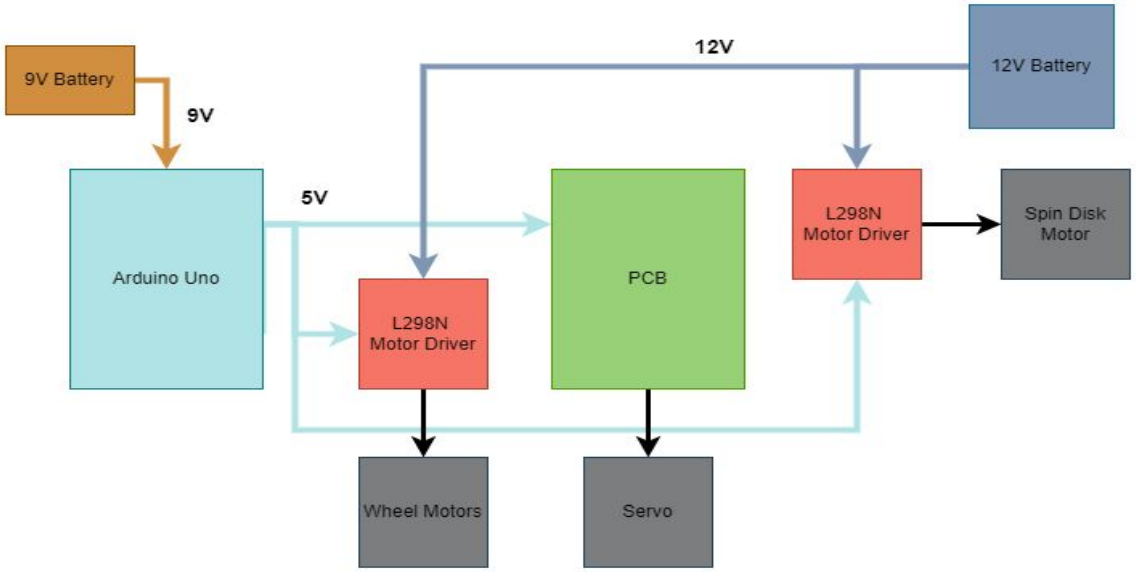
- PID control system working on Arduino
- The wheels were able to move when attached to the PCB

Power R&V

Requirements:

1. Voltage supply of 12V with 10% error to power DC motors.
2. Voltage supply of 4.8V to 6V to power servo motor.
3. Voltage supply of 2.7V to 5.5V for motor drivers.
4. Voltage supply of 2.7V to 5.5V to power ATmega328p microcontroller.
5. Voltage supply of of 9V to the transmitter
6. Voltage supply of of 3.3V to the receiver





Power connections

Challenges/ Successes: Power

Challenges:

- Wrong 5V converter
- Spinning Disk Motor Driver (L9110) powered at max voltage supply
- 9V battery for the Arduino draining fast
- 12V battery losing charge changed how much the car would turn

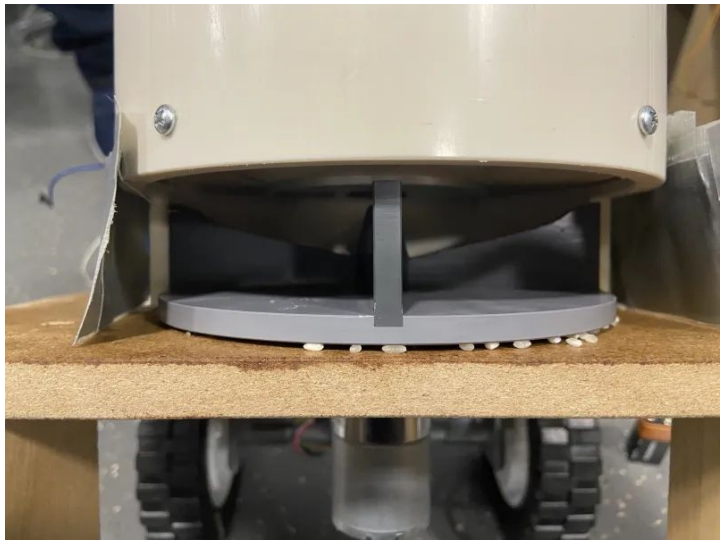
Successes:

- All subsystems were functional at the power supply provided

Salt Dispensing R&V

Requirements:

1. Servo motor must turn 90 +/- 5 degrees to open and close the dispenser flap.
2. Servo motor must close automatically once the car has travelled throughout the entire driveway.
3. Servo motor must close if on/off button has been pressed a second time.
4. Spinning disk must rotate.



Close up on the spinning disk

Closed and open state of the dispenser flap

Challenges/ Successes: Salt Dispensing

Challenges:

- Salt would get stuck in the spinning wheel and affect the motion of the wheels
- Upon startup the cars state would toggle between on and off and start in the on position when it should start in the off position
  - We had to have the initial state be on so it would start as off
- Programming the servo flap to open partially to better control the amount of salt falling down

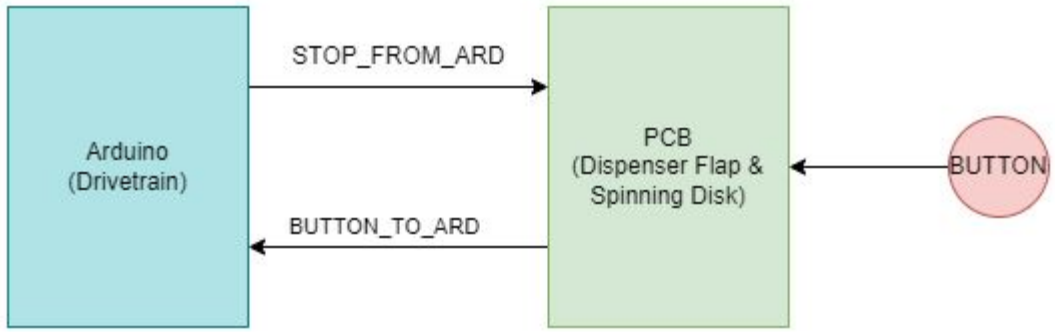
Successes:

- Dispenser flap opened using servo motor once on/off button was pressed.
- Spinning disk started turning once on/off button was pressed.
- Dispenser flap closed and spinning disk stopped turning through automatic stop or if on/off button was pressed a second time.

Control R&V

Requirements:

1. Initial press of on/off button must start the car and begin dispensing the salt.
2. Second press of on/off button must stop the car, spinning disk, and close the dispenser flap.
3. The car should automatically stop moving, spinning disk should stop turning, and the dispenser flap should close once the car has completed traveling throughout the entire driveway.



Challenges/ Successes: Control

Challenges:

- Communication between Atmega and Arduino (for drivetrain)
- On/Off Button wouldn’t work with low voltage

Successes:

- We were able to get the Atmega programmed
- Start and stop control worked as expected

Conclusion

- Learned a lot about **microcontrollers** and how thorough you have to be with your design when you choose pins for specific applications
- Learned about how important **power** requirements are
- Learned about how to control **motors** with encoders

- What we would do differently
  - focus more on the integration of the subsystems, especially during the initial design
  - give the machine shop our design requirements earlier
  - be more thorough with our PCB design (pin connections, footprints, power requirements)

Further Work

- Reduce noise interference from DC wheel motors with the sensing subsystem.
- Look into different ways to detect the edge of the driveway
- Add wheels with grip for traction when icy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