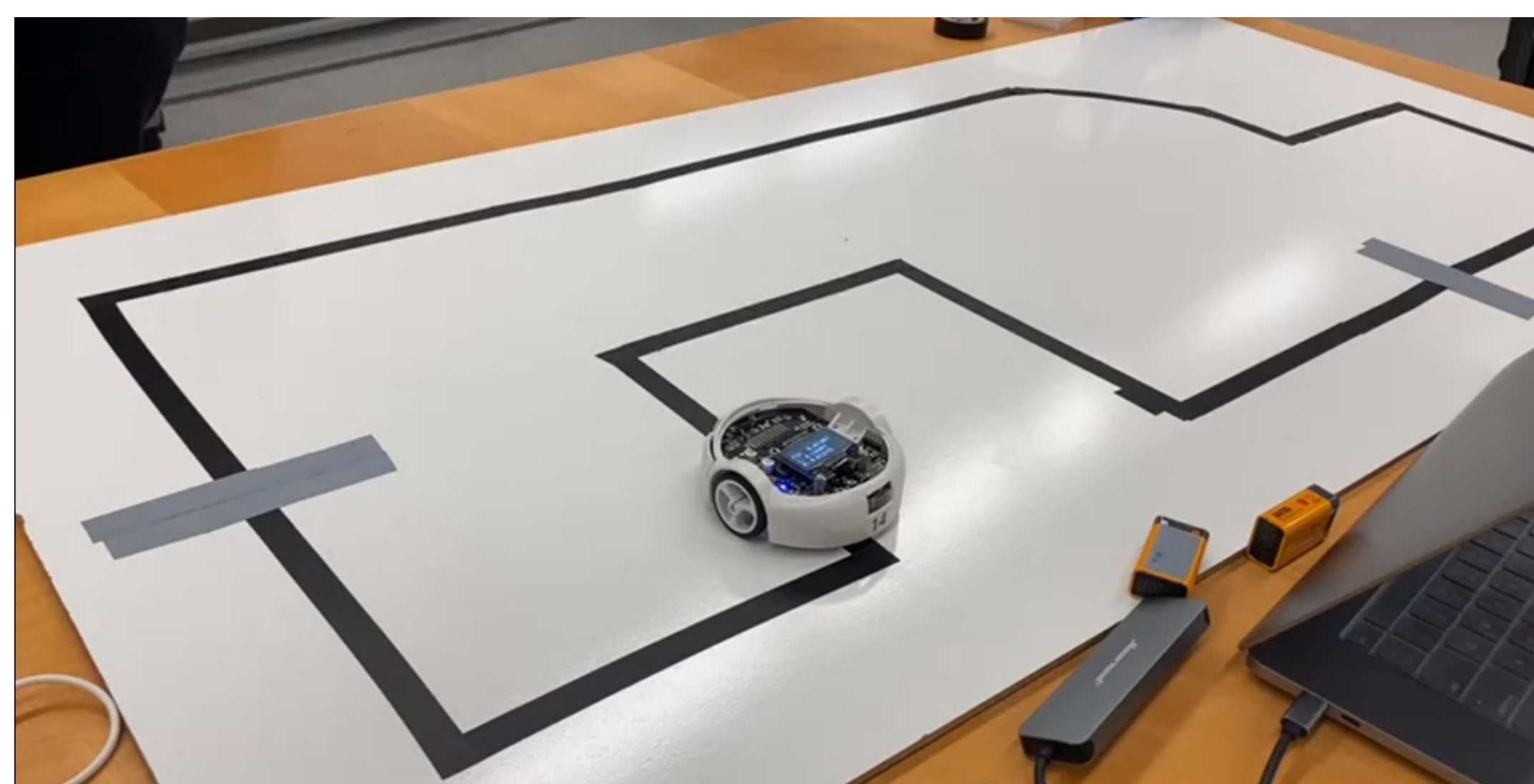


Kathy Min, Jesse Cheung, Alan Monge

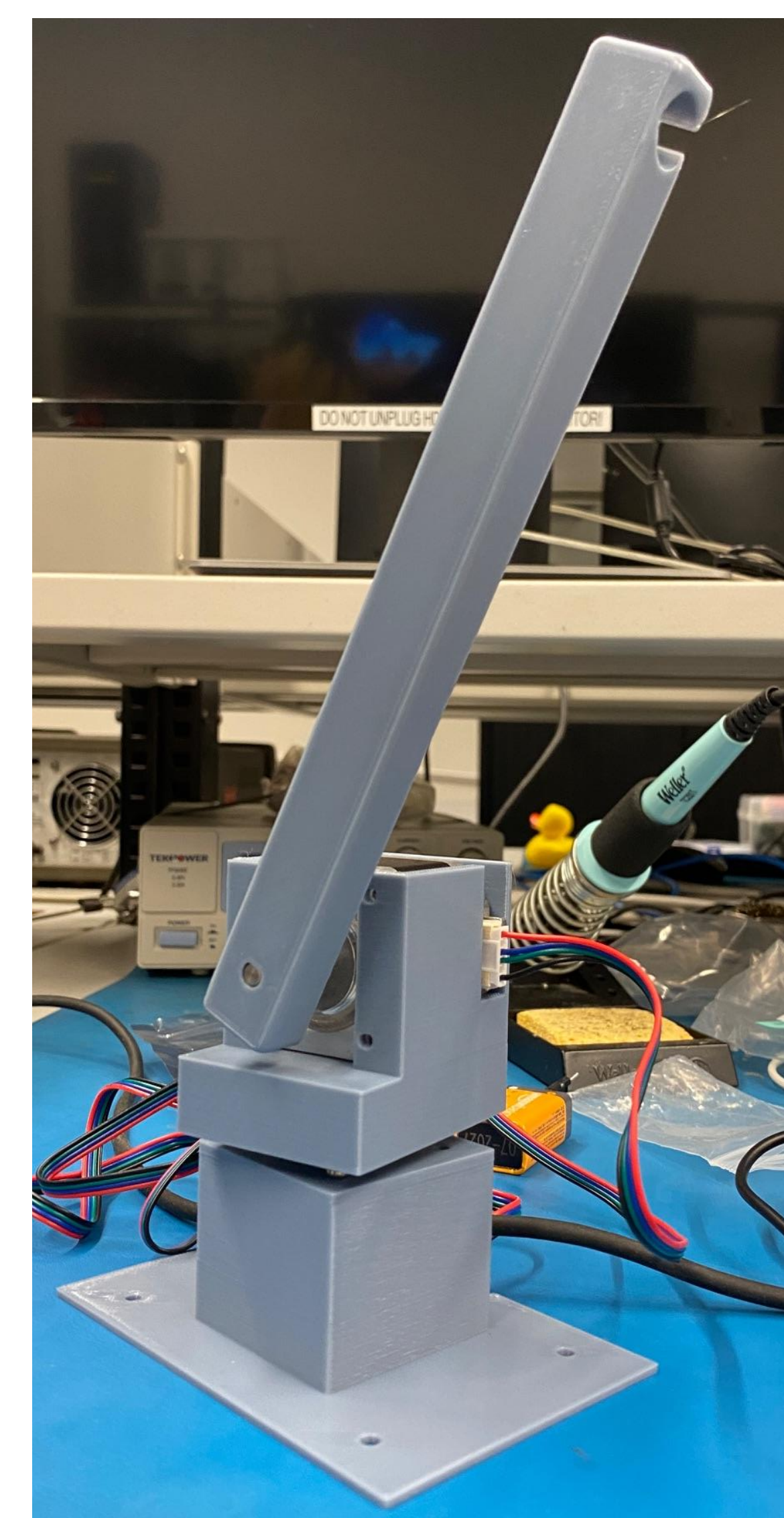
Overview

Small scale autonomous “port” system. Pololu 3pi+ serves as a cargo vehicle that takes cargo to and from dropoff and pickup locations.

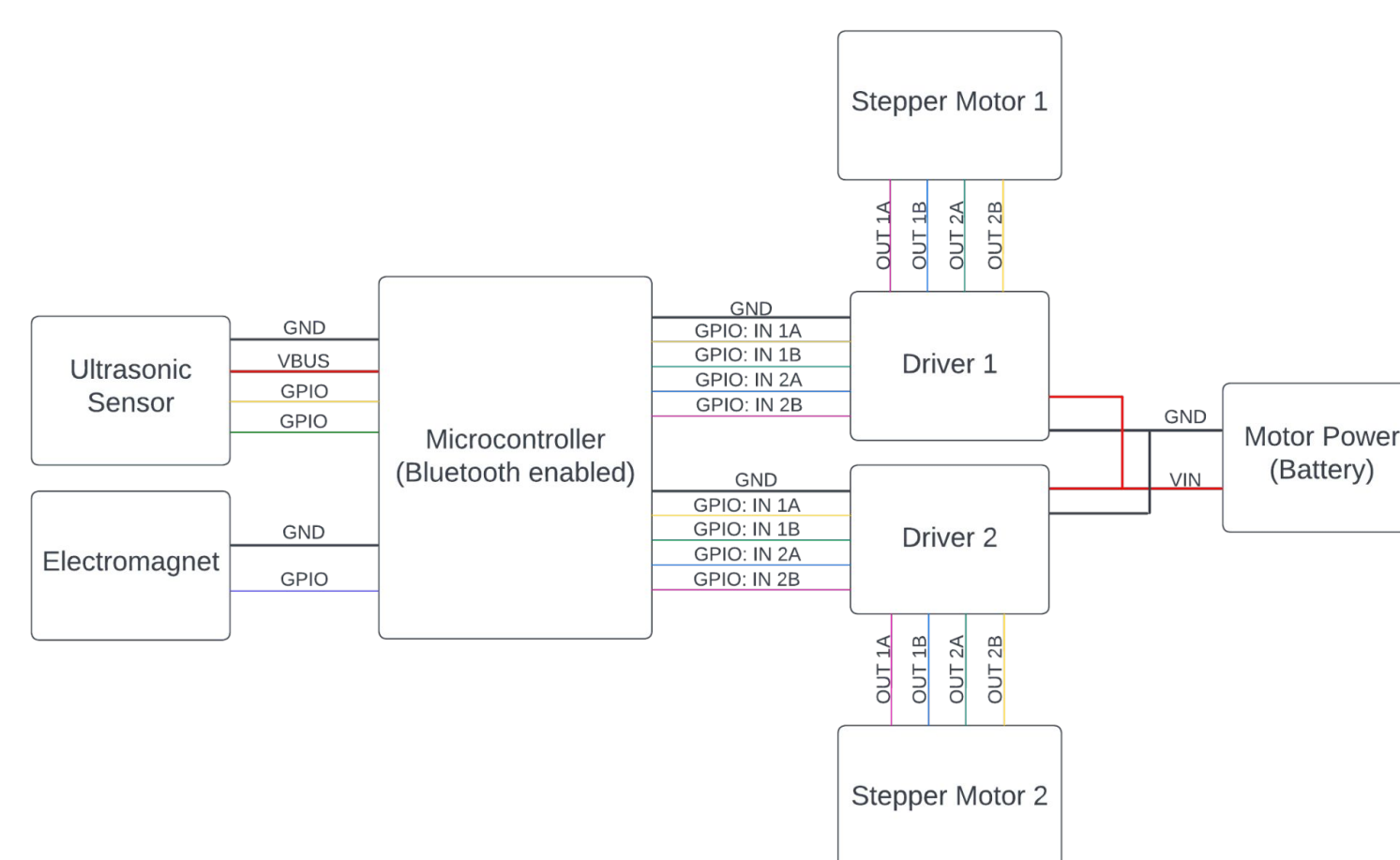


Crane System

An ESP32 is used to control two stepper motors an electromagnet and receive information from an ultrasonic sensor.



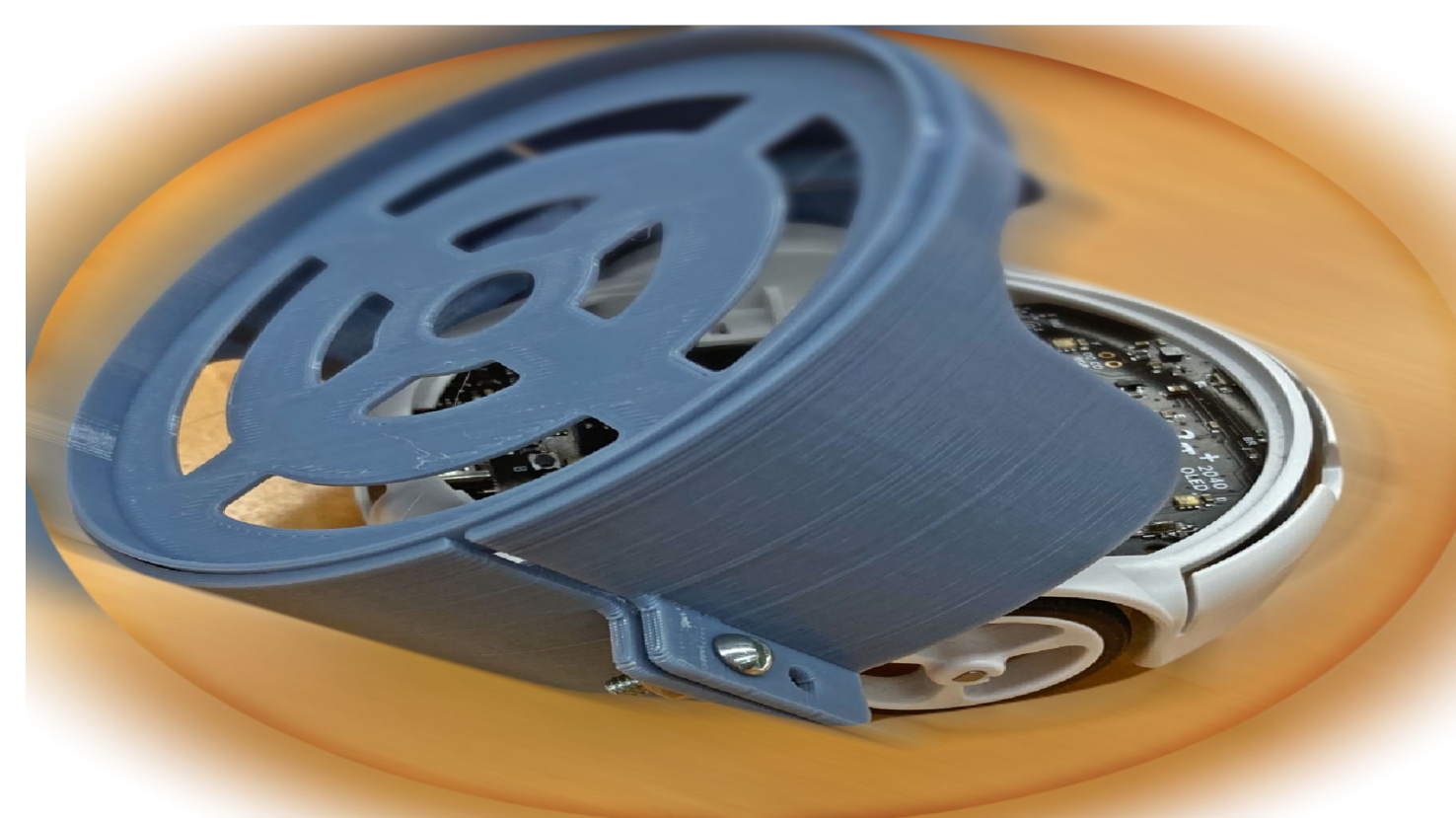
To load or unload cargo, the ESP32 needs to receive a signal from the 3pi+ and verify that a car is present by reading from the ultrasonic sensor. Once loading/unloading is complete, the crane sends a signal back to the 3pi+ to resume its path.



FSM outlines how the crane system is controlled.

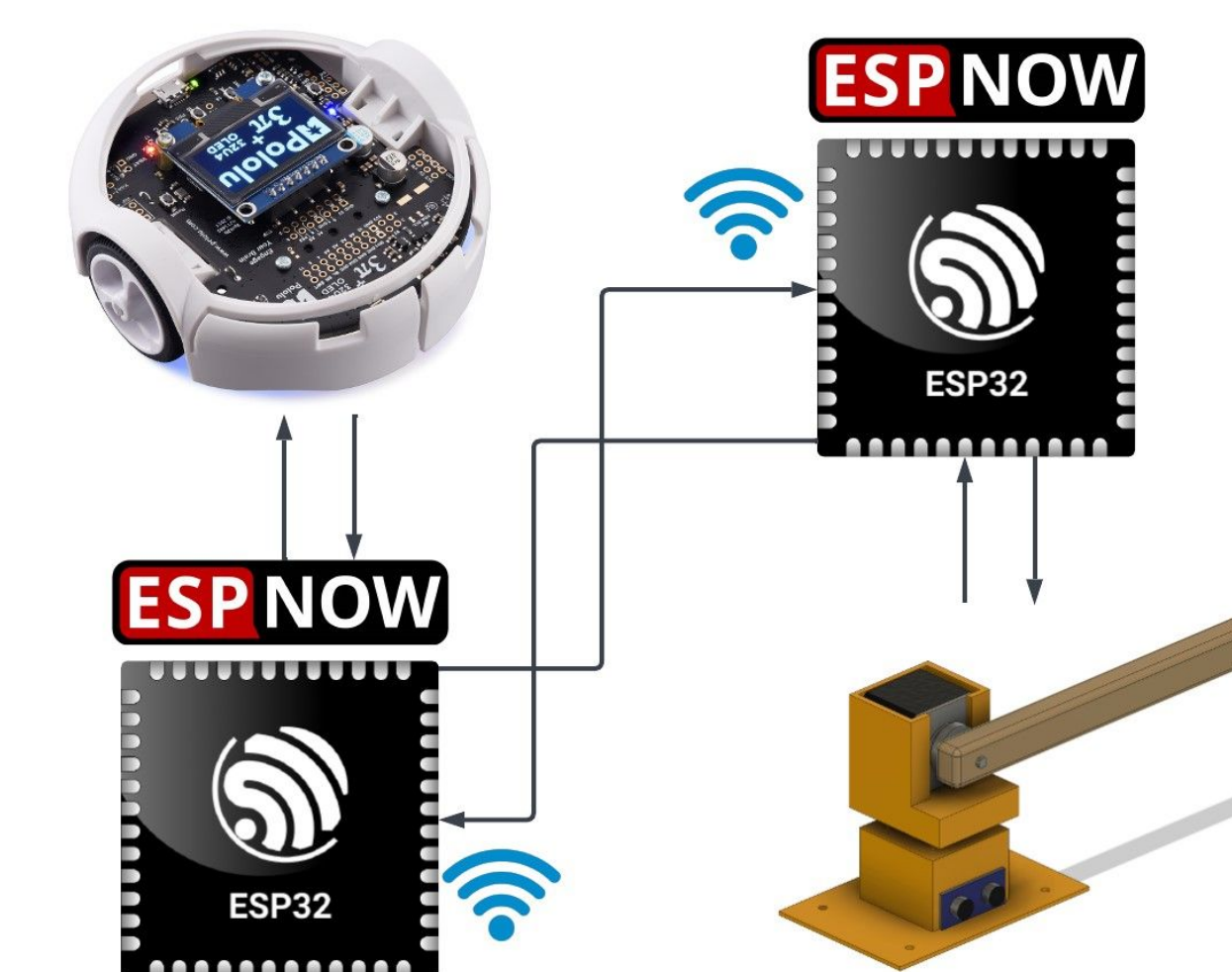
Autonomous Cargo Vehicle

With a 3pi+ Pololu robot embedded with line sensors, gyro, encoders, buttons, microcontroller and wireless technology we can turn the vehicle into an autonomous vehicle.



The structure to hold cargo is added onto the Pololu robot and is outfitted with other electronics such as an ESP32

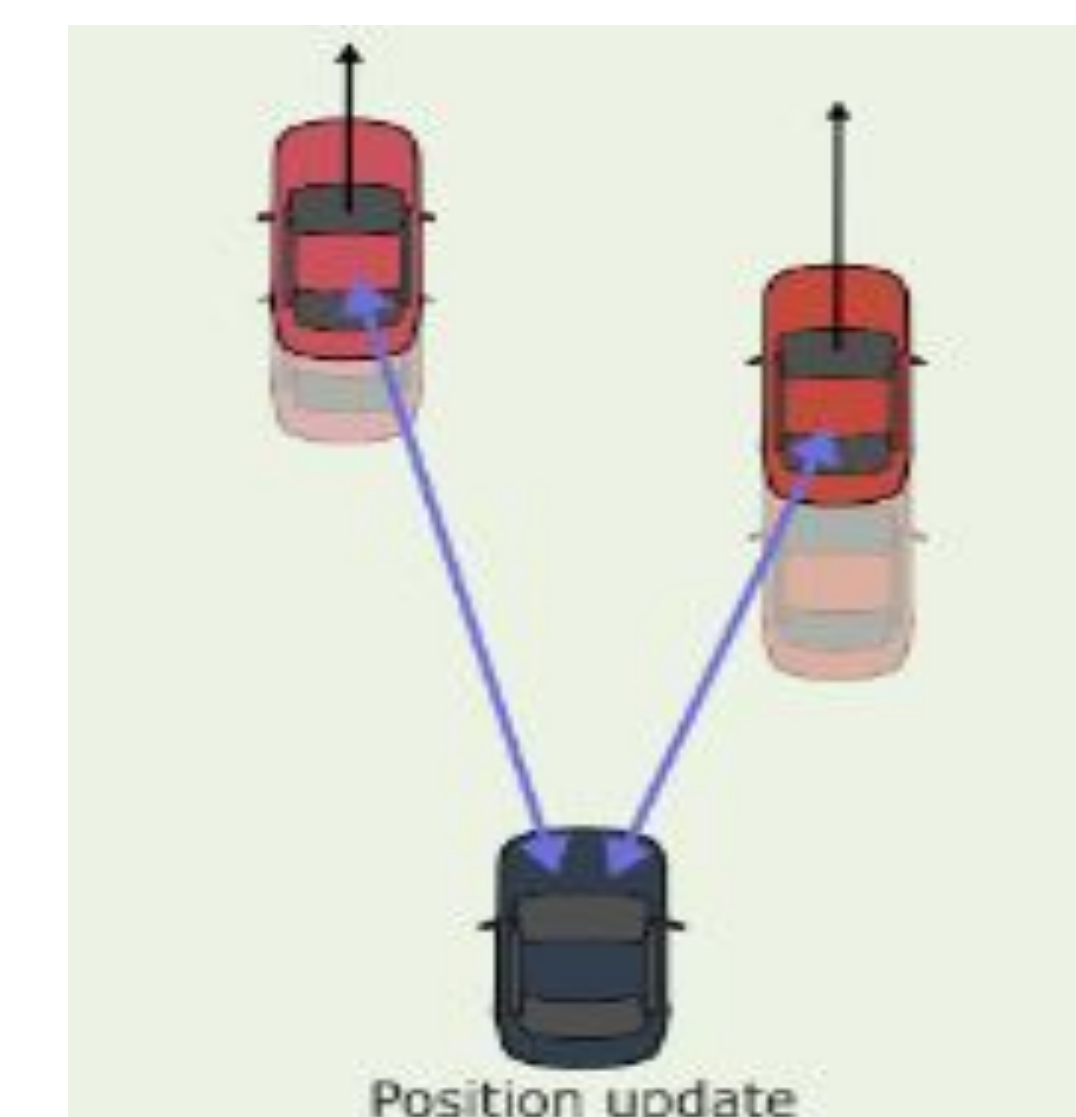
Wireless Communication



4 ESP32s are used to control two cranes and interface with two Pololu 3pi+ over UART to send and receive commands from cranes.

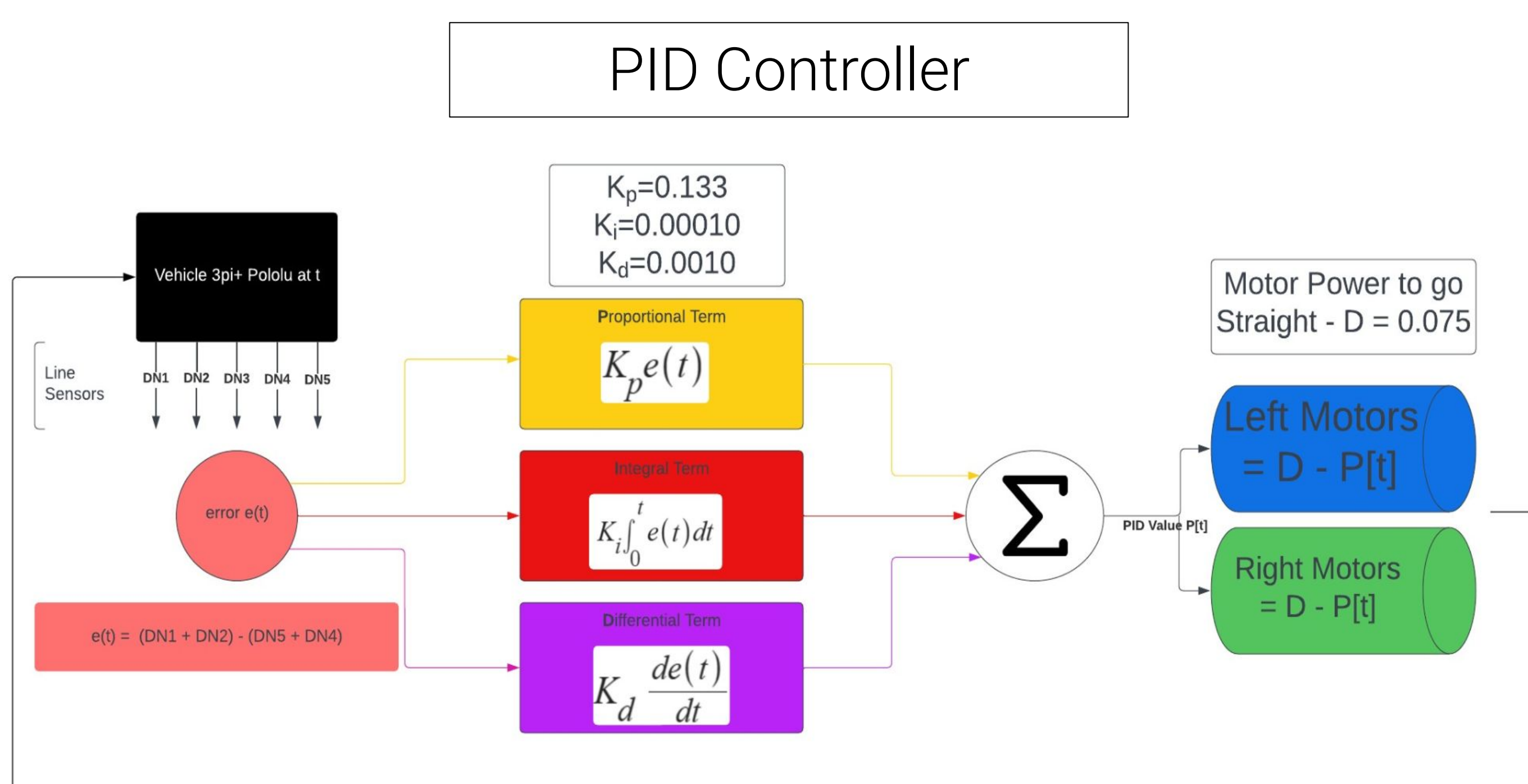
4 Way wireless communication is achieved through ESP-NOW

Localization



We separated the map into six areas and green line to mark where the areas are. We then use modular arithmetic to check which area the vehicle is in. For example if $\text{location_counter} \% 6 == 1$ then the vehicle is in area 1.

Localizations helps avoid car collisions by sending a yield signal if one car gets too close behind another.



In order for the Cargo Vehicle to be autonomous, we use a **PID Controller** to minimize the difference between the middle left and middle right line sensors as this guarantees that the 3pi+ is centered over the line it's following.

Lines



Black - Navigation



Gray - STOP

Gray signals when the robot should stop and to signal to the crane system that the car is at the destination.



Green - Localization Area Counter

Signals where the vehicle is at a particular by separating it into six seconds and using modulus operator.