

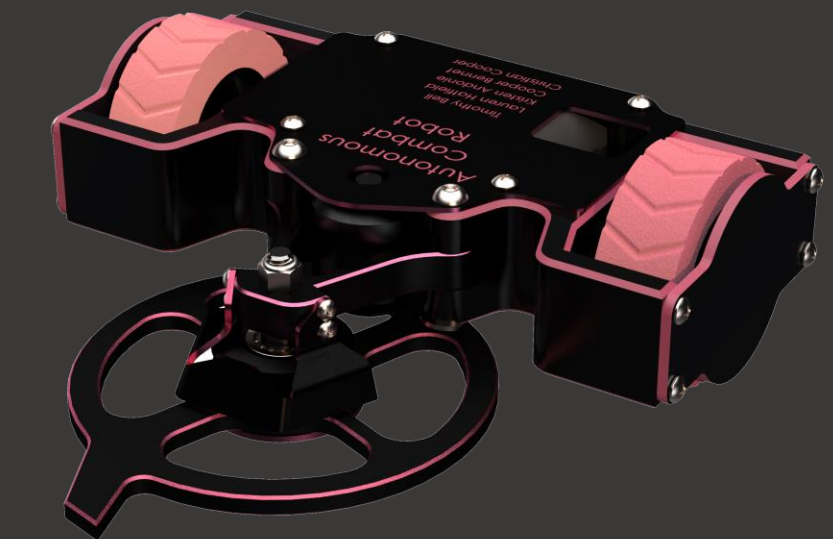


# WPI

# Autonomous Combat Robot

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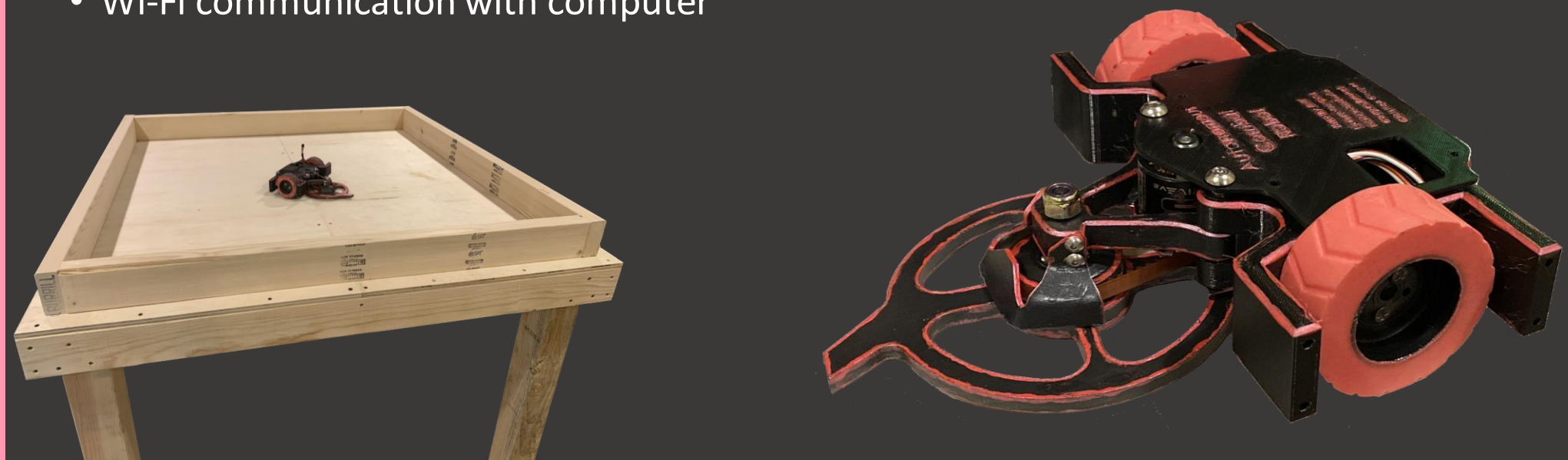
Advisors – Professor Nicholas Bertozzi (RBE, ME), Professor Michael Gennert (RBE, CS), Brad Miller (RBE)



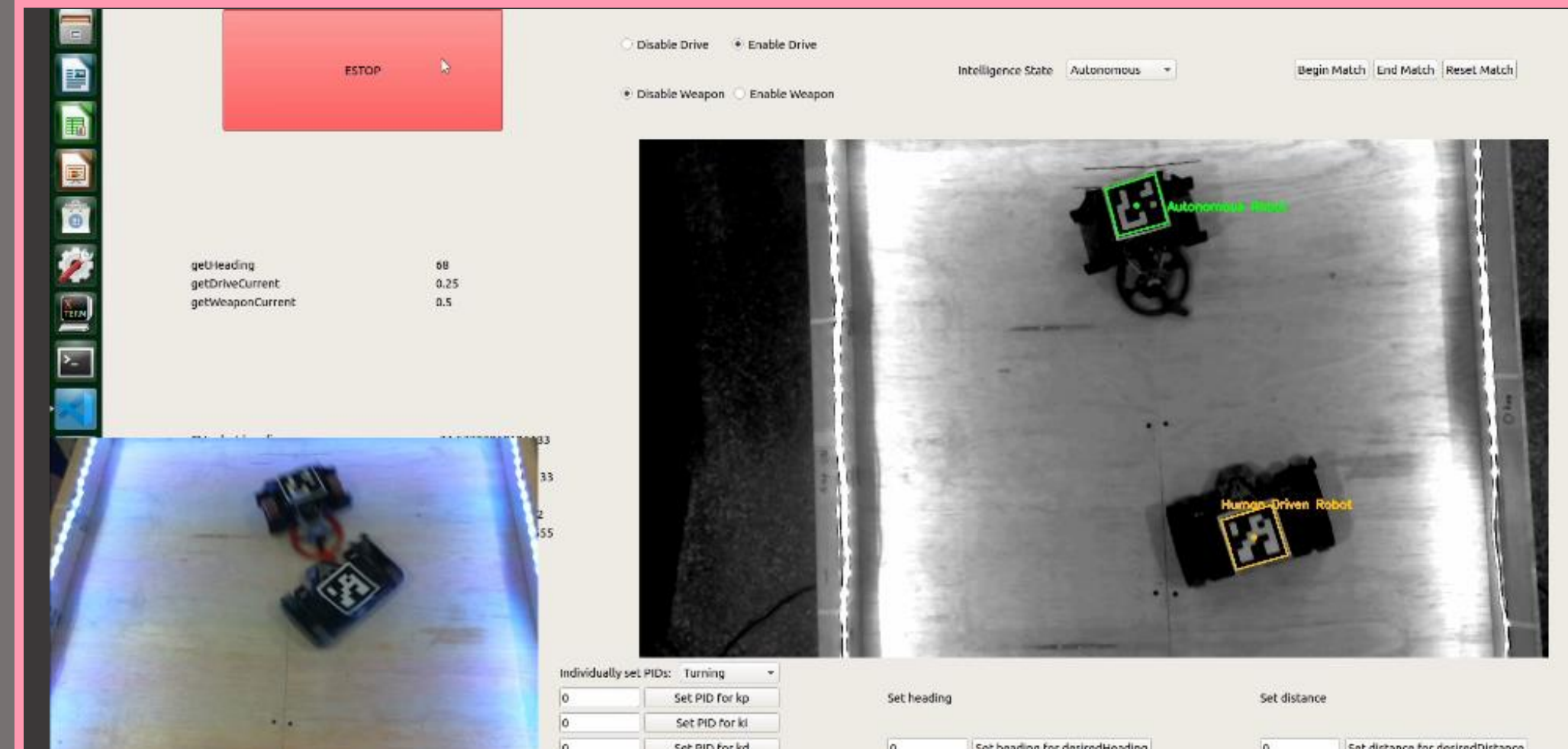
## Project Overview

### Challenge

- Autonomous high-speed combat robot
- Competitive and controlled offense during 3-minute match
- Computer vision model to detect robot and opponent
- Custom onboard sensing
- Wi-Fi communication with computer



## GUI



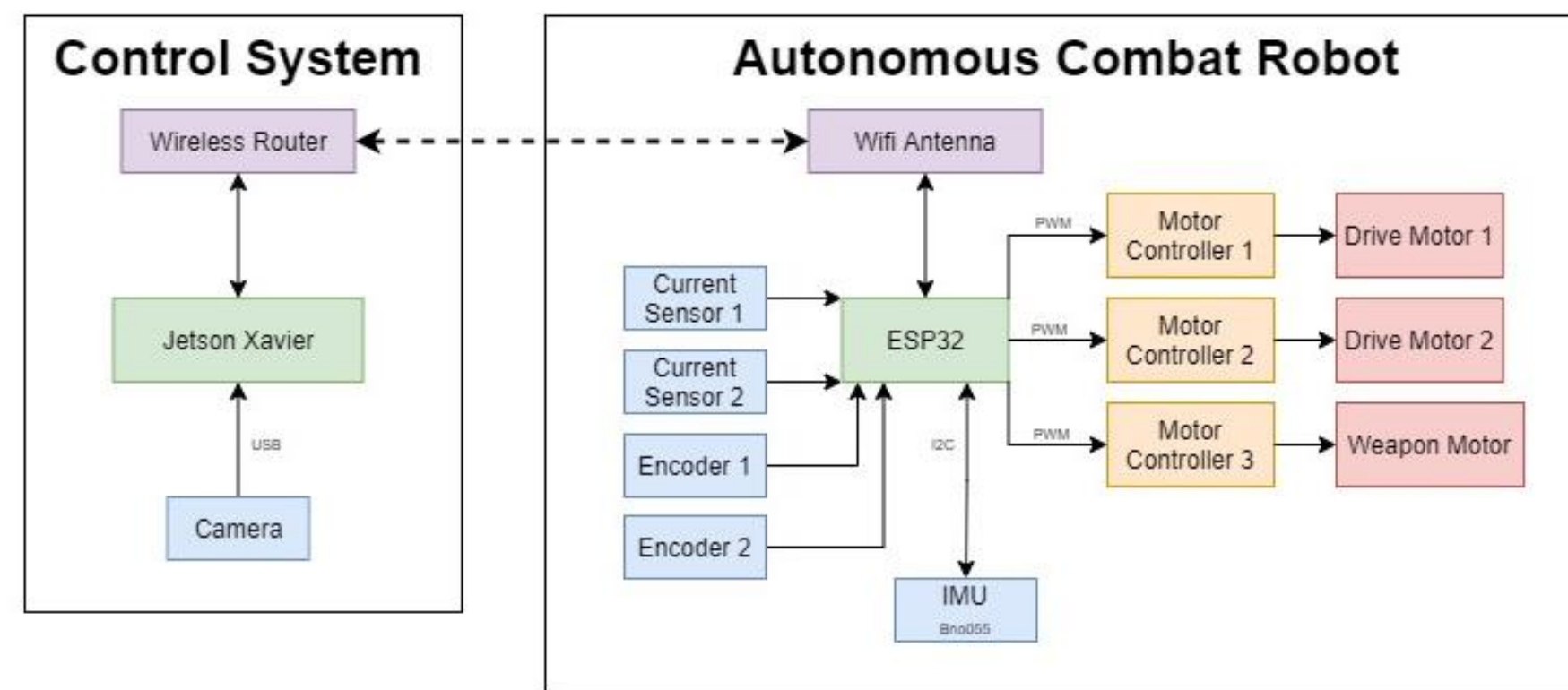
## Firmware

### Features

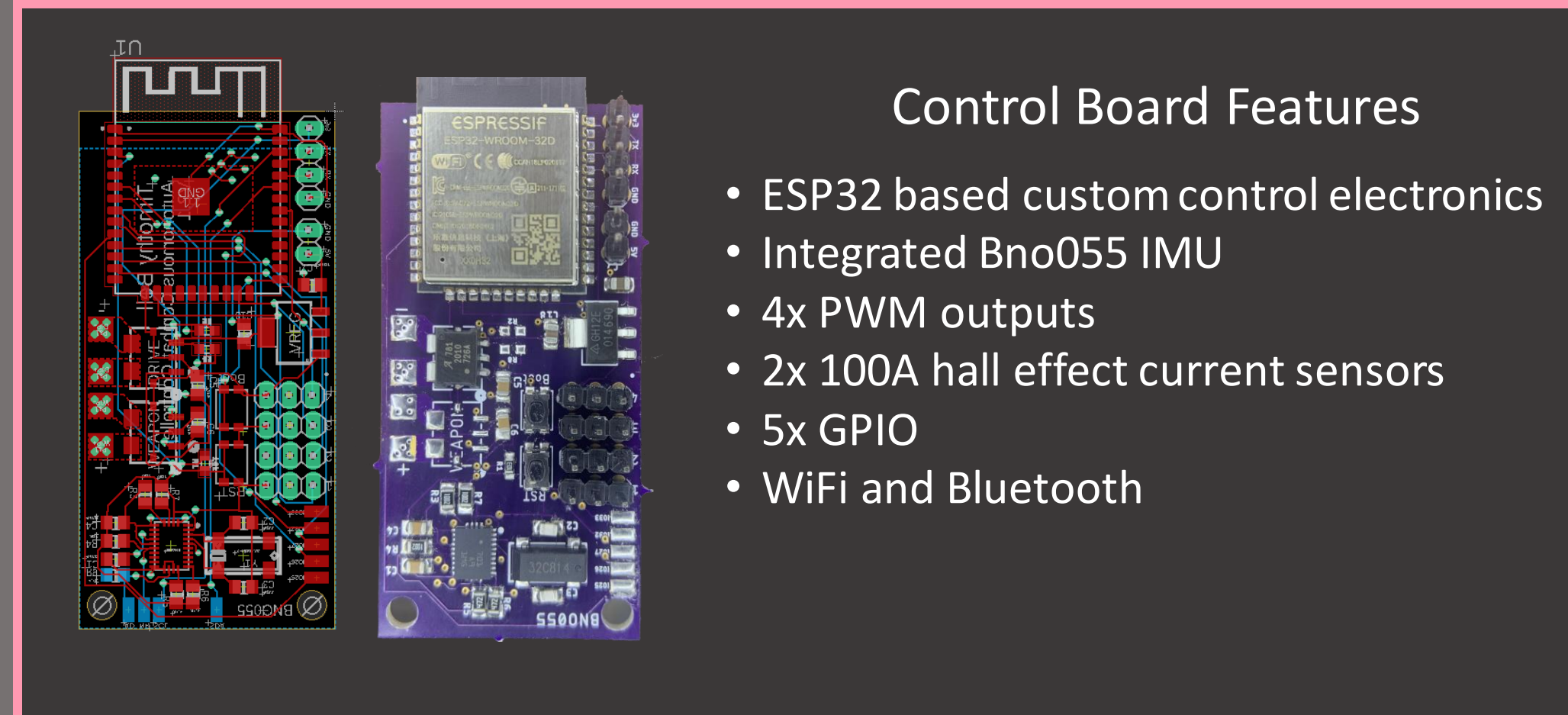
- Programmed in C++
- Utilizing PlatformIO for embedded development
- Hosts asynchronous webserver on ESP32
- Remote PID tuning
- JSON packet communication for commands and data



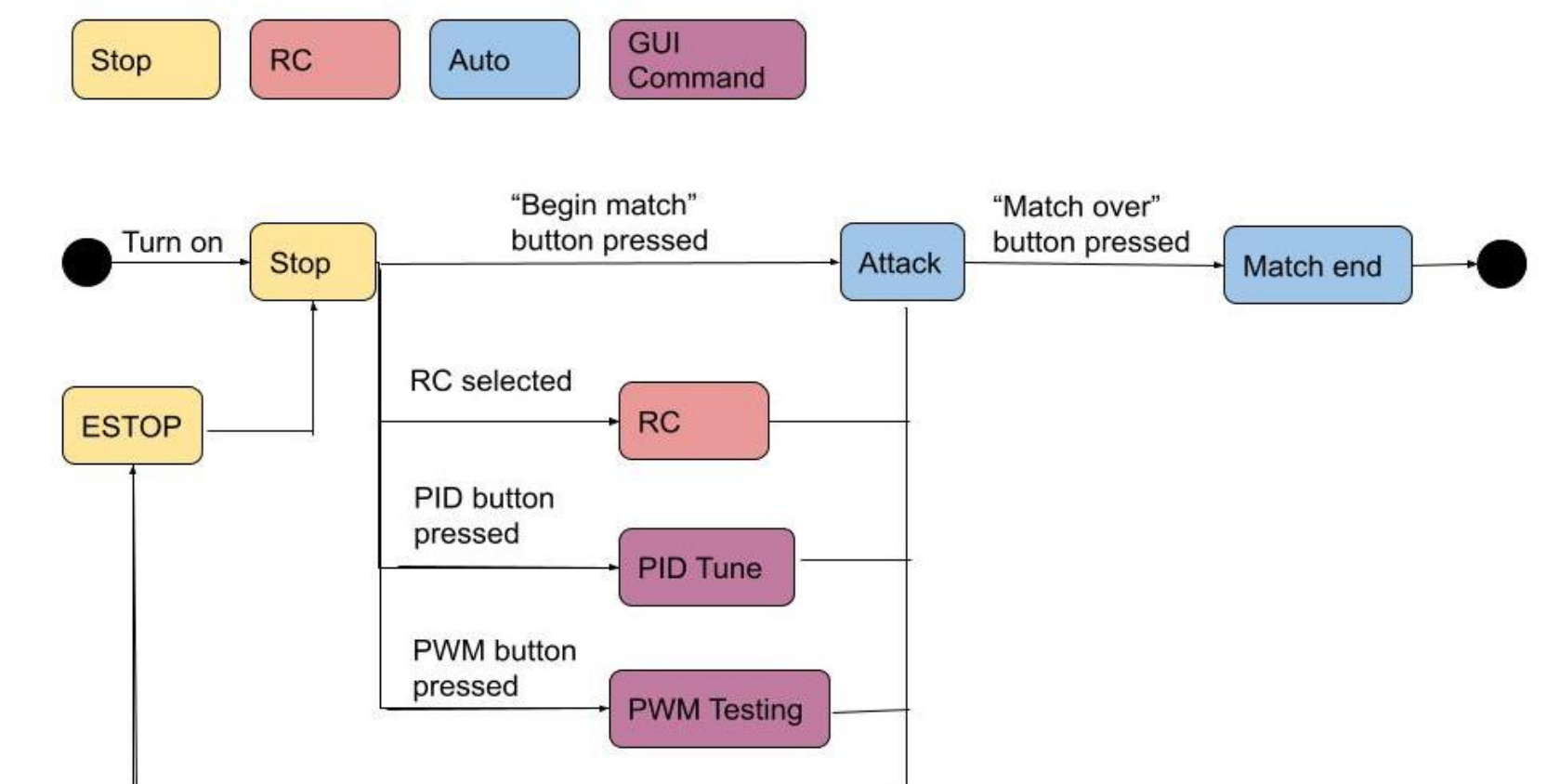
## System Diagram



## ESP32 Control Board



## State Machine Flowchart



## Design and Manufacturing

### Chassis

- 3D printed TPU construction
  - Built in shock mounting
- Brushless outrunner drivetrain with embedded encoders



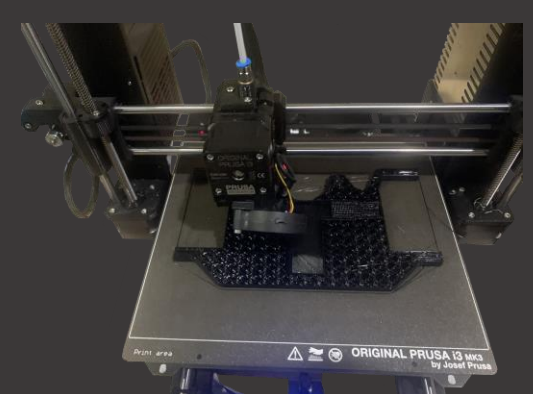
### Weapon Assembly

- AR500 steel impacting disk
- CNC turned and milled aluminum pulleys
- Titanium retaining washer
- Stores .75 kJ



### Weapon Module

- 5 axis CNC milled aluminum
- Bent grade 5 titanium armor
- Weight optimized with FEA



## Computer Vision

### Features

- Uses OpenCV to track robots
- Get position and heading from ArUco tag on robot
- Labeled ArUco tags are shown on the GUI
- 60 FPS global shutter camera to minimize blur
- Monochrome camera for faster processing



## Results

### Accomplishments

- Identifies robot and opponent position and orientation
- Robot rights itself if flipped over
- Control system sends robot movement commands
- Current sensing to detect stalls
- Full mechanical analysis of all components

### Future Work

- Compete in tournaments against human opponents
- Develop more complex behaviors
- Fortify existing data with sensor fusion
- Optimize program for improved performance

