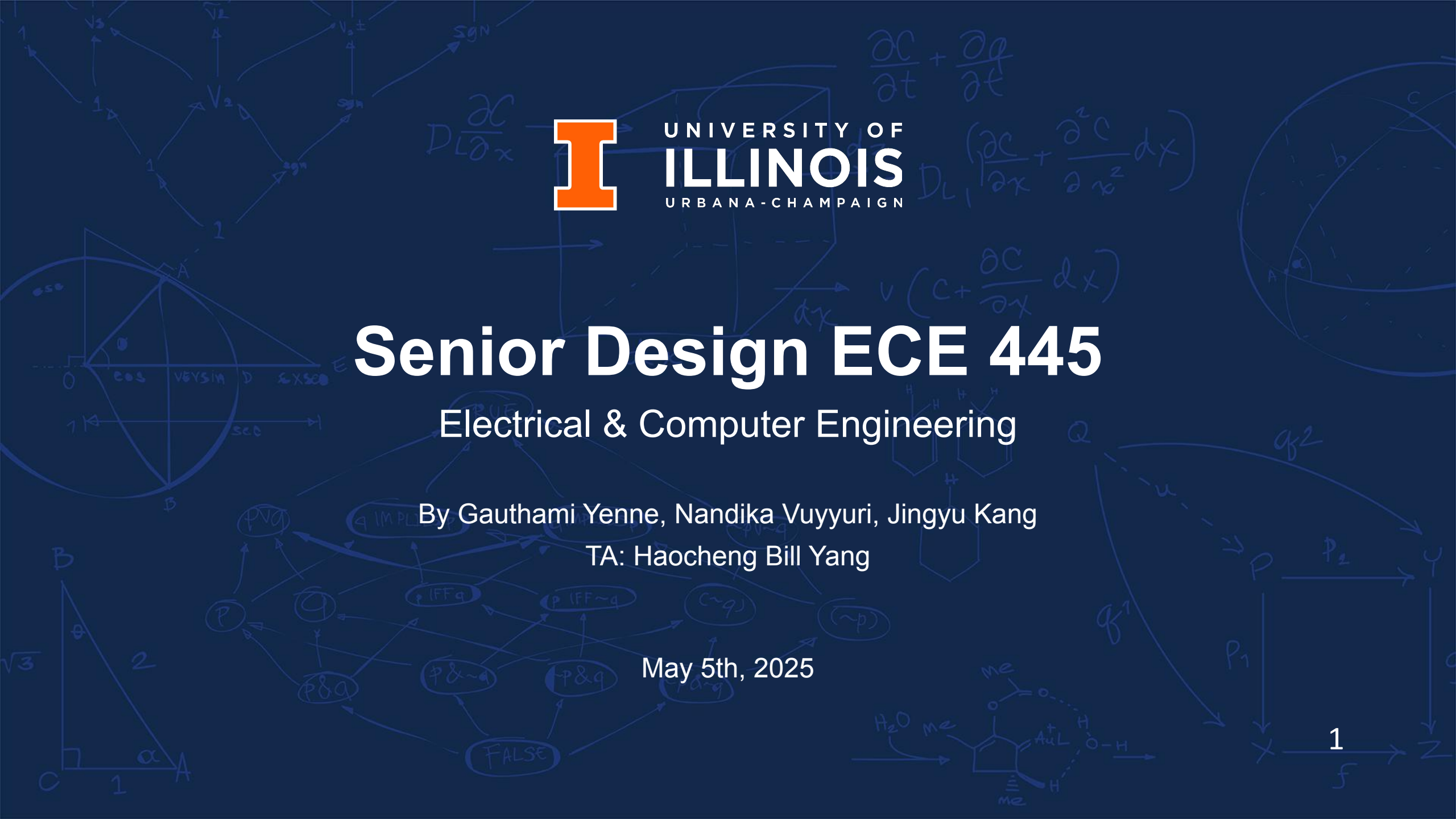

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Senior Design ECE 445

Electrical & Computer Engineering

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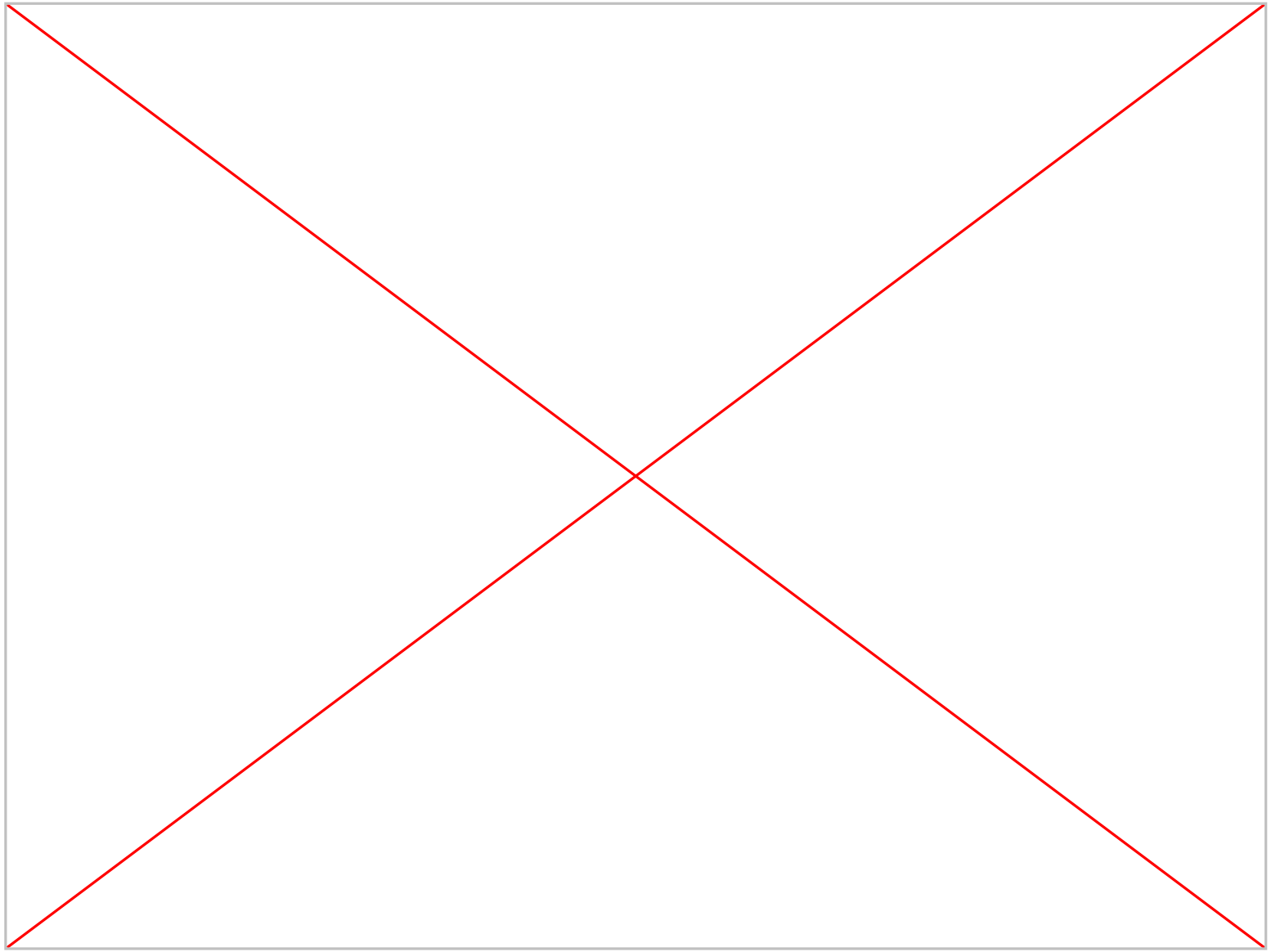
Objective

Objective

- Build a functional battlebot under 2 lbs
- Design to disable opponent bot during 1v1 combat
- Prioritize lightweight, durable, and compact components
- Ensure compliance with competition rules

Video of Our Project

Video Of Our Project



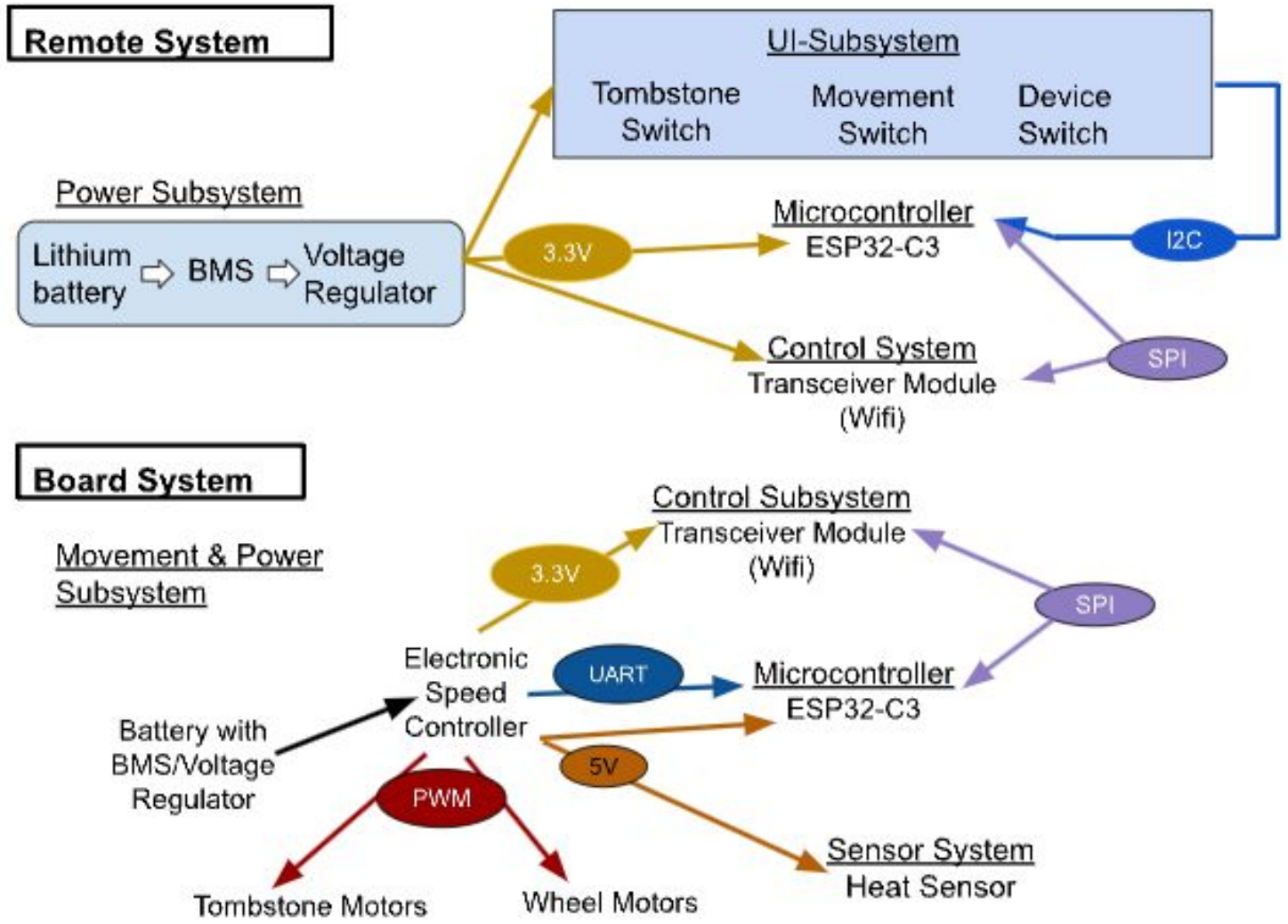
High Level Requirements

High Level Requirements

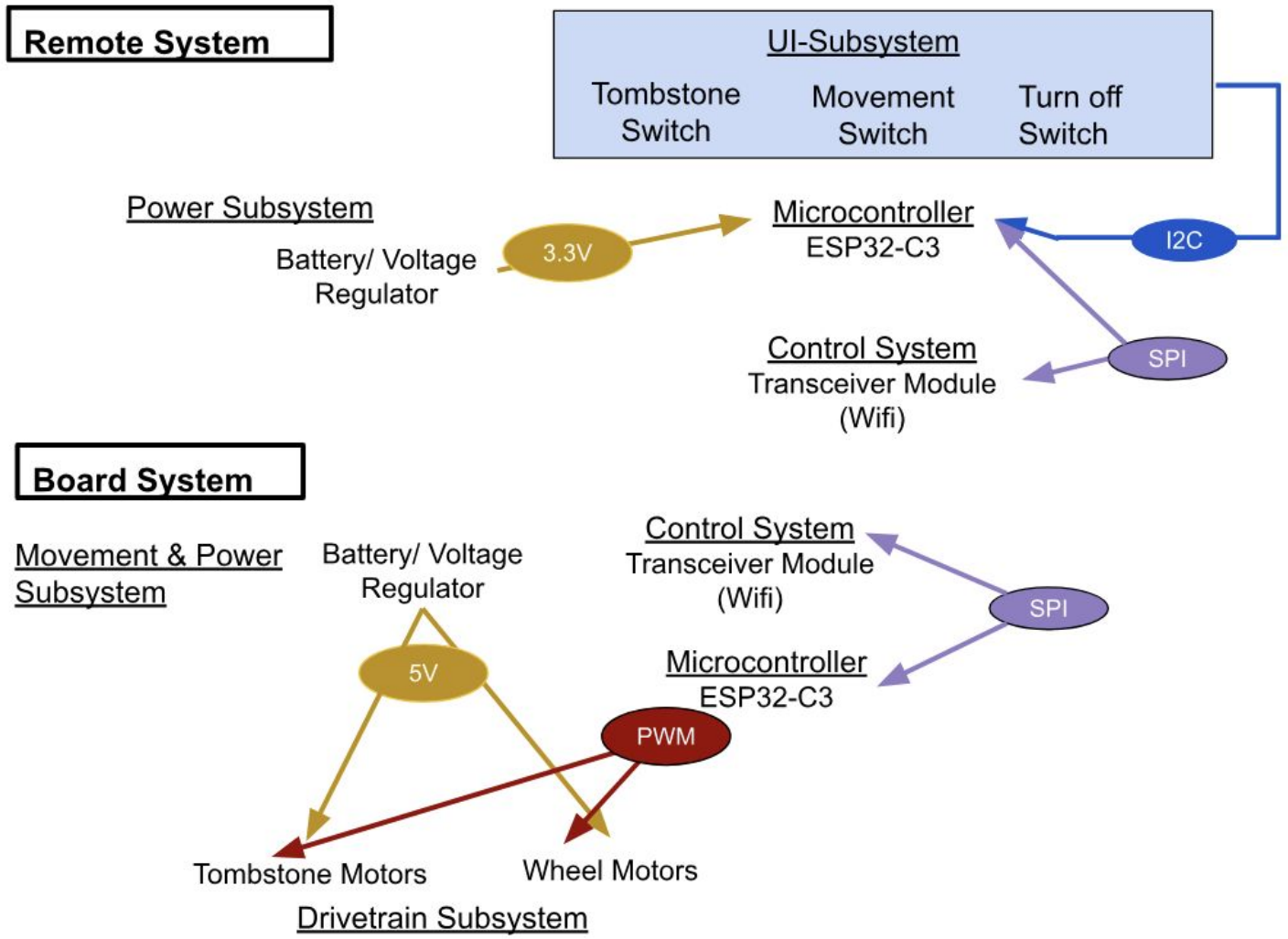
- Wireless communication using Android app or Controller
- Three-speed blade powered via regulated voltage
- Weapon spins at over 500 RPM with stable control
- Lightweight build under 2 lbs using compact parts

System Design Overview

Block Diagram Before



Block Diagram After



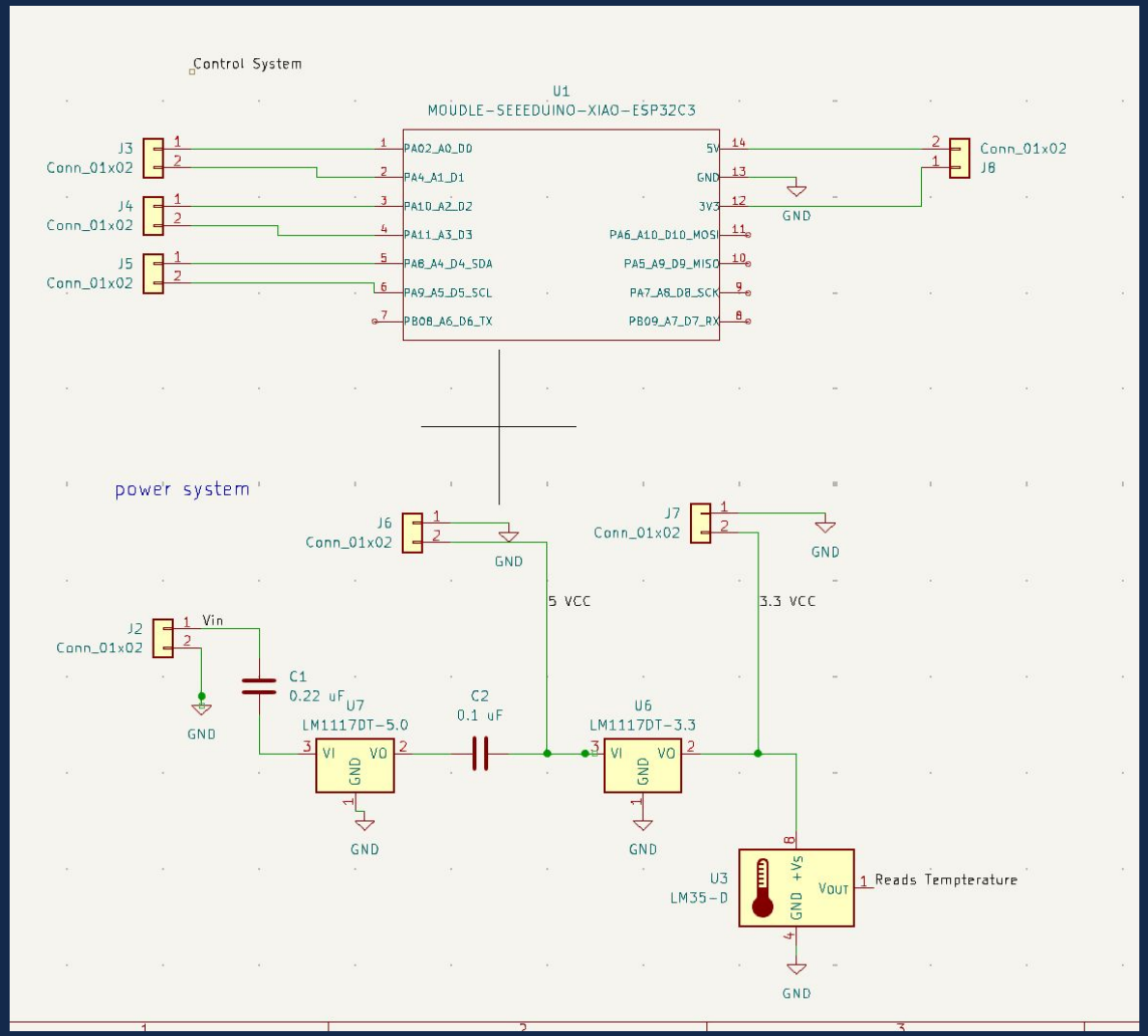
Things We Changed

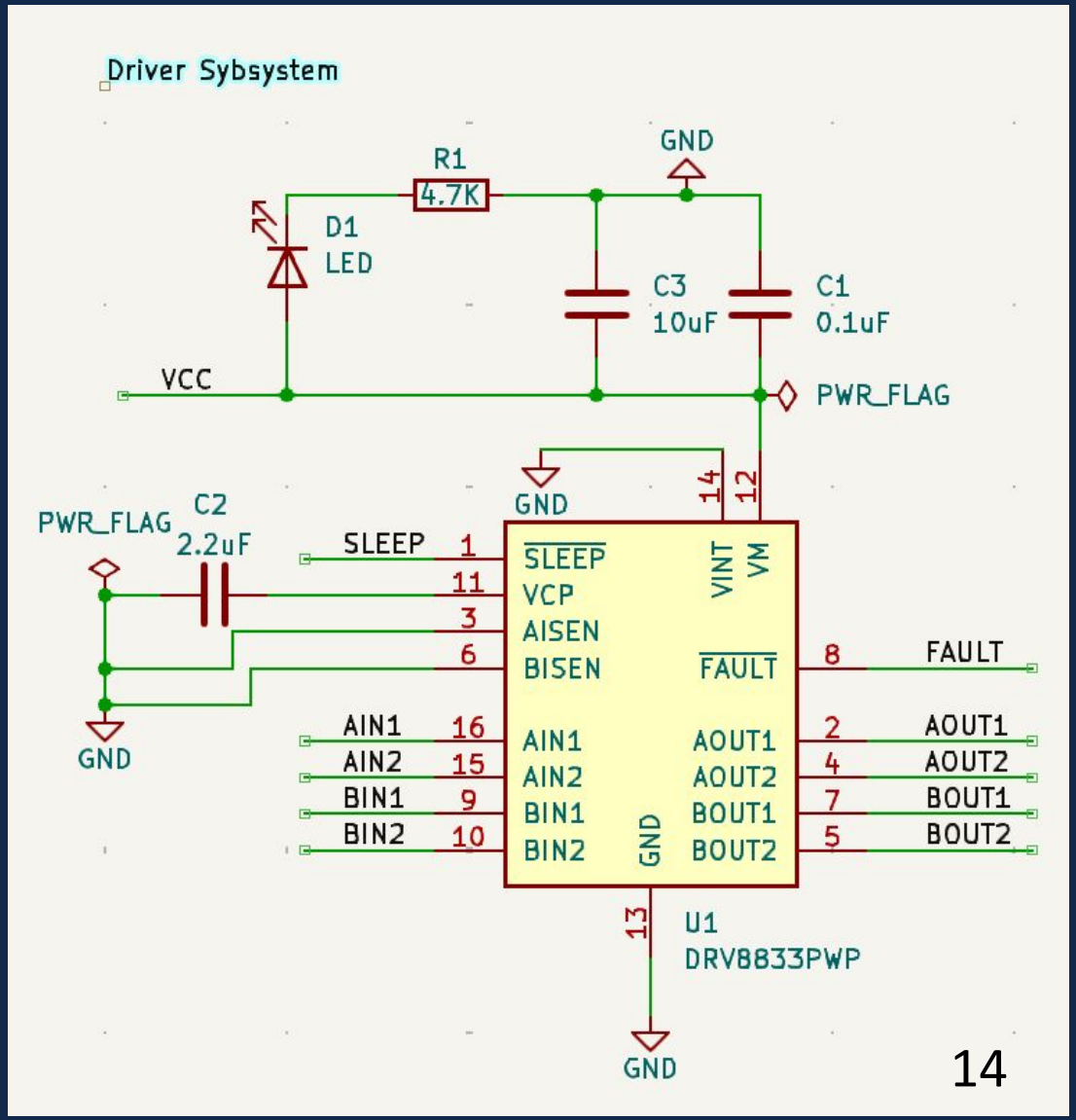
Things We Changed

- Tombstone motor from Emax RS2205 2600KV brushless motor -> Greartisan due delay in testing
- Battery due to delay in testing

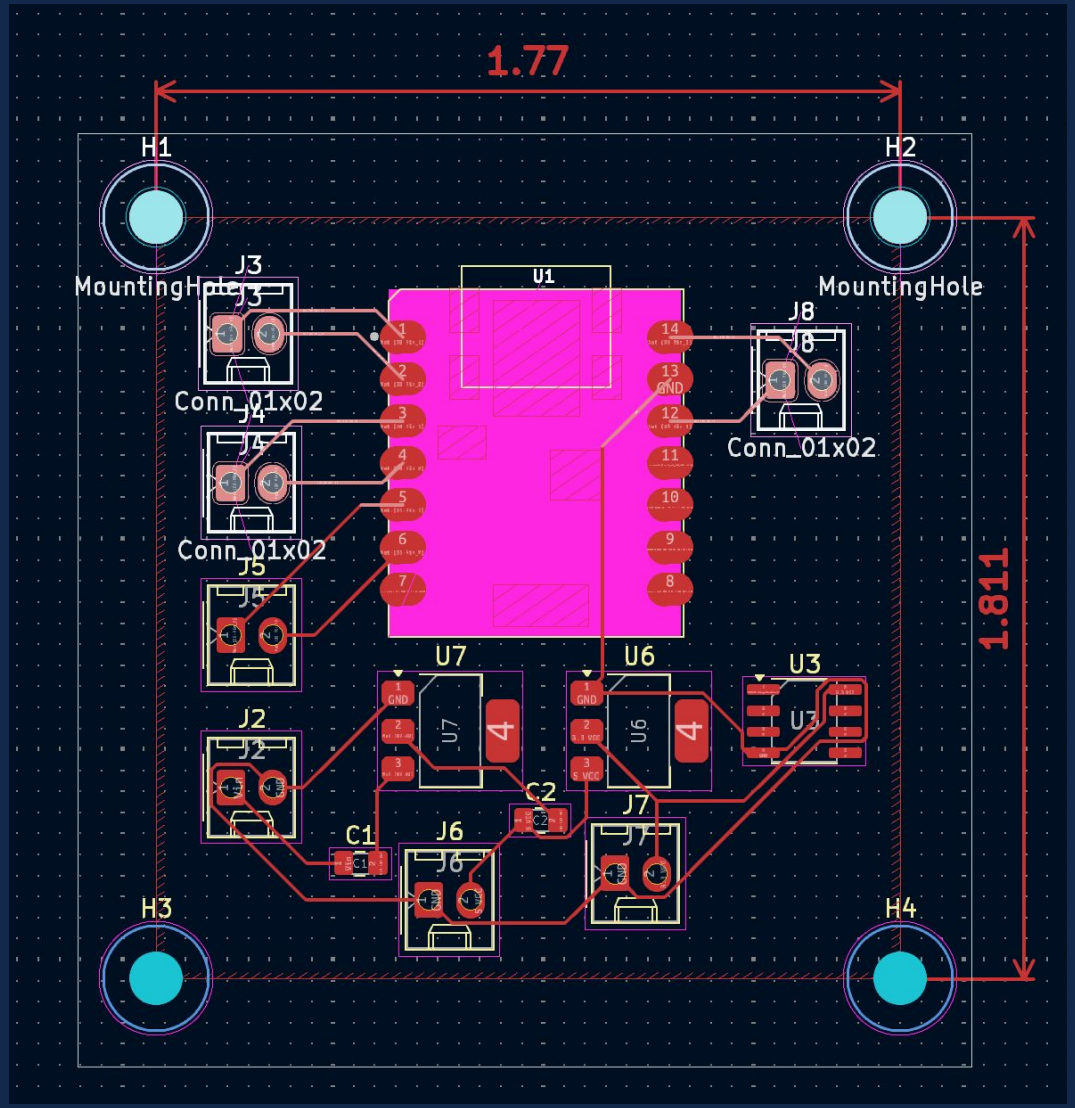
PCB Design

Final PCB


Control System
U1
MOUDLE-SEEEDUINO-XIAO-ESP32C3
J3
Conn_01x02
J4
Conn_01x02
J5
Conn_01x02
PA02_A0_D0
PA4_A1_D1
PA10_A2_D2
PA11_A3_D3
PA8_A4_D4_SDA
PA9_A5_D5_SCL
PB08_A6_D6_TX
5V
GND
3V3
PA6_A10_D10_MOSI
PA5_A9_D9_MISO
PA7_A8_D8_SCK
PB09_A7_D7_RX
J8
Conn_01x02
GND
power system
J6
Conn_01x02
J7
Conn_01x02
GND
5 VCC
3.3 VCC
J2
Conn_01x02
Vin
C1
0.22 uF
U7
LM1117DT-5.0
C2
0.1 uF
U6
LM1117DT-3.3
VI
VO
GND
U3
LM35-D
+Vs
VOUT
Reads Tempterature


Driver Sybsystem
R1
4.7K
D1
LED
GND
C3
10uF
C1
0.1uF
VCC
PWR_FLAG
C2
2.2uF
SLEEP
VCP
AISEN
BISEN
VINT
VM
FAULT
AIN1
AIN2
BIN1
BIN2
AOUT1
AOUT2
BOUT1
BOUT2
U1
DRV8833PWP

Final PCB


1.77
1.811
H1
H2
H3
H4
MountingHole
MountingHole
J3
Conn_01x02
J4
Conn_01x02
J5
J2
J8
Conn_01x02
U1
U7
U6
U3
C1
C2
J6
J7

Subsystem Overview

Power Subsystem

1. **Power Input**
   - Connector receives input voltage and GND
2. **Voltage Regulation**
   - Regulated source to 5V and 3.3V
   - Filtered with 0.22 uf capacitor

Drivetrain & Weapon Subsystem

1. **Greartisan 12V 100RPM DC Motor**
    - 1:298 reduction ratio
    - Rated torque of 2kg·cm
2. **DRV8833 Dual H-bridge Motor Drivers**
    - The driver is integrated with the drivetrain wheels to allow control and movement
    - 2.7V-10.8V
    - Up to 9600 mA peak per motor

Control Subsystem

1. **Xiao ESP32-C3 Microcontroller**
    - Powered with 5V with internal regulator for 3.3V conversion
    - Communication controlled with WiFi
    - PWM signals to DRV8833 through GPIO pins
    - Localhost web server for controls

Testing & Functional Results

Testing Functionality

1. **Power Subsystem**
   - Verify output voltage from voltage regulators using multimeter
   - Verify input voltage to ESP (3.3V) / Motor Driver (5V) using multimeter
   - Check output current to DC motors using DC power supply

Testing Functionality

Measured Values	PCB Trial 1	PCB Trial 2
ESP32 Voltage	4.21 - 4.43 V	4.78 - 5.21 V
DRV8833 Voltage	0.18 - 0.23 V	4.68 - 5.12 V
Weapon DC Motor Voltage	0.02 - 0.1 V	5.01 - 5.12 V
Drivetrain DC Motor Voltage	0.02 - 0.1 V	5.20 - 5.34 V
Weapon DC Motor Current	40 - 60 mA	580 - 640 mA
Drivetrain DC Motor Current	40 - 60 mA	640 - 720 mA

Testing Functionality

- **Wireless Control via Localhost Website**
  - Local host web interface to send HTTP commands over Wi-Fi
  - Control movement and weapon systems through the website in real-time
  - ESP32-C3 received and processed the commands accurately, sending PWM signals to the DRV8833 motor driver

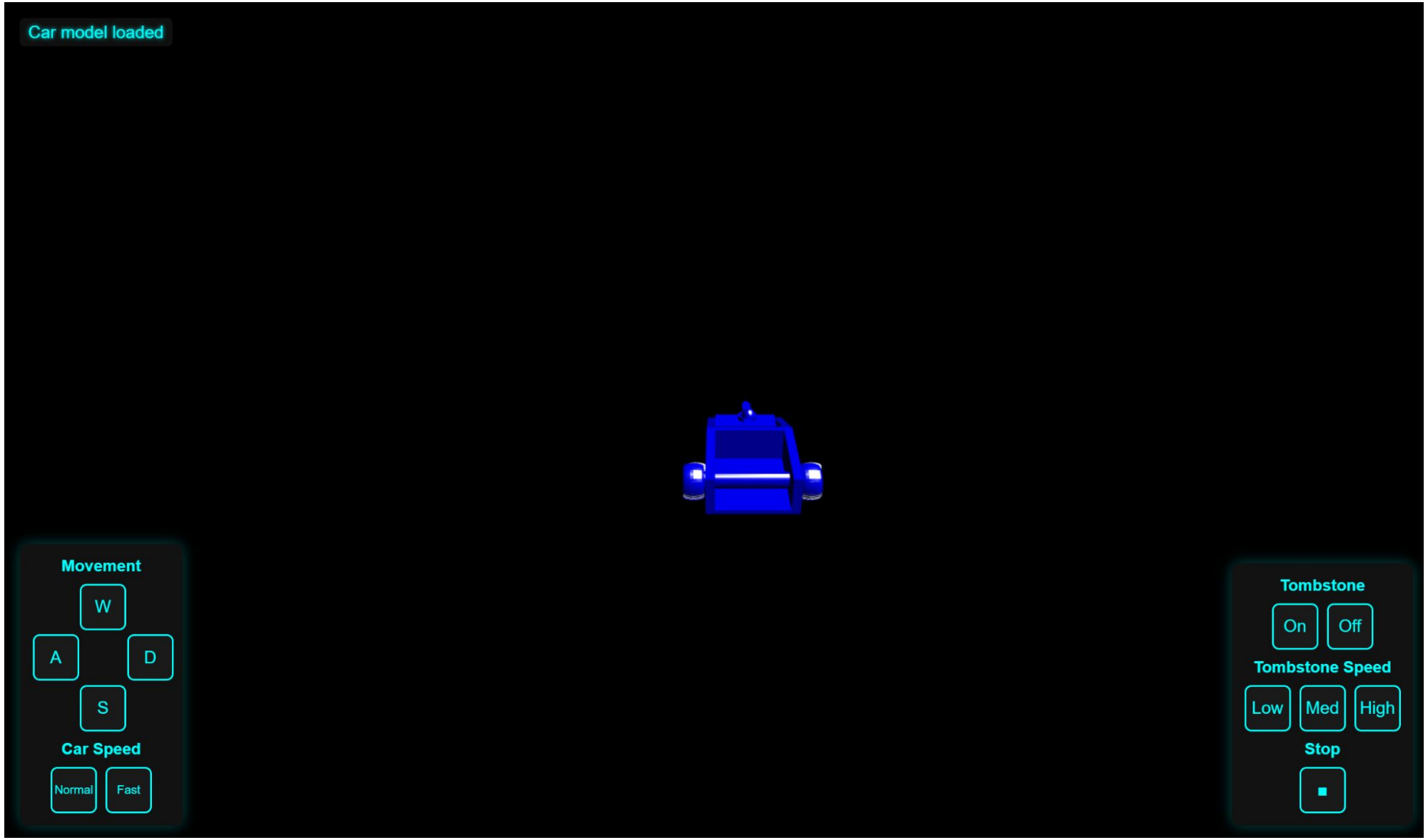
Testing Functionality

final.py

C: > Users > nandi > Desktop > working_test > final.py > send_command

```python
import requests

ESP32_IP = "192.168.4.1"

def send_command(command):
    url = f"http://{ESP32_IP}/{command}"
    try:
        response = requests.get(url, timeout=3)
        print(f"[{command.upper()}] {response.text}")
    except requests.exceptions.RequestException as e:
        print(f"Error sending {command}: {e}")

if __name__ == "__main__":
    while True:
        cmd = input("Enter command (forward, backward, left, right, stop, tombstone_on, tombstone_off, exit): ").strip().lower()
        if cmd in ["forward", "backward", "left", "right", "stop", "tombstone_on", "tombstone_off"]:
            send_command(cmd)
        elif cmd == "exit":
            print("Exiting...")
            break
        else:
            print("Invalid command. Try again.")

```

Testing Functionality



Challenges & Future Improvements

Challenges We Faced

- PCB outline errors delayed manufacturing
- Issues with Tombstone motor due to the PCB set-back
- Low current for DC motors
- Battery power issues

Future Improvements:

- Use a motor with lower torque
- Use a battery with higher voltage and discharge rate
- Add a motion sensor to detect the enemy battlebot
- Design drivetrain and weapon subsystem that would require less current loss during signal delivery

Ethics & Safety

Ethics & Safety

- **Safety (IEEE Code #1):**
  We prioritized operator and spectator safety through controlled testing, proper motor shutdown procedures, and secure power regulation. All testing was done in designated safe zones with no exposed sharp parts.

- **Security (IEEE Code #9):**
  Our Wi-Fi-controlled bot was operated via a localhost interface on a private network. Only authorized users could send commands to prevent outside interference.

- **Fair Competition (ACM Code 2.2):**
  We followed all competition rules, avoided unsportsmanlike behavior, and reported all results honestly—including design changes and limitations.

Questions?