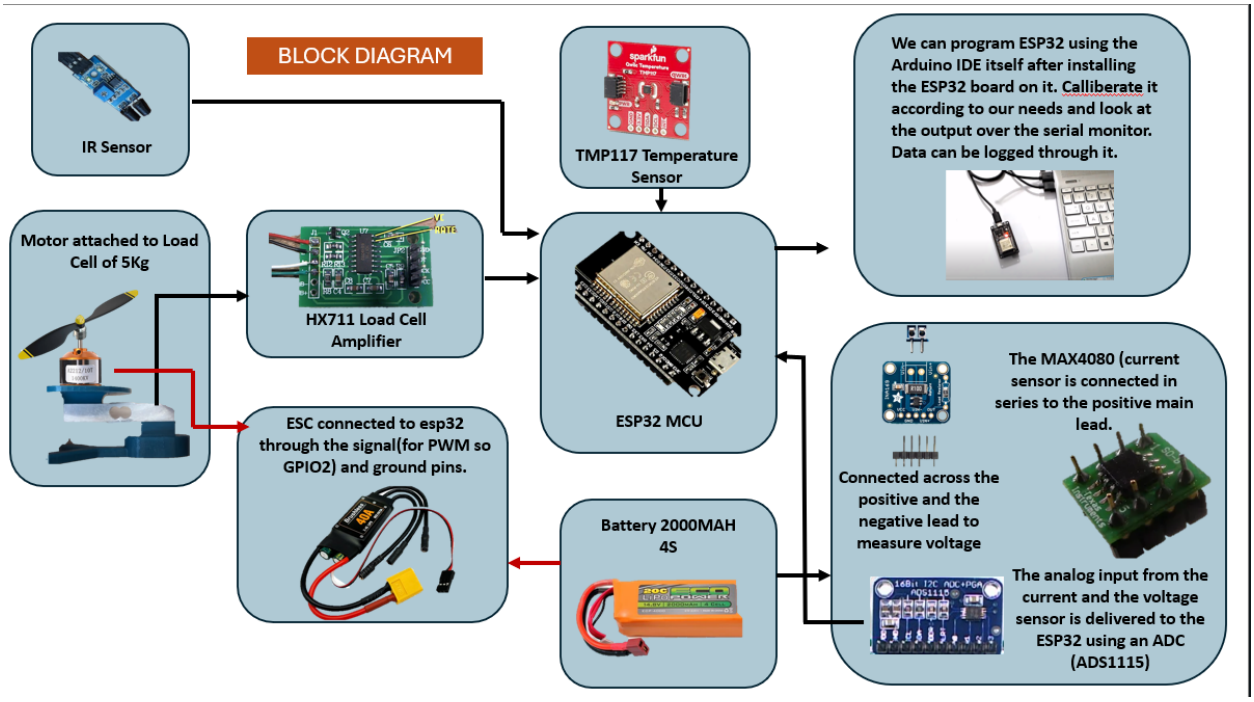
Electronics System for Thrust Test Stand

This report details the design and implementation of an electronics system for a thrust stand. The system measures parameters such as current, voltage, RPM, temperature, and thrust data for a brushless motor, using an ESP32 MCU for control and data logging. The system is powered by 2000MAH 4S 20C LiPo battery and interfaces with an ESC.

Block Diagram:



Components and Connections:

Battery

•Type: 4S 2000MAH LiPo battery

•Voltage Range: Up to 60V

Microcontroller

•Model: ESP32-S3

Sensors

1.Pressure Sensor:

•Model:HX711 with Load Cell (upto 5kg)

•Connection:

GND <--> GND (ESP32)

VCC <--> 3.3V (ESP32)

DT <--> GPIO 18 (ESP32)

SCK <--> GPIO 19 (ESP32)

2.Voltage Sensor:

•Model: NOYITO Analog Current Sensor Module based on INA169

•Connection:

IN+ <--> Positive lead of battery

IN- <--> Load side (after the shunt resistor)

OUT <--> AIN1 (ADS1115)

VCC <--> 3.3V or 5V (ESP32)

GND <--> GND (ESP32)

3.Current Sensor:

•Model:MAX4080S (Gain of 20V/V)

•Connection:

IN+ <--> Positive lead of battery

IN- <--> Load side (after the shunt resistor)

OUT <--> AIN0 (ADS1115)

VCC <--> 3.3V or 5V (ESP32)

GND <--> GND (ESP32)

4.RPM Sensor:

•Model:TSSP558038 IR Sensor

•Connection:

VCC <--> 3.3V (ESP32)

GND <--> GND (ESP32)

OUT <--> GPIO 34 (ESP32)

5.Temperature Sensor:

•Model:TMP117xxDRV

•Connection:

SDA <--> GPIO 21 (ESP32) for SDA

SCL <--> GPIO 0 (ESP32) for I2C_SCL

VCC <--> 3.3V (ESP32)

GND <--> GND (ESP32)

6.ESC:

•Battery Positive: Connect to battery positive terminal.

•Battery Negative: Connect to battery negative terminal.

GND < - - > GND (on esp32)

Signal < - - > GPIO2 (on esp32) for one of the PWM pins.

7.Load Cell to HX711

A typical load cell has four wires: red, black, white, and green

Connecting the Load Cell to HX711:

Red Wire (E+): Connect to E+ (VCC) on the HX711.

Black Wire (E-): Connect to E- (GND) on the HX711.

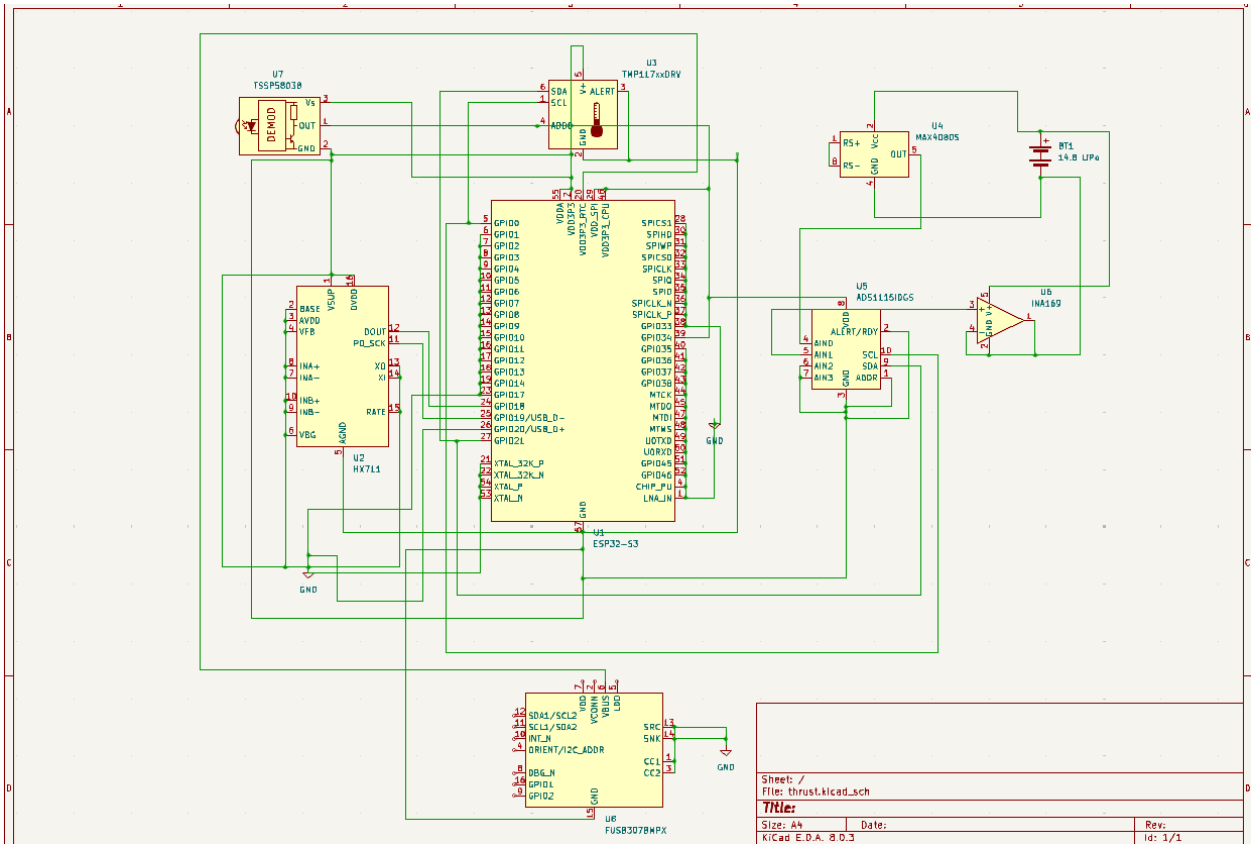
White Wire (S+): Connect to A+ on the HX711.

Green Wire (S-): Connect to A- on the HX711.

Data Logging:

Using ESP32's internal storage and sending data to a connected laptop running Arduino IDE after installing the ESP32 board onto it.

Schematic Design:



Please Note:

The Electronic Speed Controller (ESC) is not included in the system architecture due to technical constraints and time limitations. Therefore, the focus is solely on measuring and logging the specified parameters without direct motor control.

Implementation:

The ESP32 MCU is programmed to read data from the sensors and log this information to a connected laptop via the Arduino IDE. The data collected

includes voltage, current, RPM, temperature, and thrust, providing comprehensive insights into the performance of the brushless motor system.

Conclusion:

This system architecture ensures that all critical parameters are accurately measured and logged, providing valuable data for analysis and optimization of the thrust stand. The exclusion of the ESC does not hinder the primary objective of data acquisition and logging.