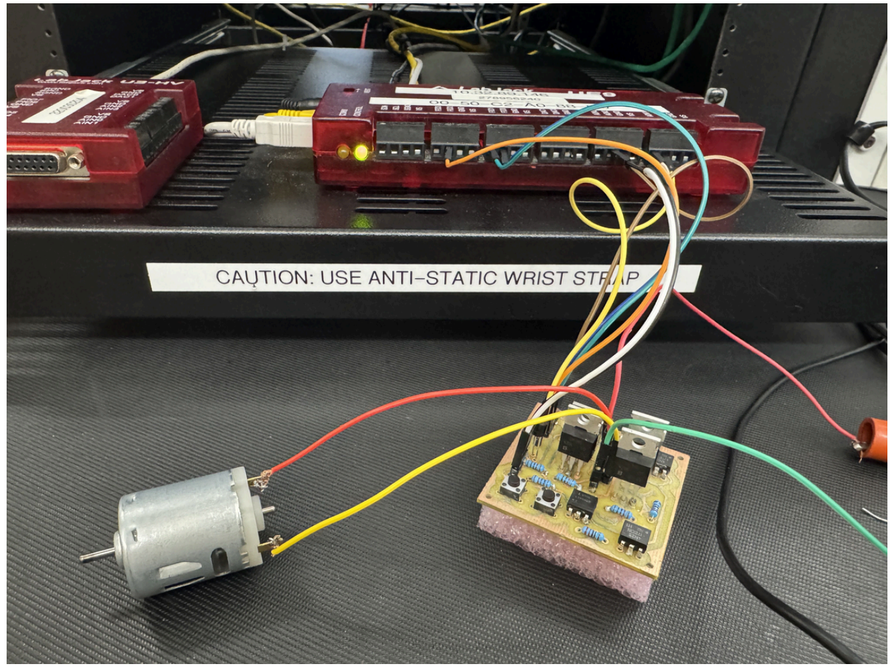
Motor Control and Emergency System Using LabJack UE9 and Python



Project Team

Team Members

- Lovepreet Singh (148872229)
- Saket Chahal (155140221)
- Hemant Vohra (149116220)
- Ankur Kashyap (149978223)

Introduction

Core Technology

Motor control is a core aspect of automation and robotics.

Safety Requirements

In critical applications, safety mechanisms like **emergency shutdowns** and **feedback monitoring** are essential.

Integrated Components

This project integrates:

- LabJack UE9 for analog/digital I/O
- Python interface for logic and display
- Emergency Stop and Reset buttons
- Temperature monitoring (TMP36 sensor)
- A custom PCB designed and fabricated by the team

Future Expansion

Designed to be **expandable** for future features like GUI and wireless control.

Abstract

Real-time DC Motor Control System

This project presents a real-time DC motor control system developed using the LabJack UE9 data acquisition module and Python.

User Control Features

The goal was to build a system that allows users to control motor **speed** and **direction** through a software-based PWM signal.

Safety Implementation

The system includes **safety features** such as an **Emergency Stop** and **Reset** button to handle fault conditions.

Hardware Design

A **custom PCB** was designed using MOSFETs and optoisolators for safe and efficient control.

Software Architecture

Python's **multithreading** enables non-blocking user control and real-time terminal feedback.

Validation

Tests confirmed accurate control, reliable emergency handling, and ease of use.

Problem Statement & Goals

Problem Statement

Develop a system to safely control a DC motor's speed and direction using LabJack UE9 and Python with built-in emergency handling and real-time monitoring.

Project Goals

- Speed and direction control using PWM
- Emergency shutdown via AIN1
- Reset mechanism via AIN2 (hold for 2s)
- Live temperature monitoring (AIN0)
- Real-time terminal UI using Python
- Custom-built, cost-efficient PCB

System Overview

LabJack UE9 Interface

Controls digital outputs and reads analog sensor data. Interfaces with emergency, reset, and temperature sensors.

Sensors & Switches

TMP36: measures ambient temperature. Pushbuttons: Emergency Stop & Reset

Python Software (Multithreaded)

Accepts user input, sends PWM signals, monitors sensors, displays real-time system status

Custom PCB

Contains optoisolators, MOSFETs, connectors. Provides electrical isolation and motor power handling

Circuit Schematic

Full System

Showing LabJack UE9 connected to analog sensors, digital outputs, and motor control components

Component

Emergency and reset button circuit, temperature sensor , MOSFETs controlling motor power

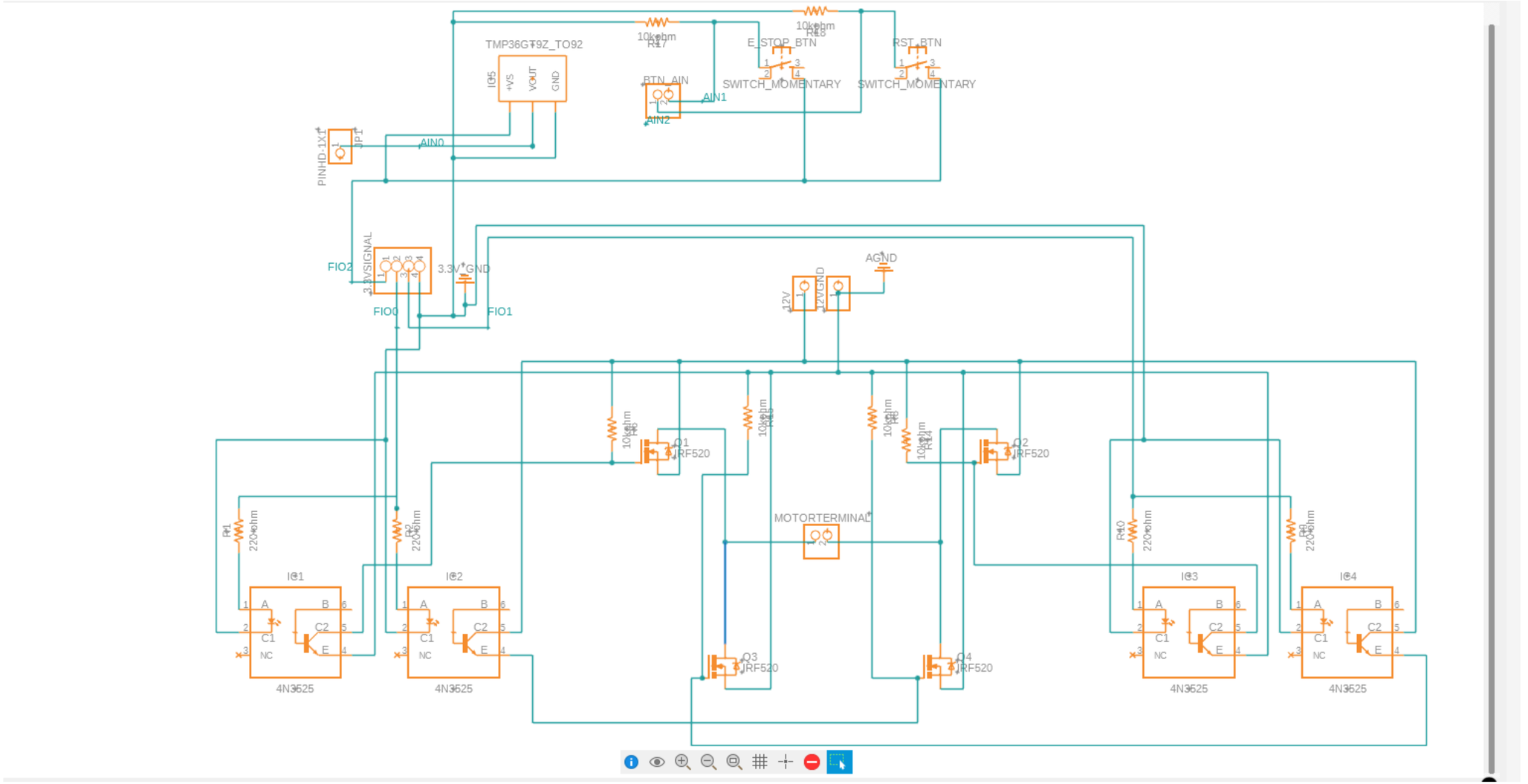
Safety

Optical isolation used for protecting LabJack from high-current spikes

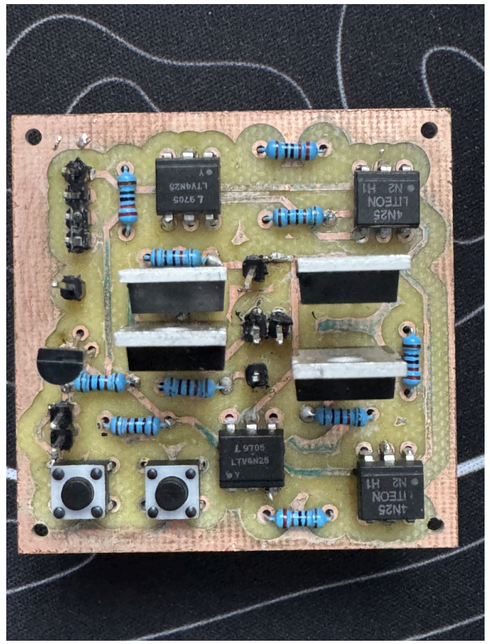
Validation

Schematic created and tested using breadboard before PCB layout

Schematic

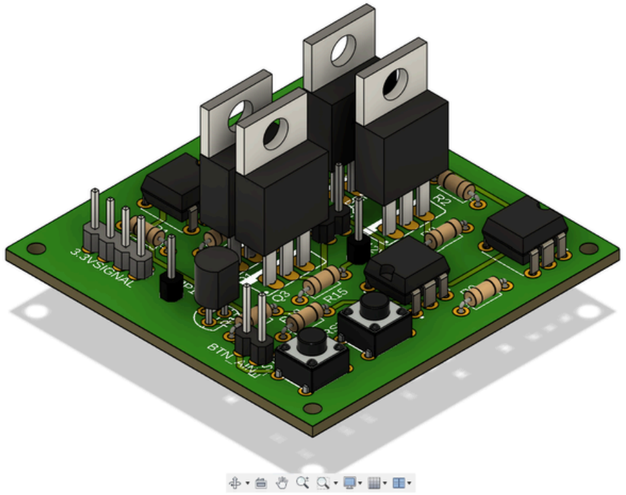

TMP36GT9Z_TO92
10kohm
R17
10kohm
R18
E_STOP_BTN
RST_BTN
SWITCH_MOMENTARY
SWITCH_MOMENTARY
BTN_AIN
AIN1
AIN2
AIN0
PINHD-1X1
JP1
FIO2
3.3VSIGNAL
3.3V
GND
FIO0
FIO1
AGND
12V
12VGND
Q1
IRF520
Q2
IRF520
Q3
IRF520
Q4
IRF520
MOTORTERMINAL
R1
220ohm
R2
220ohm
R10
220ohm
R11
220ohm
IC1
IC2
IC3
IC4
4N35
4N35
4N35
4N35

PCB Design



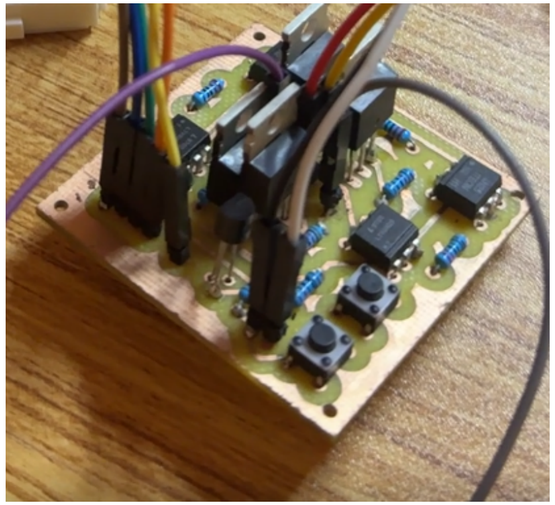
Top View

Clear trace routing to reduce noise and cross-talk. Component silkscreens labeled for easy assembly



3D Render

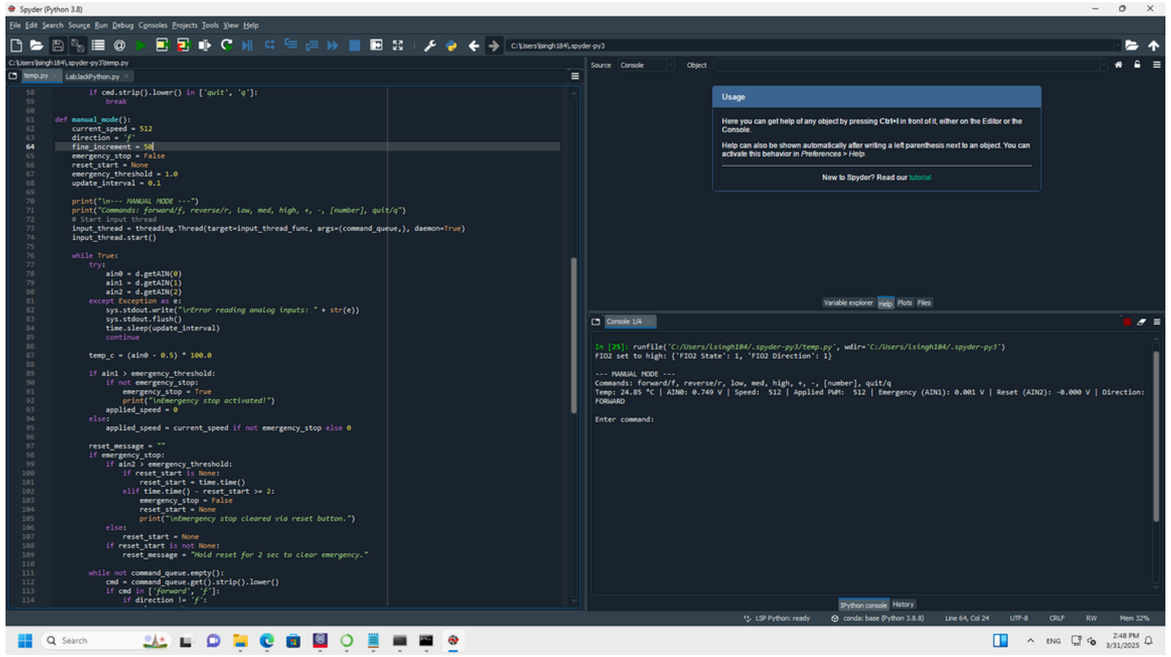
Visual of all mounted components: optos, MOSFETs, connectors. Final board simulated before printing



Completed

PCB printed and soldered manually. Components sourced with cost-efficiency in mind

Python Terminal



User Interface

Simple, responsive interface built in Python using multithreading

Command Support

forward/f, reverse/r, speed presets, manual entry (0-1023), quit/q

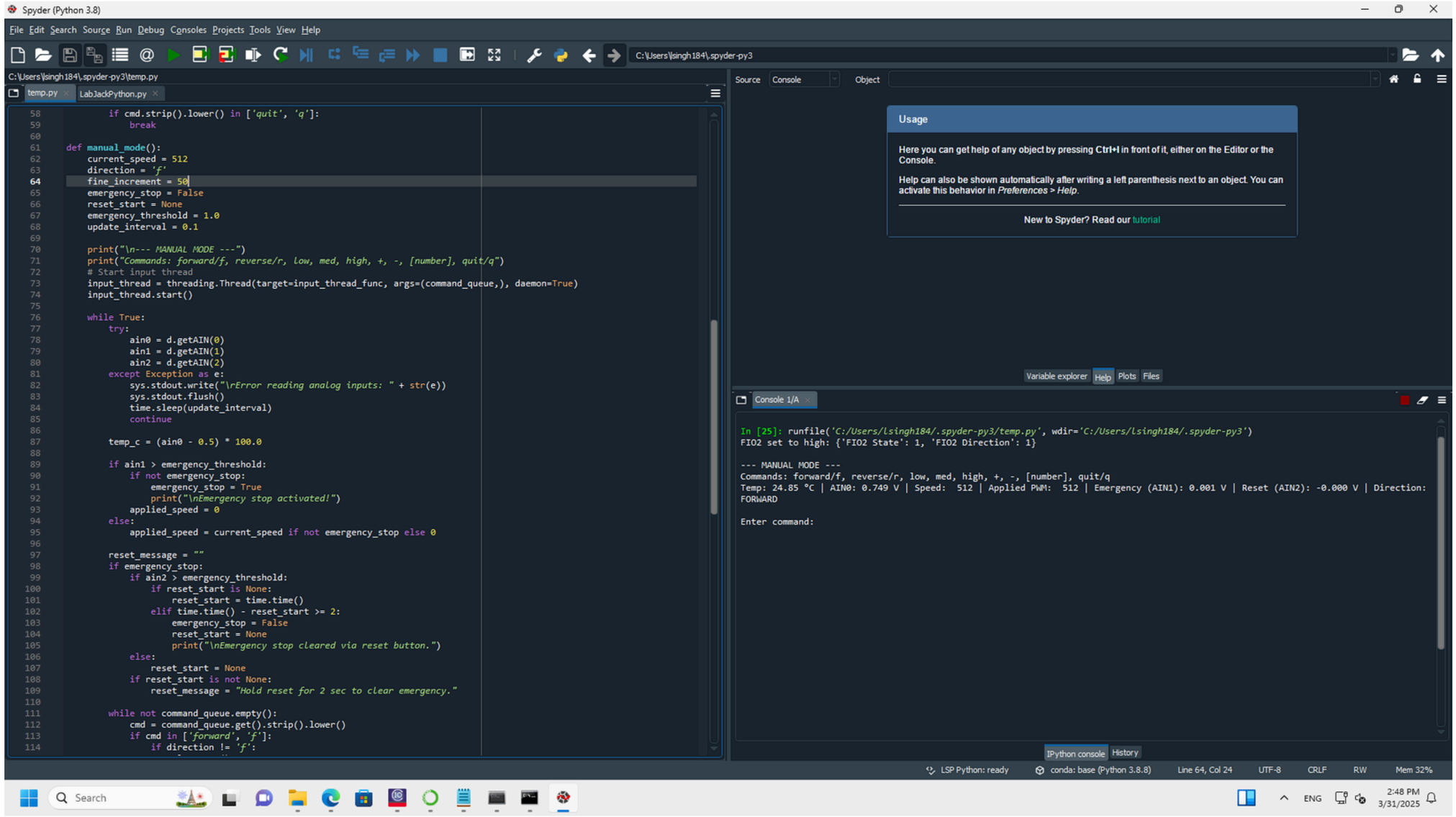
Real-time Display

Shows current speed, temperature, emergency status, reset confirmation

Compatibility

No GUI required; can run on any basic terminal

Code / Console



Results & Testing

Test Type	Result
Speed Control	0–1023 worked accurately
Direction Reversal	Safe reversal with 0.8s delay
Emergency Button	Immediate PWM stop
Reset Button	Restored function after 2s hold
Temperature Monitoring	Real-time updates on terminal

Performance Summary:

- Stable operation under long runtime
- Responsive to user input even during active loops
- All features worked in lab demonstration (A4070)

Team Member Contribution

Lovepreet Singh (148872229)

- Circuit testing and breadboard prototyping
- Assisted in final PCB assembly and soldering
- Emergency and reset switch circuit validation

Saket Chahal (155140221)

- Python code development with multithreading
- Integrated terminal interface with LabJack UE9
- Document formatting and project report compilation

Hemant Vohra (149116220)

- Designed PCB layout and component placement
- Managed BOM, sourced components
- Led lab testing and safety mechanism verification

Ankur Kashyap (149978223)

- Prepared schematics and 3D PCB rendering
- Coordinated team meetings and task allocation
- Final presentation creation and dry-run lead

References

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Digi-Key Electronics. (n.d.). Digi-Key Electronics – Electronic Components Distributor. https://www.digikey.ca/?msockid=2f1c1869837a652f17000d268241647d

LabJack. (n.d.). Data Acquisition Systems | LabJack DAQ Systems Analog & Digital I/O. https://labjack.com/