



**Gyr Falcon IntelliEdge Solutions**  
DIGITIZE, DIGITALIZE, AUTOMATE

# INTERNSHIP TASKS

BY  
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# PROJECT TITLES:



- 1.Designing a PCB design USB connectivity with the intergration of sensors like pressure, temperature,MQ3.
- 2.Designing the circuit to measure AQI and find sensors for parameters ,integrating with ESP32.

# PROJECT 1:



- Build a USB-C powered PCB using STM32 (LQFP48) MCU and LD1117-3.3 V regulator.
- Instead of onboard sensors, expose pin headers/connectors for external modules.
- Challenges: ensure clean power, stable USB communication, and flexible expansion through pins.

# DEVELOPMENT:



- USB-C 2.0 Connector with CC resistors, ESD diodes.
- Pins to Break out I2C, SPI, ADC, UART, and GPIO to headers for external sensors/modules.
- 4-layer PCB, solid ground plane, differential routing for USB, decoupling near pins.

# MY UNDERSTANDING :

- Learned how to design a USB-C powered PCB with STM32 (LQFP48) and LD1117-3.3 V regulator.
- Understood the importance of clean power, USB stability, and proper grounding/layout.
- Realized that exposing pin headers/connectors gives flexibility to attach external modules instead of fixed sensors

# KEY COMPONENTS:



## STM32F103C8T6 (Blue Pill, LQFP48)

1. The STM32F103C8T6 is an ARM Cortex-M3 microcontroller running at 72MHz with 64 KB Flash and 20 KB SRAM.
2. The LQFP48 package provides 37 GPIOs for flexible peripheral mapping and expansion.

## LD1117 (DPAK, 3.3V Regulator)

1. The LD1117 is a low-dropout linear regulator that provides a fixed 3.3V output.
2. It can supply up to about 800 mA with a dropout voltage of ~1.1V.

## USB-C Receptacle (USB2.0, 14-pin)

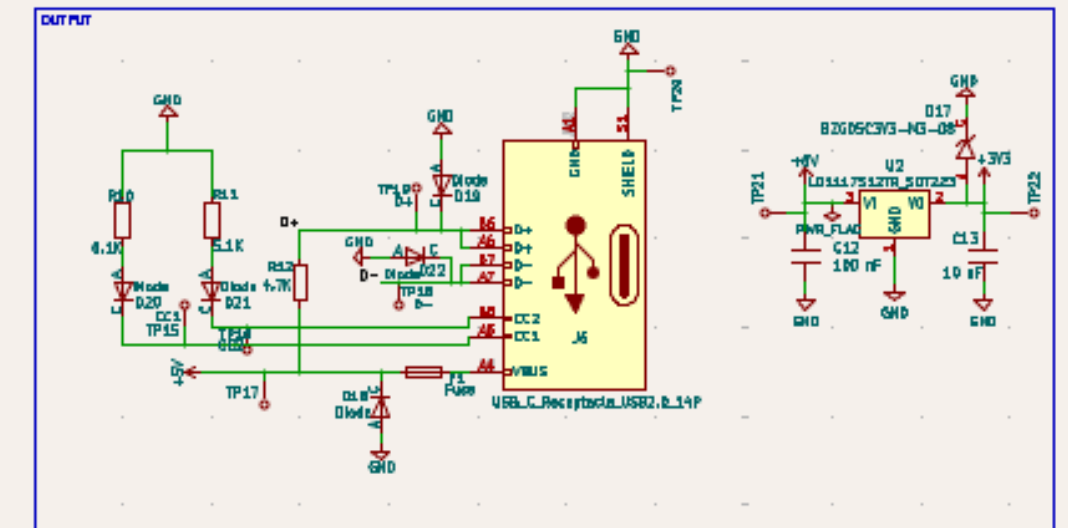
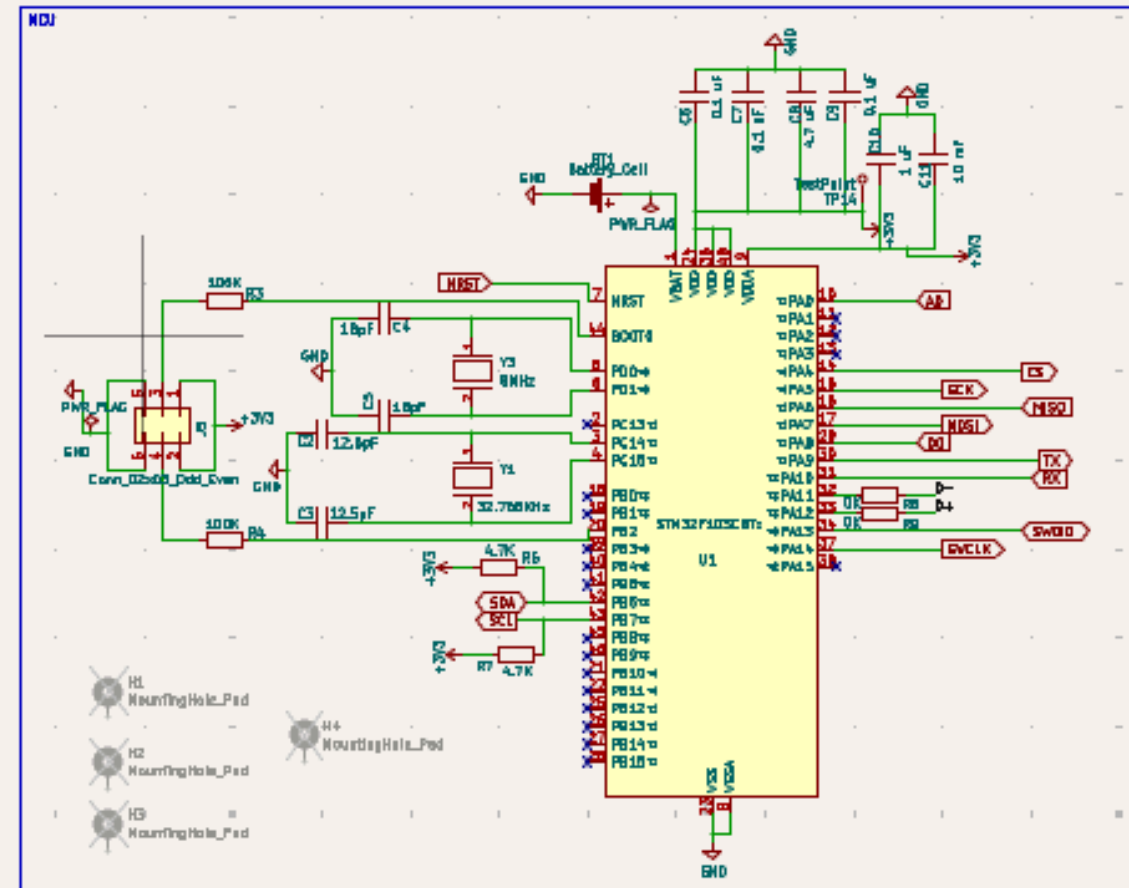
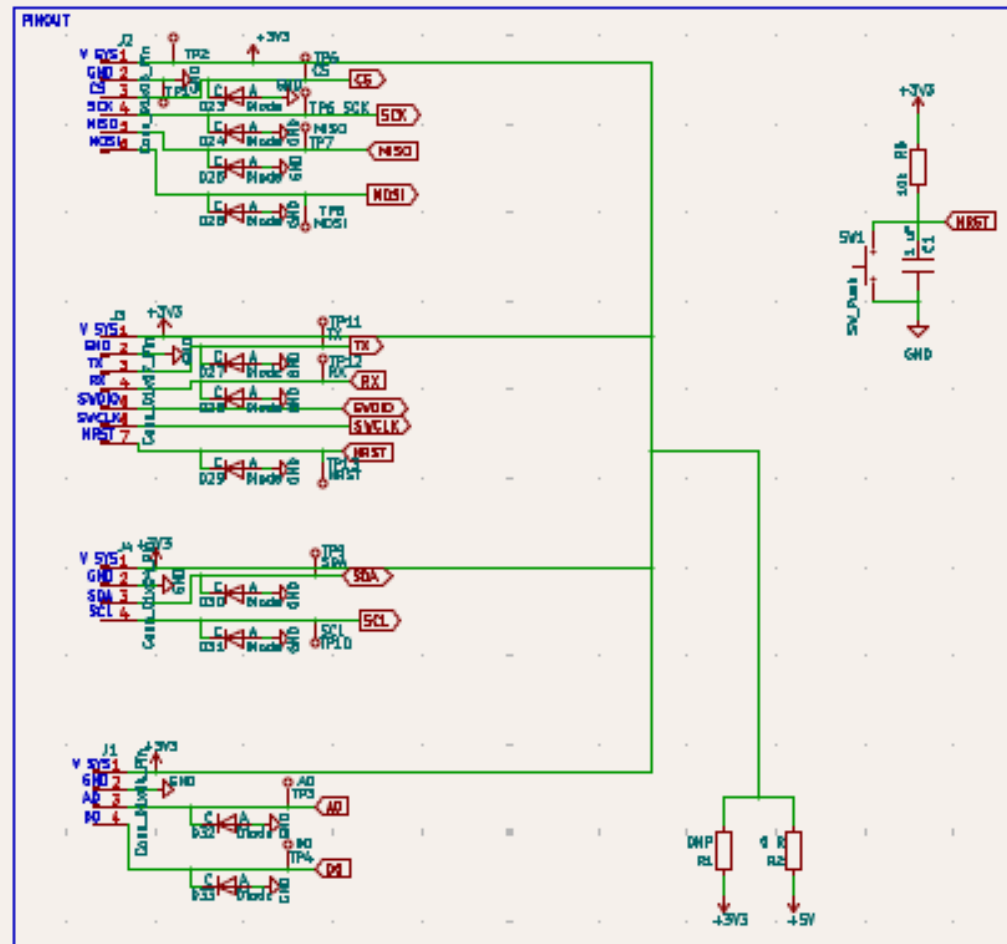
1. The USB-C receptacle uses VBUS, D+, D-, GND, and CC pins for USB 2.0 connectivity.
2. Pull-down resistors of 5.1 k $\Omega$  on CC1 and CC2 are needed to signal device mode.



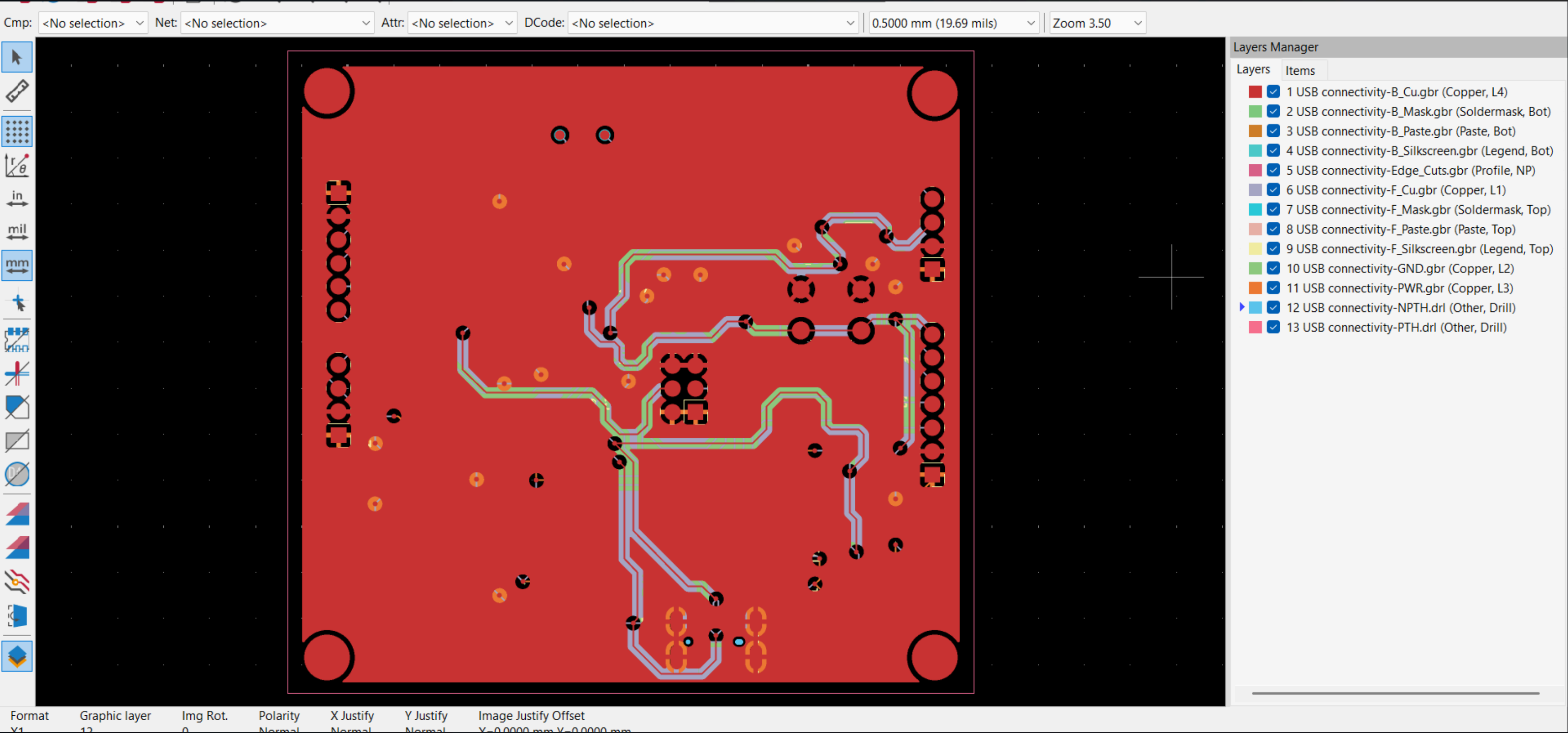
# SCHEMATIC DIAGRAM:



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# GERBER FILES:





# BENEFITS:



- USB-C gives modern, reversible, and easy-to-use connectivity.
- LD1117 provides a stable 3.3 V supply from the 5 V USB input.
- STM32F103C8T6 supports direct USB communication with a PC.
- The design is robust, and reliable.

# PROJECT 2:



- Monitors environmental conditions (temperature, humidity, pressure, altitude) and harmful gases (CO<sub>2</sub>, NH<sub>3</sub>, alcohol, benzene, LPG).
- Uses ESP32 with BME688 and MQ sensors to estimate AQI and provide real-time readings.

# DEVELOPMENT:



- An ESP32-based system integrates environmental and gas sensors to monitor air quality in real time.
- It detects pollutants like CO<sub>2</sub>, NH<sub>3</sub>, alcohol, benzene, LPG.
- The readings are processed into Air Quality Index (AQI) values and categories.
- Health for applications in smart cities, industrial safety, and sustainability.

# MY UNDERSTANDING :



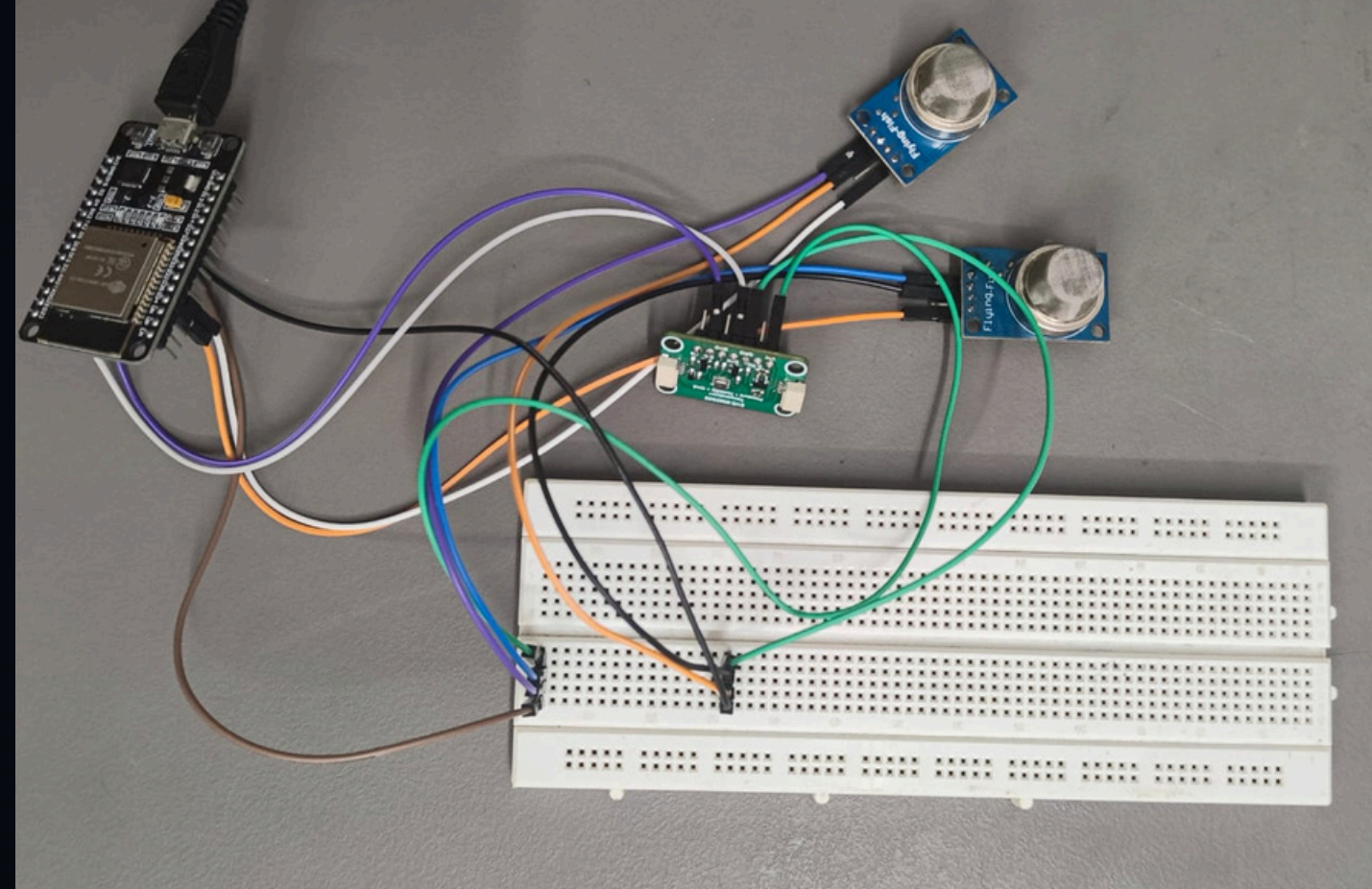
- Learned how to integrate multiple sensors on ESP32.
- Understood calibration for gas sensors.
- Gained experience in AQI calculation and environmental data analysis.

# KEY COMPONENTS:



- ESP32 microcontroller – the main controller that reads sensors and processes data.
- MQ-135 sensor – detects gases like CO<sub>2</sub>, NH<sub>3</sub>, alcohol, and benzene.
- MQ-2 sensor – detects LPG and other combustible gases.
- Power supply (USB-C / regulated 3.3V) – ensures stable operation of ESP32 and sensors.
- Software libraries – MQUnifiedSensor for MQ sensors, plus AQI mapping functions.

# PROTOTYPE:



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# RESULT:

```
aqi.ino
9  #define Voltage_Resolution 3.3
10 #define ADC_Bit_Resolution 12
11
12 // MQ-135 on GPIO34
13 #define PinMQ135 34
14 #define TypeMQ135 "MQ-135"
15
16 // MQ-2 on GPIO35 (choose another ADC pin)
17 #define PinMQ2 35
18 #define TypeMQ2 "MQ-2"
19 #define RatioMQ2CleanAir 9.83
20
21 MQUnifiedsensor MQ135(Board, Voltage_Resolution, ADC_Bit_Resolution, PinMQ135, TypeMQ135);
22 MQUnifiedsensor MQ2(Board, Voltage_Resolution, ADC_Bit_Resolution, PinMQ2, TypeMQ2);
23
24 /***** AQI Helpers (MQ Sensors) *****/
25 String getAQICategory_CO2(float ppm) {
26   if (ppm <= 400) return "Excellent";
27   else if (ppm <= 1000) return "Good";
28   else if (ppm <= 2000) return "Moderate";
29   else if (ppm <= 5000) return "Poor";
30 }
31
32 void setup() {
33   Serial.begin(115200);
34 }
35
36 void loop() {
37   float CO2eq = MQ135.read();
38   float NH3 = MQ2.read();
39   float AQI = getAQICategory_CO2(CO2eq);
40   Serial.print("==== Combined Sensor Readings =====");
41   Serial.println();
42   Serial.print("-- BME688 Data --");
43   Serial.println();
44   Serial.print("Temperature: ");
45   Serial.print(temperature);
46   Serial.print(" °C");
47   Serial.println();
48   Serial.print("Pressure: ");
49   Serial.print(pressure);
50   Serial.print(" kPa");
51   Serial.println();
52   Serial.print("Humidity: ");
53   Serial.print(humidity);
54   Serial.print(" %");
55   Serial.println();
56   Serial.print("AQI (BME): ");
57   Serial.print(AQI);
58   Serial.println();
59   Serial.print("Altitude: ");
60   Serial.print(altitude);
61   Serial.print(" m");
62   Serial.println();
63   Serial.print("-- MQ Sensor Data --");
64   Serial.println();
65   Serial.print("MQ-135 -> CO2eq: ");
66   Serial.print(CO2eq);
67   Serial.print(" ppm | AQI: ");
68   Serial.print(AQI);
69   Serial.println();
70   Serial.print("MQ-135 -> NH3: ");
71   Serial.print(NH3);
72   Serial.print(" ppm | ");
73   Serial.println();
74 }
```

Output Serial Monitor X

Message (Enter to send message to 'LilyGo T-Display' on 'COM6')

New Line 115200 baud

```
==== Combined Sensor Readings =====
-- BME688 Data --
Temperature: 30.03 °C
Pressure: 100.92 kPa
Humidity: 53.27 %
AQI (BME): 74.23
Altitude: 33.60 m
-- MQ Sensor Data --
MQ-135 -> CO2eq: 7213.06 ppm | AQI: Hazardous
MQ-135 -> NH3: 3781.38 ppm |
```



# BENEFITS:



- It continuously tracks temperature, humidity, pressure, altitude, and harmful gases, giving instant awareness of air quality.
- It combines BME688 with MQ-135 and MQ-2, so one system can measure both environmental conditions and pollutants.

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**THANK YOU**

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