



Gyrfalcon IntelliEdge Solutions
DIGITIZE, DIGITALIZE, AUTOMATE

INTERNSHIP TASKS

BY
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PROJECT TITLES:



- 1.Designing a PCB design USB connectivity with the integration 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.



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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 800mA with a dropout voltage of ~1.1V.

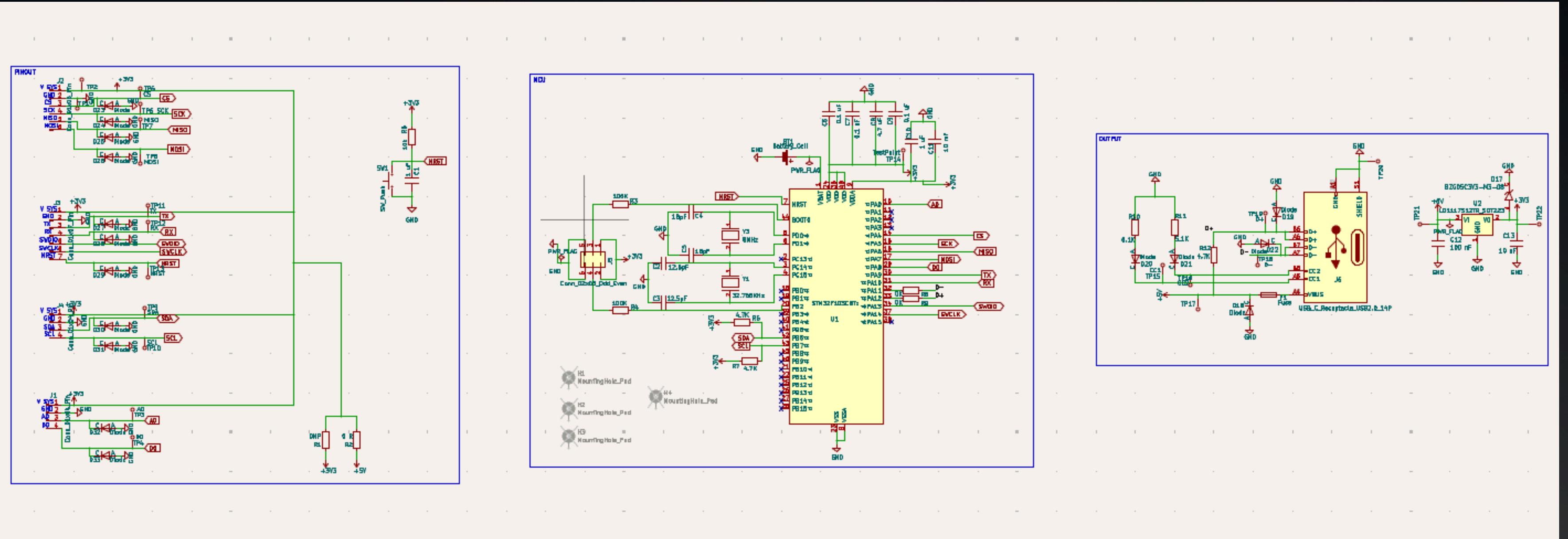
USB-C Receptacle (USB2.0, 14-pin)

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

SCHEMATIC DIAGRAM:



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GERBER FILES:



Cmp: <No selection> Net: <No selection> Attr: <No selection> DCode: <No selection> 0.5000 mm (19.69 mils) Zoom 3.50

Layers Manager

Layers	Items
1	1 USB connectivity-B_Cu.gbr (Copper, L4)
2	2 USB connectivity-B_Mask.gbr (Soldermask, Bot)
3	3 USB connectivity-B_Paste.gbr (Paste, Bot)
4	4 USB connectivity-B_Silkscreen.gbr (Legend, Bot)
5	5 USB connectivity-Edge_Cuts.gbr (Profile, NP)
6	6 USB connectivity-F_Cu.gbr (Copper, L1)
7	7 USB connectivity-F_Mask.gbr (Soldermask, Top)
8	8 USB connectivity-F_Paste.gbr (Paste, Top)
9	9 USB connectivity-F_Silkscreen.gbr (Legend, Top)
10	10 USB connectivity-GND.gbr (Copper, L2)
11	11 USB connectivity-PWR.gbr (Copper, L3)
12	12 USB connectivity-NPTH.drl (Other, Drill)
13	13 USB connectivity-PTH.drl (Other, Drill)

Format Graphic layer Img Rot. Polarity X Justify Y Justify Image Justify Offset
Y1 12 0 Normal Normal X: 0.0000 mm Y: 0.0000 mm

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:



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- Monitors environmental conditions (temperature, humidity, pressure, altitude) and harmful gases (CO_2 , NH_3 , 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 CO₂, NH₃, 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.



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MY UNDERSTANDING :

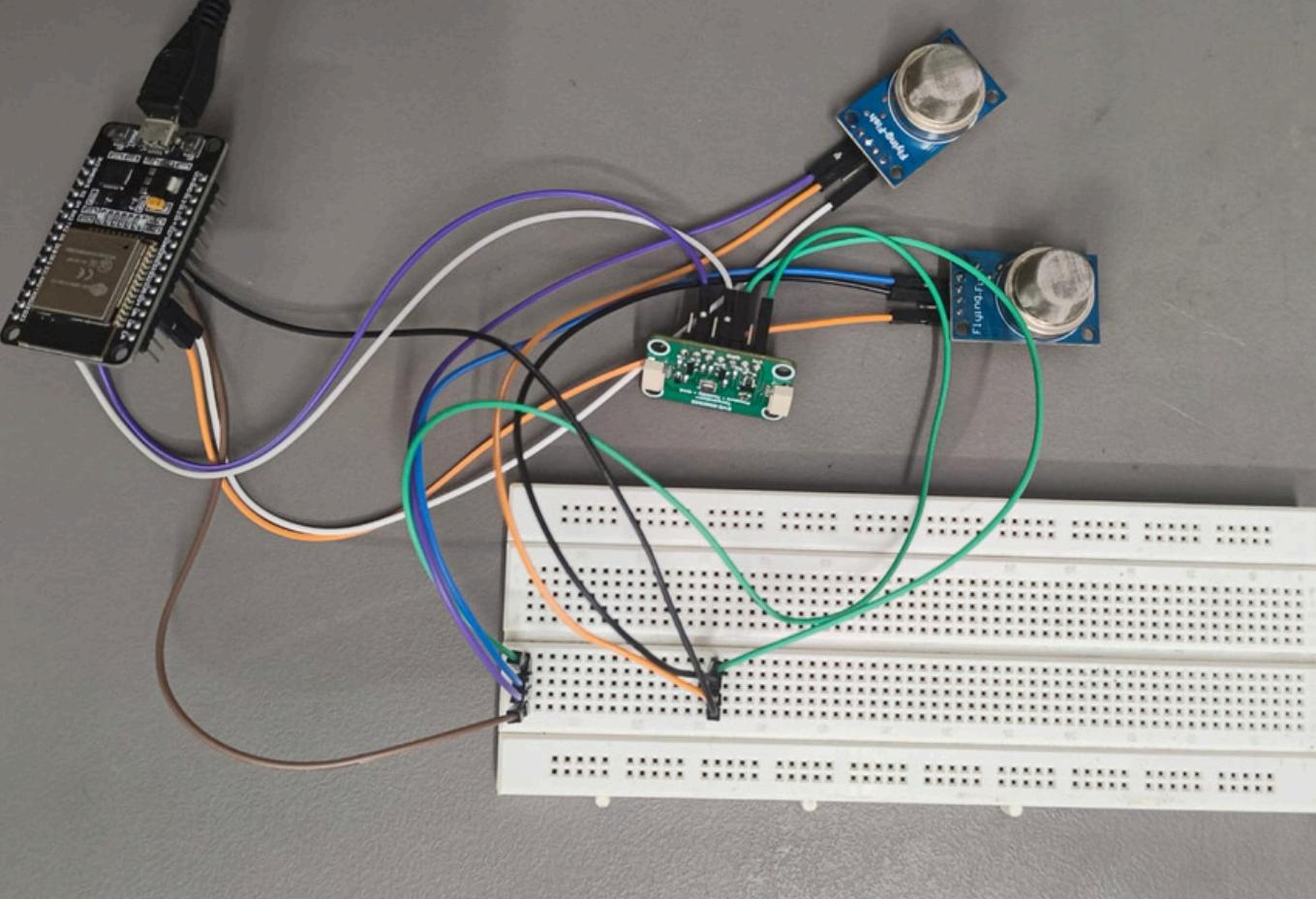
- Learned how to integrate multiple sensors on ESP32.
- Understood calibration for gas sensors.
- Gained experience in AQI calculation and environmental data analysis.

KEY COMPONENTS:



- ESP32 microcontroller - the main controller that reads sensors and processes data.
- MQ-135 sensor - detects gases like CO₂, NH₃, 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:

The screenshot shows the Arduino IDE interface with the file 'aqi.ino' open. The code defines pins for MQ-135 and MQ-2 sensors and includes a function to map CO2 levels to AQI categories. The Serial Monitor displays combined sensor readings for BME688 (Temperature: 30.03 °C, Pressure: 100.92 kPa, Humidity: 53.27 %, AQI (BME): 74.23) and MQ-135 (Altitude: 33.60 m, CO2eq: 7213.06 ppm, NH3: 3781.38 ppm).

```
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.CO2();
38   float NH3 = MQ2.NH3();
39
40   String CO2eqString = String(CO2eq);
41   String NH3String = String(NH3);
42
43   String CO2eqCategory = getAQICategory_CO2(CO2eq);
44
45   String combinedData = "CO2eq: " + CO2eqString + " ppm | AQI: " + CO2eqCategory;
46   String combinedData2 = "NH3: " + NH3String + " ppm | ";
47
48   Serial.println(combinedData);
49   Serial.println(combinedData2);
50 }
```

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

THANK YOU
