

Air Quality Monitoring System

Introduction to the project

Problem

In the present world, Air pollution is a significant environmental issue that affects many regions and countries around the world. It can be generalized as the presence of harmful pollutants in the air, or the presence of gas components and dust particles more than the recommended amount. Air pollution has a great impact on humans, leading to many conditions like respiratory diseases and also affecting the environment.

Solution

We are planning to build an Industrial Air Quality Monitoring System. It monitors and measures the level of pollutants and other harmful substances in the air. It consists of various sensors and instruments that detect the presence of gasses and particulate matter in the surrounding environment. These systems are essential for monitoring air quality and providing accurate data to help understand the level of pollution and its impacts on human health and the environment. In our project the sensors detect the substances of the air and ESP8266/ESP32 communicates with those sensors and send the collected data from the sensor to a central MQTT Broker and the actuators consume those data and indicate the severity of air pollution with LED indicator and also a buzzer. This module can be installed in various settings, including indoor and outdoor environments.

Hardware Components

ESP8266 CH340 NodeMCU Wi-Fi Module



NodeMCU is an IoT Module based on the ESP8266 wifi Module.

PROCESSOR :Tensilica LX106

CLOCK FREQUENCY : 80 - 160 MHz

RAM :64 kB

DATA STORAGE :96 kB

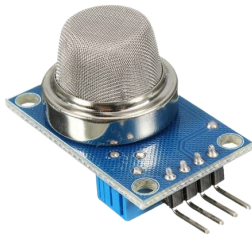
FREQUENCY :2,4 GHz

DATA INTERFACES :UART / I2C / PWM / GPIO

OPERATING VOLTAGE:3.0 - 3.6 V (operable via 5V-microUSB)

OPERATING CURRENT: 80 mA

MQ 135-Air Quality Sensor



The MQ-135 Gas sensor can detect gasses like Ammonia (NH₃), sulfur (S), Benzene (C₆H₆), CO₂, and other harmful gasses and smoke. Similar to other MQ series gas sensors, this sensor also has a digital and analog output pin. When the level of these gasses go beyond a threshold limit in the air the digital pin goes high. This threshold value can be set by using the on-board potentiometer. The analog output pin, outputs an analog voltage which can be used to approximate the level of these gasses in the atmosphere, the resistance of the sensing element changes as the concentration of gasses changes. The MQ135 air quality sensor module operates at 5V and consumes around 150mA.

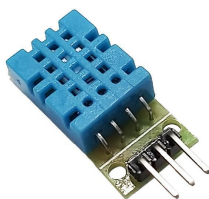
The ESP32 must be linked to the MQ-135 sensor's analog output pin in order to read data from the device. With the help of the ESP32's analog-to-digital converter (ADC), it is possible to measure the voltage output from the sensor, which is proportional to the concentration of the gas being detected. The concentration of the gas can then be determined by the ESP32 using this information and a calibration curve.

The ESP32 must be linked to the MQ-135 sensor's digital pins in order to change the sensor's parameters. These pins are used to control the sensor's sensitivity as well as power the heating element.

Standard detecting condition = 5V \pm 0.1V

For safe threshold value adjustment potentiometer range = 10k - 47k (In temperature 20 C Humidity: 65%, O₂ concentration 21%, RL = 20k)

DHT 11 Sensor



DHT11 is a low-cost digital sensor for sensing temperature and humidity instantaneously. The sensor uses a capacitive humidity sensor and thermistor-based temperature sensor to measure the temperature and humidity of the air around it. The temperature range is 0 to 50 degrees Celsius with a 2°C accuracy, while the humidity range is 20% to 90% with a 5% accuracy. The

sample interval for this sensor is almost two seconds. This temperature and humidity sensor uses digital pins to communicate with the microcontroller.

The data packet sent by the DHT11 sensor to the ESP32 contains 40 bits of data, including a start signal, 16 bits of humidity data, 16 bits of temperature data, and a checksum. This packet must be decoded by the ESP32 in order to obtain the temperature and humidity data. The data pin to which the DHT11 sensor is connected, the type of data required (temperature, humidity, or both), and the amount of time between measurements are all variables that can be configured. The DHT library's library functions can be used to set these parameters.

Operating Voltage = 3.3 V to 5.5 V DC

Maximum current in Measuring = 1.5 mA

For safety, Load Resistor = 1k

So, Voltage drop = $1k \times 1.5mA = 1.5V$

So, Actual Operational voltage = $5V - 1.5V = 3.5V$

3.7V to 5V Step-Up Boost Converter Module



This is a ready-made electronic module that can convert a lower input DC voltage of 3.7V to a higher output DC voltage of 5V. This is used to give 5V to the sensors used from the voltage gained from the ESP32 board.

LED indicator



A standard 5mm LED that can be used for indication or visualization purposes. The longer lead is the positive and the shorter lead is the negative. Normally used with a 1k resistor to limit the current flowing through it when powered with 5V.

In this project we plan to use three LEDs with green, yellow and red colors to indicate the measurement of the air pollution.

Forward current = 20mA

Forward voltage drop = 1.5V - 2V

$$R_L = (5V - 1.5V) / 20mA$$
$$R_L = 225 \text{ ohms}$$

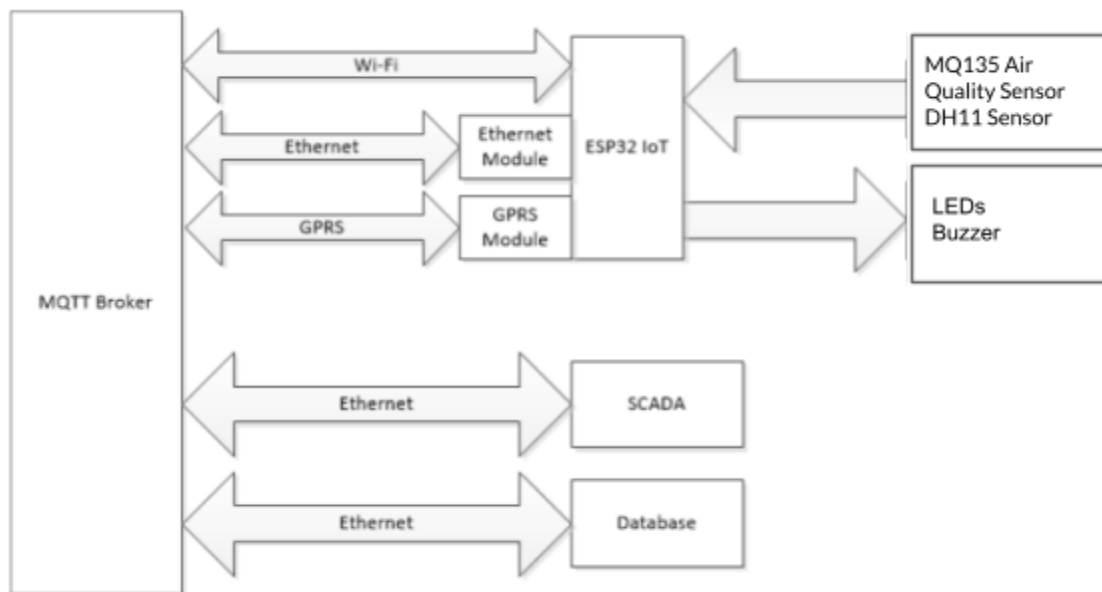
Buzzer



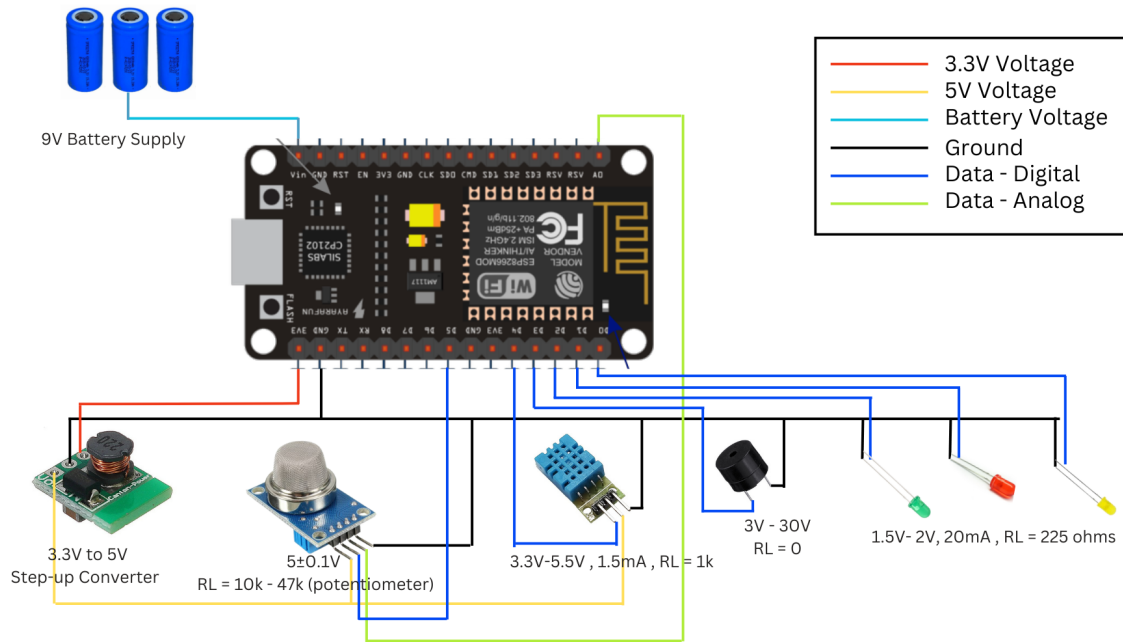
This is a small PCB Mountable 5V Passive Buzzer. It is great to add Audio Alert to your electronic designs. It operates on 5V supply, uses a coil element to generate an audible tone.

Piezo Buzzer can handle voltages from 3V to 30V without DC bias.

Basic Design Diagram



Circuit Diagram



Budget

Component	Quantity	Cost (Rs.)
NodeMCU ESP8266	1	1850
MQ 135-Air Quality Sensor	1	550
DHT 11 Sensor	1	350
3.7V to 5V Step up Converter	1	200
Buzzer	1	60
LED	3	15
Jumper wires 1*40	1	220
Breadboard	1	300
Resistors	10	10
3.7V Battery	3	1230
Total		4785

References

Data Sheets:-

[NodeMCU ESP8266](#)

[MQ 135-Air Quality Sensor](#)

[DHT 11 Sensor](#)

[ESP-12F wifi module](#)

[Piezo Buzzer](#)

<https://www.circuits-diy.com/mq135-air-quality-smoke-gas-sensor/>

[https://how2electronics.com/power-supply-for-nodemcu-with-battery-charger-boost
r/](https://how2electronics.com/power-supply-for-nodemcu-with-battery-charger-boost-r/)