IOT Based City Pollution Monitoring

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Abstract: - In this paper, we will create an IOT-based City Pollution Monitoring System that will monitor Air Quality over a web server utilizing an ESP8266 Wi-Fi device, Google Firebase Real-time Database, and a React Application. The application will visualize data stored in a Firebase Real-time Database and display a certain number of different gases in the surrounding environment, indicating the number of dangerous gases such as CO2 present in the air. It will display the air quality in PPM (parts per million) on the webpage as "Fresh Air," "Poor Air," and "Danger Air" so that we can easily monitor it. This study presents an open platform for a Wi-Fi-enabled interior air quality monitoring and control system that may be built into a' smart building' structure. This system's comprehensive software and hardware design, as well as a Number of control experiments, are described. The suggested system uses the MQTT protocol to communicate over an existing Wi-Fi wireless network. It has the ability to monitor interior air quality as well as control an air purifier to regulate particulate matter concentrations. The usefulness of the proposed design is demonstrated by the experiment results in a real-world office setting.

Key Words: — *IoT, Pollution Monitoring, MQTT protocol.*

I. INTRODUCTION

Because of the increase in the number of vehicles and the time spent on industrialization and urbanization, air pollution has become one of the major challenges today. This increase in pollution has negative effects for prosperity. This project demonstrates how to design and implement an Air Pollution Detection System. The invention here is a practical application of the Internet of Things concept. This extensive effort is an investigation into the consumption possibilities of this breakthrough in a world where natural well-being is becoming a true threat. The project is realized with the Arduino microcontroller board. An IOT device is a device that has the capacity to receive or send data and can connect with networks.

Manuscript revised April 24, 2022; accepted April 25, 2022.
Date of publication April 27, 2022.
This paper available online at www.ijprse.com
ISSN (Online): 2582-7898; SJIF: 5.59

It can communicate through the internet and other networks to an analyse, store, and process data on that network or in the cloud, and reap the advantages. These devices use extremely minimal power and resources, and they claim to deliver the solution in the most cost-effective manner feasible without compromising system accuracy.

II. LITERATURE REVIEW

As a result of this convergence, traditional businesses' IOT applications are more flexible, and technology will open doors for new developing sectors and provide new enhanced services, such as

[1] A Wi-Fi-enabled interior air quality monitoring and management system that might be implemented into a 'smart building' framework as an open platform. This system's comprehensive software and hardware design, as well as a number of control experiments, are described. The suggested system uses the MQTT protocol to communicate over an existing WiFi wireless network.

[2] LoRa Wireless Communication technology-based low-power real-time air quality monitoring system. The suggested system may be set up in a sensor network in the monitoring

region in large numbers. A single-chip microprocessor, various air pollution sensors (NO2, SO2, O3, CO, PM1, PM10, PM2.5), a Long Range (LoRa) -Modem, a solar PV-battery portion, and a graphical user interface are all included in the system (GUI).

[3] an Internet-of-Things-based indoor air quality monitoring device for detecting ozone levels near a photocopier. Near a high-volume photocopier, an experimental device with a semiconductor sensor capable of measuring ozone concentrations was mounted. The IOT device is set to collect and send data every five minutes over Bluetooth to a gateway node, which then connects with the processing node via the Wi-Fi local area network.

[4] The creation of a wireless monitoring system that may be installed in a structure. Carbon dioxide, carbon monoxide, and temperature are all measured by the system. The system described in this study may be used as a monitoring component of an HVAC control system as well as a standalone indoor air quality monitor.

2.1 Current System:

We discovered that the present air quality monitoring system makes use of Raspberry Pi, DSM501A sensor, MQ9 sensor, DHT22 sensor, and MQ135 sensor, all of which are connected to the internet of things. For establishing communication between sensors and clients, the MQTT protocol is employed. Platforms like as Node RED and IBM Blue mix are also developed. The numbers are then tracked on the IBM Blue Mix dashboard.

2.2 System Implementation:

To control and monitor the temperature and humidity of the storage environment. We'll utilize a DC motor as a cooling device to manage the temperature. The DHT11 sensor module is used to determine temperature and humidity, while the tiny Heater module is utilized to regulate the temperature of the meal. If necessary, we can also employ an IOT-based Weight sensor to check the food quantity in the storage space in the future.

Temperature, humidity, and methane gas measurements will be monitored in real time and supplied to the web to be displayed. If the temperature reaches the crucial level, an email will be sent to us, and the fan will be turned on automatically. You may also read this article on how IOT is utilized in the food sector to learn about other methods to modernize the food industry.

III. Hardware And Software Details

3.1 Details of Hardware Components Used:

DHT11 Sensor Module: The DHT11 sensor module is made up of resistive type humidity and NTC temperature sensors, as well as an 8-bit microprocessor. It guarantees quality, speed, anti-interference capability, and cost-effectiveness. The sensor has a temperature range of 0°C to 50°C and a humidity range of 20% to 90%, with a precision of 1°C and 1%. When it comes to data transmission between the sensor and the microcontroller, the full data transmission is 40 bits. The sensor sends the most important data first. 8bit integral RH data + 8bit RH data + *bit T data + 8bit decimal T data + 8bit checksum data is the data format for sending in the data.

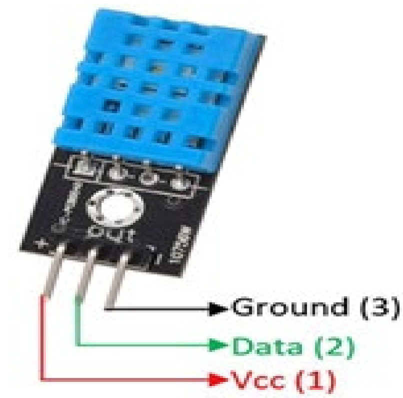

Fig.1. flow sensor

MQ-135 gas sensor: This sensor may be used to detect smoke and other potentially dangerous gases. It can detect a variety of dangerous chemicals, such as NH3, NOx, alcohol, benzene, smoke, and CO2. The MQ135 gas sensor is very sensitive to ammonia, sulphide, and benzene steam, as well as smoke and other dangerous gases. The MQ-135 air quality detector and hazardous gas detector chip are used in this module. Other circuit components on this module, such as the LM393 analogue comparator chip, make it simple to integrate this module into a hazardous gas detection project. The module works with a 5V power source and has a digital logic output (1 or 0) as well as an analogue level output (0-4V). When no gas is detected, the digital logic output is LOW (0), but when the dangerous gas concentration in the environment surpasses the specified threshold set by a potentiometer on the module, it becomes HIGH (1). Based on the concentration of the hazardous gas in the environment, the analogue level output gives an output voltage in the range of 0 to 4V; 0V for the lowest concentration, 4V for the highest concentration.

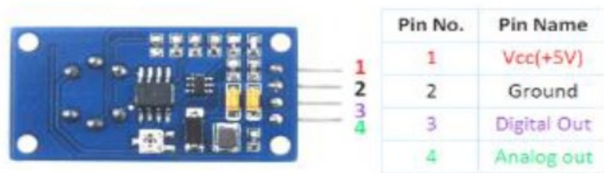

Fig.2. MQ135

NodeMCU is an open source IOT platform with a cheap cost. It came with firmware that ran on Espressif Systems' ESP8266 Wi-Fi SoC and hardware that was based on the ESP-12 module at first. Later, the ESP32 32-bit MCU was introduced to the Mix.

Fig.3. Node MCU

Following is the complete functional block diagram for implemented system in fig.4.

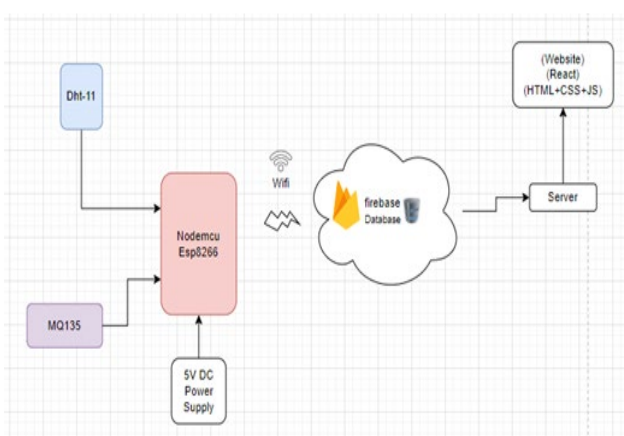

Fig.4. System block diagram

Analog input pin A0 is used to link the MQ135 Gas Sensor to the Nodemcu interface. The DHT 11 is connected to Nodemcu through Digital pin D0. The Nodemcu and MQ135 gas sensor will receive a 5V DC supply, while the DHT11 will receive a 3.3 V supply from the Nodemcu board. The Nodemcu begins reading analogue signals from MQ135 as soon as the ckt is turned on.

The Nodemcu has an integrated 10-bit ADC that converts analogue signals to digital and then stores the concentration of a specific gas based on the analogue voltage produced by the MQ135 sensor.

Following the successful reading of data from the MQ135 sensor, the Nodemcu will begin digitally reading data from the DHT11 sensor. The temperature and humidity data will be obtained via a DHT11 sensor, and then Nodemcu will send the data to a Firebase realtime database, where it will be shown using gauges and graphs as shown in the diagram below.

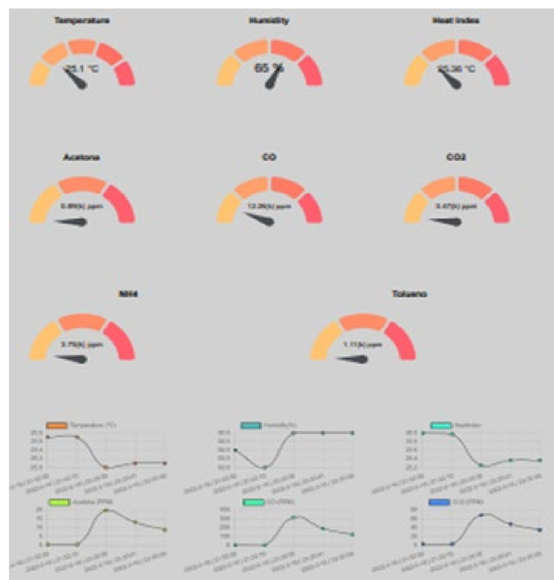

Fig.5. Firebase Realtime Data

IV. Result

On a scale of 0.1 to 1.0, this table depicts air quality health and risk. Fresh Air, Poor Air, and Danger Air are the three sections. This scale monitors the degree of air pollution and displays the risk. When the new data is compared to the baseline data, the result is displayed on this scale [18]. When the compared data is between 0.1 and 0.5, it indicates that the health risk is modest and indicates an open window. When it rises to 0.6-1.0, it indicates that the air pollution is regarded harmful for humans and I take immediate action.

Air Quality Indicator Range (PPM)	Result	Health Impacts
0-0.5	Fresh Air	Minimal impact
0.6-0.9	Poor Air	May cause minor breathing discomfort to sensitive people.
1 to above	Danger Air	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.

V. Conclusion

To enhance air quality, a system that monitors the environment's air using an Arduino microcontroller and IOT technology is proposed. The application of IOT technology improves the monitoring of numerous aspects of the environment, such as the air quality monitoring issue discussed in this study. The MQ135 detects many types of harmful gases, while the DHT11 provides current temperature and humidity, and the Nodemcu ESP8266 serves as the brains of the project. Nodemcu is in charge of the entire process, sending data to the Firebase Database, which is then displayed using Charts and Gauges.

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