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IOT-DRIVEN AIR QUALITY MONITORING SYSTEM

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ABSTRACT : The rapidly rising levels of air pollution demand a cost-effective remedy. The idea includes the creation of an air pollution parameter monitoring system with Arduino technology. You can obtain the monitored values through the IoT platform (Thingspeak). The gas sensors (DHT11, MQ7, and MQ135) provide information on air pollution levels. Nitrogen dioxide, ammonia, nitric oxide, and carbon monoxide are all indicators of air pollution. This serves as a notice to authorities about the air pollution level. The observed values are used to create a graph using the Thing Speak platform. The increasing quantities of harmful compounds in the atmosphere have demonstrated that people, particularly urban dwellers, require a way of protecting their health. This study proposes a low-cost technology for effective detection that produces precise, analytic, and manipulable results. When connected to the sensors, the Arduino UNO automatically incorporates the aforementioned components. This study is primarily concerned with hazardous gases such as sulfur dioxide, ammonia (NH3), carbon monoxide (CO), nitric oxide (NOx), and benzoene. The success of the Arduino allows for precise graph value outputs when altering data.

KEYWORDS: Internet of Things\

1.INTRODUCTION

Particulate matter problems, increased hazardous gas accumulation, business emissions, and automotive emissions are all factors leading to air pollution. Automobile use, urbanization, population growth, and business activity all contribute to the increase of pollution. Particulate matter contributes significantly to the worsening of air pollution. This needs estimating and investigating continual air quality monitoring in order to make prompt, informed judgments. This article provides a continual and impartial assessment of air quality. The Internet of Things (IoT), an increasingly prevalent technology across sectors, is critical to our air quality monitoring systems. For adequate screening, the setup will show the air quality in PPM on the website. This Internet of Things program offers wireless pollution monitoring from any area using a desktop computer or mobile device.

2.LITERATURE SURVEY

Prior to anything else, readings between 0 and 50 PPM are completely secure. 51-100 PPM is considered moderate PPM, which is common in high-traffic locations [8]. Potentially dangerous quantities of 100 to 150 PPM may be restricted to vulnerable populations. The threshold for dangerous or damaging conditions is more than 151 PPM [7], and India's capital, New Delhi, exceeds this level. Recordings of 300 PPM or higher, which are harmful and could be caused by coal gas in mines, are extremely rare .

AIR QUALITY INDEX

RANGE (PPM)	STATUS
0-50	GOOD
51-100	MODERATE
101-150	UNHEALTHY FOR SENSITIVE GROUPS
151-200	UNHEALTHY
201-250	VERY UNHEALTHY
251-300	HAZARDOUS

TABLE 1

This study used a more cost-effective version of the concept provided in [1] by streaming data to the cloud instead of an LCD display, which would have raised project costs. When considering IoT

as a platform, it is best to present the concept online, using sites such as thinger.io, Thingspeak, or the Cayenne site. These platforms have well-designed interfaces for presenting findings and downloading datasets. LPG and methane detectors are designed for home or office safety, thus their use is not required during an air quality monitoring experiment. In this investigation, instead of a GSM or GPRS module, data was transferred to the cloud over Wi-Fi [2]. The difficulty was that the sensor output value was not converted to PPM in another paper cited in [3], and the sensor was not calibrated. The United Nations Data Guidelines define 0-50 PPM as SAFE and 51,100 PPM as MODERIC. Check Table 1. At 250 parts per million, New Delhi, India's capital, has the world's highest pollution level. Even with both sensors turned on, the two internal heater components mentioned in this article have higher power requirements (P=V*I). As a result, the output voltage levels of the two sensors fluctuate, producing inconsistent findings that can be attributed to the insufficient power drive. We powered the CO sensor MQ7 with a 9-volt battery and a 7805 family LM7805 regulator because the Arduino board cannot deliver power to two sensors.

3.OVERALL SYSTEM ARCHITECTURE

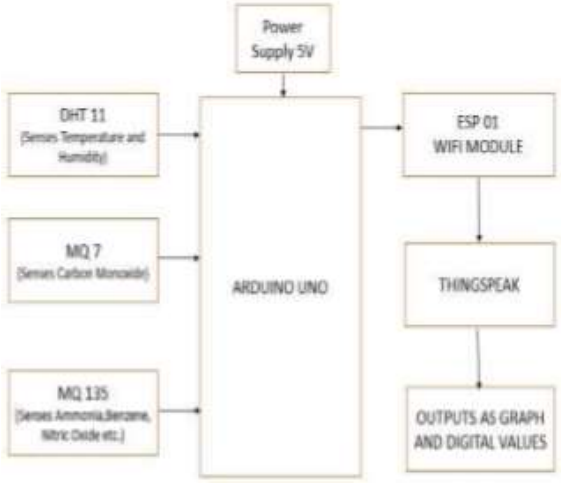

Fig-1 Block Diagram

Figure 1 depicts a schematic of the planned air pollution monitoring system. To assess air quality, the DHT 11, MQ 7, and MQ 135 gas sensors are used. When connected to an Arduino, it detects all gases and converts analog data to PPM values via the ESP 01 Wi-Fi module. Following that, the modified digital data will be transmitted to Thingspeak, an Internet of Things (IoT) platform that allows the figures to be graphed over time.

ARDUINO UNO BOARD

Fig-3.1 Arduino UNO

The Arduino microcontroller can work with a number of sensors. Many equipment expansions are easily accessible, and the board's user-friendliness allows it to be used to its full potential. The most adaptable Arduino hardware is that which can be programmed for its intended function. Furthermore, it is an open-source microcontroller device that is simple to develop and works with a wide range of sensors. It is also inexpensive and may be tested with other writing tools, like as Integrated Development Environments (IDEs). Arduino programming is simple thanks to the accessibility of online source codes.

Gas Sensors

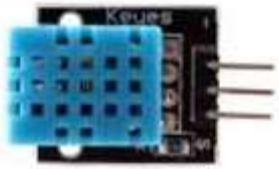

Fig-3.2 DHT 11

Temperature and humidity, the two most important air quality indicators, are measured using DHT 11. The DHT 11 is a simplistic yet improved temperature and humidity sensor. Before sending a digital signal to the output data pin, it uses a capacitive stickiness sensor and a thermistor to measure the ambient air. It is really simple to use.

MQ 7 is used to detect carbon monoxide, the principal cause of air pollution and a variety of deadly illnesses in humans. The MQ 7 Carbon Monoxide Sensor is a specific type of semiconductor sensor. The MQ 7 gas sensor is made of SnO2, a material known for its high sensitivity and low conductivity when exposed to pure air. This device is great for detecting CO targets in the air, and it is extremely user friendly. This gadget can measure CO-gas fixation concentrations ranging from 20 to 2000 parts per million.SnO2 is used for detection due to its quick response time and great sensitivity.

Fig-3.4 MQ 135

The MQ135 sensor can detect a range of gases, including as argon, smoke, benzene, nitric oxide, and ammonia. This allows the device to be used both indoors and outside. It is extremely sensitive to smoke and other dangerous gas vapors, including benzoene steam, ammonia, and sulfur. provides a longer lifespan at a fair cost.

ESP 01 Wi-Fi Module

Fig-3.5 ESP 01

With its embedded IP convention stack, the ESP 01 Wi-Fi Module acts as a separate SOC capable of connecting any microcontroller to a Wi-Fi network. The Wi-Fi module can be configured to either support an application or delegate all organizing functions to another application processor. Every ESP 01 module is pre-programmed with the AT command set firmware, so all you need to do is connect the Arduino device. The ESP 01 Wi-Fi module is an extremely low-cost gadget.

Thingspeak

Fig-3.6 ESP 01

Thingspeak is a cloud platform designed specifically for the Internet of Things. The user can save sensor data in numerous channels. Furthermore, it maintains real-time data, creates infographics, and runs modules.

4.PROCEDURE

The Arduino Uno Development Kit was used in this investigation, which includes an ATMega328P CPU. The ESP-01 Wi-Fi module, which was competitively priced, was used to equip the gadget with Wi-Fi functionality, allowing it to connect to the Thingspeak platform. Figure 4 illustrates the links between the various components. These components are as follows: Arduino Uno, MQ135, MQ7, ESP-01 Wi-Fi Module, 9-volt battery, and LM7805 regulator. As seen in Figure 4, the ESP-01 is linked to the Arduino Uno's 3.3V port. The Arduino Uno's 5 volt pin is wired to the MQ135 module. To power an additional sensor, MQ7 is attached to a 9-volt battery via a 5-volt LM7805 regulator.

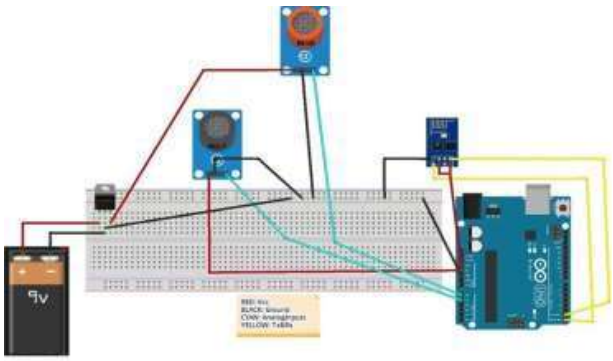

Fig-4 Connection Diagram

ESP 01 is linked to the Local Hotspot by entering the correct SSID and password. Because the MQ7 sensor requires a maximum input of 5 volts, it is not suggested to provide 9 volts directly. In contrast, an LM7805 regulator reduces 5 volts from 9 volts [4][5]. It must be calibrated in fresh air before developing an equation to translate the sensor's output voltage value to realistic PPM (parts per million) values.

5.RESULTS

Fig-5.1 Output on Thingspeak

After successfully connecting to a hotspot, the ESP-01 sets up a Thingspeak webpage. The Arduino code includes the account API key, which ensures that data is only saved to the account when the specified API key is used. Thingspeak requires a 15-second refresh period to support data push. Figure 3 depicts field profiles of MQ135 and MQ7 sensor data for the experiment site in parts per million (PPM). Figure 5.1 also shows visualization screens for networked sensors. Figure 5.2 shows a graphical analysis of data gathered using timestamping on the X-axis and air quality PPM on the Y-axis.

Fig- 5.2 Graph showing AirQuality

6.CONCLUSION

In this work, the PPM numbers mentioned in the Literature Review are likewise corrected. This project can be used indoors as well as outdoors. Because we could make such a little gadget, we could monitor the indoor air quality in a specified area if every family installed the kit. Indoor air quality must also be monitored as air pollution levels rise.A single sensor is clearly insufficient for outdoor applications due to its sensitivity range of about one meter. An alternate strategy would be to set up a network of sensors to monitor outdoor air quality.

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