Smart Air Quality Monitoring Using IoT

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Abstract. Internet of things (IoT) is a system of "Smart Devices" used over the internet through the world were it will sense and connect with our environment and involves with humans and it is a user friendly for the users and another system devices. Air pollution is one of the major issue of our generations. The rate of air pollution gradually increases with time by more number of things like increasing in vehicles, increasing in population, urbanization, industrialization which helps up in harmful disease effect on human life by directly effecting health of country exposed to it .Air quality gets decreases when enough amount of toxic gases in the atmosphere like co2,alchol,smoke,nh3,benzen and no2.In order to survey we are deploying IoT based pollution monitoring system Were it will capture all the air quality over an cyber space .existing monitoring system and no sensitivity and need technical analysis. So improvement of monitoring system are requires. To Control the issue of trending system. We propose a pollution monitoring system it will detect the percentage of pollution in our environment it shows the average density of pollution released by vehicles or any industries etc.If the pollution level get cross by average it may cause more danger to our human health.

1. Introduction

In this age of industrialization and technology, the concept of an internet of things system is one that is growing quickly. Health ,safety and other concerns of people has become important for many companies as well as manufacturers. The Internet of Things is a connection of things that can be controlled from anywhere by anyone via wireless network. Environmental problems can now lead to major catastrophes. Air pollution and sound pollution are two major problems. The major goal is to locate and detect air pollution levels. The primary issue facing all countries, developed or developing, is air pollution. Gas emissions frequently cause breathing difficulties, eye irritation, and lung cancer in both humans and animals. Other negative consequences of pollution include minor allergic reactions around the eyes, nose, and throat as well as more serious issues like bronchitis, heart conditions, lung infections, pneumonia, and worsening asthma[1]. These are the issues that typically arise when the sector does not as direct by the government, take

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appropriate action to reduce the gases. Health issues are increasing more quickly, particularly in Urban areas in developing nations where increased vehicle traffic and industrialization cause a lot of gaseous emissions contaminants [2].

The simple meaning of pollution is the existence of tiny particles that interact with everyday activities and have a harmful impact on health. To put it another way, pollution can affect the routine phase, which may potentially have an impact on the health of that which is alive. Given how widespread industrial development is expanding. There is also a significant increase in the awareness of pollution[3]. When The world's soil, water, and air are currently contaminated. This focuses solely on air pollution. Air contamination is the existence of pollutants or minute substances that have an impact on life being well-being and environment. These toxins are the outcome of automobiles, businesses. The World Health Organization, or WHO claims that 2.3 million people pass away each year for various specifically attributed to air pollution. even the system's dependability, it requires a lot of small, dynamic developments, like costly, complex network cabling. With the advancement of communication technology, air pollution monitoring techniques nowadays frequently focus on wireless methods[4]. The IoT module is used combined with a single-chip microcontroller and a variety of sensors to implement such a system. This system uses sensors to monitor gases like CO2, temperature, and humidity. The hardware component packs the stages of air pollution into the frame and gathers them. The frame is transmitted via IoT to the important server and uploaded to the IoT modem. This organization uses energy-efficient devices and operates on a modest budget[5].

The suggested work is a positive step in the right direction towards solving this issue, as it emphasizes the need for accurate, dependable, and efficient monitoring of pollution levels in the manufacturing industries. By keeping an eye on the dangerous gases that are released by nearby industries, it also compares high pollution rates to benchmark levels and determines when the quality drops below a At a certain point, it alerts people that something is unsafe. The current system only has two sensors and an Arduino controller. Q6 as well as MQ135. Its final product is delivered by a monitor with an LCD (Liquid Crystal Display). The construction of lightweight, cheap sensors has become simultaneously economically and technically possible since due to swift advancements in technology. Factors that may have an impact on both the natural system's and human health are given special consideration. IOT Air Pollution Monitoring's primary goal Monitoring pollution levels is a system's primary responsibility these days. Everyone's well-being and overall health in the long run depend on the air quality being tracked and managed. The Internet of Things, or IoT for short, is increasing in prominence continuously because to its flexibility and affordability.

IOT: The term "Internet of Things" (IOT) applies to a network of tangible items, or "things," that may be integrated with software, sensors, and other technologies that enable things to share information with each other and with other structures and objects via the internet. These devices range from common household items to cutting edge office equipment. More than 7 billion connected devices professionals predict that by 2020, there will be ten billion devices worldwide, and by 2022, there will be 22 billion of 2025's means. Oracle has a network of partner companies.

Arduino: An open-source electronics platform is known as Arduino. The software used in Arduino is Arduino IDE. It is best suitable for users with poor internet connection. there are many types of Arduino's. There are only two versions of the Arduino IDE.

Sensors: A sensor is a technology that transmits anatomical phenomena onto a form that is able to be perceived to human beings so that it is able to be processed further. The sensor

can produce in two ways digital or analog output. There are various types of sensors available[6].

2. Literature Review

2.1 Air Quality Monitoring System:

Measuring air quality plays an important role for bringing awareness among people in order to have a safe, secure and healthier future generations. Air pollution has become biggest threat to the nation as there is rapid increase in usage of vehicles, more consumption of natural resources. Government of India has already taken certain measures in order to reduce air pollution and also banned some vehicles which emit more pollution comparatively. Using this IoT project one can able to check air pollution from anywhere and anytime using their mobile or computer[7].

2.2 IoT Based Air Quality Monitoring System:

Now a days humans are affected a lot due to exposure to polluted air. This polluted air will cause severe health issues. As breathing plays an important role in one's life, everyone should take some precautions and measurements in order to control air pollution. Air pollution not only effects human beings but also very dangerous to water bodies. As Air pollution cannot be determined by human feeling, live air quality monitoring system has been proposed. By using this system one can know levels of harmful gases present in air at a particular place[8] .

2.3 Arduino Based Weather Monitoring System: Wireless Monitoring, Managing, and Control for Inter-Vehicle Vehicle Ad-Hoe Networks:

They have used 3 sensors in order to calculate temperature, intensity and humidity. The readings which are sensed by these sensors are displayed on LCD display and these readings will vary from place to place. These records are analyzed by organizations in order to control air pollution .

2.4 IoT Based Air Pollution Monitoring System:

The growing popularity of motorbikes, urbanization, and industrialization are just a handful of the components contribute to air pollution, which is destructive to the well-being of people. For this project, an Internet of Things (IoT) based air quality monitoring system was designed in order forecast air quality and notify the user of any modifications. The LCD indicates the PPM their worth, which indicates the overall amount of gases in the air.

2.5 Capable of Gas Sensor MQ-135 to Monitor the Air Quality with Arduino uno :

The air pollutants which are present in air mainly comprises of harmful gases such as CO,CO2, NO2, Acetone.MQ135 is a gas sensor which is capable of detecting these harmful gases. Air pollution is being increased due to human activities and controlling air pollution had become a challenging task to government.

3 Implementation of The System

3.1 System Hardware & Functioning

3.1.1 Sensor Interface:

The microcontroller should be connected to the air quality sensors via the proper interfaces (analog/digital pins). For information on sensor integration, consult the datasheets and documentation.

3.1.2 Coding Microcontrollers:

Develop firmware that can read information collected by sensing and push it to the cloud supplier of your choice. Makes applications for programming languages includes C++ for Arduino, Python for Raspberry Pi, & Micro Python for ESP8266/ESP32.

3.1.3 Setup for Connectivity:

Set up the microcontroller so it can establish an internet connection. Depending on the module you selected, set up cellular connectivity or Wi-Fi credentials.

3.1.4 Transmission of Data:

In order to transfer data from the microcontroller to the cloud platform, implement a secure communication protocol. One popular protocol for IoT communication is MQTT.

3.1.5 Data Analysis and Storage:

Develop pipelines for data analysis and storage on the cloud platform. Databases can be used for storing information, and algorithms can be used to examine trends in air quality.

3.1.6 Examining and Adjusting:

Test the system thoroughly in a range of environmental circumstances. If required, calibrate the sensors to guarantee precise readings.

3.2 Hardware Requirements

3.2.1 Arduino UNO :

The following figure.1 shows the Arduino UNO. The ATmega328p is the building block of

the Arduino UNO. There are fourteen digital pins altogether. The code used in Arduino is C++ programming language. Arduino UNO is manufactured by Arduino.cc. It is a low-cost, flexible and easy-to-use programmable open-source microcontroller board. The Arduino uno consists of one USB interface, 6 analogy input pins, 14 input output digital pins, one power pin.

Fig. 1. Arduino UNO

3.2.2 Bread Board:

The following figure.2 shows the Breadboard. It is also called as plug Block. It is mainly useful for building temporary circuits. It is mostly used by developers because in bread board the components can be removed and replaced easily.

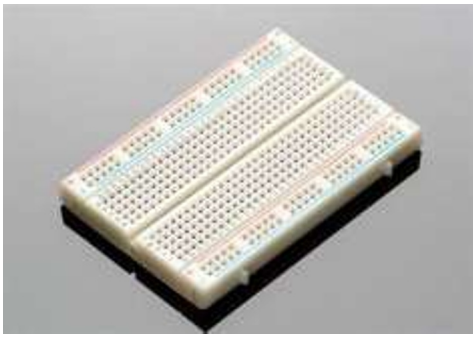

Fig. 2. Bread Board

3.2.3 MQ135 Sensor:

The following figure.3 shows the MQ135 Sensor. It is also considered as a pollution checking sensor. It can detect harmful gases like Ammonia(NH3), CO2, C6H6(Benzene) and also other dangerous gases. It consists of one digital and analogy output pin. The modules of MQ135 sensor operates at 5v and consumes till150MA.

Fig. 3. MQ135 Sensor

3.2.4 USB Cabel:
The following figure.4 shows the USB cable. It is used to connect Arduino UNO with the USB female A port of your computer. It is mainly used as a communication between hardware devices and the host. In this project USB 2.0 cable Type A/B is used to connect Arduino with computer.

Fig. 4. USB Cable

3.2.5 Jumper Wires:
The following figure.5 shows the Jumper Wires. It is also called as Dupont wire. Jumper wires can also be connected with raspberry pi, Arduino board so that we can execute our code. Jumper wires are easy to available and the cost is also low [10].

Fig. 5. Jumper Wires

3.3 Software Requirements

The following figure.6 shows the Arduino IDE. Here In this project, we used Arduino IDE. It is an open-source IDE developed by Arduino.cc which helps in writing code and uploading it to the Arduino board. Arduino IDE software supports all the operating system.

Fig. 6. Arduino IDE Software

4 Visualization and Analysis

4.1 Image showing experimental output

The following figure.7 will depicts about the complete output of the air quality monitoring system using internet of things and the python.

Fig. 7. Image showing experimental output

4.2 Hardware Setup

In this project ,we used Arduino microcontroller for data processing and mq123 sensor for detect the real-time air pollutants ,USB cable for connecting hardware module with computer. The following figure.8 shows the hardware setup.

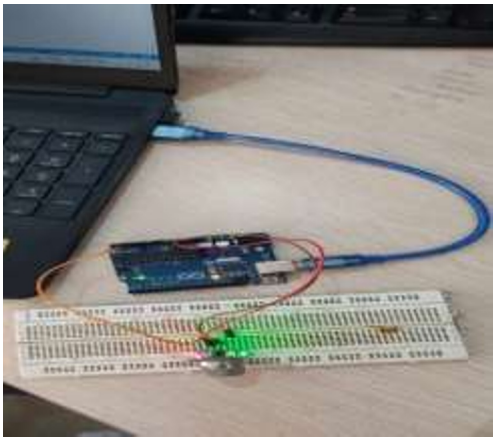

Fig. 8. Hardware Setup

4.3 Output

The following figure.9 shows the output of the project measured in ppm[parts per million] of air pollutants.

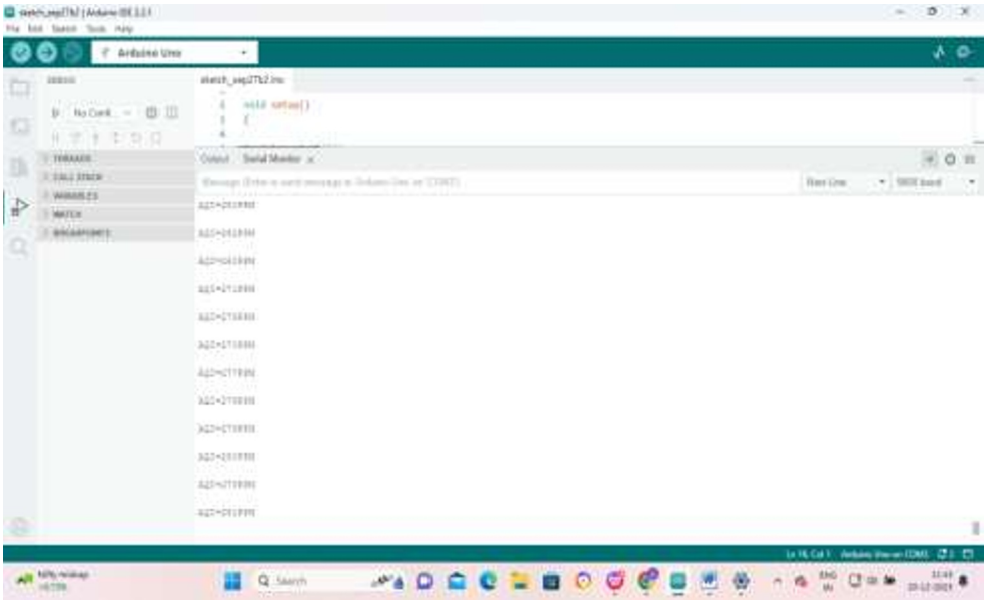

Fig. 9. Result measured in ppm of Air pollutants

5 Result

The experimental results demonstrate the use of IoT technology to implement an air pollution monitoring system has produced impressive results, demonstrating how well this integrated approach provides precise and up-to-date insights into air quality. The system showed that it could monitor particulate matter, carbon dioxide, carbon monoxide, and

other major pollutants by using a network of sensors, microcontrollers, and cloud-based platforms. Robust data collection, transmission, and storage were made possible by the IoT architecture, which laid a solid basis for thorough air quality analysis.

The project's successful sensor integration and calibration, which guaranteed the precision of pollutant concentration measurements, was one of its noteworthy accomplishments. The system demonstrated sensitivity to various pollutants, providing a comprehensive perspective of the state of air quality.

6 Conclusion

In Conclusion, the Internet of Things project that used the MQ135 sensor and Arduino to detect air pollution has shown to be a viable and efficient way to monitor the quality of the air. The field of environmental sensing has benefited from the integration of these technologies, which has shown a number of important strengths.

First off, following meticulous calibration, the MQ135 sensor demonstrated impressive precision in identifying a range of contaminants, including particulate matter, carbon dioxide, ammonia, and methane. Because of its sensitivity and adaptability, it is a useful part of an all-inclusive air quality monitoring system. Real-time monitoring was made possible by the smooth data collection, processing, and transmission made possible by the Arduino microcontroller. Because of its adaptability and simplicity in programming, it can be used by both novice and seasoned developers, which adds to the project's usefulness.

7 Future Scope

The architecture proposed in the system will help in analyzing the air quality for the particular surrounding in the real time and it will help the authorities to get the accurate data for the action.

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