

Industrial Pollution Monitoring System

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Abstract — This project aims to design and develop a low-cost, real-time monitoring system that alerts workers and notifies authorities about polluted areas. The system integrates various sensors, including air quality, temperature, humidity, and sound intensity sensors, with a PIC controller. The collected data is uploaded to the cloud using an ESP32S Wi-Fi module and transmitted to a cloud platform via MQTT protocol. A digital dashboard on a smartphone app checks for anomaly notifications and alerts users. If the industry fails to reduce pollution within a specified period, the pollution control board will shut down the industrial electricity supply until a penalty is paid, as per government rules and regulations.

Keywords- air pollution; Internet of things (IoT); NodeMCUESP32S; DHT11 sensor; Arduino IDE; gas sensor

I. INTRODUCTION

Internet of things system is a rapidly expanding idea in this era of Industrialization technology meanwhile; it has become mandatory that the manufacturing sector care about the health, safety, and welfare of workers and other human defects occurs around the industry. IOT monitoring states physical objects which are connected to internet connection wirelessly and monitored from any places. Environment issues may cause big disaster these days. Sometimes the elimination of gases affects the human being and animals were affected by lung cancer, irritation of eye, breathing problems are the issues that usually occurs while the industry does not take steps to reduce the gases as per government rules. One of the major issues was Air pollution and sound pollution by finding it and detecting is the main objective. To overcome these problems proposed work is one such step towards the environmental disaster around the manufacturing industry was being monitored efficiently, reliably and accurately.

II. OBJECTIVES OF PROJECT

1. To build a robust system that can measure the industrial pollution and help to reduce it and to decrease human interference in monitoring the industrial pollution to reduce pollution and provide a healthy environment for the workers to work in.
2. To make the industrial pollution monitoring a wireless system.
3. To protect the environment from industrial pollution.
4. To build a robust system that evaluates the industrial pollution continuously and indicates when there is an increase in the emissions and takes action to control it using wireless technology that is IoT.

III. TOOL AND TECHNOLOGIES

Hardware Requirement

- Node MCU ESP32S
- MQ2 gas sensor
- MQ7 gas sensor
- MQ135 gas sensor
- DHT11 (temperature and humidity) sensor

- Relay
- Water pump
- Exhaust fan
- Jumper cables

Software Requirements

- Embedded C
- Arduino IDE
- Blynk IoT

IV. OBJECTIVES AND METHODOLOGIES

This system ensures environmental compliance, provides real-time alerts, and helps industries reduce pollution by continuously detecting, controlling, and monitoring pollution levels in industrial environments using smart sensors and IoT technology. Additionally, the system checks and monitors air and noise pollution, indicating when emissions increase, and takes action to control them using wireless IoT technology. Figure 1 shows the block diagram of the industrial pollution monitoring system.

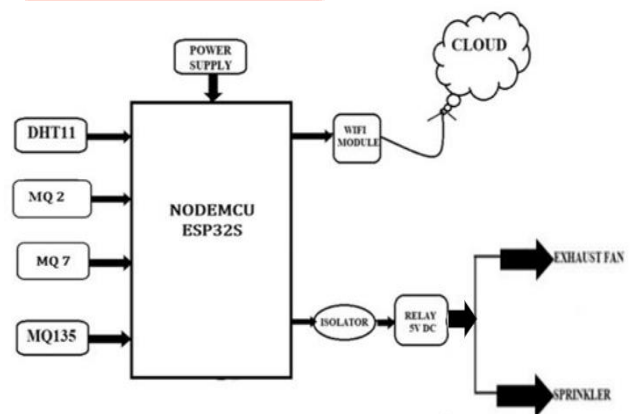


Figure 1: Block Diagram of Proposed system

Additionally, the system checks and monitors air and noise pollution, indicating when emissions increase, and takes action to control them using wireless IoT technology. Figure.1 shows the block diagram of the industrial pollution monitoring system.

Methodology 1:

- Initialize all ports of DHT11, power supply, battery, temperature detection sensors, and Relay as shown in figure 2.
- Continuously monitor sensors for temperature detection.
- Check if the temperature detection condition is met.
- If no detection (condition is false), continue monitoring sensors.

- If temperature is detected (condition is true), compare the value with the threshold value.
- If the temperature value exceeds the threshold value, turn on the exhaust fan to regulate temperature.
- Use Blynk IoT to send notifications and record temperature data for the specific area.
- Once the temperature returns to the acceptable limit, turn off the exhaust fan automatically or manually.

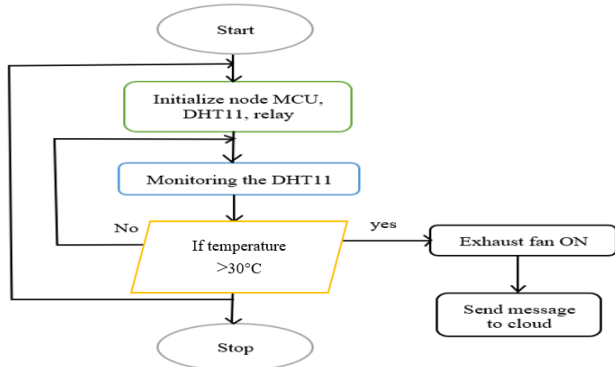


Figure 2: Flowchart for temperature change detection

Methodology 2:

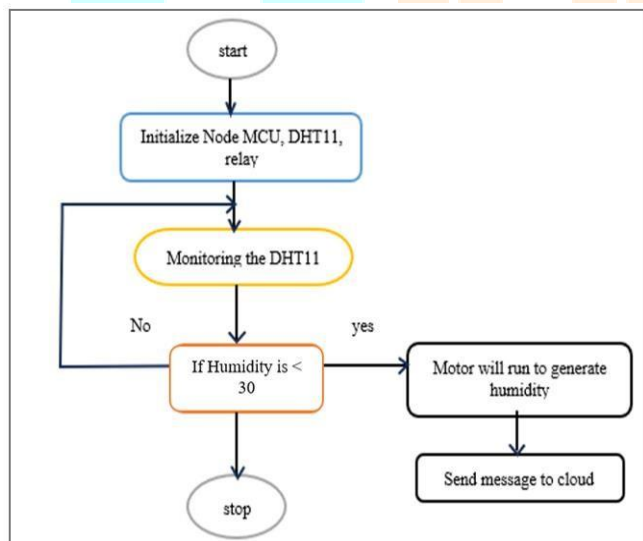


Figure 3: Flow chart for detecting change in humidity.

- Initialize all ports of DHT11, power supply, battery, humidity detection sensors, and continue monitoring sensors as shown in figure 3.
- Continuously monitor sensors for humidity detection.
- Check if the humidity detection condition is met.
- If no detection (condition is false), turn off the relay switch and continue monitoring sensors.
- If humidity is detected (condition is true), turn on the relay switch.
- Compare the detected humidity value with the threshold value.
- If the value exceeds the threshold, turn on the motor to regulate humidity.
- Use Blynk IoT to send notifications and record humidity data for the specific area.
- Once the humidity returns to the acceptable limit, turn off the motor automatically or manually.

V. IMPLEMENTATION AND RESULTS

Implementation:

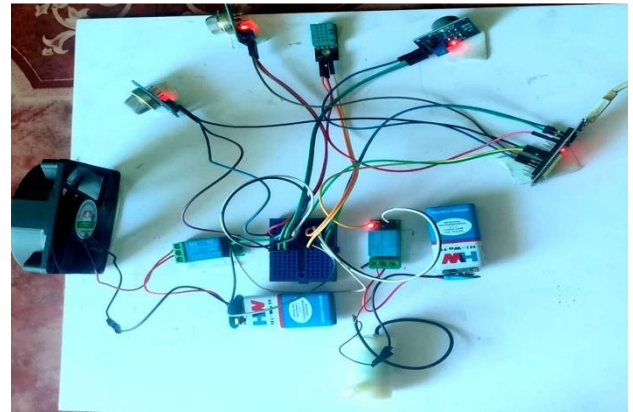


Figure 4: Hardware Setup of Model

This Figure 4 shows the Hardware Setup of Model which consists of Node MCU, MQ3, MQ135, DHT11, MQ5, 4-Channel Relay Board, Android Smart Phone.

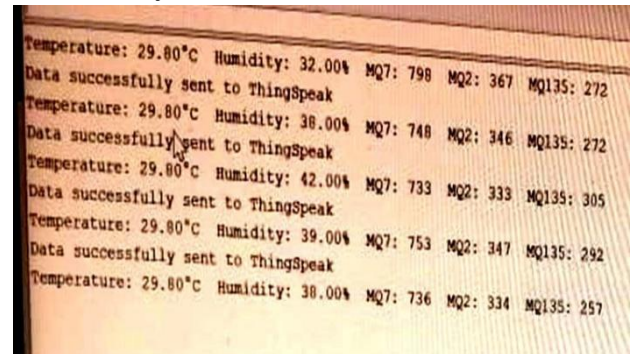


Figure 5: Serial monitor output

Figure.5 then sends the message to cloud and immediately exhaust fan will be ON.

VI. PERFORMANCE ANALYSIS

Author	Description	Improvement in proposed work
Jahan et al.,[1]	The system aims to enhance the data transmission in wireless technology by ensuring the safety and privacy preservation of the data.	This proposed technique also handles the large data where the continuous data is sent to cloud and the handling it safely is important that is applied in this project.
Medina et al., [2]	The sensors attached to the node are capable of measuring environmental parameter and microcontroller performs data processing.	The proposed project was designed to merge various parameter measurements in real time, improving the detectability of faults.

Saravanakumar et al., [3]	It introduce a low cost and energy efficient air quality monitoring system which can be easily deployed in highly polluted areas such as India's manufacturing industries to track the air quality index including IoT.	The proposed uses IoT based environmental monitoring parameter since it is not manual accuracy and efficiency is very high with the cost-effective air emissions locally, ensuring worker safety.	automated system for safety, such as fire alarms and gas leakage detection. This enables automated control actions in the absence of authorized users. Using IoT technology, various aspects of the environment, such as air quality monitoring, can be monitored, and data can be retrieved whenever and wherever required.
H. Cai et al., [4]	This paper first provides a functional framework that identifies the key areas of IoT characteristics and capabilities.	Here in this we proposed have applied big data analytics using thingspeak for continuous monitoring the levels of air pollution shown in graphs if threshold limit crosses it gives an alert information.	The MQ135 gas sensor detects various types of dangerous gases, and Arduino acts as the control unit, processing sensor data. The Wi-Fi module connects the entire process to the internet. Moreover, this is an automated monitoring system that reduces human involvement in hazardous environments, ensuring safety. The system supports new technology and effectively promotes the concept of a healthy life. It also features a mobile app that allows users to monitor pollution levels remotely.
Chiwewe et al., [5]	This research aims to create models that can predict ground level ozone levels at specific locations using big data analytics and cognitive computing. The proposed model is based on the cross correlation and spatial correlation of different air pollutants	Here we have implemented this method for finding pollution levels in surrounding air using Arduino IDE and predicting the level of harmful gases and by importing necessary libraries.	<i>Future Scope:</i> The future scope involves providing enhanced security when it comes to connecting to the system and collecting data. In this rapidly developing world, we must adopt a more scientific approach and always prioritize safety, as human error can lead to many issues. Instead of relying solely on sensors for safety purposes, it would be better if they could alarm us to dangerous situations, thereby reducing potential destruction. More statistics could be provided to gain deeper insights into the collected data. This data can then be supplied to the relevant authorities to take appropriate measures to reduce pollution levels at identified locations.
A. Sumithra et al., [6]	It consists of sensors, cloud storage, and big data analytics where the system collects the data from sensors, stores it in the cloud, and analyses it using big data analytics where they have introduced an app that can be used to monitor pollution levels.	We have used gas sensors, dht11 sensor for temperature and humidity monitoring and that can be monitored using Blynk IoT app and thingspeak online data transferring and	VIII. REFERENCES

Conclusion:
The IoT concept can be applied to a wide range of applications. In this project, we implemented the use of IoT in industrial pollution monitoring. This project presents a real-time air pollution monitoring system based on IoT.

The system uses a GSM module connected through a level converter and an IoT module to collect real-time data. Users can log in and access the data. The real-time monitoring of air quality parameters ensures that industrial emissions levels are maintained within safe limits. The system enables tracking of all data in a single place, i.e., the cloud, and reduces pollution based on the collected data.

The implementation cost is economical, as sensors microcontrollers are easily available. The online database system increases flexibility by updating current parameters of industries over a common server. The camera can be upgraded in the future with image processing algorithms to enable a fully

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