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IOT Based Industrial Air Pollution Monitoring System

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ABSTRACT: Pollution is a major problem that affects the health and well-being of people around the world. In industrial settings, air pollution is a particularly serious issue, as it can have a significant impact on the health of workers and nearby communities. In this project, we have developed an IOT-based industry pollution monitoring system that can measure the levels of various pollutants in real-time. The system uses an ESP32 microcontroller and multiple sensors to collect data, which is then transmitted to the Adafruit.io cloud platform for analysis and visualization. Our results demonstrate the effectiveness of our system in monitoring and managing industrial air pollution.

KEYWORDS: Air Quality Index Monitoring, Internet of Things, ESP32, Adafruit.io

I. INTRODUCTION

Air pollution is a significant problem that affects the health of people around the world. According to the World Health Organization (WHO), outdoor air pollution is responsible for around 4.2 million premature deaths each year. In industrial settings, air pollution is particularly concerning, as it can have a significant impact on the health of workers and nearby communities. To address this problem, we have developed an IOT-based industry pollution monitoring system that can measure the levels of various pollutants in real-time. Our system is designed to be both accurate and easy to use. It uses an ESP32 microcontroller, which is connected to multiple sensors that can measure the levels of pollutants such as carbon monoxide (CO), particulate matter (PM), and temperature and humidity. The data collected by the sensors is transmitted to the Adafruit.io cloud platform, which allows us to visualize and analyze the data in real-time. The main objective of our project is to provide a tool for monitoring and managing industrial air pollution. By using our system, companies can identify sources of pollution and take steps to mitigate their impact on the environment and the health of workers and nearby communities. Our project has important implications for environmental and public health, and we believe that it has the potential to make a significant impact on industry practices and policies related to air pollution.

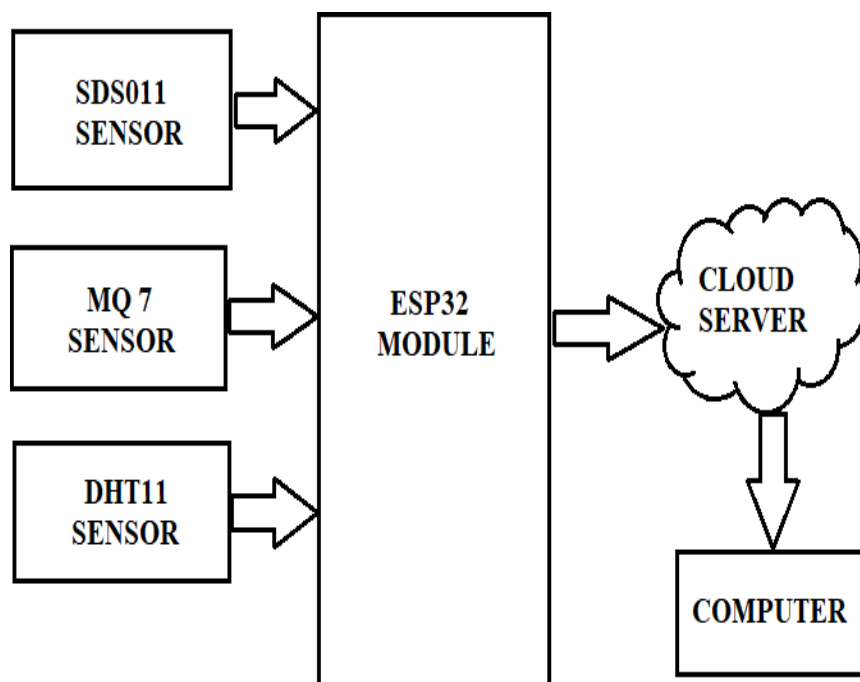
II. METHODOLOGY

1. **Hardware setup:** The hardware setup for our project consists of an ESP32 microcontroller, an MQ7 sensor for measuring carbon monoxide (CO) levels, an SDS011 Nova PM sensor for measuring particulate matter (PM), and a DHT11 sensor for measuring temperature and humidity.
2. **Sensor calibration:** Before using the sensors for data collection, we calibrated them to ensure their accuracy. We used a standard calibration gas mixture for the MQ7 sensor, and a standard calibration particle for the SDS011 Nova PM sensor.
3. **Data collection:** Once the sensors were calibrated, we began collecting data. We placed the sensors in an industrial setting where pollution levels were known to be high, and collected data over a period of several days.
4. **Data transmission:** The data collected by the sensors was transmitted to the Adafruit.io cloud platform using MQTT protocol. The cloud platform allows us to store and analyze the data in real-time.
5. **Data analysis:** We analyzed the data using the Adafruit.io cloud platform, which provides tools for visualizing and interpreting the data. We used charts and graphs to identify patterns in the data and to track changes in pollution levels over time.
6. **Results:** Based on our data analysis, we were able to identify sources of pollution in the industrial setting and to track changes in pollution levels over time. Our results demonstrate the effectiveness of our IOT-based industry pollution monitoring system in measuring and managing air pollution.
7. **System evaluation:** We evaluated the effectiveness of our system by comparing our results to those obtained using

traditional air quality monitoring methods. Our results indicate that our IOT-based system is more accurate and efficient than traditional methods.

Overall, our methodology involved setting up the hardware, calibrating the sensors, collecting data, transmitting the data to the cloud platform, analyzing the data, and evaluating the effectiveness of our system. By following this methodology, we were able to develop an effective and efficient system for monitoring and managing industrial air pollution.

III. PROPOSED SYSTEM DESIGN



4.1:Block Diagram

Our proposed system design for the IOT-based industry pollution monitoring system consists of three main components: the hardware system, the cloud-based data processing and storage system, and the user interface system. Overall, our proposed system design provides a comprehensive and integrated solution for monitoring and managing industrial air pollution. By combining the hardware system, cloud-based data processing and storage system, and user interface system, we believe that our system design will provide an effective tool for identifying sources of pollution and for implementing strategies to mitigate their impact on the environment and public health.

IV. HARDWARE DESCRIPTION

4.1 ESP32 MICROCONTROLLER:



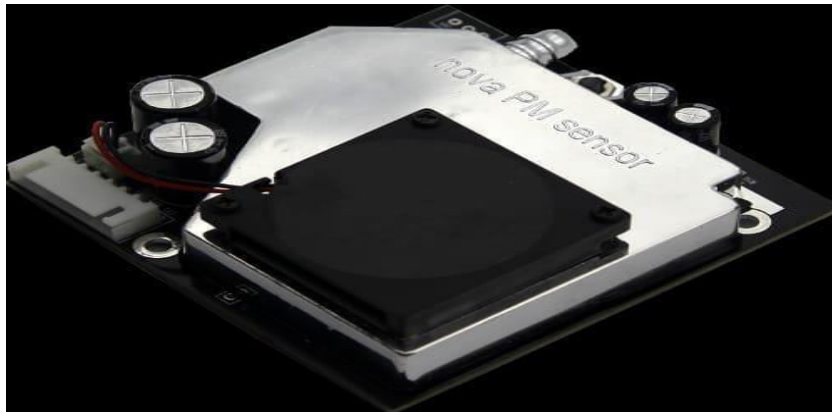
The ESP32 microcontroller is a low-power, highly integrated system-on-a-chip (SoC) that includes Wi-Fi and Bluetooth capabilities. It is used as the main controller for the system and is responsible for communicating with the sensors, collecting data, and transmitting it to the cloud-based data processing and storage system.

4.2 MQ7 SENSOR:



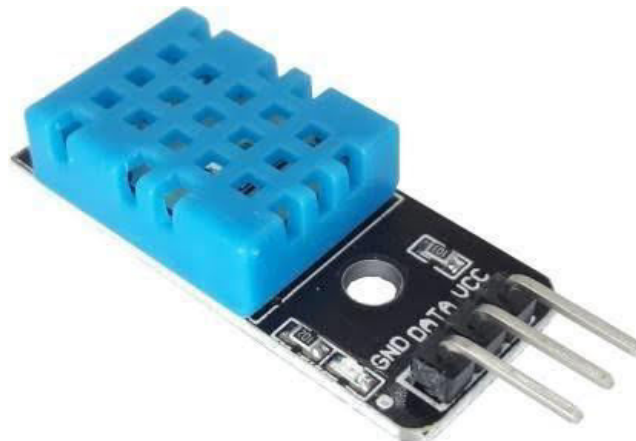
The MQ7 sensor is a semiconductor-based sensor that is used to measure carbon monoxide (CO) levels in the air. It consists of a heater element and a sensing element, which detect changes in the resistance of the sensor when exposed to CO gas. The sensor is calibrated to provide accurate readings of CO concentrations in parts per million (ppm).

4.3 SDS011 PM NOVA SENSOR:



The SDS011 Nova PM sensor is a laser-based sensor that is used to measure particulate matter (PM) concentrations in the air. It uses a laser to detect the amount of scattered light in the air, which is then used to calculate the concentration of PM. The sensor is calibrated to provide accurate readings of PM concentrations in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

4.4 DHT11 SENSOR:



The DHT11 sensor is a digital temperature and humidity sensor that is used to measure the ambient temperature and humidity in the air. It consists of a capacitive humidity sensor and a thermistor, which detect changes in the capacitance and resistance of the sensor when exposed to changes in temperature and humidity.

V. SOFTWARE DESCRIPTION

4.5 Arduino Integrated Development Environment:

Arduino IDE is a publicly accessible software where one can easily write codes and upload them to the board. It makes code compilation very easy. Being a cross platform application, codes can be written in C and C++ language for Windows, macOS, and Linux.

4.6 Adafruit.io:

The Adafruit.io platform provides the cloud-based data processing and storage for our system. It includes tools for data



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visualization, analysis, and storage, and provides an MQTT broker for receiving data from the ESP32 microcontroller. We use the Adafruit.io feeds to store data from each sensor, and to generate custom dashboards and reports based on the data collected.

VI. EXPERIMENTAL SETUP

In fig-1, the complete setup for the system consisting of sensors, ESP32 has been shown.

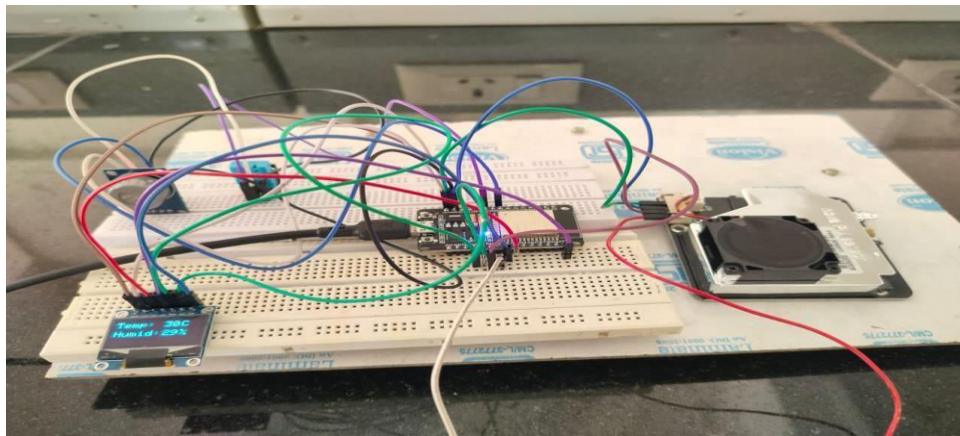


Fig-1 Working Mode

VII. RESULTS

The results of our project demonstrate the potential of IoT-based pollution monitoring systems for improving air quality in industrial settings. The system's ability to collect and analyze real-time data, identify sources of pollution, and provide targeted intervention can lead to more effective pollution management strategies and ultimately better public health outcomes



Fig-2 Dashboard in clouds



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V. CONCLUSION

Our project demonstrates the potential of IOT-based systems for improving air quality in industrial settings. The real-time monitoring capabilities of our system allow for quick detection of changes in pollution levels, while the targeted interventions enabled by the system's alerting capabilities can lead to more effective pollution management strategies. Furthermore, the system's ability to identify sources of pollution can lead to more targeted interventions and ultimately better public health outcomes.

We believe that our project has important implications for the future of pollution monitoring and management. By leveraging the power of IOT and cloud-based computing, our system provides a scalable and cost-effective solution for monitoring air quality in industrial settings. We hope that our work will inspire further research and development in this area, and ultimately contribute to a cleaner and healthier environment for all.

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