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MONITORING AND SENSING OF HARMFUL GASES USING IOT AND WSN

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Abstract - Industrial gases are gaseous substances released from industrial facilities. A large number of gases and mixes are available in gas cylinders, but the main gases are nitrogen, oxygen, carbon dioxide, argon, hydrogen, helium and acetylene. Industrial gas emissions result from the production of a variety of products and materials that are used in a variety of applications. Industrial gases are extremely dangerous and have a negative effect on anything or anybody exposed to them. Many employees in the industrial sector operate in a variety of departments including production, packaging, building, manufacturing, etc. They are in some way exposed to these dangerous gases, which have highly negative effects on them and occasionally even have fatal consequences. The sale or rental of gas cylinders and related equipment is also covered by this industrial enterprise providing tradespeople's tools and occasionally the general public. Even though they are frequently used for some applications, products like helium balloons, dispensing gases, welding gases, LPG, and medical oxygen emissions are harmful.

Keywords—Industrial Automation, IOT, WSN, gas sensors, Harmful gases, ESP32 module.

I. INTRODUCTION

Industrial gases are gaseous substances released from industrial facilities. A large number of gases and mixes are available in gas cylinders, but the main gases are nitrogen, oxygen, carbon dioxide, argon, hydrogen, helium and acetylene. Industrial gas emissions result from the production of numerous goods and materials that are used in a variety of applications. Industrial gases are extremely dangerous and severely affect anyone or anything exposed to them. Many employees in the industrial sector operate in a variety of departments including production, packaging, building, manufacturing, etc. They are in some way exposed to these dangerous gases, which have highly negative effects on them and occasionally even have fatal consequences. The sale or rental of gas cylinders and related equipment is also covered by this industrial enterprise providing tradespeople's tools and occasionally the general public. Even though they are frequently used for some applications, products like helium balloons, dispensing gases, welding gases, LPG, and medical oxygen emissions are harmful.

Industrial Internet of Things, or IoT, is currently regarded as one of the newest emerging topics affecting industrial organisations both now and in the future. Industries are modernising their systems and technology to comply with new rules, stay up with the speed and volatility of the market, and deal with emerging innovations. Industries that embraced IoT saw notable benefits in safety, efficiency, profitability, and other areas, and it is anticipated that this trend will continue as IoT technologies become more generally used.

Wireless Sensor Nodes (WSN) are spatially dispersed, dedicated sensors that gather and process cluster data or function as a network collectively.IT keeps track of the environment's physical circumstances and organises the data it collects in one place. Environmental factors like pollution levels, humidity, temperature, sound, wind, and more are measured by WSNs. The WSN is composed of nodes, which can range in number from a few to thousands and are arranged in a network. Each node is connected to one or occasionally multiple sensors. Each of these sensor network nodes' internal circuitry typically consists of the following components: a wi-fi module that is typically used for communication, a microcontroller that manages the node's processing, an electronic circuit for interfacing with the additional sensors and a power source, which is typically a power supply. For each application in which it is used, a sensor node's size may vary, and depending on the complexity of each sensor node, its price may also vary, from a few dollars to hundreds of dollars. Other resources like computing speed, energy, communication bandwidth, memory, etc. may also vary more than usual depending on the size and cost of the sensor nodes.

II. LITERATURE SURVEY

In the study, distributed systems are used as the new low-cost Internet of Things. The author has described Air Pollution Wireless Monitoring on Real Time Based on a multilayer distributed model with sensors, an ESP32 Wi-Fi module, and wireless connectivity, a low-cost wireless monitoring system is created to measure CO, CO2, and the density of dust parameters. To track air pollution in real-time, data is gathered in a computer and sent to a website. The aforesaid notion has been validated in the Ecuadorian cities of Quito, Amaguana, and Tena.

The system is highly complicated because different software languages were utilised for different tasks (such as Java for the computer system and C/C++ for converting analogue input to digital form, etc.). The author of IOT- Based Air Pollution Monitoring and Forecasting System explained that the system consists of a system where environmental sensors, such as SO2, NO2, CO sensors and Meteorological sensors (wind direction, wind speed, temperature, humidity, and air pressure), are installed in some of the monitoring points. The system can be set up in a large-scale monitoring region to create a network of monitoring sensors. By using neural network technology to analyse the acquired data, it also demonstrates the function of predicting. The WSN-based system for monitoring air pollution As the system's primary controlling component, it was built using the AVR AT-mega-32 Micro-controller. Various sensor parameter data, including MQS. MQ7.The sensor grid employed for this purpose may measure temperature and humidity. The values are computed based on probability using the ID3 algorithm. The controller and client are connected through a Bluetooth module, and the client then uses web services to reach the server. This method is capable of forecasting future air pollution in the specific contaminated area in addition to calculating the contaminants now present in the air. Here, they focus mostly on Hinjewadi and the nearby chemical industry in Pune. The author discusses an air pollution monitoring system that uses Zigbee and GPS. Various sensors are interfaced to the system to measure the majority of measurable air contaminants. like SO2, CO, NO2 and NO, among others. The monitor's graphical user interface (GUI) uses the measured data to show it. To display real-time pollutants, pollutants level, and locations across wide areas, the pollutants level is maintained on a data-based server and interfaced to Google maps. It makes use of a low power wireless sensor network and uses Google maps to display the location and pollution level graphically. Sensors have been employed in the real-time monitoring system to measure the concentration of gases like CO, NO2, CO, and 02. Libelium WASP motes, which include a communication unit and processor unit, were utilised for basic wireless communication modules. The samples are packetized and delivered to the base station after collection. A web interface is used to view this pollution data, which was created and made accessible from anywhere on the internet in the form of figures and charts. Libelium WASP notes are overpriced. This technology uses a lot of battery energy. Utilising a wireless sensor network, the designed air pollution monitoring system was put into use and tested. Pollutant gases from the environment are gathered, including CO2, NO2, and SO2. Data on pollution is gathered by the many mobile sensor arrays and sent to a central server where it is made available to Governmental power The data on pollutant levels and their compliance with regional air quality requirements are displayed. The system assesses a given area's level of health concern using the AQI. The author has dubbed an inexpensive, small, and portable air pollution monitoring system as Adu-Air: The Adu Air is designed to monitor and gather data on the carbon monoxide levels in a certain area. Using different sensors, the sensor-based system can also be used for a number of other gases, including SO2, NO2, CO2, 03, and others. This technique works well for the general population to monitor the quality of the air around them. This technology can be installed on a huge scale and used domestically by a large amount of persons. The indoor CO2 real-time system.

III. PROPOSED METHODOLOGY

IOT and WSN technology will be used in the proposed work to improve connectivity and create a good sensing area. Incorporating switching actions will allow for multiple observations of the various sensors being used. To get the best data for visualisation, many dangerous gases, including CO2, NH3, Benzene, Sulphur Dioxide, Nitrogen Oxide, and Carbon Monoxide, must be taken into account. IOT gateway will be created using the ESP32 module and Arduino IDE software in C++. Graphical dashboard representation will be used to compare and observe additional simulation outcomes.

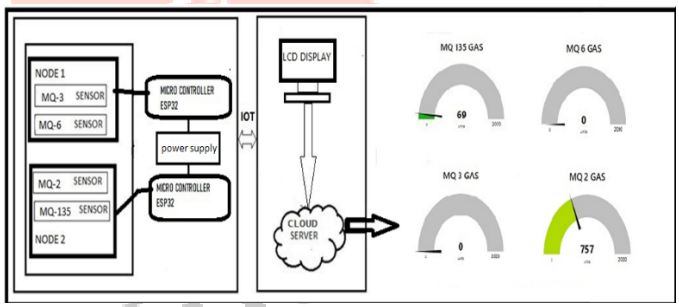

Fig. 1. Block Diagram

Sensing numerous dangerous gases that are present in industrial areas, then visualising them on a dashboard to make informed decisions about how to manage their contamination there, ensuring a safe working environment for those working in industry. additionally, to improve the system's efficiency and cost-effectiveness. The proposed work includes both the software and hardware components in such a way that, when combined with the reconfigurability concept, the IOT and WSN technologies will have observing replies for the whole period of the sensing. Node-RED will be used on a computer to display the graph of dangerous gases like CO2, NH3, Benzene, and Nitrogen Oxide. As an IOT Gateway, the C++ software for Arduino will be utilised to transport sensed data to a PC for analysis, dashboards, controlling activities can be seen and executed. Additional data may be kept in the Blynk cloud.

IV. EXPERIMENTAL RESULTS

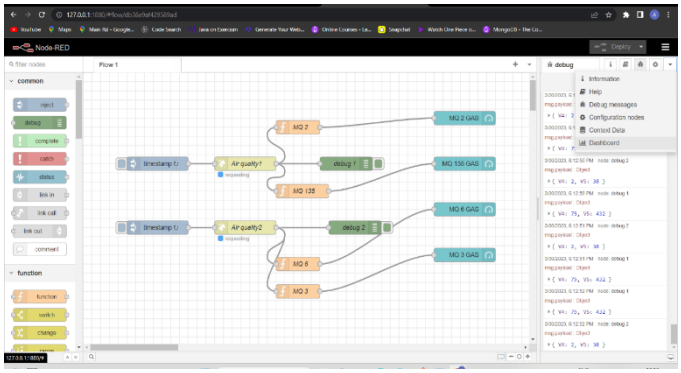

Fig. 2. Output Screen

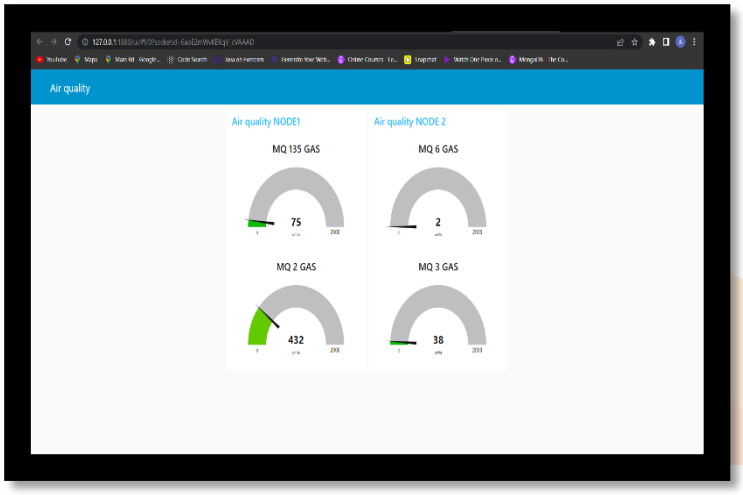

Fig. 3. Output Graphs

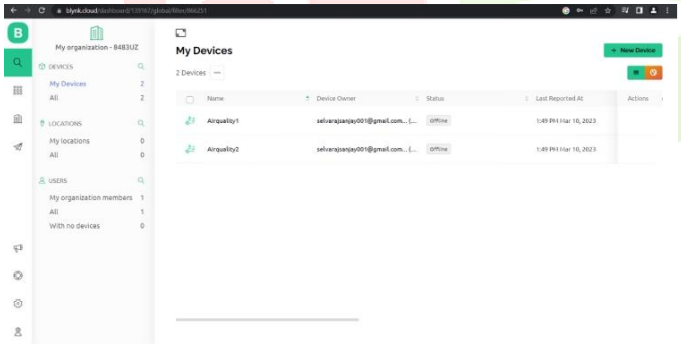

Fig. 4. Output Log

A. Experimental Results and Discussions

Since we are using four gas sensors—MQ-6, MQ-3, MQ-2, and MQ 135—the output of this project is displayed on the Output Screen. Additionally, the data is logged using a Node-RED database. The graphical display and data logging are done simultaneously as the gas sensors sense the data. If the sensed data exceeds the highest value predefined on the output screen, it is indicated through gauges with colour indication. The calibrated and displayed sensed data ranges from 0 to 2000ppm in percentage. The monitoring and regulating operations can be carried out by looking at the graphs and verifying the logged data.

V. CONCLUSION

Various methods have been used to monitor the harmful effects of the environment. WSNs have recently attracted a lot of attention in the literature when it comes to environmental monitoring. People are exposed to pollutants in both indoor and outdoor environments that are released by buildings, companies, automobiles, etc. This study focuses on the field of environmental observing using sensors. As a result of the necessity to estimate air quality with the least amount of cooling possible, a wide range of such systems have lately been created and put into use. In this work, a review of the current environmental monitoring systems is offered. The study highlights research-oriented issues that must be solved before environmental monitoring programmes can be used in real-world settings. We utilised the newest technology for this project, including IOT and wireless devices to detect gas leaks from industrial sources, which have a significant influence on many people's lives and alter the environment.

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