A Review on Monitoring And Control Of Air Quality

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Abstract- *Air quality monitoring is the action of measuring several pollutants present in the air. Air quality has an inevitable impact on human health, it is a life-threatening problem that requires great attention. Ensuring the safety of the air we breathe is one of the primary advantages of air quality monitoring. Numerous factors can affect air quality, like pollution from vehicles, Industrial activities, Weather conditions, Natural sources, Population density etc. These factors can cause many health issues including Respiratory problems, Cardiovascular disease, Lung cancer, Neurological issues, Mental health etc. According to a 2022 study by the Toxic Sites Identification Program, exposure to hazardous gasses from industrial sites is thought to be the cause of death for 200,000 people a year worldwide. Lung problems have increased due to air pollution, which leads to the cause of 8.1 million deaths worldwide in 2021. According to reports from the World Health Organisation (WHO), nearly all people on the planet (99%) breathe air that is polluted and poses a health risk to them. Hence, in order to get a good breathing environment, the air quality must be routinely monitored and evaluated. The development of sensors and monitoring technologies had a great aid in the autonomous and periodic design of monitoring devices to measure the air quality. This helps us with our study into creating a system that can track the quality of the air in indoors, cars, well, industries on a regular basis. In this work, we created an air quality monitoring and control system that measures air quality utilizing many sensors and a controller. The end product is a system that can track dust particles, temperature, humidity, pressure and toxic gases.*

Keywords- Air quality, sensor, monitoring system, controller, Internet of Things.

I. INTRODUCTION

This article guides a stepwise walkthrough by Experts for writing Air quality has an impact on human health, it is a problem that requires great attention. Eighty percent of individual activities occurring inside metropolitan and industrial areas lead to air pollution[1]– [3]. Many of the people are suffering from this effect including young children, nursing mothers, the elderly, and those suffering from long-term illnesses and those who stay indoors more. he levels of airborne contaminants in public spaces such as homes, businesses, and buildings differ from those outside. Indoor air quality is influenced by various factors, including cigarette smoke, kitchen smoke, gases from home appliances and mosquito repellent. Work-related items and clothing from the office also contribute to indoor pollution. The Republic of Indonesia's Decree of the Minister of Health Number 1405 of 2002 establishes norms and standards for indoor air quality, including humidity, temperature, dust, and pollutants like Sulphur dioxide, ammonia, carbon monoxide, and nitrogen dioxide[4].

Industries produce various pollutants, including greenhouse gases like methane and CO2, which contribute to global warming, and PM2.5 and PM10 that aggravate respiratory conditions. Burning fossil fuels releases SO2 and NOx, causing acid rain and damage to structures and ecosystems. Ground-level ozone, created by volatile organic compounds, impairs respiratory health. Hazardous air pollutants like formaldehyde and benzene pose serious health risks, including cancer. When combined, these pollutants worsen air quality and pose significant environmental risks.

Automated monitoring technologies have frequently advanced with sensor technology that is a component of the Internet of Things (IoT). Numerous industries, including healthcare, agriculture, disaster relief, and more, use monitoring systems. Depending on the object being watched over and the monitoring location, several devices or systems are utilized for remote monitoring. As a result, we created a technique to track air quality in this study. According to recent studies, air pollution may have an impact on the brain and may be a factor in neurological conditions including Parkinson's and Alzheimer's disease. In addition, bad air quality can cause headaches, exhaustion, and irritation of the eyes and throat. It can also have an impact on foetal development, which can result in low birth weight and preterm births.

Air quality monitoring and management systems provide real-time data to the public and authorities, enabling informed decisions on pollution levels. They ensure adherence to rules, assess emission control measures, and promote long-term health studies. These systems are crucial for maintaining a healthy environment and public health, promoting adherence to air quality standards and objectives. This system can be installed in several domains like industrial areas (mining,

clothing, chemical, petroleum), air-conditioned rooms, cars, wells,traffic areas, Institutions etc.

III. LITERATURE REVIEW

Numerous factors, including population growth, increased vehicle use, industrialization, and urbanization, have contributed to the rise in pollution levels over time.These variables have a negative impact on public health and well-being. To keep an eye on In this project, we will create an Internet of Things (IOT)-based air pollution monitoring system. Using a web server and the internet, we will monitor the air quality and set off an alarm when the air quality falls below a predetermined threshold, which indicates that there are enough dangerous gases, such as CO2, alcohol, smoke, benzene, and NH3, present in the air. We will be able to quickly monitor the air quality thanks to the PPM display on the webpage and LCD. With this IOT project, the pollution level from any location can be monitored using a computer or mobile device.[6]

Whether a country is developed or developing, air pollution is always the main issue. Health issues have been escalating more quickly, particularly in emerging country cities where increased industrialization and traffic volume result in the emission of several gaseous pollutants. Pollution causes harmful side effects that range from minor allergic reactions like sore throats, eyes, and noses to more significant issues like bronchitis, heart disease, pneumonia, lung infections, and worsened asthma. A survey claims that between 50,000 and 100,000 premature deaths occur annually in the United States alone as a result of air pollution. In contrast, the number in the EU is 300,000, and it exceeds 3,000,000 globally. An IOT-based air pollution monitoring system uses the Internet to monitor the quality of the air over a web server. When the air quality falls below a predetermined threshold, which is when there are enough harmful gases in the air, such as CO2, smoke, alcohol, benzene, NH3, LPG, and NOx, the system will sound an alarm. In order to make it easy to monitor, it will display the air quality in PPM on the LCD and on the webpage[7],

This project's primary goal is to track air eminence in urban and industrial areas. A set of gas sensors (CO and NO2) that are mounted on the masses and structure of an IOT (Internet of things) and a dominating server are included in the proposed outline to provide both ongoing intentional planning and short-range real-time event management. The Arduino platform is utilized in this instance to transmit data quickly and easily.Wireless sensor network, or WSN, serves as the transceiver. With the use of low rate, low information rate, and little control wireless communication technology, this offers a real-time low-rate monitoring system. Several apps can share or transmit the predicted monitoring system. We are able to visualize the values thanks to IOT.[8]

In order to measure the meteorological and environmental parameters, including temperature, humidity, light intensity, dew point, and heat index, this paper uses three sensors. The Arduino microcontroller processes the values that are read from the sensors and stores them in a text file that may be further processed to produce analysis. For easy viewing, the readings are also shown on an on-board LCD. It is possible to record the weather pattern and determine the specific weather characteristics of a given place by analysing all these observations. These documented criteria, which differ between locations, are crucial.[9]

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IV. STUDIES AND FINDINGS

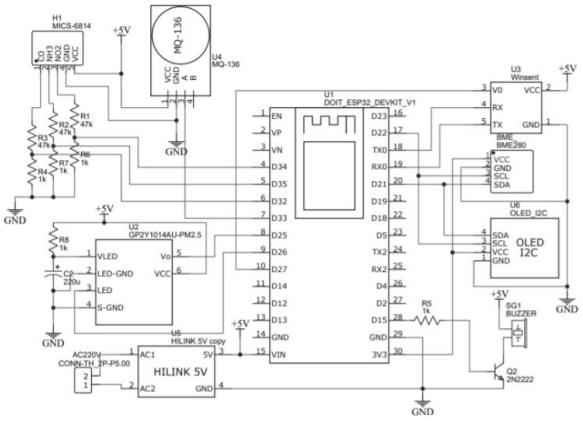
It is thought that IoT monitoring systems are the most dependable options for measuring IAQ. Because these systems use less power and have shorter latencies, they also require less maintenance work. Since real-time monitoring systems based on the Internet of Things are referred to as "smart systems," this design has garnered the attention of most researchers and industrial manufacturers. According to experts, an IoT system can keep an eye on a lot of metrics without sacrificing system efficiency [11].Significant developments and insights have been highlighted by recent studies and discoveries on air quality monitoring and control systems. The direct impact of indoor air quality (IAQ) pollutants, such as coal smoke and biomass, on chronic diseases like lung cancer, asthma, and COPD, has drawn attention to IAQ monitoring. It has been highlighted that real-

time monitoring can be achieved through the use of wireless technologies and cyber-physical systems, which use sensors to measure parameters such as temperature, CO, CO2, VOCs, PM_{10}, and PM_2. Intelligent air quality monitoring systems based on deep learning, optimization algorithms, and the Internet of Things (IoT) are being developed in the context of smart cities to monitor and anticipate air quality. This will help governments make educated decisions to safeguard public health and minimize pollution. Furthermore, a number of urban air pollution control programs have been put into place throughout the world, and systematic studies have demonstrated that successful interventions can greatly improve air quality. IoT integration for IAQ monitoring has completely changed the industry by offering real-time data analysis, preventative maintenance monitoring.

These studies highlight how crucial it is to monitor and regulate air quality using cutting-edge technologies and well-thought-out strategies in order to protect the environment and human health[13] .

A. System design

Connecting the ESP32 to every sensor already in use is the next step in the system design process. Figure shows the schematic outline of the system that was designed. Following that, we were using the Arduino IDE to write the program code to read the sensor data entered into the ESP32. We also employ LED display to show the reading data for the measurement result.



B. Material

The primary materials we use in this design are as follows:

- ESP32
- BME280 sensor module
- GP2Y1010AU dust sensor
- MQ-136 gas sensor
- MICS-6814 gas sensor module
- Winsen ZE03-SO2 gas sensor module

V. CONCLUSION

To sum up, there is a lot of promise for reducing environmental pollution and improving public health with the design and execution of the air quality monitoring and control system. Our solution uses Internet of Things (IoT) and sophisticated sensors to offer real-time data on air quality, allowing for prompt interventions and well-informed decision-making.

The project's goals of monitoring temperature, humidity, dust particles, and polluting gases (NH3, CO, NO2, and SO2) were all effectively met. and offering practical insights via an intuitive user interface. The system's capacity to maintain ideal indoor air quality is further improved by the integration of control mechanisms, such as automatic ventilation and air purification.

Future development may concentrate on enhancing the system's functionality by adding more sensors to detect a wider variety of contaminants and integrating machine learning algorithms to do predictive analysis.Programs for raising awareness and involving the community can further enhance the benefits of this technology, promoting a more sustainable and healthier environment. In general, this initiative emphasises how crucial it is to mitigate air pollution and protect public health by ongoing monitoring and preventive steps.

Air quality monitoring device

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