A REVIEW PAPER ON INDOOR AIR QUALITY MONITORING SYSTEM

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Abstract- *Effective monitoring systems are becoming more and more necessary to guarantee a healthy living and working environment as people become more aware of the significant effects indoor air quality (IAQ) has on human health and productivity. This study proposes a cutting-edge quality of indoor air that relies on IOT technology to generate significant, real-time data on necessary air quality indicators. To continuously measure and monitor various IAQ parameters, our system makes use of a network of inexpensive, energy-efficient sensors. After collection, the data is uploaded to a cloud-based platform so that users can access real-time data. By providing users with accurate and timely information, our IoT-based IAQ monitoring system plays an important role in encouraging healthier indoor environments, minimizing health risks, and ultimately improving overall quality of life.In short, IoT technology integration for indoor air quality monitoring enables people to make intelligent choices about their living and working surroundings. It advances the group's goal of building a sustainable and health-conscious future for everybody.*

Keywords: Indoor Air Pollution Control Techniques, IOT, NodeMCU

1. INTRODUCTION

The health of people, ecosystems, and the world are all seriously threatened by air pollution, an increasing environmental problem. As the world undergoes rapid industrialization, urbanization, and increased reliance on fossil fuels, pollutant emissions into the environment have increased to previously unheard-of levels. The ecosystem and people's well-being are greatly impacted by air pollution and climate change, in addition to lowering the quality of the air we breathe.

Contaminants like fine particulates, oxides of nitrogen, sulfur, carbon monoxide,organic volatile compounds, and heavy metals are released when fossil fuels burn, industrial operations, transportation emissions, and other human-caused sources burn.These contaminants can harm

people's health in addition to lowering air quality.The standard of the air we inhale in enclosed areas has huge effects on our health and well-being at a time when we spend a large amount of our lives indoors. Although it is sometimes disregarded, indoor air pollution is just as harmful to the environment and public health as its outside equivalent. Because indoor environments are contained and have multiple sources of pollution, they provide a special set of problems that require thought and creative solutions. This study presents an innovative IOT architecture for detecting room temperature, humidity, and important indoor contaminants such as CO, NH_3, CO_2, and smoke. Additionally, the system allows administrators to remotely monitor the levels of pollutants in a home or workplace. The data is processed, and if a threshold is surpassed, the smart system notifies the owner and shows the results on an LCD.

2. LITERATURE REVIEW

Harsh N. Shah, Zisman Khan, Abbas Ali Merchant, and MoinMoghal, "IOT-Based Air Pollution Monitoring System." The author concludes that to identify dangerous chemicals like CO_2 and smoke, the MQ135 and MQ6 sensors are used by the IOT-based Air Quality Monitoring System. By showing concentrations in PPM on an LCD and webpage, it provides real-time air quality monitoring. Alarms are set off whenpollution reaches a certain level, requiring an immediate response. This system encourages a proactive approach to addressing environmental challenges by aiding in the early detection and knowledge of air pollution. [6]

Jacquline M.S. Waworundeng, WalfaridHermawanLimbong, “Indoor Air Quality Monitoring System Based on Microcontroller, Android, and IoT.” The author shows that an Arduino, an MQ135 sensor, and analarm buzzer were used by the researcher to develop a monitoring system for the indoor quality of air. ThingSpeak receives data on air quality from the Arduino Uno, which is connected to the internet and has an Ethernet shield installed. AirQmon, a bespoke Android app, retrieves and displays the data on devices visually.The goal of this system, which uses the prototyping technique, is to effectively create awareness by serving as a gadget and app that alerts users about concerns related to indoor air quality. [7]

K. DurgaAnudeepika,K.Durga Devi, M. Kamala, D. Swetha, and Dr. E.V. Krishna Rao, “Implementation of Indoor Air Quality Monitoring System Using IoT and GSM.” The author presents an IOT-basedair quality monitoring system that tracks pollutants like CO, NH_3,

temperature, humidity, and dust particles utilizing sensors and Arduino. Poor indoor air quality is a common problem that many homeowners are unaware of. The solution allows for remote access via an IoT platform and shows real-time data on an LCD screen and a personal computer. Using a GSM modem, administrators can receive alert messages alerting them to pollution levels inside buildings. [9]

Kennedy Okokpujie, Etinosa Noma-osaghae, Odusami Modupe, Samuel John, "A Smart Air Pollution Monitoring System." The author proposes an Arduino-developed system for detecting air pollution to address the impact of rising industrial operations on air quality. This technology records data on a remote server that can be accessed over the internet, monitoring and analyzing air quality in real-time. Parts per million (PPM) metrics are used for measurement, and the results are precisely shown on the system's interface as well as remotely on high-tech mobile devices via the cloud. The program seeks to inform people in real-time and increase awareness of how human activity affects air quality. [10]

Manila D, "IoT Air Pollution Monitoring System using Arduino." The author suggests an air quality monitoring system to address the growing problem of air pollution. It uses IOT and air sensors to track and send real-time air quality, sound levels, and hazardous gas concentrations to an online server. This data is processed by the microcontroller and sent over the internet, allowing authorities to quickly monitor and address air pollution in different places. Through proactive management and control of air quality, the system hopes to contribute to a healthier living environment and a brighter future. [11]

3. BLOCK STRUCTURE

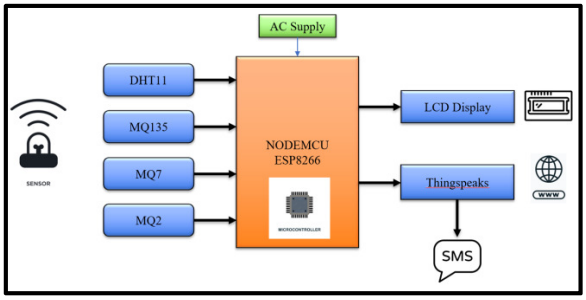

Fig.3.1 Block Structure of the Device

The block structure in Fig. 3.1 serves as the base for the proposed system for detecting air pollution. The NodeMCU is the system's central processing unit (CPU) and connects to

several sensors to gather environmental data. A NodeMCU is linked to a DHT11 sensor to provide temp and moisture values. The MQ7 sensor detects carbon monoxide (CO)in the air. The MQ135 sensor detects gas concentrations such as carbon dioxide. The MQ2 sensor detects several gases, such as LPG and smoke. Real-time data such as temp, moisture, CO level, and gas concentrations are displayed on the LCD. The ThingSpeak Platform is a cloud-based platform for sensor data storage and visualization. NodeMCU transmits the captured data to the ThingSpeak platform for analysis and storage. When predefined threshold values for any parameter (e.g., high CO levels) are exceeded, users receive SMS notifications.

4. REQUIREMENTS

4.1 Hardware Requirements

1) NodeMCU ESP8266

A small development board with the ESP8266 Wi-Fi module is called the NodeMCU ESP8266. It has a USB-TTL connection, an Arduino IDE supporter, and a 32-bit microprocessor. including GPIO pins and built-in WiFi.

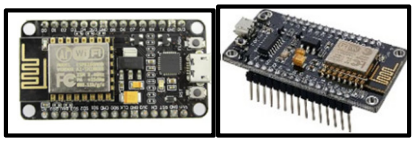

Fig.4.1. NodeMCU

2) DHT11

A digital sensor for temperature and humidity is called the DHT11. Its small size and single-wire communication protocol allow it to give precise measurements in the 0 to 50 degrees Celsius and 20% to 80% humidity range.

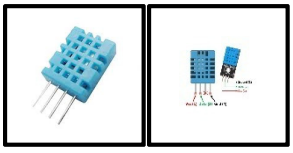

Fig.4.2. DHT11

3) MQ135 Sensor

Ammonia and carbon dioxide are two typical gases that may be detected with the MQ135 sensor.

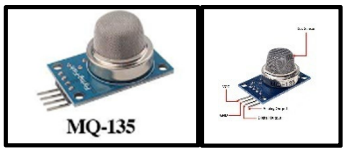

Fig.4.3 MQ135 Sensor

4) MQ7 Sensor

The MQ-7 sensor is a gas detection module commonly used for detecting carbon monoxide (CO) and natural gas (methane).

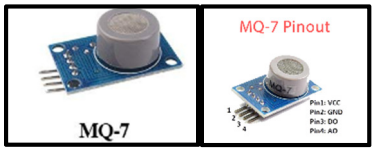

Fig.4.4 MQ7 Sensor

5) MQ2 Sensor

The MQ2 sensor is a gas detector widely used for detecting LPG and smoke in the air.It offers affordable solution for gas detection applications.

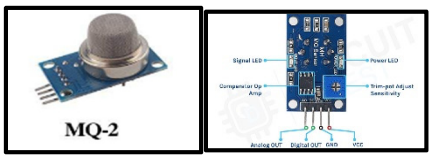

Fig.4.5 MQ2 Sensor

6) LCD Display

IoT LCDs are small, microcontroller-integrated screens for real-time data visualization in Internet of Things applications. They are available in a range of sizes and resolutions, and many of them have touchscreen functionality, which increases their adaptability for productive and user-friendly uses.

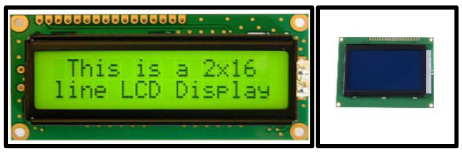

Fig.4.6 LCD Display

7) Jumper Wires

Jumper wires are insulated copper wires that are flexible and used to temporarily connect components on breadboards. They allow for simple solderless prototyping of electronic circuits and are available in a variety of lengths, colors, and connector types.

Fig.4.7 Jumper Wires

8) Breadboard

A breadboard is a prototyping platform made of plastic for electronics that has a grid of connected holes where components and jumper wires can be inserted. Because it makes solderless circuit building and testing possible, it's a flexible tool for quick prototyping.

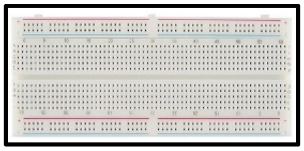

Fig.4.8 Breadboard

9) 9V battery

A 9-volt battery is a compact power source delivering 9 volts commonly used in detectors and remote controls. It comes in various chemicals, such as alkaline or lithium.

Fig.4.9 9V battery

4.2 Software Exposures

1) Arduino IDE

The Arduino Integrated Development Environment (IDE) is a user-friendly software platform that is used to write and upload code to Arduino microcontrollers. It offers an intuitive yet robust code-writing, editing, and uploading interface for Arduino boards. With features like auto-

completion, syntax highlighting, and an easy-to-use serial monitor, it may be used by both novice and seasoned developers. A streamlined version of the C++ programming language is supported by the IDE, making it usable by people with different degrees of programming experience. It also provides a variety of libraries and examples to help users build different functionality without having to write a lot of code. The Arduino IDE acts as a single location for creating embedded applications. It allows Arduino boards and computers to communicate seamlessly, which speeds up exploration and development.

2) Thingspeak Platform

An open, cloud-based IoT platform called ThingSpeak is made for gathering, storing, and displaying data from linked devices. It offers an easy-to-use interface for managing Internet of Things (IoT) projects and was developed by MathWorks. ThingSpeak facilitates the effortless gathering of data from diverse sensors or devices, instantaneous analysis and visualization of the data, and dissemination of the outcomes to other parties. It facilitates communication protocols and popular IoT device platform integration. ThingSpeak provides an adaptable solution for Internet of Things applications ranging from industrial automation to environmental monitoring, thanks to built-in features like data logging, charting, and MATLAB analytics. Because the platform can be accessed via a web interface, developers with varying levels of experience can use it to construct IoT projects that include data logging and visualization features.

5. METHODOLOGY

The NodeMCU is connected to several sensors as part of the hardware setup for the air pollution detection system to collect extensive environmental data. The DHT11 sensor is connected to the NodeMCU and measures temperature and humidity, providing vital climate data. The MQ7 sensor detects carbon monoxide (CO), the MQ135 sensor measures gas concentrations, mainly carbon dioxide, and the MQ2 sensor detects a variety of gases, including LPG and smoke. Furthermore, the NodeMCU is connected to an LCDfor real-time data visualization, providing users with an easy-to-use interface for tracking important metrics.

The essential libraries are installed in the Arduino IDE, and the code is written and uploaded to the NodeMCU. This code includes functions for the attached sensors as well as the LCD. The Serial watch displays real-time data using Serial.println() commands, allowing users to watch

sensor readings in real-time. The LCD visually shows temperature, humidity, CO levels, and gas concentrations.

The system interfaces with the ThingSpeak platform for data transfer and analysis. Create an account on ThingSpeak, get the ThingSpeak API key for data authorization, and then update the Arduino code to incorporate ThingSpeak library functions for smooth data transfer.

An alert mechanism that establishes threshold limits for every sensor parameter has been integrated into the Arduino code to improve system functionality. The system initiates an alert mechanism when readings exceed these predetermined thresholds. After the system's functionality has been checked and validated, it can be installed in the intended location. There, it will monitor air quality continuously and send out alerts in a timely manner in the event of hazardous conditions, improving user awareness and environmental safety.

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