Live Air Quality Monitoring App Using IOT

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***Abstract*—*The escalating issue of pollution demands immediate attention, given its profound impact on human health and the environment, including the alarming trends of global warming and erratic weather patterns. Of particular concern is the pervasive challenge of air pollution, which poses severe risks such as lung cancer, respiratory ailments, and heart diseases. In order to properly address this risk, ongoing real-time monitoring and analysis are needed., and assessment of air quality, enabling prompt corrective actions. In response to this need, we propose an innovative model that leverages the framework of the Internet of Things (IoT) to give users real-time information regarding the presence of harmful gases in their surroundings, thus facilitating awareness of air quality. Our system meticulously monitors key parameters, including ParticleMatter2.5, Carbon Dioxide (CO2), Carbon Monoxide (CO), temperature, and humidity with the help of ESP-32 and few other sensors such as DHT-11, MQ-135, MQ-11. The data collected is conveniently visualized on a mobile application developed using Flutter, presenting users with graphical representations and numerical values for these parameters. Furthermore, in the event that the concentration of Carbon Dioxide surpasses predefined thresholds, our system proactively sends notifications to users, ensuring their safety and well-being.*

Keywords— Real-Time monitoring, IoT, PM2.5, Flutter, DHT-11, MQ-7.

I. INTRODUCTION

Amid a world grappling with the escalating specter of air pollution and its detrimental consequences on human health and environmental equilibrium, we stand at the precipice of a groundbreaking solution – the "Live Air Quality Monitoring App using IoT." This visionary project embarks on a mission to tackle the dire need for unceasing air quality assessment in our communities and urban environments.

In an era where the quality of the air we breathe has taken center stage in the global discourse on health and sustainability, our endeavor assumes a paramount role. By harnessing the formidable potential of Internet of Things (IoT) technology, we bring forth an innovative application that revolutionizes the way we perceive and engage with our atmospheric surroundings.

It is sentinel for the very air we depend upon. The system is meticulously designed and technologically advanced, provides a constant stream of real-time data, offering insights into a spectrum of crucial air quality metrics. From the insidious PM2.5 particulate matter to the presence of noxious gases like CO and CO2, as well as vital environmental factors such as temperature and humidity, our application keeps an ever-watchful eye on the very elements that define our daily existence. But it goes beyond mere data dissemination; it's about empowerment. Our innovative solution doesn't just offer insights; it hands you the keys to informed decision-making. It provides the knowledge and agency you need to protect your health, the health of your loved ones, and the sanctity of the environment that envelopes us.

With a seamless integration of cutting-edge hardware, sophisticated software components, and the unyielding power of IoT technology, our project constitutes a significant leap forward on the path to a healthier, more informed future. It's not just an app; it's the vanguard of a transformative shift in the way we understand and interact with our environment. It's an ode to clean air, a commitment to healthier living, and a vision for a world where every breath we take is an assurance of well-being.

II. LITERATURE REVIEW

Kennedy O. [3] suggests an alternative approach to assessing air quality, which calls for using an Arduino Uno as the primary research instrument.. An external Wi-Fi module has to be interfaced with Arduino since it lacks an internal one. The module was an ESP8266. Because NodeMCU is a development board designed specifically for Internet of Things applications, it may also be utilized as the primary node controlling in a system. In their work, Kumar A et al. [4] present this. Since the NodeMCU ESP8266 only has one built-in ADC pin, additional ADC chips must be attached if more are needed.According to Kumar S. [2], the main node controller is the Raspberry Pi. [/2]

In order to detect , temperature, humidity ,Carbon Monoxide, Carbon Dioxide, pressure, particulate matter, and other characteristics, they have included sensors in their system.

There are no built-in analog-to-digital converter (ADC) connectors on the Raspberry Pi., therefore one needs to attach a second one. Here, it's linked to an Arduino Uno, which serves as a productive ADC. An external Wi-Fi adaptor is needed since their Raspberry Pi 2 model B, which lacks an integrated WiFi adapter, is being used.

They have also shown the results using the MQTT protocol on the IBM Watson IoT Platform. An onboard Wi-Fi adapter on the Raspberry Pi 3B might help cut down on the amount of electronics required. Gupta [5] uses this strategy in their system.

Using an ESP32 microcontroller is an additional method to achieve this. The ESP32 is faster than other similar devices because it has two CPU cores, an integrated Wi-Fi module, and enough ADC pins. Asra N [6] presented this in their study. Using the Blynk Platform, they have uploaded the sensor's readings to the cloud.

Particulate matter sensors are relatively costly when compared to other types of sensors. Six inexpensive PM2.5 particle sensors were investigated by Jayaratne R. [7] in a paper for a variety of applications. This aids in the development of a cheap system..

Year	Article	Author
2019	Air Quality Monitoring System.	Rawal R.
2017	Air quality monitoring system based on IoT using Raspberry Pi.	Kumar S, Jasuja A.
2018	A Smart Air Pollution Monitoring System.	Kennedy Okokpujie, Etinosa Noma-Osaghae, Odusami Modupe.
2020	Design and Analysis of IoT based Air Quality Monitoring System.	Kumar A, Kumari M, Gupta H
2019	An IoT Based Air Pollution Monitoring System for Smart Cities.	Gupta Harsh Bhardwaj Dhananjay Agrawal.
2021	An IoT Based Approach To Minimize And Monitor Air Pollution Using ESP32 and Blynk Platform.	Asra Noorain F Raju J Varsha Nanditha HG.
2020	Low-cost PM2. 5 sensors: An assessment of their suitability for various applications.	Jayaratne R, Liu X Ahn KH Asumadu-Sakyi.

III. Proposed System

The proposed system in this research project employs a suite of hardware components, including the ESP32 microcontroller, DHT11, MQ7, and MQ135 sensors, to design a instantaneous air quality observing solution as shown in Fig 1.

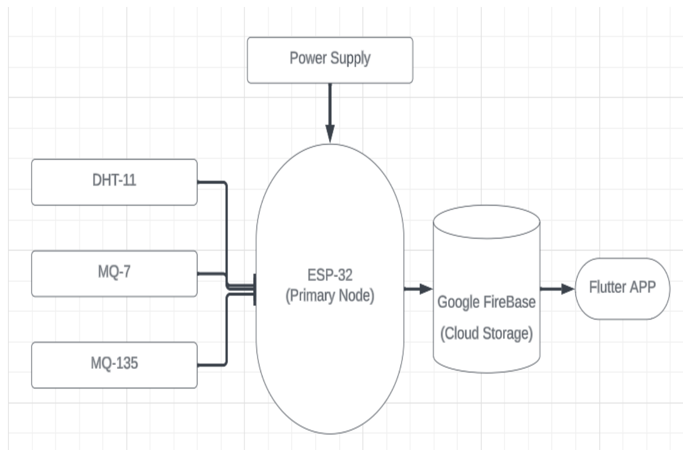


Fig 1.

The ESP32 serves as the central hub, collecting data from the sensors and transmitting it to Google Firebase, a cloud-based platform. A mobile application developed with Flutter and Dart provides a user-friendly interface for visualizing air quality data, complete with graphs and numerical values. It also includes a notification system to alert users when carbon dioxide levels surpass safe thresholds. This integrated system enhances user safety and awareness, facilitating data-driven decisions concerning air quality.

IV. Hardware Description

ESP32:

The ESP32 is a versatile microcontroller that serves as the main hardware component in the research project. It is responsible for collecting data from the attached sensors (DHT11, MQ7, MQ135), processing this data, and transmitting it to the cloud platform, Google Firebase. The ESP32's built-in Wi-Fi capabilities allow for seamless internet connectivity, making it a reliable choice for IoT applications.

DHT11:

DHT11, a low-cost digital temperature as well as humidity sensor. It is utilized in the project to observe the ambient temperature and humidity in the target environment.

This data is essential for assessing air quality and ensuring accurate measurements.

MQ7:

The MQ7 sensor specializes in detecting carbon monoxide (CO) gas concentrations. It plays a vital role in monitoring indoor air quality, particularly concerning the presence of this harmful gas. Data from the MQ7 sensor helps identify potential health risks related to CO exposure.

MQ135:

The MQ135 sensor is employed for monitoring the concentration of various gases, including carbon dioxide (CO_2). This sensor aids in assessing the overall air quality by detecting the presence of gases that can impact health and comfort

V. Software Description

Arduino IDE:

Arduino Integrated Development Environment (IDE) is utilized for programming and configuring the ESP32 microcontroller. This platform allows developers to write code in C/C++ and upload it to the ESP32 board. It enables the ESP32 to interact with the attached sensors, process data, and manage communication with other components of the system.

Google Firebase:

Google Firebase is a cloud-based platform that serves as the central data repository for the research project. It stores the real-time air quality data collected from the hardware components, including temperature, humidity, CO, CO_2, and other relevant information. Firebase also facilitates the transfer of data to the Flutter application and handles notifications based on predefined thresholds.

Flutter/Dart:

Flutter, along with the Dart programming language, is utilized to develop the mobile application that presents real-time air quality data to users. The application offers a user-friendly interface for visualizing air quality information, including graphs and numerical values. Additionally, it incorporates the Firebase SDK to enable real-time data updates and notifications when air quality parameters exceed safe thresholds.

VI. Methodology Used

The system in this research project employs a suite of hardware components, including the ESP32 microcontroller, DHT11, MQ7, and MQ135 sensors, to develop a system for monitoring air quality in real time. The ESP32 serves as the central hub, collecting data from the sensors and transmitting it to Google Firebase, a cloud-based platform. A mobile application developed with Flutter and Dart provides a user-friendly interface for visualizing air quality data, complete with graphs and numerical values. It also includes a notification system to alert users when carbon dioxide levels surpass safe thresholds. This integrated system enhances user safety and awareness, facilitating data-driven decisions concerning air quality.

6.1. Sensor Technology:

The system incorporates DHT11, MQ7, and MQ11 sensors to collect simultaneous data on temperature, humidity, and the concentration of various gases, including CO, CO_2. These sensors are strategically placed in the target environment to ensure comprehensive data collection.

6.2. Main Node - ESP32:

The ESP32 microcontroller acts as the central node in the network, it collects data from the sensors which is then processed on, and transmits it to the Firebase cloud platform. This versatile microcontroller offers a seamless connection to both the sensors and the internet, making it an ideal choice for this application.

6.3. Firebase Integration:

Data collected by the ESP32 is seamlessly transmitted to Firebase, a cloud-based database service, for storage and further processing. Firebase serves as the central data repository and allows for easy access and retrieval of air quality data.

6.4. Flutter Application:

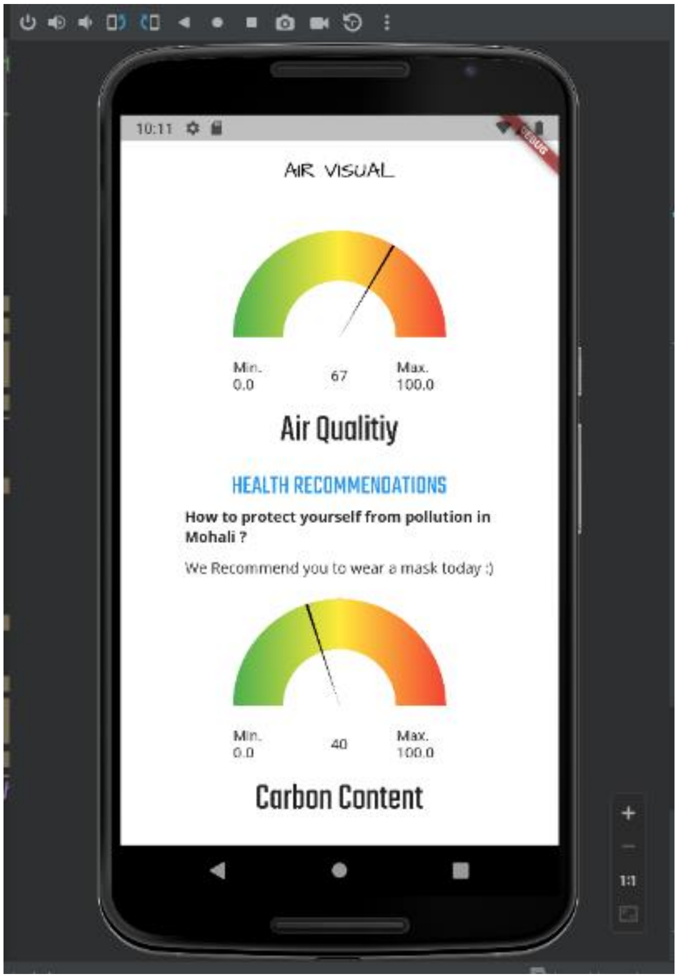
The system utilizes the Flutter framework to develop a user-friendly mobile application. Users of this application can access real-time data on air quality through a graphical interface. The information is displayed as numerical values and educational graphs., making it easy for users to understand the air quality in their surroundings.

6.5. Notification System:

One of the critical features of this system is the notification mechanism. It is designed to alert users when carbon dioxide (CO_2) levels exceed safe predefined thresholds. The notification system enhances user safety and ensures that individuals are promptly informed of any potential air quality risks.

VII. Conclusion.

In this research, we have presented a comprehensive system for live air quality monitoring using IoT technology. The integration of hardware components such as the ESP32 microcontroller, DHT11, MQ7, and MQ135 sensors, combined with software tools including Arduino IDE, Google Firebase, and Flutter/Dart, has resulted in a robust solution for real-time air quality assessment and user awareness.



This system offers significant advantages, including the ability to monitor multiple air quality parameters, visualize data through a user-friendly mobile application, and issue timely notifications when CO2 levels exceed safe thresholds. Such capabilities are crucial for informed decision-making and immediate responses to changing air quality conditions. As air quality continues to be a critical concern, our research project contributes a valuable tool for individuals and communities to safeguard their well-being and address environmental challenges. The successful integration of hardware, software, and cloud technologies demonstrates the potential of IoT in enhancing our understanding of and response to air quality issues, ultimately fostering a healthier and more informed society.

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