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Utilizing Internet of Things (IOT) Technology for Indoor Air Quality Monitoring

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Abstract
This project introduces an innovative indoor air pollution monitoring system based on IOT technology. The system employs sensors to continuously assess indoor air quality and goes beyond traditional monitoring by offering real-time health advice and emergency alerts. By analyzing sensor data, the system provides personalized health recommendations to users, guiding them in maintaining optimal indoor air quality. Furthermore, it integrates an emergency alert mechanism to automatically notify users and emergency services during critical situations. This comprehensive approach aims to improve user well-being by delivering actionable insights and ensuring swift responses to potential health hazards in indoor environments.

Keywords: IOT, Air Quality Monitoring, Real-Time Health Advice, Emergency Alerts.

INTRODUCTION

In recent years, the focus on indoor air quality (IAQ) has intensified, recognizing its profound impact on human health and wellbeing. With individuals spending approximately 90% of their time indoors, the quality of indoor air has become a critical concern. Indoor air pollution can originate from various sources such as building materials, furniture, cleaning products, and human activities, leading to adverse health effects ranging from respiratory issues to long-term chronic conditions.

To address these concerns, indoor air quality monitoring has emerged as an essential tool for assessing and managing indoor environments. Monitoring systems provide real-time or periodic measurements of key pollutants, allowing for timely intervention and mitigation strategies to maintain a healthy indoor environment. These systems employ advanced sensors and technologies to detect pollutants such as volatile organic compounds (VOCS), particulate matter (PM), carbon dioxide (CO2), carbon monoxide (CO), and various other contaminants.

Effective indoor air quality monitoring not only safeguards occupants health but also enhances productivity, comfort, and overall quality of life. By monitoring and controlling indoor air pollutants, building managers, homeowners, and occupants can create healthier and more sustainable indoor environments conducive to optimal living and working conditions. This project explores the significance of indoor air quality monitoring, discussing its importance, key pollutants of concern, monitoring technologies, and strategies for improving indoor air quality. Additionally, it examines the role of regulations and standards in promoting IAQ monitoring and outlines best practices for implementing

comprehensive IAQ management programs. Through increased awareness, proactive monitoring, and informed decision-making, stakeholders can collaboratively strive towards healthier indoor environments for all.

PROPOSED METHOD

The proposed air quality monitoring system revolutionizes traditional approaches by employing a network of Raspberry Pi devices armed with a diverse sensor array, including MQ-5 for natural gas, MQ-7 for carbon monoxide, DHT-11 for temperature and humidity, and MQ-135 for CO2 monitoring. This innovative design ensures affordability, ease of deployment, and adaptability, addressing the constraints of conventional monitoring stations. By leveraging Raspberry Pi's scalability and versatility, the system offers a flexible solution capable of scaling to diverse environments and accommodating evolving monitoring needs. Its user-friendly interface simplifies data collection and interpretation, empowering both professionals and communities to access and understand air quality information. Moreover, the integration

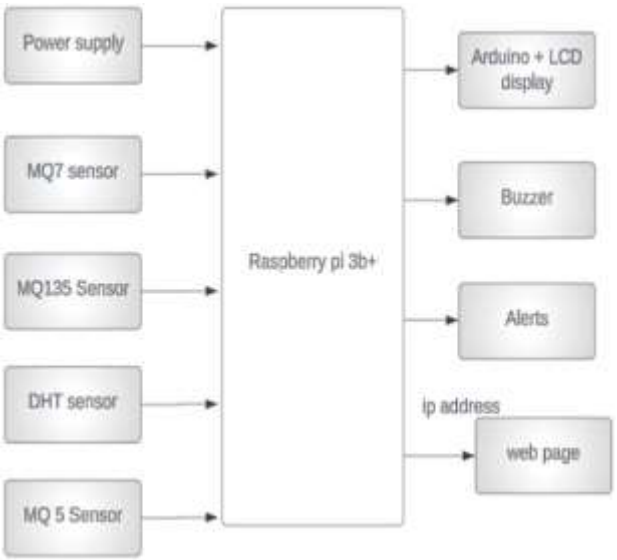

Figure 1: block diagram

of MQ-135 sensor enriches the system's capabilities by monitoring CO2 levels, providing a comprehensive picture of air quality parameters.

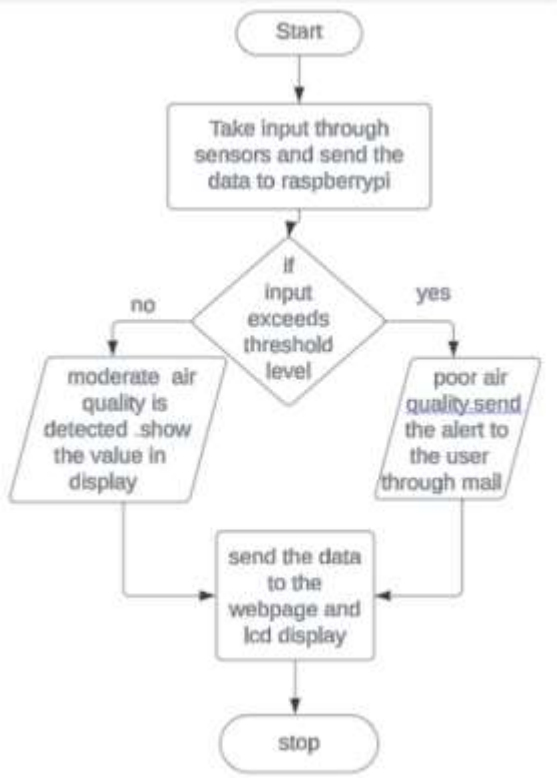

Figure 2 flow chart

METHOD AND METHODOLOGY

The circuit comprises multiple sensors, including the MQ-7, MQ-135, and MQ-5 for detecting CO, CO2, and LPG, respectively, alongside a DHT sensor for measuring temperature and humidity. These sensors, connected to an Arduino Uno for analog-to-digital conversion, gather air quality and environmental data. The Arduino Uno reads this data and transmits it to the Raspberry Pi via serial communication. Upon receiving the data, the Raspberry Pi processes it, potentially calculating gas concentrations, triggering alarms in case of dangerous levels, and displaying readings on an LCD display for user accessibility. Moreover, the Raspberry Pi is programmed to send email notifications to the user about the presence of toxic gases, providing actionable insights for prompt response. Additionally, a buzzer connected to the Raspberry Pi is activated upon detection of dangerous gas levels, enhancing safety measures.

A Installation of Raspberry pi3

1. ***Flashing of Raspbian OS into SD card:-***

STEP-1: First took a fully formatted SD card to install operating system in it. Then inserted SD Card into SD card reader and plugged it inside the USB port of the laptop. STEP-2: Then downloaded the Raspbian operating system and flashed SD card with the help of SD card formatter app. STEP-3: Then flashed Raspbian OS into SD card with the help of Ethcher. Now our Raspbian OS has been installed in the SD card.

2. ***Powering raspberrypi***

Step 1: Install and Enable VNC Server on Raspberry Pi

1. Update your Raspberry Pi:

a. Open the terminal and update your system.

2. Install RealVNC Server:
a. Use the terminal to install the RealVNC Server if it's not already installed.
3. Enable VNC Server:
a. Open Raspberry Pi Configuration.
b. Go to `Interfacing Options`.
c. Select `VNC` and enable it.
4. Start VNC Server:
a. Ensure the VNC Server service is running.

Step 2: Set VNC Password and Find IP Address

1. Set VNC password:
a. Open the terminal and set a password for VNC access.
2. Find Raspberry Pi IP address:
a. Check the IP address of your Raspberry Pi, often found in the network settings.

Step 3: Install VNC Viewer on Your Computer

1. Download and install VNC Viewer:
2. Go to the RealVNC website and download VNC Viewer for your operating system.
3. Install the application by following the on-screen instructions.

Step 4: Connect to Raspberry Pi Using VNC Viewer

1. Open VNC Viewer on your computer.
2. Add a new connection:
a) Enter the IP address of your Raspberry Pi.
b) Optionally, name the connection for easy identification.
3. Connect to Raspberry Pi:
a) Double-click the new connection.
b) Enter the VNC password you set earlier.
c) Click `OK` to establish the connection.

B. Interfacing of sensors

- STEP-1: Ardunio A0 pin to MQ5 A0
- STEP-2: Arduino A1 pin to MQ7 A0
- STEP-3: Arduino A2 pin to MQ135 A0
- STEP-4: connect data pin of dht sensor to d2 pin
- STEP-5: connect the vcc pins and ground pins of all sensors to raspberrypi.

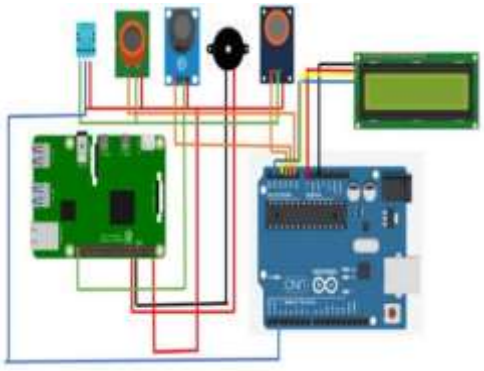

Figure 3: circuit diagram

- STEP-6:send the data from Arduino to raspberry pi through serial communication
- STEP-7: connect the buzzer to gpio 12
- Send the data to a webpage through ip address generated.
- Display the data on a lcd display

RESULT AND OBSERVATION

The result of implementing this air quality monitoring project using Raspberry Pi and sensors like MQ-5, MQ-7, and DHT11 has led to substantial advancements in environmental and public health monitoring. The system's ability to provide comprehensive, real-time data on various air pollutants and environmental parameters has enhanced the monitoring capabilities significantly. This has enabled the early detection of hazardous conditions, thereby improving public health and safety by allowing for timely interventions and informed decision- making.

The project has also fostered community engagement and environmental awareness by making air quality information more accessible and understandable to the public. This increased transparency and education have empowered individuals and communities to participate actively in polluton reduction and environmental preservation efforts.

The figure 4 is showing how our project looks and how the data well be displayed on lcd display

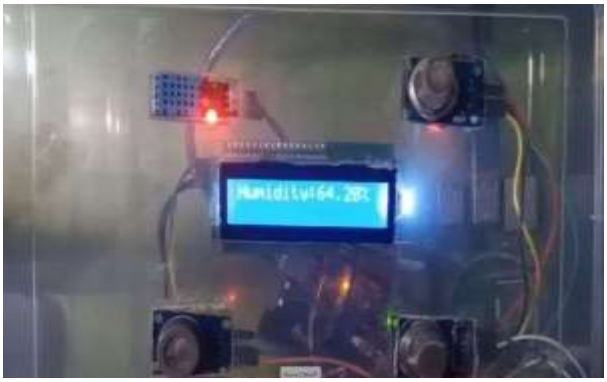

Figure 4:sensor values on lcd display

Figure 5: data on webpage

In the above figure we can see that the data will also be displayed on webpage which we have created using html as frontend and python as backend.

Figure 6: email alert for mq5 sensor

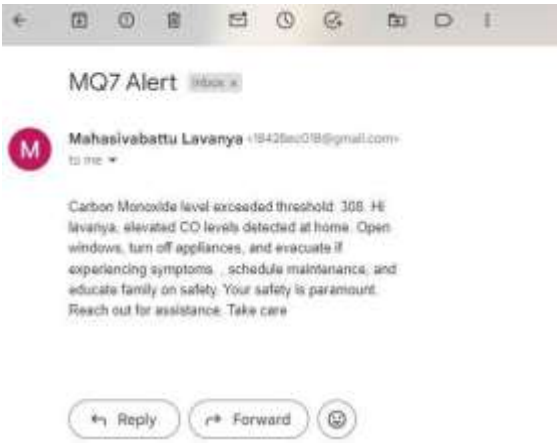

Figure 7: email alert for mq7 sensor

Figure 8: email alert for mq135 sensor

The figures 6,7,8 shows the email alerts received when the sensors exceeded the threshold level.

CONCLUSION

In conclusion, The development and implementation of the Raspberry Pi-based air quality monitoring system, integrating sensors like MQ-5, MQ-7, and DHT11, represent a significant advancement in environmental monitoring. This project addresses the critical need for accessible, accurate, and comprehensive air quality data, highlighting the system's cost-effectiveness, real-time monitoring capabilities, and scalability. It not only enhances public health and safety by providing timely data for decision-making. The system's ability to be deployed across diverse geographic locales from urban centers to rural areas ensures a broad impact, making it a versatile tool in the fight against pollution. Furthermore, the project contributes to the fields of environmental science and technology, offering a practical example of how innovative, low-cost solutions can play a crucial role in global environmental monitoring efforts. In this air quality monitoring project exemplifies how technology can be leveraged to create sustainable and impactful solutions for environmental and public health challenges. It sets a precedent for future research and development in the area of environmental monitoring, paving the way for more resilient and healthy communities worldwide.

FUTURE SCOPE

In the future, the project can expand its horizons by integrating with Internet of Things (IoT) and smart city initiatives to enhance data collection and management, allowing for more dynamic and efficient monitoring of air quality. The adoption of advanced data analytics and artificial intelligence could revolutionize the system's predictive capabilities, facilitating early warnings and more accurate forecasting of air pollution trends. There is also scope to broaden the range of monitored pollutants by incorporating additional sensors, environmental conditions. Advancements in sensor technology are anticipated to yield more precise, durable, and cost-effective sensors, further enhancing system's reliability and performance. The promotion of community- driven monitoring networks could democratize environmental monitoring, empowering individuals and local communities to take an active role in managing air quality.

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