DESIGN DEVELOPMENT APPLICATIONS OF IOT BASED GAS MONITORING SYSTEM

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Abstract:

Air quality is important aspect of environmental monitoring that can be addressed using IoT systems. Air pollution, which can result from industrial activities, transportation, and natural events such as wildfires, can have detrimental effects on human health and the environment. Traditionally, gas monitoring systems rely on manual readings or periodic sampling, which can be time-consuming and prone to errors. With the advent of the Internet of Things, it is now possible to develop real-time gas monitoring systems that can detect and alert workers to hazardous gas levels. In this paper, we present the design and implementation of a gas monitoring system using Arduino Nano along with gas sensors i.e. MQ2, MQ4, MQ135 which is capable of providing accurate, real-time gas detection. We present the design and implementation of a gas monitoring system using IoT, which is capable of providing accurate, real-time gas detection. The results demonstrate the effectiveness of the IoT-based gas monitoring system in enhancing safety measures, reducing operational costs, and improving overall industrial efficiency. This research contributes to the advancement of IoT technologies in the domain of gas monitoring and sets a foundation for future research and development in this field.

Keywords: Air quality, Gas Detection, Real Time Gas Monitoring, Gas Sensors, Arduino Nano

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1. Introduction

A good Polluted Air Detection system is needed to monitor air-quality in metro cities precise prediction Provides valuable information to protect humans from being damaged by air pollution; a reasonable feature analysis reveals the main relevant factors to the variation of air quality. In general, the solutions to these topics can extract extremely useful information to support air pollution control, and consequently generate great societal and technical impacts.

The effects of indoor pollution on city dwellers are significant. Without taking the classroom into consideration, we cannot guarantee a healthy environment for the children. CO, CO2, and NH3 are a few of the dangerous indoor pollutants. Although there are air quality monitoring stations, they are costly and immobile. A smart gadget with several sensors has been created to address this problem. In this research paper, we provide an overview of gas sensor technologies and their advantages and limitations. We also examine the design considerations for gas detection systems, including calibration and testing procedures. We then discuss the applications of gas detection systems in industrial, residential, and emerging settings, highlighting case studies and lessons learned. We explore the trends in gas detection system research and development, including wearable gas sensors and smart gas detection systems.

2. Literature Survey

Alsaadi, M., Alsmadi, M. K., & Shaout, A. (2020). A Review of IoT-based Gas Detection and Monitoring Systems. IEEE Internet of Things Journal, 7(8), 7088-7104.
This review article provides an overview of various IoT-based gas detection and monitoring systems. The authors discuss the advantages of using IoT in gas monitoring, such as real-time monitoring, remote access, and data analysis. They also describe the different types of gas sensors used in IoT-based systems, including electrochemical, infrared, and semiconductor sensors. The article concludes by discussing some of the challenges and future research directions for IoT-based gas monitoring systems.

Kaur, P., & Kumar, A. (2019). Gas leakage detection and monitoring system using IoT. International Journal of Engineering and Advanced Technology, 8(6S), 143-147.
The detection and monitoring of gas leaks using IoT is presented in this study. The writers provide details on how the system was designed and put into place. which consists of gas sensors, a microcontroller, a Wi-Fi module, and a cloud server. The systems are capable of detecting gas leaks and sending alerts to a user's smartphone in real-time. Discussion of the system's benefits and drawbacks finishes the study.

Biswas, K., & Purnaprajna, M. (2019). IoT-based Gas Monitoring System Using Machine Learning Algorithms. International Journal of Innovative Technology and Exploring Engineering, 8(8S), 389-392.
This paper presents an IoT-based gas monitoring system that uses machine learning algorithms for data analysis. The system consists of gas sensors, a microcontroller, a Wi-Fi module, and a cloud server. The authors describe the use of machine learning algorithms such as k-Nearest Neighbors (k-NN) and Support Vector Machines (SVM) for gas concentration prediction and classification. The paper concludes by discussing the performance of the system and future research directions.

Problem Statement
Existing
Traditional fixed gas monitoring systems are installed at specific locations and cannot be easily moved. This limitation can make it difficult to monitor large areas or areas that are not easily accessible. They may only provide periodic readings or alarms, which can result in delayed response times. Existing gas monitoring systems may require frequent calibration, maintenance, and replacement of sensors, which can result in high costs. The gas monitoring system using IoT can overcome many of these limitations by providing real-time monitoring, comprehensive visualization.

Proposed System

A gas monitoring system using IoT enables real-time monitoring of gas concentration levels and visualizations of gas concentration levels. The system consists of gas sensors, a microcontroller, wireless communication modules, The gas sensors are placed in different locations where gas leaks or hazardous gas concentrations are likely to occur. The gas sensors detect the concentration levels of different gases such as carbon monoxide, benzene, and ammonia, and transmit the data to the microcontroller. The microcontroller is responsible for processing the data and transmitting it to the display.

The proposed system provides several benefits, including:

- Early detection of gas leaks or hazardous gas concentrations, which can prevent accidents and protect workers' safety.
- Real-time monitoring of gas concentration levels, which enables workers to quickly identify hazardous areas and take appropriate actions.
- Comprehensive depiction of gas concentration levels, which helps employees make decisions by giving them a comprehensive grasp of the gas concentration levels.

System diagram

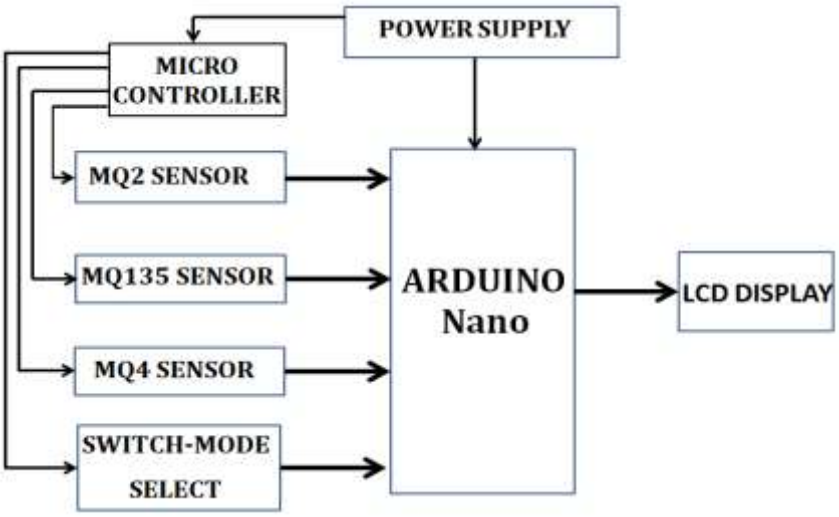
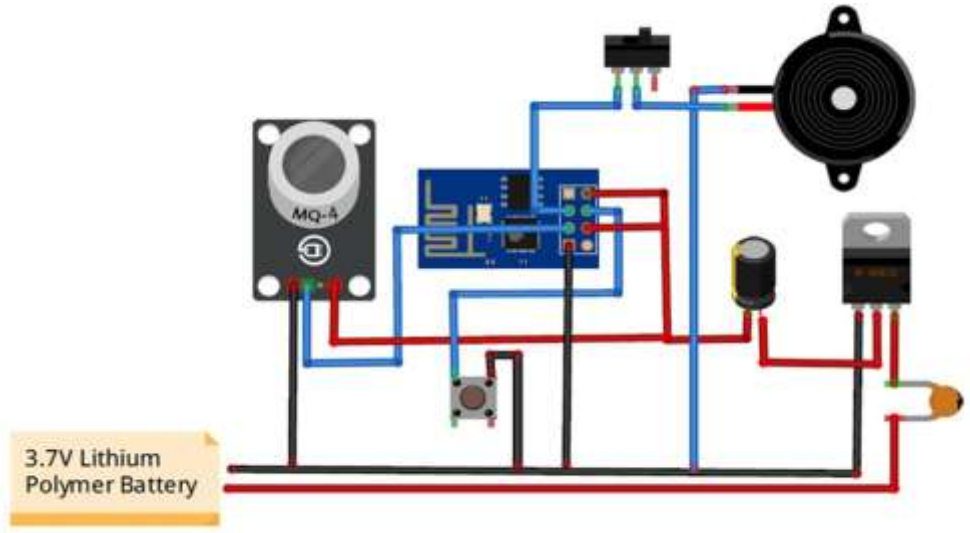


Figure 1: Circuit Diagram for Battery Data Configuration

System Requirement



Arduino Nano
The Arduino Nano is a small and versatile microcontroller board that is based on the ATmega328P microcontroller chip. It is similar to the Arduino Uno in functionality, but is smaller in size and more compact, making it suitable for smaller projects or projects where space is limited. The Arduino Nano has a number of input and output pins, including digital I/O pins, PWM pins, and analog input pins. It can be programmed using the Arduino IDE and supports a wide range of libraries and shields, making it easy to integrate into various projects.

DHT
A DHT device is a type of sensor that is used to measure temperature and humidity in an environment. DHT stands for "digital humidity and temperature", and DHT devices are designed to provide accurate and reliable readings of these two variables. DHT devices typically consist of a small sensor module that contains a temperature sensor and a humidity sensor, as well as some circuitry for converting the analog readings from the sensors into digital signals that can be read by a microcontroller or other digital device. Some DHT devices also include additional features such as a built-in thermometer or barometer.

The primary function of a DTH device is to receive satellite signals and decode them into audio and video signals that can be displayed on a television. It acts as a bridge between the satellite transmission and the television, ensuring that the signals are properly processed and converted for viewing.

Gas Sensor
The existence of different gases in the air can be detected and measured by gas sensors, which are electronic devices. These sensors function by recognizing changes in the concentration of the gas being monitored and then transforming this data into an electrical signal. A computer or other electrical device-processable and -analyzable signal. There are numerous kinds of gas sensors that can be purchased, each of which is made to detect a particular gas or group of gases. MQ-2, MQ-4, and MQ-135 are a few of the most popular kinds of gas sensors. These instruments can pick up a variety of gases, such as benzene, ammonia, and carbon monoxide.

Jumper Wires
Jumper wires are short, flexible electrical wires that are used to make connections between different components in an electronics project. They are typically made of stranded copper wire with a plastic insulation coating, and are available in different lengths and colors. The wires have metal connectors on either end, called male headers or female headers that allow them to be easily inserted into breadboards or other types of connectors.

Implementation
We present the design and implementation of a gas monitoring system using IoT. The system consists of gas sensors, a microcontroller, and a communication module. The gas sensors are used to detect the concentration of various gases in the environment, while the microcontroller processes the data and sends it to the communication module. The gas sensors used in the system are MQ-2, MQ-4, and MQ-135. These sensors are capable of detecting various gases, including carbon monoxide, ammonia, and benzene. The microcontroller used in the system is the NodeMCU ESP8266, which is a low-cost, Wi-Fi-enabled microcontroller. The communication module used in the system is the ESP8266 Wi-Fi module, which is integrated with the NodeMCU. The system is powered by a 5V power supply and is designed to be portable. It can be placed in any location where gas monitoring is required, and the data can be accessed remotely through a web application.

3. Results analysis

The gas concentration data can be analyzed over a period of time to identify trends and patterns. This can help to identify areas where gas concentration levels are increasing or decreasing and take appropriate actions to mitigate the risk. In this, we have developed a Hardware Kit having gas sensors, Arduino, power supply. A software code embedded into Hardware controls the working of gas sensors, power supply embedded on the Hardware kit. It enhances safety protocols, improves operational efficiency, and supports a proactive approach towards maintaining a safe environment.

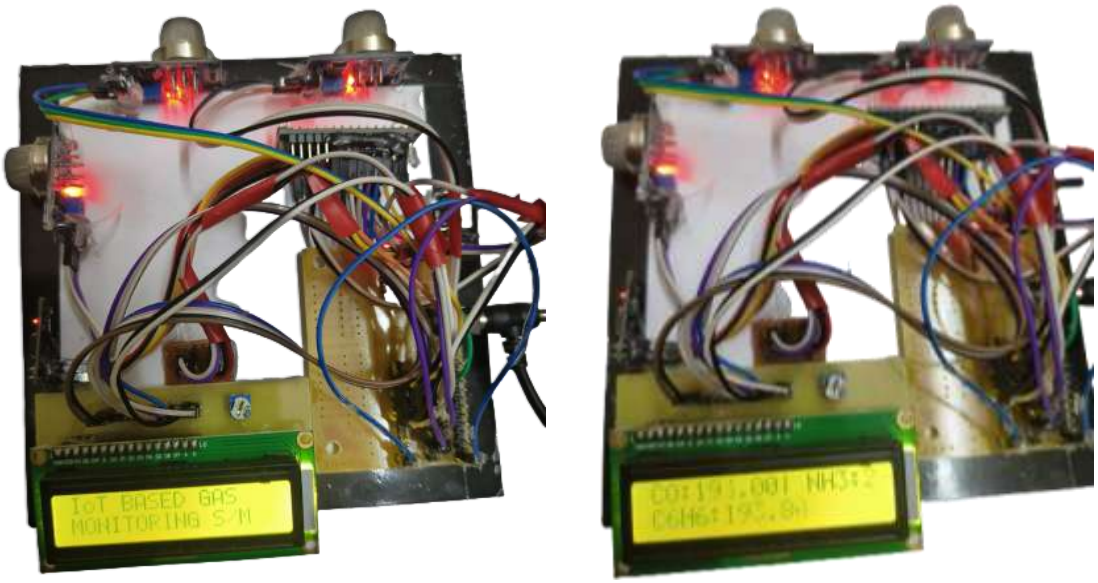


Figure 2: Outcomes with system measure result

Application

- **Oil and Gas Industry**: Gas monitoring systems can help in detecting gas leaks in oil refineries, pipelines, and storage tanks. Early detection of gas leaks can prevent potential accidents, protect employees' safety, and minimize equipment damage.
- **Mining Industry**: Gas monitoring systems can help in detecting dangerous gases, such as methane, in mines. Early detection of these gases can help in preventing explosions and ensuring the safety of miners.
- **Agriculture Industry**: Gas monitoring systems can be used to monitor the levels of greenhouse gases, such as carbon dioxide, in greenhouses. This can help in optimizing plant growth and improving crop yield.
- **Smart Cities**: Gas monitoring systems can be used in smart city applications to monitor air quality in urban areas. This can help in identifying areas with poor air quality and taking measures to improve it.

Future Enhancements

- **Integration with other IoT Devices:** The gas monitoring system can be integrated with other IoT devices, such as temperature sensors, humidity sensors, and air quality sensors, to provide a more comprehensive view of the environment being monitored.
- **Use of Artificial Intelligence:** The system can leverage the power of artificial intelligence (AI) algorithms, such as deep learning, to improve the accuracy of gas detection and classification, reduce false alarms, and increase the speed of response to gas leaks.
- **Wireless Power Transmission:** The gas sensors can be powered wirelessly using technologies such as Radio Frequency (RF) energy harvesting, which would eliminate the need for battery replacement and improve the system's reliability.
- **Integration with Mobile Devices:** The system can be enhanced by developing mobile applications that can be used by workers to access the gas concentration data, monitor the location of the sensors in real-time, and receive alerts.

4. Conclusion

The gas monitoring system using IoT is a powerful technology that can help prevent gas-related accidents and ensure the safety of workers in various industries. This system enables real-time monitoring of gas concentration levels, and provides alerts and visualizations of gas concentration levels, which can help workers quickly, identify hazardous areas and take appropriate actions to ensure their safety. The system was able to

detect and alert to the presence of different gases, including carbon monoxide, ammonia, and benzene.

The gas monitoring system using IoT has numerous applications in industries such as oil and gas, mining, chemical, agriculture, indoor air quality, and smart cities. It has the potential for future enhancements, such as integration with other IoT devices, use of AI, wireless power transmission, real-time video monitoring, integration with mobile devices, and improved analytics, which can lead to more accurate and comprehensive monitoring, faster response times, and better decision-making.

5. References

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