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Gas Leakage Detection System with Remote Monitoring

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***ABSTRACT* — The design of an industrial gas monitoring system using the Internet of Things is presented in this study(IoT). Here, we use an MQ-2 gas sensor to identify chemicalslike LPG, alcohol, and smoke. The analog signals from the gas sensor are read using a node-MCU microcontroller or wi-fi development board. We entered the gas value [10] into the code. These analog values are transmitted by the node- MCU to the Blynk app on the smartphone. The app displaysa "Gas Detected" warning when the gas value rises above 10.As soon as the sensor detects a gas leak, an alarm sounds in the form of a buzzer, alerting anybody around, and the exhaust fan in that particular area is turned on to extract thegas. A gas detection system is necessary to continuously monitor the environment and help prevent gas leakage, thereby lowering the risk of fire and property damage. The gas leakage detection IoT-based project is a system thatdetects gas leaks in industrial and residential areas using IoTsensors. This system uses an array of sensors, such as MQ2 to detect and monitor the level of gas in the surrounding environment. Once a gas leak is detected, an alarm is triggered to alert the user of the potential danger. Additionally, the system sends an alert message to the user'ssmartphone, enabling them to take necessary actions in a timely manner. This project aims to improve the safety of residential and industrial areas by detecting gas leaks in real-time using IoT technology.**

KEYWORDS - Internet of Things (IoT), Node MCU, MQ2 Gas sensor, Blynk Application

I. INTRODUCTION

Gas leakage detection is a process of identifying the presence ofgas leaks in an area before it becomes a potential hazard to human health and safety. Gas leakage is a significant threat to the safety of individuals and the environment in both residentialand industrial areas. Gas leaks can occur in a variety of environments, including industrial facilities, residential areas, and commercial buildings. The release of gases can lead to fire, explosions, and health hazards. Therefore, detecting gas leakageis crucial to ensure the safety of people and the environment. With the advancements in IoT technology, gas leakage detectionsystems can now be implemented using IoT sensors. This IoT- based gas leakage detection project aims to develop a real-time system that can detect gas leaks and notify users of potentialdanger. Various types of gas sensors are available, including MQ2, MQ2 gas sensors, MQ2 flammable gas, and smoke sensor. The type ofsensor used depends on the type of gas being detected and theenvironment in which it is being used. Gas leakage detection isan important aspect of safety and risk management in manyindustries, and it is essential to have reliable and accurate detection systems in place to protect both people and property. The system uses an MQ2 sensor to monitor the gas level in the surrounding environment. These sensors are connected to a microcontroller, which processes the data and sends the information to the cloud server. The server then triggers an alarmand sends an alert message to the user's smartphone when a gasleak is detected. The user can take the necessary actions toprevent a catastrophic incident from occurring. This project notonly improves safety but also provides a cost-effective and efficient solution for gas leakage detection.[7]

II. PROBLEM STATEMENT

Gas leakage is a significant safety and health hazard that can cause harm to people, animals, and the environment. When gas leaks occur, they can lead to fires, explosions, and poisoning, causing severe injuries or even death. Furthermore, gas leaks can also cause property damage and environmental pollution.

To address this issue, gas leak detection systems have been developed to detect and locate gas leaks before they become a hazard. However, several challenges remain in the effectivedetection of gas leaks. Some of these challenges include the following:

- Difficulty in detecting some gases: Certain gases can be challenging to detect, such as odorless and colorless gases, which makes it difficult to detect leaks early.
- False alarms: False alarms can cause unnecessary evacuations and disruption, leading to complacency in responding to actual emergencies.
- Maintenance: Maintenance of the detection systems can be time-consuming and expensive, leading to delayed detection of gas leaks.
- Environmental factors: Environmental factors such as temperature, humidity, and wind can affect the accuracyof gas leakage detection systems.

Therefore, the problem statement for gas leakage detection is todevelop a reliable, accurate, and cost-effective system that can detect gas leaks early, minimize false alarms, and withstand various environmental conditions. The system should be easy tomaintain and operate, ensuring the safety of people, animals, andthe environment.

The problem statement for a gas leakage detection project wouldbe to design and develop a gas leakage detection system that candetect gas leaks quickly, accurately, and reliably. The system should address the following challenges:

- Early detection of gas leaks: The system should detect gas leaks at an early stage to minimize the risk of accidents and health hazards.
- Identification of gas types: The system should be able to detect various types of gases accurately, including odorless and colorless gases, to prevent false alarms and increase the effectiveness of the system.
- Localization of gas leaks: The system should accurately pinpoint the location of the gas leak to allow for quick repairs and to minimize the spread of gas to other areas.
- Low maintenance: The system should be easy to install, operate, and maintain, to minimize downtime and ensure the long-term reliability of the system.
- Cost-effectiveness: The system should be cost- effective, allowing for widespread deployment and usage in various environments, including industrial, commercial, and residential areas.

Overall, the gas leakage detection project's objective would be todevelop a system that is reliable, accurate, cost-effective, and easy to maintain, that ensures the safety of people, animals, andthe environment.

III. EXISTING SYSTEM

There are several existing gas leakage detection systems available in the market, each with its advantages and disadvantages. Here are a few examples:

- Fixed Gas Detection Systems: These systems consist ofgas sensors installed in fixed locations that detect gas leaks and send alerts to a control panel or a central monitoring station. They are suitable for use in large industrial facilities, such as chemical plants andrefineries, where there is a high risk of gas leaks.
- Portable Gas Detectors: These detectors are handheld devices that can be carried around to detect gas leaks in confined spaces, such as tanks and pipelines. They are easy to use, highly portable, and ideal for use in small- scale industrial applications and residential settings.
- Ultrasonic Gas Leak Detection Systems: These systemsuse high-frequency sound waves to detect the sound of gas escaping from pipelines, tanks, and other storage containers. They are highly sensitive, require minimal maintenance, and are suitable for use in harsh environments.
- Infrared Gas Detection Systems: These systems use infrared sensors to detect the presence of gas leaks. They are highly accurate and can detect a wide range ofgases, but they require regular maintenance and are relatively expensive.
- Wireless Gas Detection Systems: These systems use wireless sensors to detect gas leaks and transmit data to a central monitoring system. They are easy to install, highly scalable, and are ideal for use in large industrialfacilities and remote locations.
- Overall, the choice of an existing gas leakage detectionsystem for a project depends on the specific application,environment, and requirements of the project.

IV. LITERATURE SURVEY

Sr. No.	Paper Title	Author Name	Publication Year	Result
1.	Internet of Things (IOT) Based Gas Leakage Monitoring and Alerting System with MQ-2 Sensor [17]	Rohan Chandra Pandey, Manish Verma, Lumesh Kumar Sahu	2017	This paper choice of using a real time gas leakage monitoring and Sensing the output levels of gas has been clearly observed by the help of this system.
2.	Gas Leakage Detection and Smart Alerting and Prediction Using IoT [18]	Asmita Varma, Prabhakar S, Kayalvizhi Jayavel	2017	The proposed gas leakage detectoris promising in the Field of safety.
3.	IOT Based Gas Leakage Detection System with Database Logging, Prediction and SmartAlerting [21]	Chaitali Bagwe, Vidya Ghadi, Vinayshri Naik, Neha Kunte	2018	The system provides constant monitoring and detection of gas leakage along with storage of datain database for predictions and analysis. The IOT componentsused helps in making the system much more cost effective in

				comparison with traditional Gas detector systems.
4.	Internet of Things (IoT) Based Gas Leakage Monitoring and Alerting System with Mq-6 Sensor [19]	Rohan Chandra Pandey, Manish Verma, Lumesh Kumar Sahu, Saurabh Deshmukh	2018	A discussion on how the aims and objectives are met is presented. An overall conclusion IOT based toxic gas detector is it has become more efficient, more applicable to today's applications and smarter.
5.	Gas Leakage Detection and Smart Alerting System Using IoT[20]	Shital Imade, Priyanka Rajmanes, Aishwarya Gavali	2018	In this paper we use IOT technology for enhancing the existing safety standards. While making this prototype has been to bring a revolution in the field of safety against the leakage of harmful and toxic gases

TABLE 1. Feature comparison of gas diffusion models.

Model	Application	Complexity	Computing Power	Accuracy	Relevant Parameter	Characteristic	Disadvantage
Gaussian Plume [5]	Large-scale and long time	Easy	Few	Bad	Density, explosion limits, air temperature, wind velocity and direction, and atmospheric stability	Simulate instantaneous or continuous leakage	Only applicable to neutral gas, low accuracy
Gaussian Puff [6]	Large-scale and short time	Easy	Few	Bad	Density, explosion limits, air temperature, wind velocity with direction, and atmospheric stability	Simulate instantaneous point source	Only applicable to neutral gas, low accuracy
FEM-3 [7]	Un-constrained	Difficult	Large	Good	Air temperature, and wind velocity with direction	Continuous and limited time gas source leakage Used continuous leakage experimental data According to the turbulent diffusion theory	Huge computations and difficult computer simulations
Gas Turbulent Diffusion [10]	Large-scale and long time	Easy	Few	Bad	Density, explosion limits, air temperature, wind velocity and direction, and atmospheric stability	Continuous gas leakage	Only applicable to neutral gas, low simulate accuracy

V. METHODOLOGY AND TECHNICAL BACKGROUND

A. Proposed System

The model will be designed on a Printed Circuit Board(PCB). The project will be containing several devices such as the microcontroller, controller and resistors. The microcontroller will continuously read the data coming from the sensor every few milliseconds it will process and calibrate to check the gas level on the dashboard which we made through the Blynk application.It will read the data in real time and repeat the previous process if no gas is found, at which point it will. The red LED will illuminate, the buzzer will sound, and the system will send an alert message informing the user that an LPG gas leak has been detected. If no LPG gas leak is discovered, the system will keep checking the gas level using the LPG gas sensor until it does. Here, we use an MQ-2 gas sensor to identify chemicals like LPG,alcohol, and smoke. The resistance between the gas sensor's twoelectrodes rises in response to the presence of a gas in the atmosphere. The analog data from the gas sensor are read using a node MCU microcontroller or wi-fi development board. We entered the gas value [10] into the code. These analog values are transmitted by the node-MCU to the Blynk app on the smartphone. The app displays the alert "Gas Detected" when the gas value rises above 10. Overall, a gas leakage detection project can help to keep people safe by quickly detecting the presence of gas in the air and triggering appropriate actions to prevent harm. With the right combination of sensors, microcontrollers, and alarms, a gas leakage detection project can provide reliable and effective gas detection and warning capabilities.

II. Jumper Wires

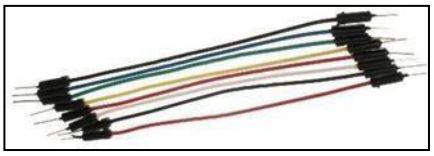


Figure 3 jumper wires

Jumper wires are a type of wire that is used to connect electronic components together on a breadboard or other type ofprototyping board. They are typically made of thin, flexible wirewith pins or connectors on both ends, allowing them to be plugged into breadboards or other electronic components. They are particularly useful for quickly and easily making temporary connections between components and for testing andtroubleshooting electronic circuits.[13]

III. Buzzer

Figure 4 buzzer

A buzzer is an electronic component that produces a loud, continuous, or intermittent sound. It is often used as an audible indicator in electronic devices to alert the user of an event or condition, such as a warning or an error message. The buzzer is an audio signaling device, that may be electromechanical or piezoelectric, or mechanical type. The main function of this is toconvert the signal from audio to sound.[14]
Here we used this buzzer for giving a siren and knowing the useror local people when the gas leaked.

IV. LED Light

Figure 5 LED lights

LEDs are often used in gas leak detection systems as visual indicators to provide information about the status of the system.[15]

V. Exhaust Fan

Figure 6 Exhaust fan

Exhaust fans work for removing unwanted odors, moisture,smoke and other pollutants in the air. [16]
We used exhaust to remove unwanted smoke which is generatedif gas is leaked into industries etc…

VI. MODULE DESIGN

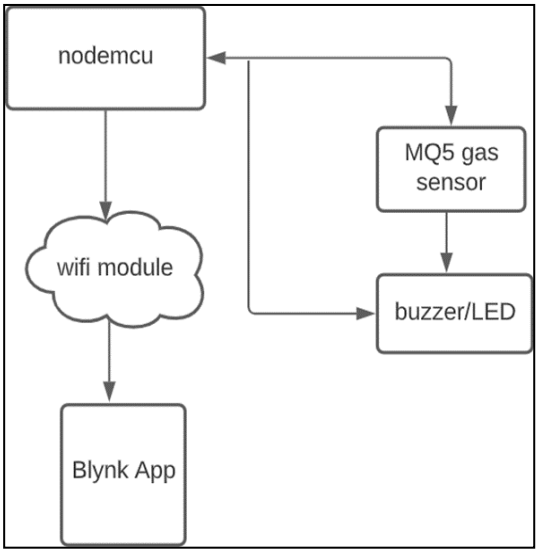


Figure 7: use case diagram

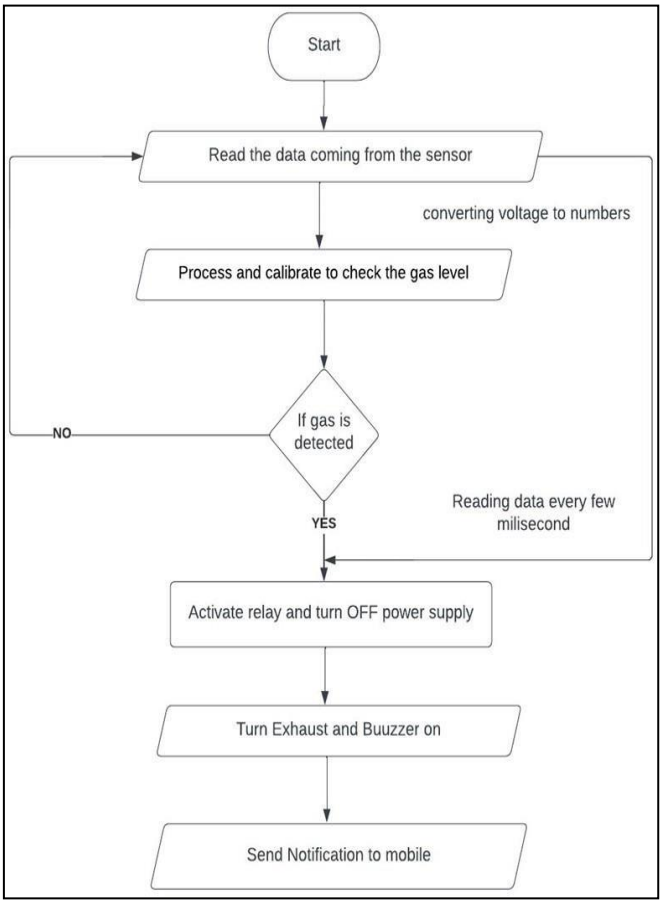
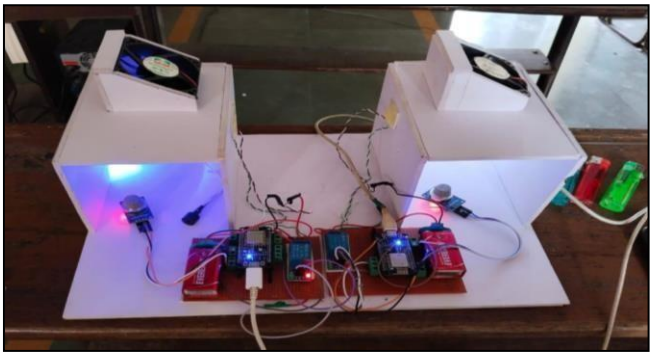


Figure 8 System design

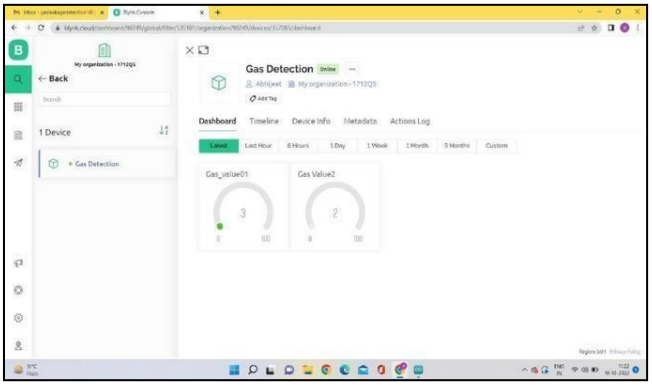
As shown in the circuit in Figure 2, the model will be designed on a Printed Circuit Board (PCB). The project will be containing several devices such as the microcontroller, controller, resistors, and filter capacitance. The microcontroller will continuously read the data coming from the sensor every few milliseconds it will process and calibrate to check the gas level on the dashboard which we made through the Blynk application.It will read the data in real time and repeat the previous process if no gas is found, at which point it will. The red LED will

illuminate, the buzzer will sound, and the system will send an alert message informing the user that an LPG gas leak has been detected. If no LPG gas leak is discovered, the system will keepchecking the gas level using the LPG gas sensor until it does. Here, we use an MQ-2 gas sensor to identify chemicals like LPG,alcohol, and smoke. The resistance between the gas sensor's twoelectrodes rises in response to the presence of a gas in the atmosphere. The analog data from the gas sensor are read using a node MCU microcontroller or wi-fi development board. We entered the gas value [10] into the code. These analog values are transmitted by the node-MCU to the Blynk app on the smartphone. The app displays the alert "Gas Detected" when thegas value rises above 10. Overall, a gas leakage detection project can help to keep peoplesafe by quickly detecting the presence of gas in the air and triggering appropriate actions to prevent harm. With the right combination of sensors, microcontrollers, and alarms, a gasleakage detection project can provide reliable and effective gas detection and warning capabilities.

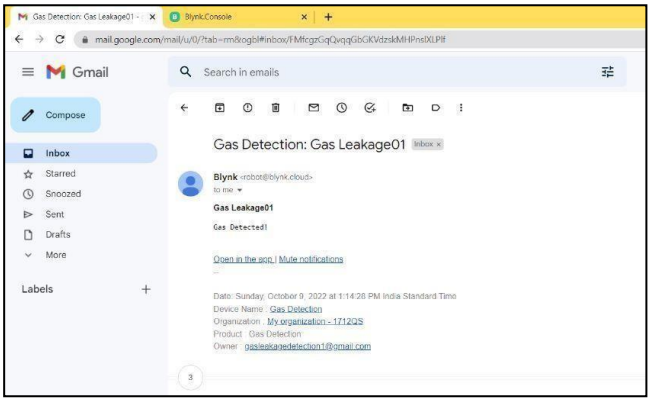
VII. TESTING RESULTS



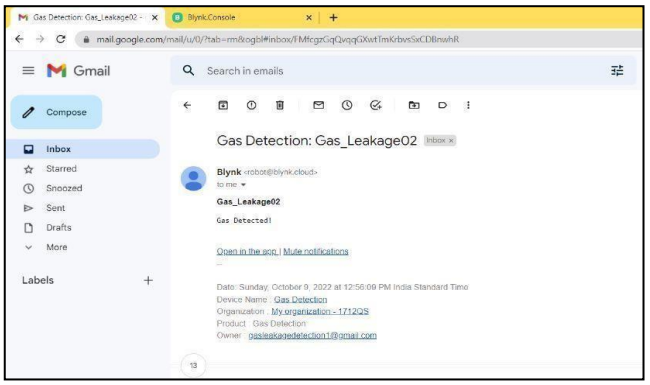
This is a prototype model of gas leakage detection system.



This is the Dashboard of our project where we will get to know the value of how much the gas is been leaked.



Received alert mail to the user when gas detected in room no.01



Received an alert mail to the user when gas detected in room no.02

VIII. CONCLUSION

In conclusion, gas leakage detection projects are essential for ensuring the safety of people and property in a wide range of settings, including homes, workplaces, and industrial facilities. The development of a gas leakage detection system involves a systematic approach to sensor selection, calibration, system design, installation, alert generation, and maintenance to ensure its effectiveness and reliability. The success of a gas leakage detection project depends on several factors, including the choice of sensors, the integration of hardware and software components, and the maintenance of the system. It is essential to carefully consider the application, environmental conditions, and userrequirements when selecting the hardware and software components for the gas leakage detection system. Overall, a well-designed and implemented gas leakage detection system can provide early detection of gas leaks, generate timely alerts, and prevent potential disasters. As technology advances, gas leakage detection systems are becoming more sophisticated and reliable, and their importance in ensuring the safety of people and property continues to grow.

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