PAPER NAME

IOT GAS LEAKAGE FROM ABSTRACT.docx

WORD COUNT **2766 Words**	CHARACTER COUNT **15668 Characters**
PAGE COUNT **26 Pages**	FILE SIZE **3.3MB**
SUBMISSION DATE **Nov 19, 2024 12:21 PM GMT+5:30**	REPORT DATE **Nov 19, 2024 12:22 PM GMT+5:30**

9% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 7% Internet database
- 0% Publications database
- Crossref database
- Crossref Posted Content database
- 8% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Small Matches (Less then 10 words)

Aditya Divyansh

Summary

IoT-Based Intelligent Gas Leakage Detector

Minor Project Report

Submitted for the partial fulfillment of the degree of

Bachelor of Technology

In

Internet of Things (IOT)

Submitted By

Aditya Jaiswal
0901IO221005

Divyansh Soni
0901IO221031

UNDER THE SUPERVISION AND GUIDANCE OF

Dr. Dhananjay Bisen
Assistant Professor

Centre for Internet of Things

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
Deemed to be university
NAAC ACCREDITED WITH A++ GRADEA

June 2024

DECLARATION BY THE CANDIDATE

We hereby declare that the work entitled **"IoT-Based Intelligent Gas Leakage Detector"** is our work, conducted under the supervision of **Dr. Nookla Venu Assistant Professor** during the session July – December 2024. The report submitted by us is a record of bonafide work carried out by me.

We further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Aditya Jaiswal
0901IO221005
B.Tech. V Sem

Divyansh Soni
0901IO221031
B.Tech. V Sem

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

Guided By:

Dr.Dhananjay Bisen
Assitant Professor
Centre for Internet of Things
MITS, Gwalior

Departmental Project Coordinator

Dr. Nookla Venu
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

Approved by HoD
19/11/24

Dr. Praveen Bansal
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

PLAGIARISM CHECK CERTIFICATE

This is to certify that we, students of B.Tech. in **Internet of Things (IOT)** have checked our complete report entitled **"IoT-Based Intelligent Gas Leakage Detector"** for similarity/plagiarism using the "Turnitin" software available in the institute.

This is to certify that the similarity in my report is found to be 9% which is within the specified limit (20%).

The full plagiarism report along with the summary is enclosed.

Aditya

Aditya Jaiswal
0901IO221005

Divyansh Soni

Divyansh Soni

0901IO221031

Checked & Approved By:

Saumyajit Ghosh 20/11/24

Dr. Saumyajit Ghosh
Assistant Professor
Centre for Internet of Things
MITS, Gwalior

ABSTRACT

Gas leaks pose a serious threat to safety in homes and commercial spaces. This project introduces a smart solution using an Arduino Uno microcontroller and key components to detect and respond to gas leaks proactively. The system includes an MQ2 sensor for LPG detection, a servo motor to shut off the gas supply, a DC fan for ventilation, and a buzzer for immediate alerts.

When the sensor detects gas levels exceeding the safe limit, the system springs into action. The servo motor turns off the gas supply by adjusting the regulator, the buzzer sounds an alarm to warn those nearby, and the DC fan helps ventilate the area by dispersing the gas. Once the air is clear and gas levels are safe, the system resets itself—returning the servo motor to its original position, silencing the buzzer, and stopping the fan to conserve energy.

This innovative project offers a reliable and efficient way to enhance safety, reduce risks, and prevent accidents caused by gas leaks in various settings.

Aditya Divyansh

ACKNOWLEDGEMENT

The full semester Internship/ Project has proved to be pivotal to my career. We are thankful to our institute, **Madhav Institute of Technology & Science** to allow us to continue our disciplinary/interdisciplinary Internship/ Project as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme approved by the Academic Council of the institute. We extend our gratitude to the Director of the institute, **Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

We would also like to extend my gratitude to the entire team at **Organization's Name**, especially **Industry Mentor Name(s)**, for their collaboration and support during my time with the organization. We are grateful for the opportunity to work alongside such talented individuals and to learn from their expertise and experiences.

We would sincerely like to thank our department, **Centre for Internet of Things,** for allowing us to explore this project. We humbly thank **Dr. Praveen Bansal**, Assistant Professor and Coordinator, Centre for Internet of Things, for his continued support during the course of this engagement, which eased the process and formalities involved. We are sincerely thankful to my faculty mentors. We are grateful to the guidance of **Dr. Dhananjay Bisen**, Assistant Professor, and Centre for Internet of Things, for his continued support and guidance throughout the project. We are also very thankful to the faculty and staff of the department.

Aditya Jaiswal
0901IO221005

Divyansh Soni

0901IO221031

Centre for Internet of Things

CONTENT

Table of Contents

ACRONYMS

LPG	Liquified Petroleum Gas
MQ2	Gas Sensor Module
DC	Direct Current
USB	Universal Serial Bus
GND	Ground
UNO	Arduino Uno Microcontroller

Divyansh

CHAPTER 1: INTRODUCTION

To enhance safety in environments prone to LPG gas leaks, the **IoT-Based Intelligent Gas Leakage Detector** integrates several components, including an MQ2 gas sensor, an Arduino Uno microcontroller, a servo motor, a buzzer, and a DC fan. When the gas concentration crosses a pre-set threshold, the system takes immediate action: the servo motor shuts off the gas supply, the buzzer emits a warning sound, and the DC fan activates to disperse the leaked gas. After the gas levels return to a safe range, the system resets itself, restoring all components to their initial states. This efficient and timely response reduces the likelihood of accidents, including fires and explosions, while also conserving energy for optimal performance.

IoT-Based Intelligent Gas Leakage Detector: Definition

This system is a proactive safety measure for detecting and responding to LPG gas leaks in different environments. It uses a gas sensor to detect leaks, an actuator to stop the gas flow, and an alarm to alert people nearby. When a leak is detected, the actuator shuts off the gas, and the alarm sounds to warn everyone. The system also activates ventilation to clear the gas. This setup helps prevent fires, explosions, and health risks, ensuring the safety of both people and property.

Objectives

1. Accurately detect LPG gas leaks using a reliable IoT-enabled gas sensor.
2. Instantly alert occupants through both visual and audible warnings.
3. Stop gas leakage by automatically shutting off the supply with a servo motor or similar actuator.
4. Activate ventilation to reduce gas concentration in the affected area.
5. Ensure energy efficiency and system reliability for sustained operation.
6. Enhance safety protocols in residential, commercial, and industrial spaces to minimize risks related to gas leaks.

CHAPTER 2: LITERATURE SURVEY

This literature review examines previous studies, research, and products related to gas detection and safety systems. It covers essential topics like gas sensor technologies, microcontroller-based safety systems, actuator mechanisms, alarm systems, ventilation systems, energy efficiency concerns, safety requirements, and practical applications. By analyzing past projects, research articles, and industry standards, scholars can understand the effectiveness, limitations, and best practices of gas detection and prevention systems. The review also explores advanced developments such as machine learning algorithms and Internet of Things (IoT) integration. Overall, this literature review provides a foundational understanding for designing and implementing a reliable and effective gas leak detection and prevention system.

2.1 LPG Gas Leakage Accidents in the Past

The literature review includes studying notable LPG gas leakage accidents like the 2004 Ghislenghien explosion in Belgium and the 2013 East Harlem explosion in New York City. These incidents highlight the severe consequences of LPG gas leaks, including fatalities, injuries, and property damage. By examining reports, case studies, and scholarly articles on these events, researchers can learn valuable lessons about the causes, impacts, and preventive measures. This information helps design effective gas detection and prevention systems to enhance safety in residential, commercial, and industrial settings.

2.2 How This Project Helps to Minimize Accidents

The Gas Leakage Detection and Prevention System is a crucial safety measure to reduce the risks associated with LPG gas leaks. It aims to prevent accidents and ensure the safety of people in various environments through advanced technologies and proactive measures.

The system uses highly sensitive gas sensors to continuously monitor the area for LPG gas. These sensors can detect even small leaks, serving as an early warning system to alert occupants to potential dangers.

When a gas leak is detected, the system immediately notifies the building's occupants with an audible alarm, prompting them to take necessary safety actions. Visual alerts can also be used to increase awareness.

Aditya Divyansh

One of the system's key features is its automatic gas shut-off mechanism. Equipped with an actuator, such as a servo motor, the system can quickly and effectively stop the gas supply when a leak is detected. This rapid response helps prevent fires or explosions by containing the leak.

Additionally, the system can activate a ventilation mechanism to disperse the gas and reduce its concentration in the air. This step helps minimize health risks associated with prolonged exposure to LPG gas.

By integrating these features, the Gas Leakage Detection and Prevention System provides an effective solution to enhance safety and reduce the likelihood of accidents in various settings.

Aditya Narayan

CHAPTER 3: COMPONENTS USED

3.1 Hardware Used

Arduino Uno: This microcontroller is the heart of the project, offering an easy-to-use interface for programming and managing various components. It ensures smooth operation and seamless integration of the entire system.

The MQ2 Gas Sensor Module: Designed specifically for detecting LPG gas, this sensor provides an analog signal that corresponds to the gas concentration. It ensures accurate and reliable detection to monitor the environment.

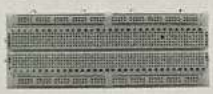
Servo Motor: The servo motor acts as the system's actuator, converting signals from the Arduino into motion. It adjusts the gas regulator or shut-off valve to address leaks promptly.

Buzzer: The buzzer works as an alert system, producing a distinct sound when gas is detected. It warns people of potential danger, enabling quick action to maintain safety.

DC Fan: This fan helps ventilate and disperse leaked gas. Controlled by a MOSFET transistor, it ensures effective airflow to reduce risks associated with gas leaks.

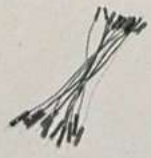
MOSFET Transistor: This component controls the DC fan, acting as a switch. It adjusts the fan's operation based on the detected gas levels, improving efficiency and safety.

Breadboard: Serving as a platform for connecting components, the breadboard or custom PCB simplifies wiring and ensures stable system performance under different conditions.



LPG Gas Regulator: The regulator controls the gas flow from the cylinder, maintaining consistent pressure. This ensures stable operation and enhances safety by preventing issues related to fluctuating gas flow.

Jumper Wires: Jumper wires are essential for connecting various components in the system. They provide a flexible and reliable way to establish electrical connections on the breadboard, ensuring smooth communication and functionality between all parts of the setup.



Aditya Narayanan

3.2 Software Tools Used

The **Arduino IDE (Integrated Development Environment)** is the primary software used to write, compile, and upload code to the Arduino Uno microcontroller. It's designed to be user-friendly, offering features like code autocompletion, syntax highlighting, and a built-in serial monitor for debugging. The IDE also includes a rich library of pre-written functions and example codes, making it accessible for beginners while still meeting the needs of experienced users. Its compatibility with multiple operating systems ensures that it works seamlessly across different platforms, making it a reliable tool for creating and managing Arduino projects.

CHAPTER 4: METHODOLOGY

4.1 Structure of Design

This project's design structure integrates a number of elements. The framework can be summed up as follows:

Module for Monitoring Gas: An MQ2 sensor created especially to detect gaseous LPG is used in this module. It communicates with the Arduino Uno's analog input pin to gather information on gas concentration levels. When gas is detected, the system may react correctly since calibration guarantees precise detection. This module is the first line of defense for promptly locating leaks of LPG gas.

Microcontroller Platform: Because of its adaptability and intuitive interface, the Arduino Uno acts as the main control unit. It controls the functioning of ventilation parts, gas sensors, actuators, and alarms. Command execution, data processing, and real-time monitoring are made possible by control logic created with the Arduino IDE. It is the foundation of the Gas Leakage Detection and Prevention System because of its dependability, which guarantees performance.

Actuation Mechanism: In reaction to monitored gas levels, this mechanism uses a servo motor to regulate the regulator knob or gas shut-off valve. The Arduino Uno's digital output pin is connected to the servo motor, which rotates in response to preprogrammed orders. By promptly and precisely stopping the gas flow when an LPG gas leak is discovered, this device lowers possible risks and ensures environmental safety.

Alarm System: A buzzer that is attached to the Arduino Uno's digital output pin is part of the alarm system. It alerts residents to possible danger by emitting an auditory warning when LPG gas is detected. The buzzer, which can be programmed using the Arduino IDE, serves as an essential warning system in the event of a gas leak, triggering a fast evacuation or the implementation of suitable safety measures, thus improving public safety.

4.2 Implementation of Hardware

An MQ2 gas sensor module is connected to the Arduino Uno's analog input pin (A0) as part of the hardware configuration for the Internet of Things-Based Intelligent Gas Leakage Detector in order to monitor gas levels. To operate the gas shut-off valve, a servo motor is connected to a digital output pin (such as pin 9) of the Arduino. A buzzer is connected to a different digital output pin (such as pin 8) to provide auditory alerts. To aid in dispersing the gas leak, a MOSFET transistor is also used to turn on a DC fan. To ensure neat and safe connections, every component is put together on a breadboard or a bespoke PCB. Reliable performance is made possible by effective power delivery systems and energy management, which provide stable operation.

Aditya Divyansh

CHAPTER 5: WORKING OF THE SYSTEM

5.1 Working of System

1. **Initialization:** The system runs self-checks to ensure all components are working and ready. It sets up communication protocols and verifies hardware connections, guaranteeing reliability and smooth operation.

2. **Gas Detection:** The MQ2 gas sensor constantly monitors the air to detect LPG gas. The Arduino Uno processes the sensor's signals, converting them into digital data for analysis and decision-making.

3. **Gas Detection Threshold:** The system uses predefined safety limits to check gas levels. If levels go beyond the limit, it triggers a response. These thresholds can be adjusted based on environmental conditions and gas concentrations.

4. **Actuation Mechanism:** When gas is detected, the Arduino controls the servo motor to shut off the gas valve or adjust the regulator. This stops the gas flow quickly and prevents further leakage.

5. **Audible Alarm:** Upon detecting gas, the buzzer produces a loud alarm, alerting everyone to take immediate action. This ensures quick evacuation and timely safety measures.

6. **Ventilation Activation:** If gas levels stay high, the DC fan is turned on to disperse the gas and improve air quality. Proper ventilation helps reduce risks like explosions and health hazards.

7. **Continuous Monitoring:** The system continuously tracks gas levels, analyzing data for changes or patterns. Real-time monitoring ensures safety by allowing proactive responses to any fluctuations.

8. **Response Time:** The system reacts quickly to gas leaks, minimizing risks and ensuring fast detection and action. Short response times enhance safety and reduce potential harm.

9. **Safety Measures:** Built-in safety features, like fail-safes and self-diagnostics, prevent false alarms and ensure reliable performance in different conditions. These measures maintain the system's integrity and effectiveness.

5.2 Code

```
#include <Servo.h>

// Define the pin connections
const int mq2Pin = A0; // MQ-2 sensor connected to analog pin A0
const int buzzerPin = 8; // Buzzer connected to digital pin 8
const int servoMotorPin = 9; // Fan connected to digital pin 9
const int fancontrolPin = 10;

const int gasThreshold = 400; // Gas level threshold (adjust based on calibration)
const int fanThreshold = 10;

Servo gasServo; // Create a servo object

void setup() {
  // Initialize pin modes
  pinMode(buzzerPin, OUTPUT);
  pinMode(fancontrolPin, OUTPUT);

  // Attach the servo to the servo pin
  gasServo.attach(servoMotorPin);
  gasServo.write(0); // Initial position (gas regulator on)

  Serial.begin(9600); // Begin serial communication for debugging
}

void loop() {
  int lpgValue = analogRead(mq2Pin); // Read gas sensor value

  Serial.print("Gas level: ");
  Serial.println(lpgValue); // Display gas level for monitoring

  if (lpgValue > gasThreshold) { // If gas level exceeds the threshold
    // Activate the system
    gasServo.write(145); // Turn servo to 90 degrees to shut off gas regulator

    tone(buzzerPin, 3000); // Turn on the buzzer
    delay(5000);
    noTone (buzzerPin);

    delay(5000);

    gasServo.write(0);

    digitalWrite(fancontrolPin, LOW);// Turn on the fan
    delay(10000);
    digitalWrite(fancontrolPin, HIGH);

  } else {
    // Deactivate the system
    noTone(buzzerPin); // Turn off the buzzer
    if (lpgValue > gasThreshold) {
    digitalWrite(fancontrolPin, HIGH); // Turn off the fan


     tone(buzzerPin, 3000); // Turn on the buzzer
     delay(5000);
     noTone (buzzerPin);

     delay(5000);

     gasServo.write(0);

     digitalWrite(fancontrolPin, LOW);// Turn on the fan
     delay(10000);
     digitalWrite(fancontrolPin, HIGH);

  } else {
    // Deactivate the system
    noTone(buzzerPin); // Turn off the buzzer
    if (lpgValue > gasThreshold) {
    digitalWrite(fancontrolPin, HIGH); // Turn ON the fan
    }else{
      digitalWrite(fancontrolPin, LOW); // Turn off the fan
    }
  }
  Serial.print(" LPG sensor value: ");
  Serial.println(lpgValue);

  delay(500); // Delay for stability
}
```

Aditya Divyansh

CHAPTER 6: RESULT AND DISCUSSION

6.1 Result

Goals Achieved: The Gas Leakage Detection and Prevention System successfully met its goals of detecting LPG gas leaks and implementing safety measures. After thorough testing, the system consistently detected gas leaks, activated the shut-off valve, and sounded alarms to alert occupants.

Gas Detection Accuracy: The combination of the MQ2 sensor and Arduino Uno provided high sensitivity and accuracy in detecting LPG gas. Calibration processes ensured reliable detection and triggered appropriate actions when thresholds were crossed.

Timely Response: The system quickly identified leaks, turned off the gas supply via the servo motor, and alerted residents with an alarm. This rapid response minimized risks and enhanced safety.

Enhanced Safety Measures: Additional safety features like continuous monitoring and ventilation activation improved the system's effectiveness. Real-time monitoring enabled proactive responses, while the DC fan dispersed gas to improve air quality.

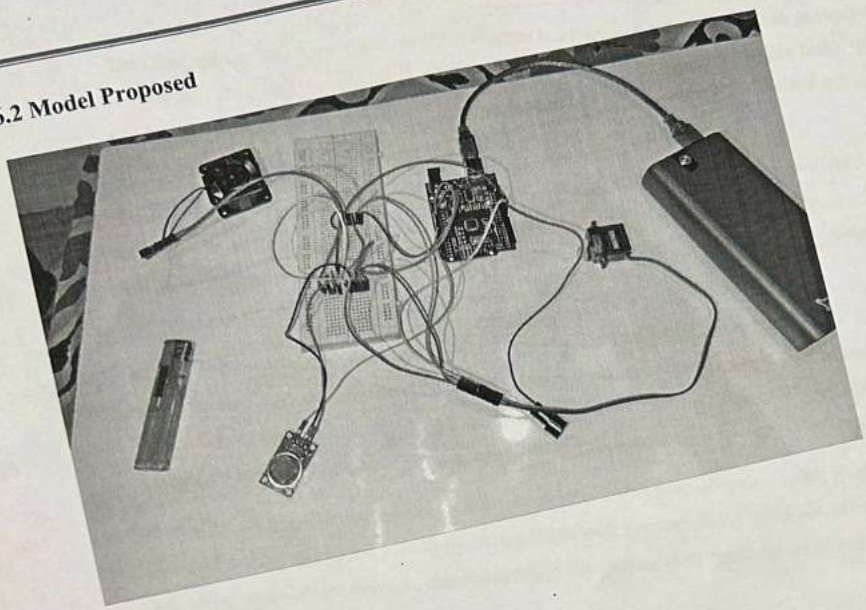
Performance and Reliability: The system demonstrated stable and reliable performance during testing. Built-in safety mechanisms like self-diagnostics and fail-safes ensured smooth operation, reducing false alarms and preventing failures.

Future Enhancement:

While effective, the system could benefit from:

1. Advanced gas sensing technology for even greater accuracy.
2. Remote monitoring and control for real-time oversight.
3. Data logging tools for better performance analysis and optimization.

6.2 Model Proposed



CHAPTER 7: CONCLUSION

The Gas Leakage Detection and Prevention System is a significant advancement in gas safety technology, designed to detect and minimize the risks associated with LPG gas leaks. By combining advanced sensors, precise controls, and robust safety features, it ensures reliable performance and enhanced safety in both homes and commercial spaces.

During testing, the system accurately detected gas leaks, quickly activated the shut-off mechanism, and sounded alarms to alert occupants. Its fast response time and features like ventilation activation and continuous monitoring reinforced its effectiveness in mitigating potential risks.

While the system achieved its primary objectives, there is room for improvement. Future upgrades could include advanced sensors for better accuracy, remote monitoring capabilities, and enhanced data logging for deeper insights. These improvements would further boost the system's reliability and overall performance, ensuring optimal safety in various settings.

In conclusion, the Gas Leakage Detection and Prevention System offers a reliable solution for preventing LPG gas leaks, providing communities with greater safety and peace of mind. As gas safety technology evolves, this project lays the groundwork for future innovations and advancements.

Aditya Divyansh

REFERENCES

1. **Arduino UNO Documentation:** Docs
2. MQ2 Gas Sensor Documentation
3. (PDF) Sensor-Based Gas Leakage Detector System
4. (PDF) Gas leakage detection and alerting system using Arduino Uno

Aditya Divyansh

Similarity Report

9% Overall Similarity

Top sources found in the following databases:

- 7% Internet database
- Crossref database
- 8% Submitted Works database
- 0% Publications database
- Crossref Posted Content database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	**mitsgwalior on 2024-11-16** Submitted works	4%
2	**web.mitsgwalior.in** Internet	2%
3	**Jaipuria Institute of Management on 2024-05-19** Submitted works	<1%
4	**City University of Hong Kong on 2023-08-07** Submitted works	<1%
5	**University College Dublin (UCD) on 2024-10-30** Submitted works	<1%
6	**University of Salford on 2022-12-15** Submitted works	<1%
7	**University of Western Australia on 2023-10-20** Submitted works	<1%
8	**engineersgarage.com** Internet	<1%

Sources overview

Similarity Report

9	Qiujun A. Liu, Hadiseh Karimi, Kimberley B. McAuley. "Estimating uncer... Crossref	<1%

Aditya Divyansh

Sources overview