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**International Journal on Advanced Computer Engineering and
Communication Technology**

ISSN: 2278-5140

Volume 14 Issue 01, 2025

Auto Time and Gas Leakage Detection Based on Knob Controller

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Peer Review Information

Submission: 05 Feb 2025

Revision: 17 Mar 2025

Acceptance: 18 April 2025

Keywords

Gas Monitoring

Automatic Shut-Off Mechanism

IoT Technology

Abstract

The gas monitoring system utilizes gas leak detection and automated timing to improve safety in households through IoT technology. Unlike traditional setups that rely on basic gas sensors providing mere alerts, this system incorporates advanced sensors along with an automatic shut-off mechanism, offering a more preventive and responsive security solution. Upon detecting even a minor gas leak, the system instantly halts gas flow, minimizing the possibility of accidents. The integration of IoT technology facilitates real-time alerts via an LCD display and an emergency alarm, enabling users to take immediate action. This functionality ensures rapid response, thereby reducing potential damage and hazards. By addressing the limitations of conventional gas leak detection techniques, this system strives to transform gas safety standards. The primary goals of this system include accurate detection of LPG leaks, an automated shut-off feature, and instantaneous communication for quick intervention. Designed for residential, commercial, and industrial applications, this solution establishes a new benchmark in gas safety, providing users with better control and heightened awareness of gas-related risks.

INTRODUCTION

The increasing reliance on gas burners for cooking and heating in residential, commercial, and industrial settings highlights the need for effective safety measures to prevent accidents caused by gas leaks. Gas leaks pose a serious threat, potentially leading to fires, explosions, and health hazards such as carbon monoxide poisoning. These risks are further exacerbated by the absence of automated safety mechanisms in conventional systems. Most existing safety solutions depend on manual intervention and user attentiveness, making them reactive rather than preventive. This dependency increases the likelihood of human error, leaving both homes

and commercial spaces vulnerable to accidents. To address these challenges, the development of an automated safety system is crucial.

In this context, the project "Gas Knob Controller Based on Leak Detection and Automatic Timing" is introduced to overcome the limitations of traditional safety mechanisms. This advanced system offers a comprehensive solution by detecting gas leaks, controlling gas flow, and providing real-time alerts to prevent potential hazards. The system operates using multiple sensors and automated control functions, ensuring user safety without requiring continuous supervision. The core component of the system is the Arduino Uno microcontroller,

which collects and analyses data from gas and flame sensors. When the gas knob remains open for an extended period without an active flame or when a gas leak is detected due to faulty equipment or system malfunctions, the system immediately activates a servo motor to automatically turn off the gas knob.

Additionally, a buzzer and LED indicators alert users in real-time, enabling a quick response. To further enhance safety, the system incorporates an automatic timing function, which shuts off the gas burner if left on for a preset duration, thereby reducing the risk of accidents. The system also features an OLED display that provides real-time updates on system status, including alerts and operational feedback. By utilizing embedded systems and IoT technologies, the gas knob controller enhances the safety and reliability of gas appliances. This innovation not only reduces the risks associated with gas leaks but also improves energy efficiency by preventing unnecessary gas consumption. Its implementation ensures the safe and sustainable use of gas burners across various applications.

LITERATURE SURVEY

Arun Kumar et al. (2024) [1] introduce a gas leakage detection system designed to enhance safety in various environments through real-time notifications and automatic response mechanisms. The system employs a gas detector coupled with a GSM module to alert users via SMS in the event of a gas leak. A key feature is the continuous operation of a buzzer, which sounds until the gas concentration returns to a safe level, thereby preventing potential explosions or fires. This approach emphasizes the importance of timely detection and immediate alerting to mitigate risks associated with gas leaks. The study highlights the system's suitability for residential and commercial settings, focusing on its ability to provide proactive safety measures. The integration of SMS alerts and audible notifications ensures that users are promptly informed of any hazardous conditions, thus contributing to overall safety and preventing gas-related incidents.

Mahabooba et al. (2024) [2] introduce an advanced LPG gas leakage detection and cut-off system that integrates IoT technology for enhanced safety in both household and industrial settings. The system employs MQ-6 gas sensors to detect the presence of flammable gases with high accuracy. Upon detecting a gas leak, the system activates a servo motor to cut off the gas supply, thereby preventing further leakage. The integration of a web application allows for real-time monitoring and remote

control, providing users with timely alerts and the ability to manage the system from connected mobile devices. This proactive approach not only mitigates the risk of gas-related accidents but also ensures regulatory compliance and user convenience. The study underscores the significance of combining IoT with traditional safety measures, marking a significant advancement in gas safety technology. This system offers a comprehensive solution for both immediate response to gas leaks and long-term safety management, setting a new standard for gas leak detection and emergency response systems.

Chaudhary and Mishra (2019) [3] present a gas leakage detection system using Arduino technology, designed to enhance safety in residential and commercial environments. The system utilizes an MQ-6 gas sensor to detect LPG leaks and integrates a GSM module to send SMS alerts to users in case of detection. The design incorporates an audible alarm system to alert occupants of gas leaks, and the system also features a visual indication through LEDs to denote the presence of gas. This approach provides a straightforward and cost-effective solution for early gas leak detection and emergency response. The system's ability to alert users remotely via SMS adds an extra layer of safety, especially in scenarios where no one is present at the location. The study highlights the system's effectiveness in detecting varying levels of gas leakage and its suitability for various applications, including homes, hotels, and industrial settings. This model offers a practical and efficient solution to mitigate the risks associated with gas leaks and enhance overall safety.

Chafekar et al. (2018) [4] present a comprehensive system for automatic gas accident prevention using Arduino and GSM technology. The study focuses on the development of a gas leakage detection system equipped with an MQ-5 gas sensor, known for its high sensitivity to LPG and natural gases. This system aims to enhance safety by automatically detecting gas leaks and initiating multiple precautionary measures. Upon detection, the system shuts off the gas supply valve and activates an exhaust fan to disperse leaked gas. Additionally, it turns off the main power supply to prevent potential fire hazards. An SMS alert is sent to the user via a GSM module to provide timely notifications. The system's effectiveness lies in its ability to integrate these safety features, offering a robust solution to prevent gas-related accidents. This approach not only detects leaks but also proactively mitigates risks associated with gas leakage, demonstrating a practical and effective

safety enhancement for both residential and industrial applications.

Loshali et al. (2017) describe the design and implementation of an LPG gas detector system that integrates both hardware and software components to address gas leakage issues. The system utilizes an MQ-5 gas sensor to detect LPG and includes a solenoid valve to shut off the gas supply in case of a leak. It also features a visual display and an audible alarm to alert users of gas presence. The system is designed to

deactivate the alarm once the gas concentration drops below a specified threshold, reducing false alarms and ensuring user comfort. This approach underscores the practical application of gas detection technology in household settings, with potential for industrial use as well. The study demonstrates the effectiveness of combining sensor technology with responsive safety measures to prevent gas-related accidents, highlighting the system's adaptability.

Author	Title	Year	Key Focus	Methodology	Results/Findings
Mahabooba et al.	IoT-Integrated LPG Gas Leakage Detection and Cut-Off System	2024	Advanced IoT-based LPG gas leakage detection and cut-off system for household and industrial safety.	Uses MQ-6 gas sensors for accurate detection, activates a servo motor to stop gas flow, and integrates a web application for real-time monitoring and remote control.	Enhances gas safety by providing real-time alerts, remote accessibility, and regulatory compliance, making it a significant advancement in gas leakage prevention systems.
Mahabooba et al.	IoT-Integrated LPG Gas Leakage Detection and Cut-Off System	2024	Advanced IoT-based LPG gas leakage detection and cut-off system for household and industrial safety.	Uses MQ-6 gas sensors for accurate detection, activates a servo motor to stop gas flow, and integrates a web application for real-time monitoring and remote control.	Enhances gas safety by providing real-time alerts, remote accessibility, and regulatory compliance, making it a significant advancement in gas leakage prevention systems.
Chaudhary and Mishra	Arduino-Based Gas Leakage Detection System with SMS Alerts	2019	Development of an Arduino-based gas leakage detection system for residential and commercial safety.	Utilizes an MQ-6 gas sensor for LPG leak detection, a GSM module for SMS alerts, an audible alarm for occupant warning, and LED indicators for visual notification.	Provides a cost-effective and efficient solution for early leak detection, offering remote alerts and increasing safety in various applications, including homes, hotels, and industrial sites.
Chafekar et al.	Automatic Gas	2018	Development of an automatic	Utilizes an MQ-5 gas	The system effectively detects

	Accident Prevention System Using Arduino and GSM Technology		gas leakage detection and accident prevention system integrating Arduino and GSM technology.	sensor for LPG and natural gas detection. Upon detecting a leak, the system shuts off the gas supply, activates an exhaust fan to disperse gas, turns off the main power supply, and sends SMS alerts.	gas leaks and initiates multiple safety measures, reducing fire hazards and ensuring rapid emergency response for residential and industrial applications.
Loshali et al. 2017	LPG Gas Detection System Using Sensor Technology and Safety Mechanisms	2017	Design and implementation of an LPG gas detector system integrating hardware and software components for enhanced safety.	Uses an MQ-5 gas sensor to detect LPG leaks, a solenoid valve to shut off gas supply, a visual display, and an audible alarm to alert users. The system deactivates alarms once gas concentration is reduced to avoid false alerts.	Demonstrates a practical and efficient safety system suitable for both residential and industrial applications by reducing risks associated with gas leaks.

Figure: Literature Survey Table

OBJECTIVES

The primary objective of this project is to design and develop an affordable, efficient, and automated safety system for gas burners that addresses critical safety concerns associated with gas leakage and flame loss. The system aims to integrate real-time detection, automatic control, and user alerts, providing a comprehensive solution to minimize gas-related accidents. The specific objectives are as follows:

- Real-Time Detection of Gas Leakage and Flame Loss:** The system is designed to continuously monitor gas burners using gas and flame sensors. The gas sensor detects leaks in the event of faulty equipment, accidental flame loss, or unattended burners, while the flame sensor ensures that a burner flame is present during operation. This real-time detection capability minimizes the time between hazard occurrence and response, significantly reducing potential risks.
- Automatic Gas Knob Shutoff:** Upon detecting gas leakage or flame loss, the system will automatically engage a servo motor to rotate the gas knob to the off position. This feature eliminates the need for manual intervention, which is often delayed due to user oversight or absence, and ensures immediate hazard mitigation.
- Audible and Visual Alerts:** To enhance user awareness, the system incorporates audible and visual notification mechanisms. A buzzer emits an alarm to alert nearby users, while LEDs and an OLED display provide clear visual feedback, detailing the hazard and the system's status. This multi-channel notification system ensures that users are promptly informed, enabling timely action if needed.

- **Timer-Based Gas Burner Operation:** A timer function is integrated into the system to enable users to predefine the operational duration of the gas burner. This feature ensures that the burner is automatically turned off after the set time, preventing prolonged usage and potential hazards due to unattended operations.
- **Enhanced Safety and Accident Prevention:** By combining real-time detection, automated control, and user alerts, the system significantly enhances the safety of gas burners. It minimizes the risk of accidents caused by gas leaks, unattended flames, or human error, ensuring a safer environment for both residential and industrial settings.

PROPOSED WORK

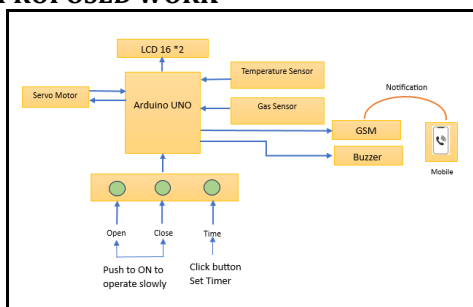


Figure: Block Diagram

- The envisioned system pioneers an advanced gas safety mechanism by integrating an array of sensors, actuators, and an Arduino Uno microcontroller to augment safety measures and automation capabilities. This "Auto Time and Gas Leakage Detection-Based Gas Knob Controller" is meticulously engineered to identify critical hazards, such as gas leakage and flame extinguishment, and initiate immediate countermeasures to avert potential threats.
- At the system's core lies a network of precision-driven sensors, including a gas sensor for detecting leaks and a flame sensor for identifying flame presence or absence. Upon detecting a hazardous anomaly, these sensors transmit real-time data to the Arduino Uno, which intelligently processes the input and triggers an automated intervention. The system actuates a servo motor that promptly rotates the gas knob to the off position, effectively ceasing the gas supply to prevent further leakage and avert potential disasters.
- To reinforce user awareness, the system disseminates real-time alerts via multiple communication channels. A buzzer emits an

audible warning, while LED indicators and an OLED display provide visual cues, elaborating on the nature of the detected hazard and the system's corresponding response.

- Additionally, the system integrates a timer-controlled gas burner regulation feature, empowering users to define predetermined operational durations. This functionality ensures that burners are automatically deactivated upon reaching the set time limit, mitigating the risks associated with unattended cooking and optimizing energy efficiency. By amalgamating these features, the system ensures heightened safety and operational convenience across both residential and industrial settings.

METHODOLOGY

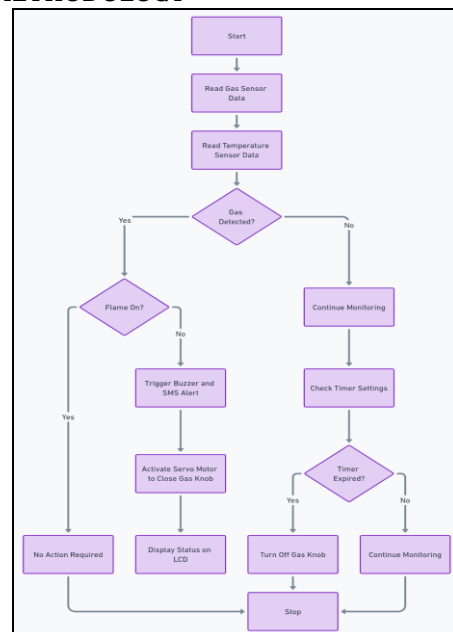


Figure: Flowchart

The methodology for developing this system involves the following steps:

- **Component Selection and Design:** Select sensors (gas, flame, and smoke sensors), actuators (servo motor), and the Arduino Uno microcontroller. Design the circuit integrating these components with a buzzer, LED, and OLED display.
- **System Integration:** Write the control logic using Arduino IDE to process sensor data and control the servo motor for gas knob operation. Ensure that the gas and flame sensors provide real-time input to the system, and implement a timer for controlled burner operation.
- **Testing and Calibration:** Test the system in a controlled environment by simulating gas leaks and flame loss to ensure the sensors respond accurately.

Calibrate the sensors and timer to meet safety standards.

- **User Interface Development:** Implement the OLED display to provide users with real-time updates about the gas system's status.
- **Final Implementation:** Assemble the hardware and software, ensuring smooth communication between all components, followed by system integration testing in real-world scenarios.

RESULT



Figure: Hardware view of Project

- Testing was conducted by releasing LPG into the surrounding environment near the sensor. The gas detection and response module were deployed to identify and analyse its presence. The evaluation results were recorded over multiple instances, spanning different times and days, to assess the concentration levels of gas in the air around the sensor. The final four recorded values indicated an infinite loop scenario due to excessively high gas concentrations.
- The device was systematically tested by positioning the LPG unit at varying distances from the gas source. It was observed that as the distance between the gas source and the detection system increased, the response time of the LPG monitoring system exhibited a proportional delay. Furthermore, the gas sensor demonstrated heightened sensitivity in an environment with pure air. The sensor's sensitivity was found to fluctuate with temperature variations, while the reference voltage remained stable over prolonged durations. At a fixed gas concentration, the detected voltage output remained consistent.
- The gas sensor showcased an exceptionally rapid response to gas exposure, as indicated by minimal time variation between test results with identical gas concentrations, despite significant discrepancies in the detected voltage levels.
- This section presents the findings derived from the Smart Gas Leakage and Temperature Monitoring System and evaluates its efficacy in real-time surveillance, automated gas shutoff, and emergency alert generation. The system's performance is assessed based on crucial parameters, including sensor precision, response efficiency, and user operability. Additionally, the reliability of its automated safety protocols and GSM-based alerting mechanism is meticulously analysed.

CONCLUSION

It provides a reliable solution to prevent accidents caused by gas leakage and flame loss. Using advanced sensors and the Arduino Uno microcontroller, the system ensures enhanced safety for kitchens and industrial environments. It detects hazards such as gas leaks and flame failures in real-time and takes proactive measures by automatically shutting off the gas knob. The system also includes timer-based burner control and provides audible and visual alerts via a buzzer, LEDs, and an OLED display. This practical and scalable solution promotes efficient gas usage while minimizing risks. Future enhancements, such as IoT-based remote monitoring, can further expand its functionality, making it suitable for broader safety applications. The system achieves its goal of ensuring gas safety through automation, real-time monitoring, and emergency notifications. Its reliable performance and accuracy make it an effective safety solution for homes, kitchens, and industries. This Gas Leakage and Temperature Monitoring System is a smart safety solution that provides real-time monitoring, automated shutoff, and emergency alerts to prevent gas hazards in homes and industries.

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