IJMRT: Volume (7), Issue 2, 2024
International Journal of Multidisciplinary Research Transactions
(*A Peer Reviewed Journal*)
www.ijmrt.in

ISSN (Print):2663-2381
ISSN (Online):2663-4007

Automated Fire and Gas Detection: An Integrated Safety System using LabVIEW

Jeevanathan S[1], Sachin S[2*], Furkhan Anas H[3], Shujath Ali Khan M[4], Gopikrishnan A[5*]

[1]*Student, Department of Instrumentation and Control Engineering, Saranathan College of Engineering, Trichy, India.*
[2]*Student, Department of Instrumentation and Control Engineering, Saranathan College of Engineering, Trichy, India.*
[3]*Student, Department of Instrumentation and Control Engineering, Saranathan College of Engineering, Trichy, India.*
[4]*Student, Department of Instrumentation and Control Engineering, Saranathan College of Engineering, Trichy, India.*
[5]*Assistant Professor, Department of Instrumentation and Control Engineering, Saranathan College of Engineering, Trichy, India.*

[*]Corresponding author

DoI: https://doi.org/10.5281/zenodo.15035444

Abstract

Fire and gas leaks can be dangerous, causing harm to people and property. This paper presents a smart fire and gas detection system that improves safety using multiple sensors and automatic decision-making. The system includes four gas sensors and a five-channel flame sensor, both providing digital signals to detect risks. A voting method is used for gas detection to reduce false alarms. An LM35 temperature sensor also checks the surrounding temperature and alerts when it reaches dangerous levels. When a hazard is detected, the system turns on a buzzer and LED lights to warn people. An infrared sensor detects a human entry into hazardous areas and provides an alert. If a fire is detected, a sprinkler system automatically activates to control the flames. To handle false alarms, a push button is provided to stop the system, along with an LED indicator. All monitoring and control are done through a LabVIEW interface. This system provides a reliable and easy-to-use solution for fire and gas safety.

Keywords: Fire detection, gas leakage, intrusion detection, gas sensor, flame sensor, infrared sensor, myRIO, LabVIEW.

1. Introduction

Fire accidents and gas leaks are serious threats in both industrial and residential areas [1]. They can cause loss of life, property damage, and environmental harm. Early detection of such hazards is crucial to prevent disasters, but many existing safety systems have some limitations [2]. Traditional fire and gas detection systems often rely on a single sensor type, which can sometimes give false alarms or fail to detect real threats due to sensor faults or environmental conditions like dust and humidity [3]. This can lead to unnecessary panic or worse a failure to respond to actual dangers. Many current systems also lack smart decision-making. If a sensor detects gas or fire, the system immediately triggers an alarm, even if the reading is inaccurate. This increases the chances of false alarms, which may lead people to ignore warnings over time. Additionally, most systems do not integrate multiple safety features, such as detecting when a person enters a dangerous zone, making them less effective in real-life situations [4]. To overcome these issues, this paper presents a smart fire, gas and temperature monitoring system that improves accuracy and reduces false alarms [5]. It uses multiple sensors, including gas sensors, a five-channel flame sensor and a temperature sensor LM35, to monitor hazardous conditions [6]. A voting-based decision system ensures that alarms only trigger when multiple sensors confirm the presence of danger. An infrared sensor is also included to detect if someone enters a hazardous area and it provides an alert [7]. All sensor data is processed using myRIO and displayed in LabVIEW for real-time monitoring. If a threat is detected, the system activates alarms, LEDs and a sprinkler system to control the fire [8]. A manual push button is also provided to stop the system in case of a false alarm. By integrating multiple sensors and a smart decision-making approach, this system enhances safety, reduces false alarms and provides a reliable solution for fire and gas hazard detection [9].

2. Literature Review

Literature review related to gas leakage and fire detection system. Table 1 shows the literature review of gas leakage and fire detection system.

Table 1. Literature Review of gas leakage and fire detection system

Author	Title	Year	Observation
Deshmukh et al. [1]	A LabVIEW-Based Remote Monitoring and Controlling of Wireless Sensor Node for LPG Gas Leakage Detection	2016	This work focuses on a LabVIEW-based system for remote monitoring and control of wireless sensor nodes for LPG gas leakage detection. The system's ability to provide real-time monitoring and control is a key reference for this project.
Jerome et al. [2]	'Auto Home' an NI myRIO Based Project	2017	This work explores the use of NI myRIO for home automation, including safety monitoring. While the focus is on automation, the integration of safety features such as gas and fire detection provide valuable insights.
Velmurugan et al. [3]	A Novel Hardware Implementation of Forest Fire Detection Using myRIO	2017	This study introduces a hardware implementation for forest fire detection using myRIO. The system's ability to detect fires in large, open areas provides valuable insights for designing fire detection systems in other contexts.
Mangala et al. [4]	Monitoring and Control for Industrial Parameters Using LabVIEW and myRIO Board	2018	This work focuses on monitoring and controlling industrial parameters using LabVIEW and myRIO. The study highlights the versatility of these tools in creating customized solutions for industrial safety and monitoring.
Perilla et al [5]	Fire Safety and Alert System Using Arduino Sensors with IoT Integration.	2018	This work highlights advancements in fire and gas detection systems, evolving from manual alarms to IoT-based solutions. Modern systems use wireless communication and multiple sensors for faster and more accurate detection. Automated safety measures like exhaust fans and sprinklers enhance protection, ensuring efficiency and cost-effectiveness.
Devan et al., [6]	Fire safety and alerting system in railways	2018	This work discusses an automatic fire rescue system designed for railways using

			myRIO and LabVIEW. It employs flame for real-time monitoring, triggering alarms and safety measures when hazards are detected.
Han ni Zaw et al [7]	Design and Implementation of Flame Sensor and Obstacle Detection for Automatic Fire Fighting Robot.	2018	This study focuses on fire and gas detection advancements, integrating modern sensors with Arduino for automation. It uses flame and gas sensors for real-time monitoring, triggering alarms and safety measures when fire or gas is detected. Automated responses, such as buzzers and ventilation fans, enhance safety by providing immediate alerts and risk mitigation.
Jualayba et al., [8]	Hazardous Gas Detection and Notification System.	2018	The work includes an alerting mechanism to notify users of potential gas leaks.
Singh et al. [9]	Spatio-temporal Mapping of Green House Gas Emission in Urban Settings using a Vehicle Mounted IoT Enabled Pollution Sensing Modules	2019	This work presents an innovative approach to mapping greenhouse gas emissions in urban environments using IoT-enabled sensors mounted on vehicles. The system provides real-time data collection and spatial analysis, which is crucial for urban pollution monitoring. While this system is effective for large-scale environmental monitoring.
Bharath prabu et al., [10]	IoT Based LPG Leakage Monitoring System by using myRIO-LabVIEW	2020	This work explores the use of NI myRIO for safety monitoring. The integration of IOT makes an user-friendly interface.
Arthiya et al. [11]	Automatic Fire Rescue System in Railways By using myRIO-LabVIEW	2021	This work discusses an automatic fire rescue system designed for railways using myRIO and LabVIEW. The integration of fire detection and automated response mechanisms is highly relevant to this project.
Puthillath et al. [12]	Gas Leakage Detection and Alerting System for Home and Industry	2021	This work presents a gas leakage detection system that can be used in both home and industrial settings. The system includes an alerting mechanism to notify users of potential leaks.
Muhammad Ahmad Baballe et al [13]	Automatic Gas Leakage Monitoring System using MQ-5 Sensor.	2021	This work focuses on fire and gas detection using modern sensors integrated with Arduino for automation. It employs flame and gas sensors for real-time monitoring, triggering alarms and safety measures when hazards are detected. Automated responses like buzzers and

			ventilation fans enhance safety by providing immediate alerts and reducing risks.
Manasa et al. [14]	Fire and Gas Leakage Detection Robotic System Using NI myRIO	2022	This work presents a robotic system for detecting fires and gas leaks using NI myRIO. The use of robotics for hazard detection and response introduces innovative approaches to safety monitoring
Rahman et al. [15]	An Integrated Hardware Prototype for Monitoring Gas Leaks, Fires, and Remote Control via Mobile Application	2022	This study introduces a hardware prototype capable of detecting gas leaks and fires while offering remote control via a mobile application. The integration of multiple sensors and a user-friendly interface is commendable.
Vernekar and Maheshan [16]	Flow Rate Controlled Water Sprinkler Using myRIO Controller and LabVIEW	2022	This study introduces a water sprinkler system controlled by myRIO and LabVIEW. Although the primary focus is on flow rate control, the integration of real-time monitoring and control mechanisms is relevant to fire detection and suppression systems.
Bhagat et al. [17]	Gas Leakage, Fire and Temperature Detection System for Industry	2023	This work discusses a system designed for industrial environments that detects gas leaks, fires, and temperature variations. The use of multiple sensors and real-time alert mechanisms ensures timely responses to potential hazards.
Okokpujie et al. [18]	Development and Evaluation of a MQ-5 Sensor-Based Condition Monitoring System for In-Situ Pipeline Leak Detection	2024	This work focuses on using MQ-5 sensors for pipeline leak detection. The study evaluates the effectiveness of the sensor in detecting leaks and provides insights into the challenges and solutions for in-situ monitoring.
Kumar [19]	Real-Time Vehicle Emission Monitoring using LabVIEW and NI myRIO	2024	This study discusses a system for monitoring vehicle emissions in real-time using LabVIEW and myRIO. The use of real-time data processing and visualization techniques is applicable to environmental monitoring systems.
Wurood Fadhil et al [20]	Comprehensive Safety Monitoring System Using Arduino for Fire and Gas Detection.	2024	This work highlights advancements in fire and gas detection systems, shifting from manual alarms to smart, automated safety solutions. Modern systems use sensors like flame and MQ2 gas detectors, integrated with Arduino for real-time

			monitoring and alerts. Automated responses such as buzzers, LED indicators, and ventilation fans enhance safety by providing immediate warnings and mitigating risks.

From the literature review it is observed that a combined system improves safety by handling multiple risks at once instead of using separate units for fire detection, gas leakage and safety alarms.

3. Automated fire and gas detection system

The automated fire and gas detection system consists of three main components: gas detection, fire detection and temperature monitoring. Figure 1 shows the flow chart of the automated fire and gas detection system.

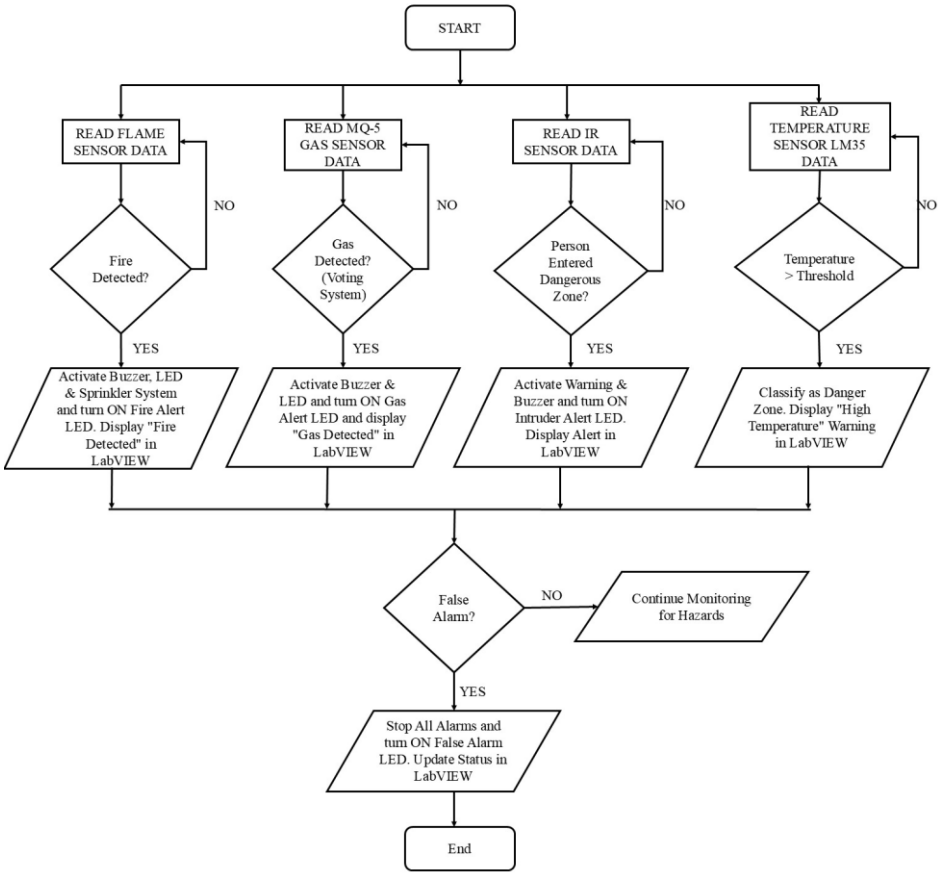

Figure 1. Flow chart of the automated fire and gas detection system

It uses four gas sensors to check for flammable gases. Instead of depending on just one sensor, a voting-based method is used. This means that an alarm will only go off if multiple sensors detect gas, reducing the chances of false alarms from a faulty sensor or minor gas traces. For fire detection, a five-channel flame sensor is placed in different locations to detect flames. If fire is detected, the system activates a buzzer, LED indicators and an automatic sprinkler system to control the situation. An infrared sensor is also used to check if a person enters a dangerous area where gas or fire has been detected. If someone enters, the system immediately gives an alert to warn them. A temperature sensor i.e, LM35 is used to continuously check temperature levels. If the temperature becomes too high, the system marks the area as dangerous and triggers safety responses. All the sensor data is processed using myRIO, a real-time control device. The system is connected to LabVIEW, where users can see real-time sensor readings and system status. If an alarm is activated my mistake or due to faulty sensor, a manual push button is available which allows the operator to stop the alarm and reset the system. By combining multiple sensors, smart decision-making and real-time monitoring, this system provides a more accurate, reliable and fast way to detect fire and gas hazards. It helps improve safety in homes, factories and other buildings, reducing risks and preventing accidents. Table 2 shows the specification of sensors.

Table 2. Specification of sensors

S.NO	Name of the sensor	Detection type	Model make	Range
1	LM35	Temperature	LM35DZ	-55°C to 150°C @ 4 to 20 v
2	MQ5	CH4, LPG	MQ5 module	300 to 10000 ppm @ 0.1 to 4.5 V
3	Flame sensor	Fire	5 Channel YG1006	-25°C to 85°C

			Photo Transistor module	@ 3.3 to 9V
4	IR sensor	Obstacle	CA-023	2 to 30cm @ Angle 35°

4. Methodology

This system is designed to detect fire, gas leaks and temperature changes accurately while also warning if someone enters a dangerous area. Figure 2 shows the block diagram window of the fire and gas detection system.

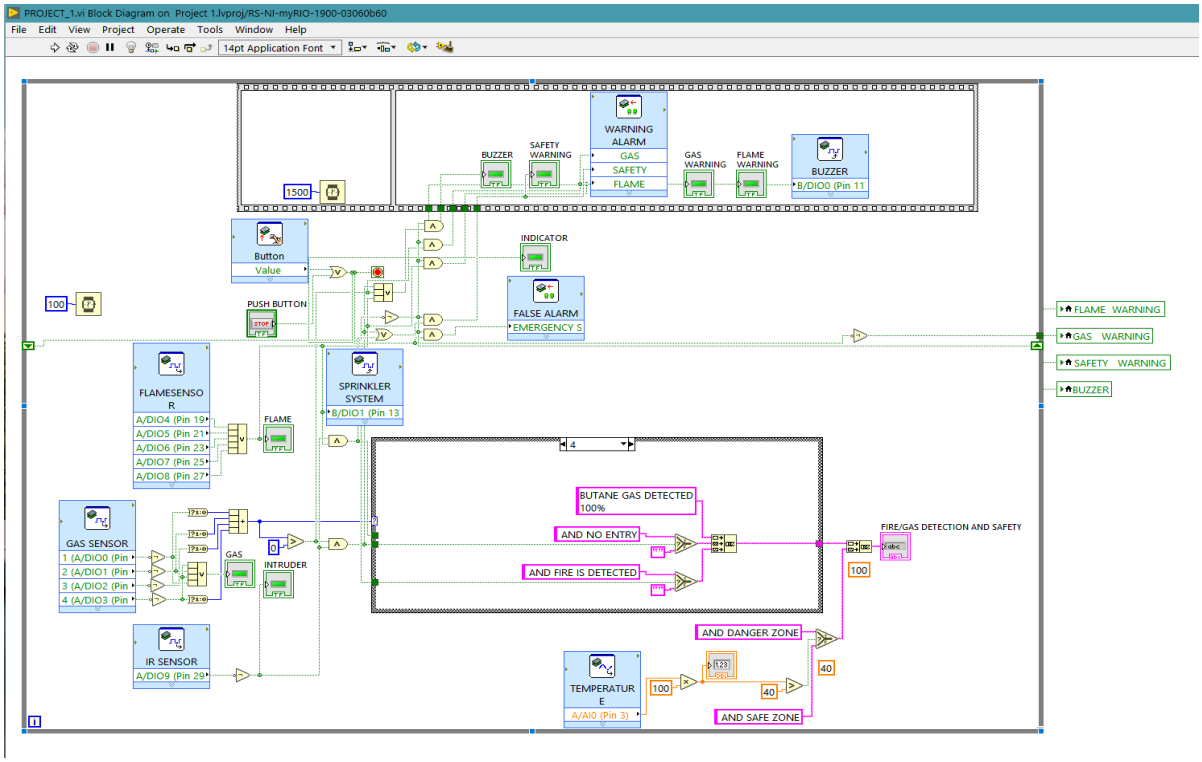

Figure 2. Block diagram window of the fire and gas detection system

It uses multiple sensors and processes the data in myRIO and LabVIEW for real-time monitoring and response. The system has four gas sensors, each giving a digital output (HIGH or LOW). These outputs are sent to LabVIEW, where a case structure checks how many sensors detect gas. Based on this number, the system displays a message in the Front Panel

window. If gas leakage is confirmed, the first LED on myRIO turns ON and the system activates a buzzer and LED indicators to warn users. A five-channel flame sensor is placed in different locations to detect fire. If a flame is detected, the system turns ON the second LED on myRIO, sounds a buzzer and activates LED indicators. The sprinkler system is also turned ON to help control the fire. The fire warning is shown in LabVIEW's Front Panel window for real-time monitoring. The LM35 temperature sensor continuously checks the temperature. If the temperature goes beyond a safe limit, the system marks the area as a danger zone and displays a warning in LabVIEW's Front Panel window. An infrared sensor is used to detect if a person enters a hazardous area where gas leakage or fire is present. If someone enters, an alert is triggered and the third LED on myRIO turns ON. Figure 3 shows the experimental setup of the automated fire and gas detection system.

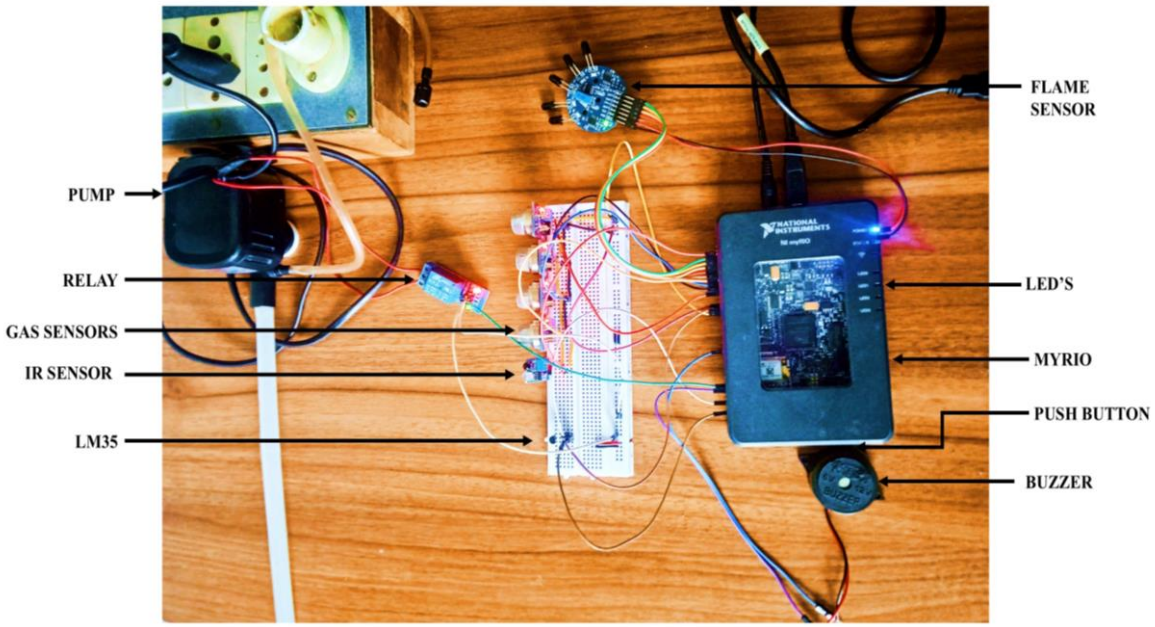

Figure 3. Experimental setup of the automated fire and gas detection system**.**

A warning is displayed in LabVIEW, helping users take action to keep the person safe. A manual push button is provided to stop the system in case of a false alarm. When the button is

pressed, the system stops all alarms and the fourth LED on myRIO turns ON to show that the false alarm mode is activated. This status is also displayed in LabVIEW's Front Panel window. All sensor outputs are processed and displayed in LabVIEW's Front Panel window, where users can see real-time updates on fire, gas, temperature and person detection. The four LEDs on myRIO indicate different hazards, making it easy to understand the system's status. By using multiple sensors, smart decision-making and real-time monitoring, this system improves safety and reduces false alarms, making it useful in homes, factories and other buildings.

5. Result and Discussion

The automated fire and gas detection system was tested successfully and showed accurate detection of gas leaks, fire and abnormal temperature changes while reducing false alarms. The four gas sensors provided digital outputs, and the system only triggered an alarm when multiple sensors detected gas, preventing false alerts. The flame sensor detected fire effectively, activating the buzzer, LED indicators and sprinkler system. The LM35 sensor monitored temperature and an alert was displayed when it crossed a safe limit. The IR sensor detected if a person entered a hazardous area and provided a warning. myRIO' s four LEDs clearly indicated gas leaks, fire, intrusions and false alarm activations. Table 3 shows output responses of the fire and gas detection system.

Table 3. Output responses of the fire and gas detection system

Sensors	Range	Threshold value	actuator	Ture	False
Gas sensor (MQ5)	300 ppm to 10000ppm	>300ppm	Buzzer	Red	Green
Flame sensor	25°C to 85°C	>60°C	Buzzer and Sprinkler system	Red	Green
IR sensor	5 cm – 80 cm	>30cm	-	Red	Green
LM35	-55°C to 150°C	>50°C	-	Danger zone	Safe zone

Figure 4 shows the front panel window of the fire and gas detection system.

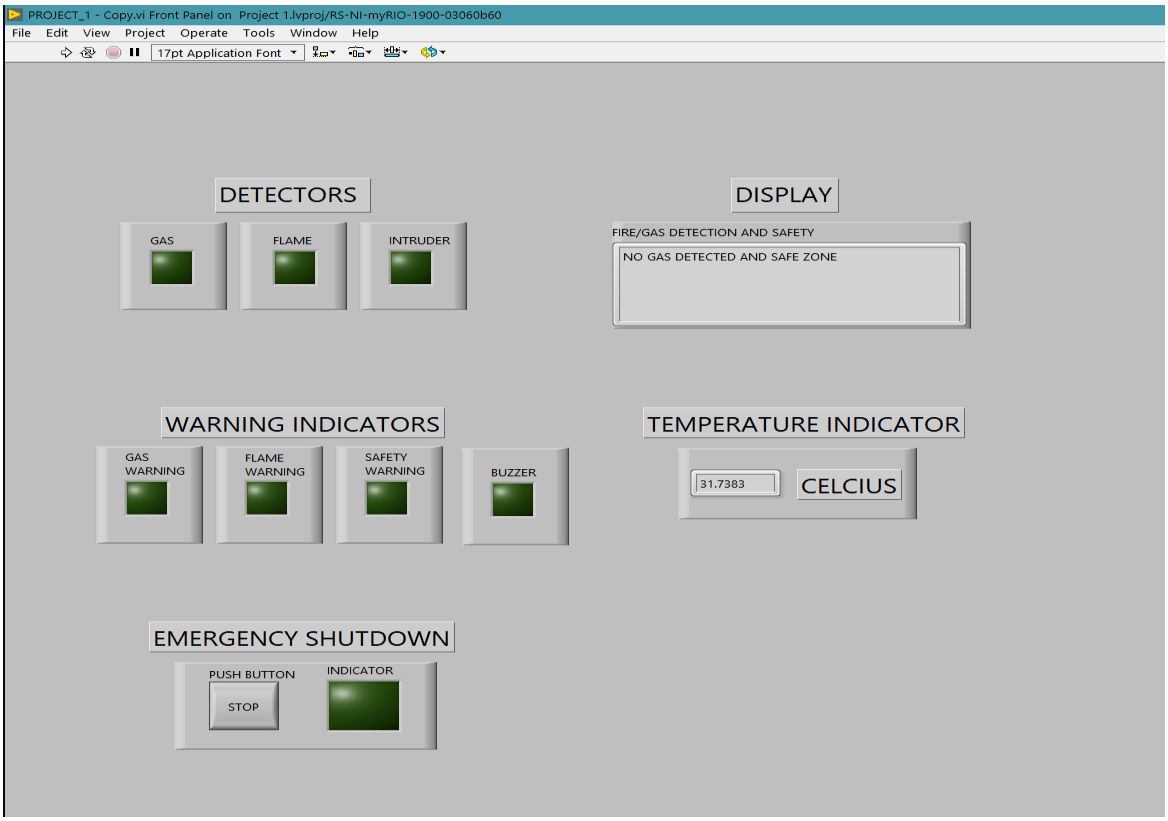

Figure 4. Front panel window of the fire and gas detection system

A manual push button allowed users to stop alarms if needed. LabVIEW's Front Panel window displayed all sensor readings in real-time, making monitoring easy. The voting-based approach improved accuracy by ensuring alarms were triggered only when multiple sensors confirmed danger. Overall, the system provided reliable, real-time hazard detection, reducing false alarms and improving safety in homes and industries.

6. Conclusion

This system provides a smart and reliable way to detect gas leaks, fire, temperature changes, and reducing false alarms by using a voting-based decision method. Unlike traditional systems that rely on a single sensor, this system uses multiple sensors to improve accuracy. The real-time monitoring in LabVIEW helps users track hazards easily, while myRIO' s LEDs, buzzer and sprinkler system ensure quick alerts and automatic responses. The IR sensor adds an extra

safety by detecting movement in dangerous areas and the manual push button allows users to stop false alarms when needed. With its ability to detect multiple hazards and minimize false alarms, this system is a practical and effective solution for improving safety in homes and industries. In the future, adding wireless alerts and remote monitoring could make it even better.

References

[1] L.P. Deshmukh et al., "A LabVIEW Based Remote Monitoring and Controlling of Wireless Sensor Node for LPG Gas Leakage Detection," International Symposium on Electronics and Smart Devices (ISESD) November 29-30, 2016.

[2] A. Jerome et al., "'Auto Home' an NI myRIO Based Project," International Journal of Internet of Things 2017, 6(2): 29-33.

[3] D. Velmurugan et al.," A Novel Hardware Implementation of Forest Fire Detection Using myRIO," International Journal of Innovative Research in Computer and Communication Engineering Vol. 5, Issue 3, March 2017.

[4] R. Mangala et al., "Monitoring and control for industrial parameters using labview and myRIO board," Journal of Emerging Technologies and Innovative Research (JETIR) July 2018, Volume 5, Issue 7.

[5] Perilla et al," Fire Safety and Alert System Using Arduino Sensors with IoT Integration" ICSCA 2018, February 8–10, 2018, Kuantan, Malaysia © 2018 Association for Computing Machinery.

[6] Devan, P. A. M., et al., (2018). Fire safety and alerting system in railways. 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT).

[7] HAN NI ZAW et al," Design and Implementation of Flame Sensor and Obstacle Detection for Automatic Fire Fighting Robot" International Journal of Scientific Engineering and Technology Research (IJSETR)Vol.07, Issue.02, February-2018.

[8] Jualayba et al., (2018). Hazardous Gas Detection and Notification System. 2018 IEEE 10th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM).

[9] B. Singh et al., "Spatio-temporal Mapping of Green House Gas Emission in Urban Settings using a Vehicle Mounted IoT Enabled Pollution Sensing Modules," 4th International Conference on Information Systems and Computer Networks (ISCON) GLA University, Mathura, UP, India. Nov 21-22, 2019.

[10] Bharath prabu et al., "IoT Based LPG Leakage Monitoring System by using myRIO-LabVIEW" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 9, Issue 3, March 2020.

[11] M. Arthiya et al., "Automatic Fire Rescue System in Railways By using myRIO- LabVIEW," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering Vol. 9, Issue 3, March 2021.

[12] B. Puthillath et al., "Gas leakage detection and alerting system for home and industry," International Journal of Creative Research Thoughts (IJCRT) Volume 9, Issue 4 April 2021.

[13] Muhammad Ahmad Baballe et all," Automatic gas leakage monitoring system using mq-5 sensor" Review of Computer Engineering Research 2021 Vol. 8, No. 2, pp. 64-75 (2021).

[14] S. Manasa et al., "Fire and Gas Leakage Detection Robotic System Using NI myRIO," International Journal of Research in Engineering, Science and Management, vol. 5, no. 5, pp. 266-268, May 2022.

[15] M. A. Rahman et al., "An Integrated Hardware Prototype for Monitoring Gas Leaks, Fires, and Remote Control via Mobile Application," International Journal of Advanced Computer Science and Applications, vol. 13, no. 10, pp. 834-840, 2022.

[16] H. G. Vernekar and C. M. Maheshan, "Flow Rate Controlled Water Sprinkler Using myRIO Controller and LabVIEW," Journal of Electrical Engineering and Automation, vol. 4, no. 4, pp. 297-306, Dec. 2022.

[17] P. Bhagat et al., "Gas Leakage, Fire and Temperature detection system For Industry," Journal of Emerging Technologies and Innovative Research (JETIR) June 2023, Volume 10, Issue 6.

[18] I. P. Okokpujie et al., "Development and Evaluation of a MQ-5 Sensor-Based Condition Monitoring System for In-Situ Pipeline Leak Detection," Instrumentation Mesure Métrologie, vol. 23, no. 1, pp. 1-11, Feb. 2024.

[19] N. K. Kumar, "Real-Time Vehicle Emission Monitoring using LabVIEW and NI myRIO," CVR Journal of Science and Technology, vol. 27, pp. 85-92, Dec. 2024.

[20] Wurood Fadhil et al," Comprehensive Safety Monitoring System Using Arduino for Fire and Gas Detection" Iraq University College Journal of Engineering and Applied Sciences 2024.Vol 3., Issue.1.