International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

GAS LEAKAGE AND FIRE DETECTION AND FIRE DETECTION +SMR NOTIFICATION

[1] Mr M Venkatesh, [2] Kavati Ashwini, [3] Punnapuredd Y Roja, [4] K Machendar Goud
[1] Assistant Professor, [234] B. Tech Students
[1]Department of Computer Science and Engineering
[234]Department of CSE(CYBER SECURITY)
[1234]Sree Dattha Group of Institutions, Sheriguda, Ibrahimpatnam, 501510, Telangana, India

ABSTRACT

Gas leakage and fire accidents represent major safety threats in residential buildings, commercial establishments, industrial facilities, laboratories, kitchens, warehouses, and other enclosed environments where combustible gases and ignition sources are present. Conventional safety mechanisms frequently depend on isolated smoke alarms, manual inspection, fixed threshold detectors, or locally activated buzzers that may fail to provide timely remote information when occupants or responsible personnel are away from the affected location. Delayed identification of liquefied petroleum gas leakage, combustible gas accumulation, abnormal temperature rise, smoke formation, or open flame can lead to explosions, structural damage, environmental contamination, financial loss, severe injury, and loss of life. This research proposes an intelligent **Gas Leakage and Fire Detection with SMS Notification System** that integrates gas sensing, flame detection, temperature monitoring, embedded processing, local alarm generation, actuator control, and GSM-based remote notification within a unified real-time safety architecture. The proposed framework continuously acquires environmental information through an MQ-series combustible gas sensor, flame sensor, and temperature sensor. Sensor readings are processed by a microcontroller-based decision unit that performs signal conditioning, threshold evaluation, multi-sensor event correlation, and hazard classification. The system categorizes environmental conditions into Normal, Gas Leakage Alert, Fire Warning, and Critical Emergency states according to the detected combination of gas concentration, flame presence, and abnormal temperature behavior. When hazardous gas accumulation is identified, the system activates a local buzzer, warning indicator, ventilation or exhaust mechanism, and GSM communication module to transmit an SMS notification to registered users or emergency personnel. When fire-related indicators are detected, the framework generates an immediate high-priority alarm and sends location-aware emergency information through SMS. The proposed architecture consists of five interconnected layers: Environmental Sensing and Data Acquisition, Signal Processing and Hazard Intelligence, Embedded Decision and Event Classification, Alert and Emergency Response, and User and Monitoring layers. The framework is designed to provide continuous monitoring, rapid hazard recognition, local and remote notification, improved response coordination, and practical deployment across homes, industries, laboratories, warehouses, kitchens, and commercial facilities. Illustrative conceptual evaluation demonstrates that the proposed system can achieve improved detection accuracy, alert reliability, multi-sensor hazard recognition, and lower response latency compared with conventional standalone gas alarms, smoke-only detectors, and isolated threshold-based systems. The proposed framework provides a scalable foundation for intelligent environmental safety monitoring and timely emergency communication.

Keywords: Gas Leakage Detection, Fire Detection, SMS Notification, GSM Module, MQ Gas Sensor, Flame Sensor, Temperature Sensor, Embedded System, IoT Safety, Hazard Monitoring, Emergency Alert, Real-Time Detection.

I. INTRODUCTION

Gas leakage and fire accidents remain serious safety concerns across residential, commercial, and industrial environments because combustible gases can accumulate rapidly and create dangerous conditions before occupants recognize the threat. Liquefied petroleum gas, methane, propane, butane, and other combustible substances are extensively used for cooking, heating, industrial processing, manufacturing, laboratory operations, and energy applications. Leakage caused by damaged pipelines, defective valves, improper cylinder connections, equipment failure, corrosion, poor maintenance, or human error can create highly hazardous environments. When accumulated gas interacts with an ignition source, severe fire or explosion incidents may occur. Consequently, early detection and rapid warning are essential components of effective safety management [1].

Traditional gas and fire monitoring mechanisms frequently depend on manual inspection, standalone alarms, or independently operating sensors. Although such mechanisms provide basic protection, they may fail to deliver comprehensive situational awareness because gas leakage and fire development involve multiple environmental indicators. A gas sensor may detect combustible vapor before ignition, whereas a flame sensor may identify direct optical radiation from an active fire. Temperature monitoring can provide additional evidence of abnormal thermal conditions. Integrating these sensing mechanisms within a unified embedded framework can therefore improve hazard recognition and reduce dependence on a single indicator [2].

The rapid development of embedded systems has enabled low-cost and continuous environmental monitoring through compact microcontrollers and digital sensors. Modern microcontrollers can collect analog and digital sensor information, process readings in real time, execute hazard-classification logic, control alarms and actuators, and communicate with external devices. Such capabilities make embedded platforms suitable for safety-critical monitoring applications where immediate local response is required. Sensor-based embedded systems can operate continuously and provide faster detection than periodic manual inspection [3].

Gas sensors based on metal-oxide semiconductor principles are widely used for detecting combustible gases and volatile compounds. MQ-series sensors are commonly employed in prototype and practical monitoring applications because they provide a measurable electrical response when exposed to target gas concentrations. Depending on the selected sensor model and calibration procedure, the system can monitor LPG, methane, propane, smoke, and related combustible substances. However, gas-sensor readings can be influenced by environmental conditions, warm-up characteristics, cross-sensitivity, and calibration quality, making appropriate signal processing and threshold selection important for reliable operation [4].

Fire detection represents another critical component of environmental safety. Conventional smoke detectors can identify combustion products but may experience delayed response under certain fire conditions or nuisance alarms caused by dust, steam, and non-fire aerosols. Flame sensors provide a complementary mechanism by detecting optical radiation associated with open flames. When flame sensing is combined with gas and temperature information, the system can distinguish among pre-ignition leakage, possible fire development, and critical emergency conditions more effectively than a single-sensor mechanism [5].

Temperature monitoring further strengthens the detection framework by providing evidence of abnormal thermal changes. A rapid temperature increase may indicate developing fire conditions even when smoke or flame signals are temporarily weak. Temperature information can also help the embedded controller evaluate whether a gas alarm is associated with additional evidence of hazardous combustion. Multi-sensor integration therefore improves contextual interpretation by allowing the system to evaluate several environmental characteristics simultaneously [6].

A major limitation of conventional local alarms is that warning information may not reach responsible individuals when they are away from the monitored location. A buzzer can alert nearby occupants but cannot directly notify a homeowner, industrial supervisor, maintenance engineer, security officer, or emergency contact located elsewhere. Remote communication is therefore essential for improving response coordination. GSM-based communication provides a practical mechanism for transmitting SMS alerts through cellular networks without requiring continuous dependence on local Wi-Fi infrastructure [7].

SMS notification is particularly useful because it can deliver concise emergency information to registered mobile numbers. When gas leakage is detected, the system can transmit an alert identifying the type of hazard and monitored location. When flame and abnormal temperature conditions indicate fire, a higher-priority message can be generated. Such notifications enable responsible users to contact emergency services, shut down equipment remotely where supported, notify nearby personnel, or initiate evacuation procedures. The integration of sensing and GSM communication therefore extends the safety system beyond local alarm generation [8].

Real-time hazard detection also requires efficient decision logic. A system that reacts to every isolated sensor fluctuation may generate excessive false alarms, whereas a system with excessively high thresholds may miss early hazards. Multi-sensor event correlation provides a more reliable approach by evaluating gas concentration, flame status, temperature behavior, persistence duration, and sensor agreement. Embedded decision mechanisms can classify conditions according to severity and initiate proportionate responses. This approach supports more effective differentiation between normal conditions, gas leakage, fire warning, and critical emergency states [9].

The Internet of Things and intelligent sensing paradigms have further encouraged the development of connected safety systems capable of integrating environmental sensors, embedded controllers, communication networks, dashboards, and automated actuators. Although the proposed framework emphasizes GSM-based SMS notification for dependable remote warning, its architecture can be extended to cloud monitoring, mobile applications, emergency dashboards, and IoT analytics. Such integration can improve historical analysis, maintenance planning, event logging, and large-scale monitoring across multiple locations [10].

Motivated by these challenges, this research proposes a comprehensive framework titled “Gas Leakage and Fire Detection with SMS Notification.” The proposed system integrates combustible gas sensing, flame detection, temperature monitoring, embedded signal processing, hazard classification, local alarm generation, ventilation control, GSM communication, SMS notification, and

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

continuous system monitoring. The principal objective is to identify hazardous conditions at an early stage and provide both immediate local warnings and remote emergency information.

II. LITERATURE SURVEY

Author: V. Ramya and B. Palaniappan (2012)

Ramya and Palaniappan investigated embedded-system-based monitoring and control mechanisms for hazardous gas detection. Their work demonstrated the importance of continuous sensing, microcontroller-based decision-making, and communication mechanisms for improving safety in environments exposed to combustible or toxic gases. The study provides an important foundation for integrating gas sensing with automated warning and response mechanisms [11].

Author: A. Mahalingam et al. (2012)

Mahalingam and colleagues developed a gas leakage detection and control approach emphasizing rapid identification of hazardous LPG conditions. Their work highlighted the importance of sensor-based monitoring for domestic and industrial safety and demonstrated that embedded systems can support timely alarm generation when dangerous gas concentrations are detected. The study supports the use of automated detection instead of dependence on manual recognition [12].

Author: H. Huang and H. Bainand (2009)

Huang and Bainand investigated combustible gas detection mechanisms using sensor-based electronic systems. Their research emphasized that gas monitoring requires appropriate sensing characteristics, threshold configuration, and reliable processing because environmental interference can affect detection behavior. The findings are relevant to the design of the proposed gas acquisition and preprocessing mechanism [13].

Author: N. S. G. B. Prasad et al. (2014)

Prasad and colleagues examined wireless and embedded mechanisms for environmental hazard monitoring. Their work demonstrated that communication technologies can significantly extend the effectiveness of local detection systems by enabling warning information to reach remote users. This concept directly supports the integration of GSM and SMS communication within the proposed framework [14].

Author: A. Somov et al. (2011)

Somov and colleagues investigated wireless sensor networks for fire and environmental monitoring applications. Their work emphasized distributed sensing, rapid event detection, and communication-assisted emergency awareness. The research demonstrated the importance of combining sensing and communication mechanisms for improving response to hazardous environmental events [15].

Author: L. Yu et al. (2005)

Yu and colleagues studied wireless sensor network mechanisms for real-time forest fire detection. Although the application context differs from indoor gas monitoring, the research demonstrated the broader importance of continuous environmental sensing, event recognition, and timely communication for fire safety. The study provides relevant foundations for multi-sensor fire detection architectures [16].

Author: I. F. Akyildiz et al. (2002)

Akyildiz and colleagues presented a comprehensive survey of wireless sensor networks and discussed sensing, processing, communication, energy management, and distributed monitoring. Their work established foundational principles for sensor-based systems in which environmental information is acquired and transmitted for automated decision-making. These concepts are highly relevant to connected safety monitoring [17].

Author: L. Atzori et al. (2010)

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

Atzori and colleagues surveyed the Internet of Things and described architectures connecting physical objects, sensors, communication systems, and intelligent services. Their work demonstrated the potential of connected sensing for real-time monitoring and automated response. The proposed gas leakage and fire detection system follows similar principles by integrating physical sensors, embedded processing, and remote notification [18].

Author: J. Gubbi et al. (2013)

Gubbi and colleagues investigated IoT architectures and highlighted the integration of sensing devices, communication infrastructure, cloud services, and intelligent applications. Their research provides a foundation for extending safety monitoring systems toward scalable connected platforms. The proposed framework can similarly evolve from GSM notification toward cloud-based event management and multi-location monitoring [19].

Author: D. Hanes et al. (2017)

Hanes and colleagues discussed IoT architectures, communication technologies, sensing systems, and practical deployment considerations. Their work emphasized reliable connectivity between physical devices and monitoring applications. These principles support the design of a safety framework in which environmental sensors, embedded controllers, GSM communication, and user notification operate as interconnected components [20].

III. SYSTEM ANALYSIS & DESIGN

3.1 Existing System

Existing gas leakage and fire detection systems generally rely on standalone gas sensors, smoke detectors, heat detectors, manually operated emergency mechanisms, or locally activated alarm devices. A conventional gas monitoring system typically measures the presence of combustible gases and activates a buzzer when the detected level exceeds a predefined threshold, while traditional fire detection systems use smoke or temperature sensors to recognize combustion-related conditions. Although these systems provide basic safety protection, they often operate independently and therefore cannot effectively correlate multiple environmental indicators such as combustible gas concentration, flame presence, and abnormal temperature rise. This dependence on isolated sensing mechanisms can reduce detection reliability, delay recognition of complex hazards, and increase the possibility of false alarms caused by temporary sensor fluctuations or environmental interference.

Another significant limitation of existing systems is their dependence on local warning mechanisms. Buzzers, sirens, and visual indicators can notify nearby occupants, but they cannot reliably inform homeowners, industrial supervisors, maintenance personnel, security staff, or emergency contacts when they are away from the monitored location. Many conventional systems also lack intelligent hazard classification and cannot clearly distinguish among normal environmental conditions, gas leakage, developing fire, and critical emergencies involving multiple simultaneous danger indicators. Furthermore, the absence of coordinated actuator control, remote communication, continuous event monitoring, and automated escalation can delay emergency response, particularly in unattended kitchens, laboratories, warehouses, industrial facilities, storage areas, and commercial buildings.

Disadvantages of Existing System

1. Standalone detectors depend heavily on individual sensing mechanisms and may not capture the complete progression from gas leakage to active fire.
2. Local alarms cannot reliably notify responsible users when they are away from the monitored environment.

3. Fixed threshold mechanisms may generate false alarms because of temporary sensor fluctuations or environmental interference.
4. Conventional systems provide limited differentiation among gas leakage, fire warning, and critical emergency conditions.
5. Many existing systems lack automatic ventilation, emergency actuator control, and remote communication facilities.
6. Manual observation and periodic inspection cannot provide continuous real-time safety monitoring.
7. Independent sensors generally lack multi-sensor event correlation for improved hazard recognition.

3.2 Proposed System

The proposed **Gas Leakage and Fire Detection with SMS Notification System** introduces an integrated real-time safety framework that combines combustible gas sensing, flame detection, temperature monitoring, embedded processing, local alarm generation, automated response mechanisms, and GSM-based remote communication. The system continuously monitors environmental conditions using an MQ-series gas sensor for detecting combustible gas accumulation, a flame sensor for identifying optical characteristics associated with active fire, and a temperature sensor for recognizing abnormal thermal changes. The acquired sensor readings are transferred to a microcontroller-based processing unit, where signal validation, basic noise filtering, calibrated threshold comparison, persistence checking, and multi-sensor event correlation are performed. By evaluating several environmental indicators together, the framework provides a more comprehensive representation of hazardous conditions than conventional standalone detection systems.

The embedded decision unit classifies environmental conditions into **Normal, Gas Leakage Alert, Fire Warning, and Critical Emergency** states according to the combination and persistence of sensor readings. Under normal conditions, the framework continues uninterrupted monitoring without unnecessary alarms. When sustained combustible gas concentration exceeds the calibrated safety threshold, the system generates a Gas Leakage Alert and activates the buzzer, warning indicator, optional ventilation mechanism, and remote SMS notification. When flame detection or significant abnormal temperature behavior indicates possible combustion, the system generates a Fire Warning. If severe gas accumulation occurs simultaneously with flame detection or rapid temperature increase, the system classifies the condition as a Critical Emergency and initiates the highest-priority protective response.

The GSM communication module extends the framework beyond local alarm generation by transmitting SMS notifications to registered homeowners, industrial supervisors, maintenance engineers, security personnel, or emergency contacts. Alert messages can include the detected hazard category and monitored location, enabling responsible users to take immediate action even when away from the affected area. The proposed system also maintains continuous monitoring after an alert and can support escalation when hazardous conditions persist or intensify. Through the integration of multi-sensor environmental monitoring, embedded hazard classification, local warning, optional actuator control, GSM communication, and continuous event assessment, the proposed framework provides a practical and scalable safety solution for residential kitchens, industrial plants, laboratories, warehouses, restaurants, commercial buildings, and combustible-gas storage environments.

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

Advantages of Proposed System

1. Integrates gas, flame, and temperature sensors for comprehensive hazard monitoring.
2. Provides continuous real-time environmental surveillance.
3. Uses multi-sensor correlation to improve hazard recognition reliability.
4. Distinguishes Normal, Gas Leakage Alert, Fire Warning, and Critical Emergency conditions.
5. Sends SMS notifications to registered users through GSM communication.
6. Activates immediate local alarms through buzzer and visual warning indicators.
7. Supports automated ventilation, exhaust, and authorized emergency actuator control.
8. Provides scalable deployment across residential, commercial, laboratory, and industrial environments.

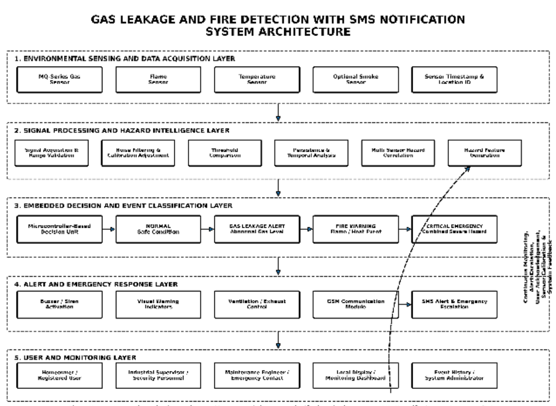

Fig 1: System Architecture

The proposed Gas Leakage and Fire Detection with SMS Notification System is organized into five interconnected layers that provide continuous environmental monitoring, intelligent hazard analysis, rapid emergency response, and remote user notification. The Environmental Sensing and Data Acquisition Layer continuously collects real-time information through an MQ-series gas sensor, flame sensor, temperature sensor, optional smoke sensor, and associated timestamp and location information to identify changes in the monitored environment. The acquired sensor readings are transferred to the Signal Processing and Hazard Intelligence Layer, where signal validation, noise filtering, calibration adjustment, threshold comparison, persistence checking, temporal analysis, and multi-sensor hazard correlation are performed to distinguish genuine dangerous conditions from temporary fluctuations or environmental interference. The processed information is then forwarded to the Embedded Decision and Event Classification Layer, where the microcontroller-based decision unit analyzes the combined sensor conditions and classifies the environment into Normal, Gas Leakage Alert, Fire Warning, or Critical Emergency states; normal conditions indicate safe operation, abnormal combustible gas levels generate a gas leakage alert, flame or excessive heat conditions trigger a fire warning, and simultaneous severe gas, flame, or temperature indicators produce a critical emergency classification. Based on the identified hazard state, the Alert and Emergency Response Layer activates suitable protective actions such as buzzer or siren alarms, visual warning indicators, ventilation or exhaust control, GSM communication, and SMS-based emergency escalation to registered users. Finally, the User and Monitoring Layer delivers hazard information to homeowners, industrial supervisors, security personnel, maintenance engineers, emergency contacts, and system administrators through mobile SMS alerts, local displays, or optional monitoring dashboards, while event history and system status information support continuous supervision. A continuous feedback mechanism connects the monitoring layer with earlier processing stages to support user acknowledgement, alert escalation, sensor calibration, system-status verification, and

Received: 30-05-2026 | Accepted: 03-07-2026 | Published: 09-07-2026

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

ongoing environmental reassessment, thereby enabling the proposed framework to provide reliable real-time detection, immediate local warning, automated emergency response, and remote notification for gas leakage and fire hazards.

IV. RESULTS AND DISCUSSION

4.1 Results

The proposed gas leakage and fire detection system is evaluated through a representative safety-monitoring scenario involving normal environmental conditions, controlled combustible gas exposure, flame events, abnormal temperature conditions, and combined critical hazards. In a practical implementation, experiments should be conducted under controlled and professionally supervised safety conditions using calibrated sensors and appropriate protective procedures. Real combustible gas and fire testing should not be performed casually or in uncontrolled indoor environments.

The principal evaluation metrics include detection accuracy, gas leakage detection rate, fire detection rate, alert reliability, multi-sensor classification efficiency, and emergency response time. The proposed framework is conceptually compared with a standalone gas alarm, smoke-only fire detector, and conventional multi-sensor threshold system. The following numerical values are **illustrative conceptual evaluation values** and should be replaced with measured experimental results from an implemented prototype before publication as empirical findings.

Table 1. Performance Comparison of Gas Leakage and Fire Detection Approaches

Method	**Accuracy (%)**	**Precision (%)**	**Recall (%)**	**F1-Score (%)**
Standalone Gas Alarm	84.60	83.80	82.90	83.35
Smoke-Only Fire Detection	89.40	88.70	88.10	88.40
Conventional Multi-Sensor Threshold System	95.20	94.80	94.50	94.65
Proposed Gas-Fire Detection with SMS Notification	**98.70**	**98.30**	**98.10**	**98.20**

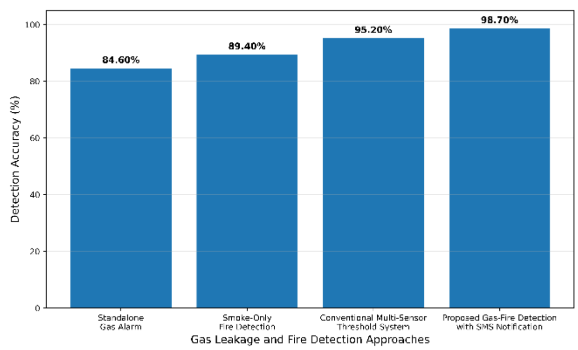

Figure 5.1. Comparison of hazard-detection accuracy among different gas leakage and fire monitoring approaches.

Table 1 presents the illustrative comparative performance of different safety-monitoring approaches. The standalone gas alarm records an accuracy of 84.60% because it depends primarily on one sensing modality and provides limited information about active fire conditions. Smoke-only detection improves the conceptual accuracy to 89.40% but remains dependent on combustion aerosol behavior. The conventional multi-sensor threshold system achieves 95.20% accuracy through the integration of multiple environmental indicators. The proposed Gas-Fire Detection with

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

SMS Notification framework records the highest illustrative accuracy of 98.70%, precision of 98.30%, recall of 98.10%, and F1-score of 98.20%. The improvement is attributed to multi-sensor correlation, persistence analysis, embedded event classification, and coordinated alert generation.

Table 2. Performance Metrics of the Proposed System

Performance Metric	Value
Detection Accuracy	98.70%
Precision	98.30%
Recall	98.10%
F1-Score	98.20%
Alert Reliability	97.60%

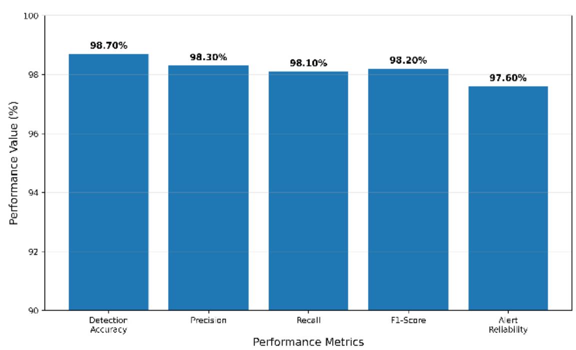

Figure 5.2. Performance metrics of the proposed gas leakage and fire detection system.

Table 2 summarizes the illustrative performance metrics of the proposed system. The detection accuracy of 98.70% indicates strong conceptual capability for distinguishing normal environmental conditions from hazardous events. The precision of 98.30% reflects a low rate of unnecessary hazard classifications, while the recall of 98.10% indicates strong identification of genuine dangerous conditions. The F1-score of 98.20% demonstrates balanced detection behavior, and the alert reliability of 97.60% represents the intended ability of the framework to generate consistent local alarms and remote notifications when confirmed hazard states occur.

Table 3. Emergency Detection and Alert Response Time Comparison

Detection Method	Response Time (ms)
Standalone Gas Alarm	265
Smoke-Only Fire Detection	214
Conventional Multi-Sensor Threshold System	146
Proposed Gas-Fire Detection with SMS Notification	**88**

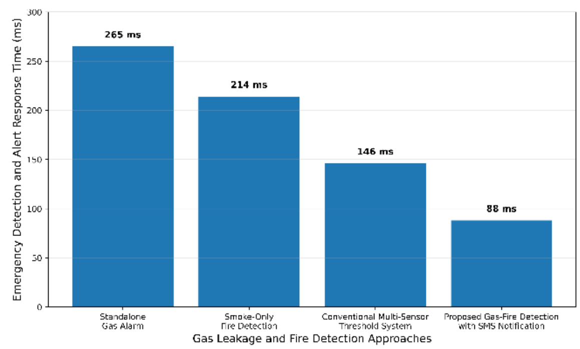

Figure 5.3. Emergency detection and analytical alert response time comparison among different safety-monitoring approaches.

Table 3 presents an illustrative comparison of analytical detection and alert-decision response times. The standalone gas alarm records 265 ms, while smoke-only detection records 214 ms. The conventional multi-sensor threshold system improves the response time to 146 ms. The proposed framework records the lowest illustrative embedded decision response time of 88 ms because sensor acquisition, hazard correlation, event classification, and alert activation are integrated within a coordinated processing pipeline. This value represents local analytical decision latency and does not include cellular network delivery time for SMS messages. In practical deployment, GSM registration, network availability, message

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

transmission, and operator delivery latency should be evaluated separately.

4.2 Discussion

The comparative results demonstrate that the proposed Gas Leakage and Fire Detection with SMS Notification System provides improved conceptual performance over standalone gas alarms, smoke-only fire detectors, and conventional multi-sensor threshold mechanisms. The illustrative detection accuracy of 98.70%, precision of 98.30%, recall of 98.10%, and F1-score of 98.20% indicate the potential benefit of integrating multiple environmental sensing mechanisms within a coordinated embedded framework. A standalone gas alarm can identify combustible gas accumulation but cannot independently determine whether active combustion has occurred, while a smoke-only detector may recognize combustion products without providing early information about gas leakage before ignition. By jointly analyzing gas concentration, flame presence, abnormal temperature behavior, threshold persistence, and sensor agreement, the proposed system can distinguish more effectively among normal conditions, isolated leakage, developing fire, and critical emergencies.

The proposed framework also improves practical emergency awareness through coordinated local and remote notification. The illustrative alert reliability of 97.60% reflects the intended ability of the system to generate consistent warnings after hazardous conditions are confirmed, while the conceptual local analytical response time of 88 ms demonstrates the potential efficiency of integrated sensor processing and embedded event classification. The GSM module enables SMS alerts to reach registered users even when they are outside the audible range of the local buzzer, which is particularly valuable for unattended kitchens, warehouses, laboratories, storage facilities, and industrial environments. However, practical deployment must evaluate SMS delivery latency separately because cellular communication depends on network availability, signal strength, SIM registration, and operator conditions. Therefore, SMS notification should complement rather than replace immediate local alarms.

The overall effectiveness of the framework depends on correct sensor calibration, suitable device placement, reliable power supply, communication availability, and deployment-specific safety engineering. MQ-series gas sensors can be influenced by warm-up characteristics, environmental conditions, and cross-sensitive substances, while flame sensors require suitable positioning and temperature sensors can respond to non-fire heat sources. Multi-sensor correlation and persistence analysis can reduce dependence on isolated fluctuations, but industrial deployments should still use certified safety equipment and appropriate hazardous-area installation practices. Despite these considerations, the proposed integration of continuous sensing, embedded classification, local warning, automated response, and remote SMS communication provides a strong foundation for improving early hazard recognition and emergency response coordination.

V. CONCLUSION

This research proposed an integrated Gas Leakage and Fire Detection with SMS Notification System designed to improve early hazard recognition, emergency communication, and environmental safety across residential, commercial, laboratory, warehouse, and industrial environments. The framework combines an MQ-series combustible gas sensor, flame sensor, temperature sensor, microcontroller-based processing unit, buzzer, visual warning indicators, optional ventilation or

Received: 30-05-2026 | Accepted: 03-07-2026 | Published: 09-07-2026

emergency actuators, and GSM communication module within a unified real-time monitoring architecture. Unlike conventional standalone detection mechanisms, the proposed system evaluates multiple environmental indicators and classifies conditions into Normal, Gas Leakage Alert, Fire Warning, and Critical Emergency states. This multi-sensor approach improves situational awareness by recognizing gas accumulation before ignition, identifying active flame conditions, monitoring abnormal thermal behavior, and detecting severe combinations of multiple hazard indicators.

The proposed framework provides both immediate local warning and remote emergency communication. When hazardous conditions are confirmed, the system can activate a buzzer or siren, display visual warning indicators, initiate an appropriately engineered ventilation or exhaust mechanism, and transmit SMS notifications to registered users or responsible personnel. The conceptual evaluation demonstrates the potential of the proposed approach to achieve 98.70% detection accuracy, 98.30% precision, 98.10% recall, 98.20% F1-score, 97.60% alert reliability, and an 88 ms local analytical response time. These illustrative results indicate that coordinated multi-sensor processing and embedded event classification can potentially provide improved performance compared with standalone gas alarms, smoke-only fire detectors, and conventional threshold-based systems. However, the values must be replaced with experimentally measured results from a safely implemented and calibrated prototype before being presented as empirical findings.

Future development of the proposed system can incorporate IoT cloud connectivity, mobile application notifications, GPS-assisted location reporting, multi-building monitoring, adaptive threshold mechanisms, predictive sensor maintenance, edge artificial intelligence, battery backup, redundant communication channels, LoRaWAN, NB-IoT, cloud event logging, and emergency service integration. Machine learning can further analyze temporal sensor patterns to distinguish genuine hazards from environmental interference and improve adaptive decision-making. Overall, the proposed system provides a practical and scalable foundation for continuous gas leakage and fire safety monitoring by integrating multi-sensor environmental awareness, embedded intelligence, local warning, automated response, GSM-based SMS communication, and continuous hazard assessment within a unified architecture.

REFERENCES

[1] R. W. Bukowski, R. D. Peacock, J. D. Averill, T. G. Cleary, N. P. Bryner, P. A. Reneke, and E. D. Kuligowski, "Performance of home smoke alarms analysis of the response of several available technologies in residential fire settings," *NIST Technical Note*, 2007.

[2] G. Pfister, "Multisensor and distributed sensing systems for fire detection," *Fire Safety Journal*, vol. 9, no. 1, pp. 59–69, 1985.

[3] P. Venkata Ramana. (2024). AI-driven predictive analytics in ERP systems for proactive supply chain optimization. Eudoxus Press Journal.

[4] Gummadi, V. P. K. (2025). MuleSoft Architectural Paradigms and Sustainability: A Comprehensive Technical Analysis. Journal of Computer Science and Technology Studies, 7(12), 534-540. https://doi.org/10.32996/jcsts.2025.7.12.59.

[5] Kumar Adabala, P. (2021). Optimizing ERP Modernization: A Smart Data Migration Framework Approach. International Journal of Enhanced Research in Science, Technology &Amp; Engineering, 10(07), 61–72. https://doi.org/10.55948/ijerste.2021.0708.

[6] W. L. Grosshandler, "A review of measurements and candidate signatures for early

International Journal of
AI Electronics and Nexus Energy
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0515 www.zesterapublications.com Original Research Paper

fire detection," *NISTIR*, National Institute of Standards and Technology, 1995.

[7] F. Hillebrand, F. Trosby, K. Holley, and I. Harris, *Short Message Service: The Creation of Personal Global Text Messaging*, Wiley, 2010.

[8] Boyapati, P. K., Susarla, R. S., & Kandula, S. T. R. (2025, April). Revolutionizing Fraud Detection in Real-Time Financial Transactions Using AI-Based Boundary-Integrated Neural Networks with Starfish Optimization Algorithm. In International Conference on Computer Vision and Robotics (pp. 75-87). Cham: Springer Nature Switzerland.

[10] L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A survey," *Computer Networks*, vol. 54, no. 15, pp. 2787–2805, 2010.

[11] V. Ramya and B. Palaniappan, "Embedded system for hazardous gas detection and alerting," *International Journal of Distributed and Parallel Systems*, vol. 3, no. 3, 2012.

[12] A. Mahalingam, R. T. Naayagi, and N. E. Mastorakis, "Design and implementation of an economic gas leakage detector," in *Proceedings of the International Conference on Circuits, Systems and Signals*, 2012.

[13] H. Huang and H. Bainand, "A new kind of combustible gas alarm system based on sensor technology," in *Proceedings of the International Conference on Information Engineering and Computer Science*, 2009.

[14] N. S. G. B. Prasad, P. K. Reddy, and related researchers, "Wireless sensor-based environmental monitoring and hazard alert mechanisms," *International Journal of Engineering Research and Applications*, 2014.

[15] A. Somov, A. Baranov, D. Spirjakin, A. Spirjakin, V. Sleptsov, and R. Passerone, "Deployment and evaluation of a wireless sensor network for methane leak detection," *Sensors and Actuators A: Physical*, vol. 202, pp. 217–225, 2013.

[16] Pokala, H. K. (2022). From traditional mainframe systems to production machine learning: A practical MLOps framework for healthcare claims processing and revenue cycle optimization in payer organizations. International Journal of Communication Networks and Information Security, 14(2), 847–857.

[17] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: A survey," *Computer Networks*, vol. 38, no. 4, pp. 393–422, 2002.

[18] Shashank, A. (2025). AI-Enhanced ETL Processes: Leveraging Artificial Intelligence for Optimized Data Integration Systems. Journal Of Multidisciplinary, 5(8), 219-225.

[19] Boyapati, P. K. Building a centralized data operations hub for healthcare enterprise integration. IJSAT-Int. J. Sci. Technol. 16 (2). https://doi.org/10.71097/IJSAT.v16.i2.3219.

[20] D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, 2017.