IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

Smart Home Safety and Emergency Monitoring System for Elderly Care: A Literature Survey

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Abstract: *The growing number of older adults living independently has increased the need for home technologies that can identify hazards and notify caregivers promptly. Recent Internet of Things (IoT) studies explore household monitoring through environmental sensors, wireless communication, image-based analysis, and automatic responses to dangerous conditions. This survey reviews fourteen studies published from 2024 to 2026 that relate to elderly monitoring, fire and smoke detection, gas-leak prevention, integrated home safety, and emergency assistance. Across these works, low-cost sensing devices and networked controllers can support local alarms and remote notifications, while some systems also take direct action, such as shutting off a gas supply or activating ventilation. However, the reviewed solutions generally address separate hazards or specific use cases. This leaves an opportunity to develop a unified and affordable platform for gas leakage, smoke and fire, room temperature, restricted-area intrusion, manual SOS requests, and caregiver notification..*

Keywords: Smart home, elderly care, Internet of Things, gas leakage detection, fire detection, emergency monitoring

I. INTRODUCTION

Older adults who live alone may face household emergencies that are not noticed immediately. Examples include leaking cooking gas, smoke or fire, uncomfortable or unsafe room temperatures, entry into restricted areas, and situations in which a person needs help but cannot contact family members quickly. An IoT-based safety system can monitor selected conditions continuously and send alerts to relatives or caregivers when readings indicate a possible problem. Depending on its design, the system may also activate an alarm or initiate a protective action.

This survey reviews recent work relevant to a Smart Home Safety and Emergency Monitoring System for elderly care. The intended project brings several functions together: gas-leak detection, smoke and fire monitoring, room-temperature monitoring, restricted-area security, a manual SOS control, and automatic caregiver alerts. Fall detection is outside the scope of this proposed system.

II. METHODOLOGY

The reviewed literature was selected from IEEE-related publications dated 2024–2026, as described in the source survey. Search terms covered smart homes for older adults, IoT-based home safety, gas-leak detection, fire and smoke monitoring, temperature sensing, intrusion detection, emergency alerts, and multi-sensor monitoring. A paper was considered relevant when it described a feature or design approach that could inform at least one part of the proposed system. Work focused on fall detection and older publications were excluded from the stated review scope.

For comparison, the selected studies were grouped into five themes: monitoring older residents, fire and smoke detection, gas-leak detection and control, integrated multi-sensor safety, and emergency assistance.

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III. LITERATURE REVIEW

A. Elderly Home Monitoring

Liao et al. [1] describe a home-monitoring platform that uses LoRa, Wi-Fi, and Bluetooth alongside current, voltage, and water-flow sensors. It observes patterns in household activity and can alert relatives when activity appears unusually low. The approach illustrates how changes in everyday behaviour can provide indirect evidence that a resident may need assistance.

The STM32-based system in [2] monitors several indoor conditions, including temperature, humidity, light, air quality, and flammable gas. When readings exceed configured limits, it sounds a local alarm and sends a GSM message to a guardian. Combining an on-site warning with a remote message is relevant to homes where an older resident may not be able to respond to every alert.

B. Fire and Smoke Detection

The design reported in [3] combines a wireless sensor network with EfficientNet-B0 image classification. It uses gas and smoke sensing, audible and visual alarms, water sprinklers, and LoRaWAN communication for image transmission. The paper reports local fire detection within five seconds and notification to emergency centres within ten seconds. These results indicate the potential value of combining sensor readings with image analysis, although performance depends on the test conditions.

Study [4] examines federated-learning methods for fire and smoke prediction at the edge. It compares several training approaches and uses LIME and SHAP to help explain model predictions. This work explores whether learning-based prediction can complement fixed sensor thresholds while keeping model decisions more interpretable.

The “Wake-on-Fire” design in [5] uses MQ-2 gas sensing, a DHT22 temperature sensor, an ESP32-CAM, GPS, and an ESP8266 networking module. A Kalman filter is used to reduce sensor noise, and a low-power wake-up method is intended to conserve energy. When a fire event is detected, the system can activate sprinklers and transmit images with location information.

C. Gas Leakage Detection and Mitigation

An image-processing-based household safety approach [6] monitors gas concentration and room temperature and is designed to close a gas valve when a hazardous condition is identified. It also uses the Blynk application and distributed sensors for monitoring multiple areas. The LPG detector in [7] uses an Arduino, an MQ-2 sensor, and a solenoid valve; its authors report a response time of three seconds and 95% accuracy in controlled testing.

The ESP32 kitchen system in [8] adds automatic ventilation and sequential notifications. If the first contact does not acknowledge a gas-leak alert within fifteen seconds, the system forwards the warning to another contact. This escalation model may be useful when timely acknowledgement is important. The system described in [9] sends gas- and fire-related alerts through Telegram and reports an average notification delay of 1.97 seconds, along with stable operation during a 24-hour test. Another kitchen safety design [10] presents live LPG readings on a Blynk dashboard and uses a solenoid valve to stop the gas supply.

D. Multi-Sensor and Integrated Home Safety

Ye et al. [11] present an IoT monitoring approach that combines information from devices related to fire, gas, water, and electrical safety. Its central idea is to collect readings from different sources and coordinate the resulting response through one system. The home-automation design in [12] brings together security, climate control, and appliance management, with centralized monitoring and alerts. Together, these studies support the feasibility of a common monitoring layer, though the specific functions and implementation details differ between systems.

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E. Emergency and Elderly Assistance

The wearable approach in [13] analyses physiological signals and vocal indications of distress to identify possible emergencies. The study reports model accuracy in the range of 94–97% and includes a manual SOS option. The manual control is particularly relevant because a resident may recognize an emergency before an automated detector does.

The care-management system in [14] uses Firebase and machine-learning methods for real-time vital-sign monitoring and emergency calling. Although its main focus is health information rather than household hazards, its use of automatic contact escalation offers a useful design idea for caregiver notification.

IV. COMPARATIVE ANALYSIS

The studies indicate three recurring design approaches: continuous sensing, wireless communication, and a response to detected hazards. Elderly-monitoring systems focus on keeping family members informed, while gas- and fire-safety designs often emphasize immediate action, such as closing a valve or starting ventilation. Integrated platforms show that readings from multiple devices can be collected centrally, but the reviewed studies do not consistently cover all of the requirements of the proposed elderly home-safety system.

The following design lessons emerge from the reviewed work:

- Use affordable sensors to monitor relevant conditions continuously.
- Provide a local warning and a remote notification when a hazard is detected.
- Where appropriate and safe, trigger an automatic protective response, such as gas shut-off.
- Include a simple manual SOS control for situations that automated sensing may miss.
- Escalate alerts to additional contacts if the first recipient does not respond.

V. IDENTIFIED RESEARCH GAP

The reviewed solutions remain divided by hazard and application. Some focus on LPG leakage, others on fire prediction, indoor conditions, or activity monitoring. These functions are not always connected through a single platform, and multi-contact alert escalation is not consistently available. As a result, caregivers may need to rely on separate devices or applications to understand different types of household risk.

The identified gap is the need for a cost-conscious integrated system that combines gas-leak detection, smoke and fire monitoring, room-temperature checks, restricted-area intrusion alerts, manual SOS requests, and staged caregiver notifications. The proposed work aims to bring these functions into one coordinated design. Fall detection is not included in its scope.

VI. CONCLUSION

Research published between 2024 and 2026 demonstrates a range of approaches for improving home safety and supporting older adults, including IoT sensors, wireless links, image analysis, edge-based learning, and automated responses. Individual studies provide useful building blocks, but their functions are generally limited to particular hazards or monitoring needs. The literature therefore supports further work on an affordable, integrated Smart Home Safety and Emergency Monitoring System that combines environmental hazard detection with SOS support and caregiver alert escalation.

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