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IOT BASED GAS LEAKAGE DETECTION & ALERT SYSTEM

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ABSTRACT

Liquefied petroleum gas is used for cooking in most Indian homes and in hotels, hostels, and small industries, and piped natural gas is spreading in many cities. A leak from a worn hose, a loose regulator, or a burner left open can fill a kitchen with gas within minutes, and a single spark from a switch or appliance can then cause a fire or explosion. Many such accidents happen when nobody is present or when the smell is not noticed in time. This paper presents an IoT based gas leakage detection and alert system that senses leaking gas, raises local alarms, takes automatic safety action, and informs the user and neighbours remotely.

The system uses an MQ-6 semiconductor gas sensor for LPG together with an MQ-2 sensor for general combustible gases and smoke. Both sensors contain a small heater that keeps the sensing element at its working temperature, and the change in their resistance in the presence of gas is converted into a voltage through a load resistor and read by the analog input of an ESP32 microcontroller. The readings are converted into approximate concentration in parts per million using calibration curves, and a DHT11 sensor provides temperature and humidity so that the effect of these conditions on the sensor can be taken into account.

When the gas concentration crosses a warning level, the controller sounds a buzzer and flashes a warning light. If it crosses a higher danger level, the system switches on an exhaust fan through a relay to ventilate the room, closes a 12 V normally open solenoid valve on the gas line, and disconnects the power to non-essential kitchen sockets through a contactor so that no new spark can be produced. These actions are carried out locally and do not depend on the internet connection.

At the same time, an alert is sent to the owner through a mobile notification from a cloud platform and through an SMS and a missed call from a SIM800L GSM module. The cloud dashboard shows the live gas level, the state of the fan and valve, and a history of past events. Because a gas sensor must be heated continuously, the power supply was designed with a 12 V adapter, separate regulated rails for the heater, logic, and valve, and a battery backup that keeps the detector working during power cuts.

A prototype was tested with controlled release of LPG from a lighter in a closed test chamber. The system detected leaks at about 300 ppm, well below the lower explosive limit of LPG, activated the fan and valve within 2 s of the danger threshold, and delivered the mobile alert in about 6 s. Future work includes wireless detector nodes for several rooms, automatic cylinder weight monitoring, and pattern analysis to distinguish slow leaks from cooking fumes.

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I. INTRODUCTION

Gas fuels have made cooking and heating cleaner and more convenient, and LPG connections have reached a very large number of households in India through government schemes in recent years. At the same time, the number of domestic users who are unfamiliar with safe handling has also grown. News reports regularly describe fires and explosions caused by leaking cylinders, cracked rubber tubes, and regulators left open, often with serious injuries and loss of life. Small restaurants, canteens, and hostels that store several cylinders together face even higher risk.

LPG is heavier than air and collects near the floor, where it may not be smelled immediately, and a person who is asleep or out of the house cannot notice a leak at all. The odour added to the gas helps, but it depends on the user being present and alert. Once the concentration reaches the flammable range of roughly two to ten percent by volume, any spark from a light switch, refrigerator relay, or mobile charger can ignite it. The time available to act is therefore short, and a detector that only sounds an alarm is useful only if someone hears it.

Electronic gas detection is well established in industry, where fixed detectors are connected to control systems that shut valves and start ventilation. Similar functions can now be built for homes at low cost using semiconductor gas sensors, Wi-Fi enabled microcontrollers, relays, solenoid valves, and GSM modules. From an electrical engineering point of view, such a system must also be designed so that it does not itself become a source of ignition, and so that it continues to work when the mains supply fails.

This paper describes an IoT based gas leakage detection and alert system that measures gas concentration with MQ series sensors, sounds local alarms, starts an exhaust fan, closes a solenoid valve on the gas supply, isolates kitchen sockets, and sends alerts over the internet and the GSM network. The design gives attention to sensor heater power, calibration, relay and valve driving, supply safety, and battery backup, with the aim of providing reliable protection at a cost suitable for ordinary households.

II. LITERATURE SURVEY

Research on gas sensing for safety applications has examined several sensing technologies. Catalytic bead sensors, which measure the heat released by combustion of gas on a heated element, are common in industry and respond well to flammable gases, but they consume significant power and can be poisoned by certain vapours. Infrared sensors measure absorption of light at specific wavelengths and are stable and selective, but they are costly for domestic use. Metal oxide semiconductor sensors such as the MQ series change their resistance when reducing gases react with oxygen on the surface of a heated tin dioxide layer. Studies have reported that these sensors are cheap, sensitive, and easy to use with microcontrollers, although their response depends on temperature, humidity, and ageing, and they respond to several gases at once, so careful calibration and threshold selection are needed. Periodic recalibration in clean air has been recommended to handle slow drift over months of operation.

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The heater in a semiconductor gas sensor has received particular attention in studies concerned with power and reliability. A typical MQ sensor heater draws around 150 mA at 5 V, which is a large load for battery powered devices, and the sensor needs a preheating period of several minutes after power is applied before its readings become stable, with longer burn in when the sensor is new. Researchers have explored pulsed heating schemes that reduce average power, but these complicate calibration. Other work has shown that the load resistor value affects the sensitivity and the output voltage range, and that the ratio of sensor resistance in gas to its resistance in clean air, taken from the characteristic curves, gives a practical estimate of concentration in parts per million.

Many academic projects have built gas leakage detectors around Arduino and similar microcontrollers. The simplest designs compare the sensor output with a fixed threshold and sound a buzzer, while others add an LCD, an exhaust fan, and a servo or stepper motor to turn off the cylinder regulator knob. Solenoid valves on the gas line have been proposed as a more reliable way to cut the supply. Studies have also discussed the choice between relays and solid state switches for driving fans and valves, noting that relay contacts can produce sparks and should be placed outside the area where gas may collect, or enclosed, while MOSFET based switching avoids contact arcing for DC loads. Isolating kitchen power sockets on detection has been suggested to remove other sources of ignition.

Remote alerting has been added to gas detectors through GSM modules, Wi-Fi modules, and IoT cloud platforms. GSM based systems send SMS messages or place calls to stored numbers and work without internet access, which makes them attractive in areas with weak broadband. Wi-Fi based systems publish readings to cloud dashboards using MQTT or HTTP and send push notifications through mobile applications. Researchers have compared alert delay across these channels and found that both can deliver alerts within a few seconds under normal network conditions. Several studies recommend using both channels together for safety applications, so that the failure of one does not prevent the alert from reaching the user.

Studies on the reliability of domestic detectors have discussed false alarms, sensor drift, and supply failures. Cooking fumes, alcohol, and aerosol sprays can trigger semiconductor sensors, and repeated false alarms cause users to disconnect detectors. Suggested remedies include using two sensors with different sensitivities, requiring the reading to stay above threshold for a short time, and compensating for temperature and humidity. Researchers have also stressed that a detector that loses power during a power cut offers no protection at the moment when candles or generators increase the risk. The system described in this paper applies these findings through dual MQ sensors, time based confirmation, environmental compensation, fail safe valve control, dual channel alerting, and battery backup.

III. SYSTEM ANALYSIS

The gas leakage detection system is analysed as sensing, control, safety actuation, power supply, and communication blocks. The sensing block has an MQ-6 sensor for LPG and an MQ-2 sensor for smoke and other combustible gases, each with a 5 V heater and a 10 kilo-ohm load resistor, whose output voltages are read by the ESP32

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through a divider that scales them into its 3.3 V input range, and a DHT11 for temperature and humidity. The control block computes the sensor resistance ratio, converts it into ppm using stored curves, and compares it with warning and danger thresholds after a two second confirmation. The actuation block contains a buzzer and warning lamp, a relay for the 230 V exhaust fan, a MOSFET driver for the 12 V solenoid valve, and a contactor that isolates kitchen sockets. The power block uses a 12 V adapter, buck regulators for 5 V and 3.3 V rails, and a 12 V battery with automatic changeover. The communication block uses Wi-Fi with MQTT and a SIM800L GSM module for SMS and calls. The two heaters together draw about 300 mA continuously, the solenoid valve about 500 mA while energised, and the GSM module up to 2 A in short bursts, so each of these loads is given its own regulated path with adequate decoupling. The valve coil is driven through a logic level MOSFET with a flyback diode, which avoids relay contact arcing on the DC side and protects the controller from the inductive voltage spike when the coil is switched off.

Existing System

In most homes and small eateries there is no electronic gas detection at all. Safety depends on users smelling the gas and closing the regulator, which is not possible when they are asleep, away from home, or when the leak is slow and occurs near the floor. Some households have installed standalone gas alarms that sound a buzzer when gas is detected, but these do not take any action to stop the leak, do not ventilate the room, and cannot inform anyone who is not within hearing distance. Many of these alarms run only from mains power and stop working during power cuts. Mechanical safety devices on regulators cut the flow only when the hose bursts completely and do not respond to small leaks. Industrial gas detection systems with shut off valves and remote monitoring exist, but they are expensive and require professional installation, so they are rarely found in homes, hostels, or small restaurants. As a result, no record is kept of small leaks that occur repeatedly and point to a worn hose or regulator.

Disadvantages of Existing System

- Detection depends on users smelling gas, which fails when they are absent or asleep.
- Standalone alarms only sound a buzzer and take no protective action.
- The gas supply is not cut off automatically when a leak is detected.
- The room is not ventilated, so gas continues to accumulate.
- Electrical sockets remain live and can ignite leaked gas.
- Nobody outside hearing range is informed of the leak.
- Mains only alarms stop working during power cuts.
- Single sensor alarms give false alarms from cooking fumes and sprays.
- No history of leaks is kept to identify faulty hoses or regulators.
- Industrial systems are too costly for homes and small eateries.

Proposed System

The proposed system detects gas leakage using two MQ series sensors and an ESP32 controller and responds with graded local and remote action. After a preheating period,

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the sensors are sampled every 500 ms and their readings are averaged and corrected for temperature and humidity. A warning level of about 300 ppm LPG triggers an intermittent buzzer and amber light, and a danger level of about 1000 ppm, confirmed for two seconds on both the average and the rate of rise, triggers the full response. The exhaust fan is switched on through a relay mounted in a sealed enclosure away from the floor, the normally open solenoid valve on the gas line is energised to close, and a contactor removes power from the kitchen sockets. An alert is published over MQTT to the cloud, which sends a push notification, and the GSM module sends SMS messages and places a call to stored numbers. The valve reopens only after a manual reset once the gas level has fallen. A battery keeps sensing, alarms, valve, and GSM working during mains failure.

Advantages of Proposed System

- Detects LPG leaks at low concentration well below the explosive limit.
- Dual sensors and time confirmation reduce false alarms.
- Automatically closes the gas supply through a solenoid valve.
- Starts an exhaust fan to ventilate leaked gas from the room.
- Isolates kitchen sockets to remove possible sources of ignition.
- Sends alerts through both mobile notifications and GSM SMS and calls.
- Works during power cuts through battery backup and automatic changeover.
- Keeps a cloud history of gas levels and leak events.
- Local protection works even when the internet connection is lost.
- Built from low cost parts suitable for homes, hostels, and eateries.

IV. METHODOLOGY

The methodology began with the preparation and calibration of the gas sensors. Each sensor was powered continuously for 48 hours for burn in, and its resistance in clean air was measured to obtain the reference value R0. Known small quantities of LPG from a lighter were then released into a sealed 20 litre test chamber, and the sensor resistance ratio was recorded against the estimated concentration to fit the calibration curve used in the firmware. The heater current and the current drawn by the relay, valve, and GSM module were measured, and the regulator and battery were sized for the worst case load. The ESP32 firmware was organised as a state machine with normal, warning, danger, and reset states, with sensor sampling, averaging, compensation, and threshold checking in a timed loop, and with actuation and alerting handled in the danger state. MQTT messages were sent to a cloud broker and linked to a dashboard and notification service. Tests measured detection level, time to actuation, alert delay, and behaviour during a simulated power failure. Each test was repeated at least ten times, and false alarm behaviour was checked separately by exposing the sensors to cooking fumes, incense smoke, and a deodorant spray.

SYSTEM ARCHITECTURE

The architecture of the gas leakage detection system is arranged as layers that lead from sensing to response. The Sensing Layer contains the MQ-6 and MQ-2 gas sensors with their heaters and the DHT11 environmental sensor. The Signal Conditioning Layer scales and filters the sensor voltages and applies temperature and

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humidity compensation. The Controller Layer on the ESP32 converts readings into ppm, runs the state machine, and decides the alarm level. The Local Alarm Layer drives the buzzer and warning light. The Safety Actuation Layer controls the exhaust fan relay, the solenoid valve driver, and the socket isolation contactor. The Power Supply and Backup Layer provides regulated rails for heaters, logic, and valve, with automatic changeover to battery. The Connectivity Layer uses Wi-Fi with MQTT and the GSM module for SMS and calls. The Cloud Layer stores readings and events and applies alert rules, and the Application Layer presents live gas levels, device states, and notifications.

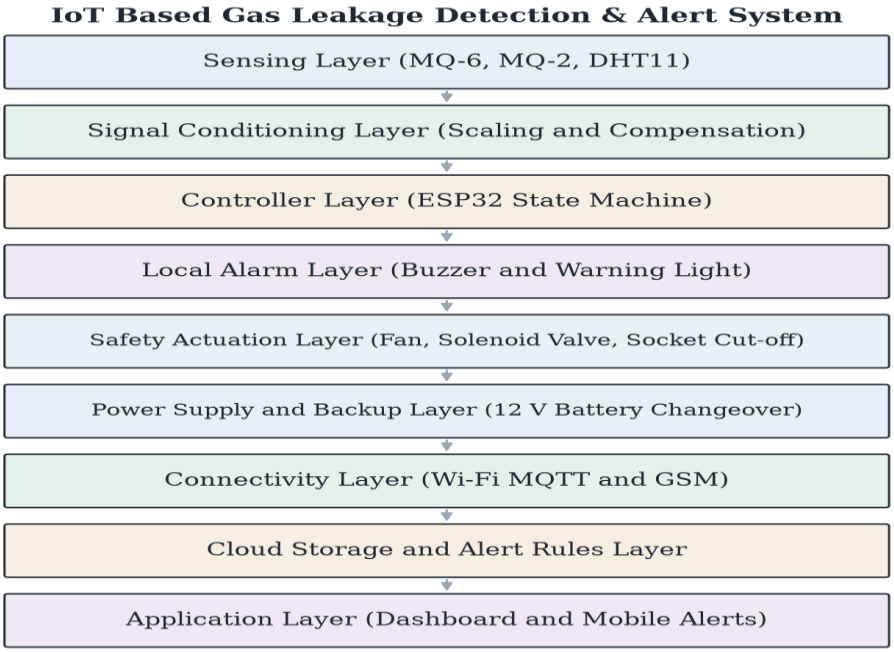
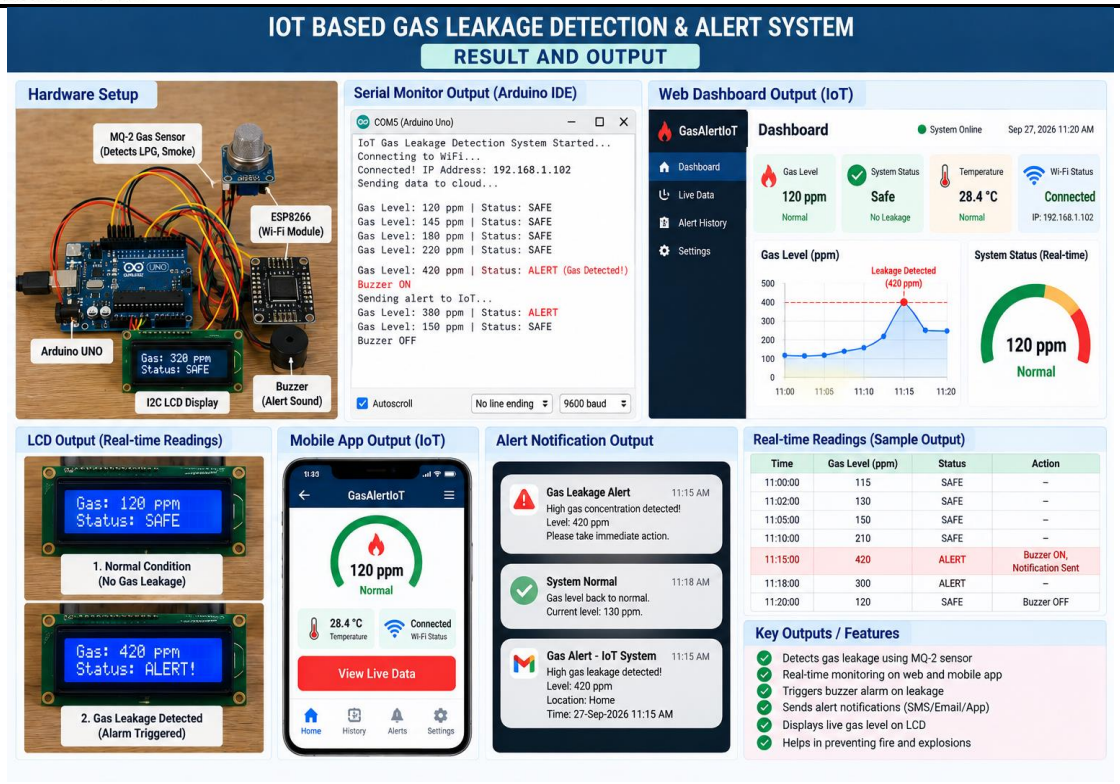


Fig. 1 System Architecture

V. RESULT AND OUTPUT

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VI. CONCLUSION

This paper presented an IoT based gas leakage detection and alert system that combines semiconductor gas sensing, automatic safety action, and remote alerting in a single low cost unit. Using MQ-6 and MQ-2 sensors with an ESP32 controller, the system measures gas concentration, sounds local alarms, starts ventilation, closes the gas supply, isolates electrical sockets, and informs the user through the cloud and the GSM network.

Testing in a closed chamber showed that the system detected LPG at about 300 ppm, which is a small fraction of the lower explosive limit, and that the valve closed and the fan started within about two seconds of the danger threshold being confirmed. The use of two sensors, averaging, and a short confirmation time prevented false alarms from brief puffs of cooking fumes and aerosol sprays, which is important if users are to trust and keep the detector connected.

The electrical design contributes directly to safety. Continuous heater power was provided from a dedicated regulated rail so that the sensors stayed at their working temperature, the relay for the fan was mounted in a sealed enclosure away from where gas collects, and the solenoid valve and socket contactor remove both the fuel and the likely ignition sources. Battery backup with automatic changeover kept detection, alarms, and alerts working during simulated power failures, when the risk in many homes actually increases.

Future work will extend the system with wireless detector nodes for several rooms and storage areas, load cell based monitoring of the cylinder weight to warn of slow leaks and low gas, and simple learning methods to distinguish normal cooking patterns from genuine leaks. Certification aspects such as intrinsically safe enclosures

and compliance with domestic gas safety guidelines should also be studied before large scale deployment in homes and commercial kitchens.

REFERENCES

[1] Kumar, R. D., Prudhviraj, G., Vijay, K., Kumar, P. S., & Plugmann, P. (2024). Exploring COVID-19 through intensive investigation with supervised machine learning algorithm. In Handbook of Artificial Intelligence and Wearables (pp. 145-158). CRC Press.
[2] Swathi, B., Vijay, K., Sushanth Babu, M., & Dinesh Kumar, R. (2024, November). Machine Learning Techniques in Cloud Based Intrusion Detection. In The International Conference on Artificial Intelligence and Smart Environment (pp. 557-564). Cham: Springer Nature Switzerland.
[3] Sv satyakrishna, shirisha rangu, bhargavi nalacheruve. (2024) Prospective investigation on colorectal cancer with SMOTE on machine learning Algorithm
[4] Dr.G.Vishnu Murthy, BhargaviNalacheruve 1Professor, Department of computer Science & engineering, Anurag University, TS, India. 2Student, Department of computer Science & engineering, Anurag University, TS, India.
[5] V. N. S. Manaswini, K. K, C. Nigam, S. S. Ali, R. Niranjana, and Suman, "Real-Time Object Detection in Drone Surveillance Using YOLOv5," in Proc. 2025 3rd Int. Conf. IoT, Communication and Automation Technology (ICICAT), Gorakhpur, India, 2025, pp. 1–6, doi: 10.1109/ICICAT68430.2025.11414670.
[6] B. Soundarya, V. N. S. Manaswini, M. Ayyakrishnan, R. D. Kumar, "Contextual Analysis of Big Data Analytics in Intelligent Transportation Frameworks," in Intersection of Artificial Intelligence, Data Science, and Cutting-Edge Technologies: From Concepts to Applications in Smart Environment, Lecture Notes in Networks and Systems, vol. 1353, Cham: Springer, 2025, doi: 10.1007/978-3-031-88304-0_79.
[7] R. D. Kumar, V. N. S. Manaswini, "Applications of blockchain in smart cities: detecting fake documents from land records using blockchain technology," in Blockchain for Smart Cities, Elsevier, 2021, pp. 105–117, doi: 10.1016/B978-0-12-824446-3.00017-X.
[8] Tejavath Veeramma, Badarla Anil, Guguloth Ravinder, "An advanced movie recommender using collaborative filtering and sentiment analysis," International Research Journal of Modernization in Engineering Technology and Science, vol. 7, no. 7, July 2025, doi: 10.56726/IRJMETS81618.
[9] Ravi Kumar Banoth, Ramana Murthy B V, "Automatic crop recommendation system using LightGBM and decision tree machine learning models," Journal of Machine and Computing, vol. 5, no. 1, pp. 343, Jan. 2025, doi: 10.53759/7669/jmc202505026.
[10] Ravi Kumar Banoth, Dr. B.V. Ramana Murthy, "Smart agriculture through IoT and machine learning for analyzing carbon footprints," in Proc. Int. Conf. Computer Science and Communication Engineering (ICCSCE), Apr. 2025.
[11] Ravi Kumar Banoth, B. V. Ramana Murthy, "Soil image classification using transfer learning approach: MobileNetV2 with CNN," SN Computer Science, vol. 5, art. no. 199, 2024, doi: 10.1007/s42979-023-02500-x.