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Smart Gas Leakage Detector Using IoT Sensors

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Abstract: The IoT-based Gas Leakage Detection System integrates various components including an Arduino microcontroller, gas sensor, LCD display, Wi-Fi module, buzzer, GSM module, GPS module, and a DC fan. This system aims to provide real-time monitoring and alerting for gas leaks, enhancing safety in domestic and industrial environments. The gas sensor continuously detects gas concentrations, triggering the alarm system upon detecting a leak. The LCD display provides local feedback, indicating the gas levels detected. In case of a leak, the buzzer alerts nearby individuals, while the GSM module sends SMS alerts to designated contacts, ensuring remote notification. Additionally, the GPS module enables tracking the system's location, facilitating rapid response in emergency situations. The integration of Wi-Fi allows for remote monitoring and control via a smartphone or computer. Finally, the DC fan helps to disperse the leaked gas, further mitigating potential hazards. This comprehensive system offers robust gas leak detection and management capabilities for enhanced safety and peace of mind. The sensors are plays key roles to detection of gas leakage. The most of the areas are home, office and industries are facing the gas leakage issues in the holidays. So our proposed model worked efficiently and control fire accidents and save the human resources. In this system, the main advantage is alert to entire or individuals by sending SMS through GPS location of spot. So prevention will initiate before fire accident

Keywords: *Internet of Things, Microcontroller, GSM, GPS, LCD*

1. Introduction

In an era characterized by rapid technological advancement, ensuring safety in both domestic and industrial settings is paramount. One critical concern is the detection and management around the leakages in gas; it is the main risks to the property, human and environment. To address this challenge, use internets of Things are merged and get new solution to provide monitoring, detection, and response capabilities.

The IoT-based Gas Leakage Detection System represents a sophisticated integration of various components designed to provide real-time monitoring and alerting for gas leaks. At its core lies an Arduino microcontroller, serving as the central processing unit orchestrating the system's functions. The system incorporates a highly sensitive gas sensor capable of continuously detecting gas concentrations, enabling prompt detection of leaks[1][2].

Local feedback is provided through an LCD display, offering real-time insights into the gas levels detected. [3][4] In the event of a leak, multiple layers of alert mechanisms come into play. A buzzer emits audible alerts to nearby individuals, while a GSM module ensures remote notification by sending SMS alerts to designated contacts, enhancing responsiveness and facilitating timely intervention.

Moreover, the integration of a GPS module enables precise tracking of the system's location, facilitating rapid response in emergency situations. Meanwhile, Wi-Fi connectivity allows for seamless remote monitoring and control via smartphones or computers, empowering users with comprehensive oversight and management capabilities [6].

To further mitigate potential hazards, a DC fan is employed to disperse leaked gas, thereby minimizing the risk of ignition or harm. Overall, this comprehensive system offers robust gas leak detection and management capabilities, exemplifying the transformative potential of IoT technologies in enhancing safety and peace of mind in both domestic and industrial environments [10].

2. Related Works

[1] This paper was used two sensors, one of the sensors is to detect gas leakage and second one is used to detection

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gas leakage location. The concept and development of an SMS-based gas leak alert system is presented in this study. An 8051 microcontroller with assembly language programming was interfaced with the outputs of two gas sensors (MQ-6) to identify gas leaks in a specific area. Relays connect a dedicated GSM phone with a line to the microcontroller's output. In order to facilitate timely and appropriate response, the GSM phone is set up to send gas leakage notifications to another GSM phone via a short message service (SMS) message that includes the location. The device makes it possible to monitor gas leaks in isolated areas, which speeds up response times in the event of a leakage issue.

[2] Gas leaks are a serious issue for the residential, commercial, and industrial sectors as well as for gas-powered vehicles such as cars, buses, and CNG (compressed natural gas) vehicles. In order to avert gas leak-related accidents, installing gas leak detecting devices in strategic locations is one preventive measure. The goal of this project is to create a gadget that can recognize and halt gas leaks in susceptible locations on its own. A gas sensor is used by the system to identify any LPG (liquefied petroleum gas) leaks, and the GSM is used to notify the user via SMS of the leak. The gas sensor detects gas leaks and lowers its output when the amount of LPG in the air beyond a certain threshold. The microcontroller recognizes this and simultaneously turns on the buzzer and LED. After that, the system notifies the client by texting the designated mobile number with an SMS.

[3] For the purpose of collecting ambient data from different structural installations, mesh, ad-hoc, and hierarchical sensor networks have all been employed extensively throughout the years. Linear sensing systems are sensing systems with their nodes arranged in an ordered manner. Traditionally, sensor networks have attempted to operate as an unofficial or lattice design in densely populated areas, which has resulted in issues with networking and resource management. The establishment of an intelligent data transmission path and gap recovery—which happens when a node is unable to interact with a node on either side of the gap—are important tasks for linear sensor networks. To handle these issues, it is suggested to implement a linear sensor node implementation request for piping systems using a specially designed security measurement in addition to techniques used to solve internet backbone creation, release interference recognition, but also transmission of high-priority messages in a consistent manner while maintaining the firm's continuous operation. In a system with low energy consumption, high data dependability, and low latencies, leaks can be found and detected, and the value of the proposed system is demonstrated by comparing it with other systems.

[4] Gas Leakage Detector with GSM for Factory Safety is a safety device designed to solve the problem of plant explosions that cause several fatalities. This system's purpose is to locate gas leaks in manufacturing environments. If there is a gas leak at that workplace, the employees will be informed by an alarm. In order to take measures to stop an unwanted scene from happening, GSM will also notify the authority, whose factory it is. Any potential explosion brought on by a gas leak can be prevented by this technology. After this mechanism is installed, GSM will improve it.

[5] House fires have been happening a lot lately, and there is now a greater risk to people's lives and property. Liquid petroleum gas has a high degree of in flammability and can leak from spill sources in a number of ways. Although LPG is a need for every family, it should be used carefully because it causes many accidents annually due to home gas spills. The majority of fire incidents are brought on by cheap flexible chambers or by controllers that are left on while not in use. A gas leak causes a variety of accidents that result in both material loss and human injuries. These days, a big part of people's security is determined by the home wellbeing identification framework. The number of deaths has increased recently due to the explosion of LPG. A framework to detect LPG spills is necessary in order to keep a strategic distance from this problem. This endeavour aims to provide protection and warn people, especially labourers who work in hazardous conditions. When it comes to LPG gas, we don't always know the exact situation in our daily lives. In our daily lives, we are unaware of the exact state of LPG gas culmination, which causes hardship in addition to the spillage recognition feature that notifies clients of the correspondingly structured chamber requirement. This framework effectively monitors the problems that arise in daily living. This report examines many innovations that are used to find gas leaks. This study outlines the benefits and drawbacks associated with the latest developments.

3. Method

The Internet of things Gas Leakage Detection System is a comprehensive solution incorporating an Arduino microcontroller, gas sensor, LCD display, Wi-Fi module, buzzer, GSM module, GPS module, and a DC fan. Its primary goal is real-time monitoring and alerting for gas leaks, enhancing safety in domestic and industrial settings. The gas sensor continuously monitors gas concentrations, triggering alarms upon detection. The LCD display provides local feedback on gas levels, while the buzzer alerts nearby individuals. The GSM module sends SMS alerts to designated contacts for remote notification, and the GPS module enables tracking the system's location for rapid response. Wi-Fi integration allows remote monitoring and control via smartphones or computers.

Finally, the DC fan disperses leaked gas, further mitigating hazards. This system offers robust gas leak detection and management capabilities for enhanced safety.

3.1 Objective

The main intention of smart gas leakage system is check real-time monitoring an alerting for leakages in domestic and industrial environments. Integrating various components including an Arduino microcontroller, gas sensor, LCD display, Wi-Fi module, buzzer, GSM module, GPS module, and DC fan, the system aims to enhance safety by detecting leaks promptly, alerting individuals, sending SMS notifications, enabling remote monitoring, and facilitating rapid response in emergency situations.

3.2 Outcomes

Gas sensor data collected by Arduino Uno triggers GSM alerts, LCD warnings, and buzzer alarms for real-time gas leak detection. Integrated WiFi enables remote monitoring, while GPS aids in pinpointing leak locations. DC fan activation ensures ventilation, with a regulated power supply ensuring system reliability.

3.3 Benefits

- Real-time gas detection and alerts prevent potential hazards, ensuring the safety of individuals in domestic and industrial environments.
- Wi-Fi and GSM integration allow for remote monitoring and control, providing peace of mind from anywhere.
- GPS tracking facilitates quick emergency response by pinpointing the system's location in case of gas leaks.
- Integrating multiple components like LCD display, buzzer, and fan ensures thorough gas leak detection and management.

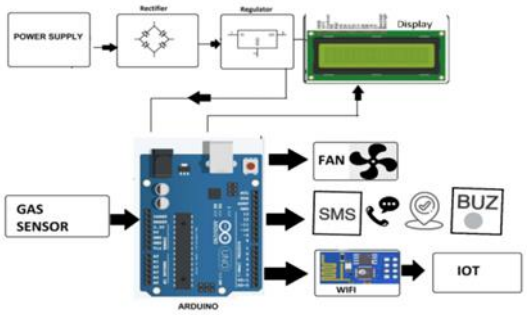


Fig 1. Smart Gas Detection Model

4. Implementation

The implementation of gas sensors using Arduino Uno, along with additional components such as a GSM module, LCD display, WiFi module, buzzer, GPS module, DC fan, and regulated power supply, offers a comprehensive gas leakage detection system. Arduino Uno serves as the central control unit, receiving data from the Gas sensor regarding the existence of harmful gases available in the environment. The GSM module enables the system to send real-time alerts and notifications to designated users via text messages or calls in the event of a gas leak, ensuring swift response measures can be taken. The LCD display provides visual feedback, presenting gas concentration levels or warning messages for easy interpretation by users. Integration with WiFi allows for virtual observation and authority capabilities, authorized users to get real-time data and receive alerts through their smartphones or computers. Additionally, the inclusion of a buzzer provides audible warnings to alert individuals in the vicinity about the gas leak. GPS functionality enables the system to provide location information, aiding emergency responders in quickly locating the affected area. A DC fan can be activated to ventilate the area and disperse the leaked gas safely. Finally, a regulated power supply ensures stable and reliable operation of the entire system, essential for continuous monitoring and timely response to gas leaks. This integrated setup offers a robust and effective solution for gas leakage detection and mitigation in various environments, enhancing safety and minimizing risks

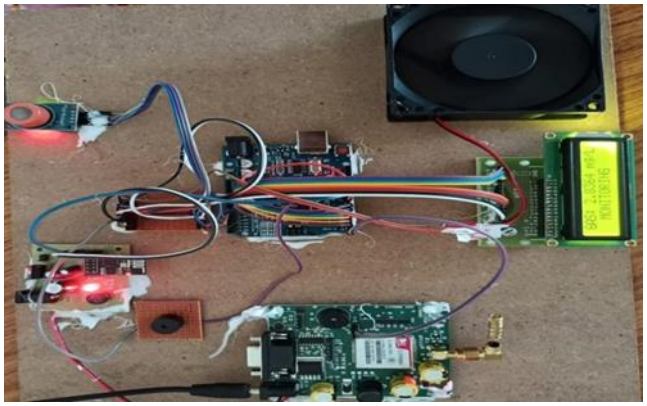


Fig 2. Smart Gas Detection Model

The fallowing components are used in the Smart Gas detection working model:

i. ARDUINO UNO
ii. GAS SENSOR
iii. GSM
iv. LCD
v. WIFI
vi. BUZZER
vii. GPS
viii. DC FAN
ix. REGUATED POWER SUPPLY

Components Description:

i. Arduino Uno

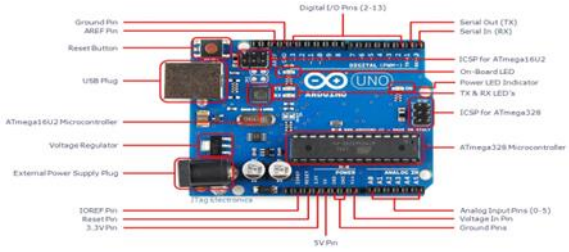


Fig 3. Arduino Board

The Arduino Uno is the most widely used version of the platform. When most people refer to an Arduino, they are referring to this particular board. An excellent option for new comers, the Uno is one of the most well-liked boards in the Arduino lineup. The Arduino Uno has been through several modifications; the most recent one is shown in detail here (Rev3 or R3).

i. GAS SENSOR- MQ9 Sensor-SE-1009-D

Fig 4. MQ9 Sensor-SE-1009-D

Gas detectors use a variety of technologies to measure and display the concentration of specific gases in the air. Gas detectors are battery-operated safety equipment that is typically used to avoid toxic exposure and fire. They can be purchased as mobile or fixed devices, and they function by using a variety of visual or aural cues, such lights, alarms, or a combination of signals, to indicate the presence of elevated gas concentrations. Modern multifunctional or multi-gas devices may detect multiple gases at once, whereas many older, conventional gas detector systems were designed to detect only one gas. Separate units for keeping an eye on little work areas, or units that can be joined or connected to form a defense system

ii. Global System for Mobile Communications

Fig 5. GSM 900A

GSM modems are specific sorts of modems that function over wireless networks that require a subscription, much like a mobile phone. A GSM modem functions similarly to a mobile phone for a computer and accepts a Subscriber Identity Module (SIM) card. For GSM network functionality, the computer can even use a separate mobile phone as a modem.

iii. LCD

An electronic display module known as an LCD (Liquid Crystal Display) screen has several uses. One of the most fundamental modules seen in many different devices and circuits is the 16x2 LCD display. Other multi-segment LEDs including those with seven segments are not as good as these modules. The reasons for this are that LCDs may display unusual and even custom characters (unlike in seven segments), animations, and other content without being expensive or difficult to program.

Fig 6. 16x2 Liquid Crystal Display

i. WiFi Module

A low-cost Wi-Fi chip with complete TCP/IP stack and MCU (microcontroller unit) capability, the ESP8266 is made by Chinese manufacturer Espressif system, which is situated in Shanghai.

Fig 7. ESP8266

The ESP-01 module, produced by a third-party producer named AI-Thinker, brought the chip to the notice of western manufacturers in August 2014. This little module enables microcontrollers to establish basic TCP/IP connections using the Hayes-style comma and connect to a Wi-Fi network.

iv. Buzzer

Mechanical, electromechanical, or electronic buzzers and beepers are examples of auditory signaling devices. Alarms, timers, and verifying human input—such as a mouse click or keystroke—are common applications for buzzers and beepers.

Fig 8. Alert buzzer

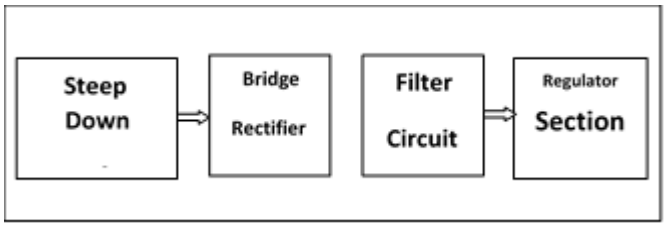
v. DC FAN

Direct current fans, or DC fans for short, are electrical appliances that are frequently used in a variety of settings for cooling. DC fans use a steady flow of electric charge in one direction, as opposed to AC (alternating current) fans, which run on an electricity supply that is constantly changing.

Fig 9. DC Fan

vi. Regulated Power Supply

A controlled power supply is necessary for all digital electronics. This post will teach us how to obtain a controlled positive supply from the main power source.



4. Results and Discussion

- The LCD display will show the gas concentration in mg/L in real-time.
- If the gas concentration exceeds the threshold, the buzzer and fan will be activated.
- If configured correctly with a valid SIM card an GSM module, an SMS along with location will be sent to the specified mobile number to alert the prevention of fire.

the fallowing results was gives us to gas leakage detection and loction along with the longtitude and latitude values through SMS, So we can easily trace and prevent the loss.

4.1 Gas Leakage through SMS

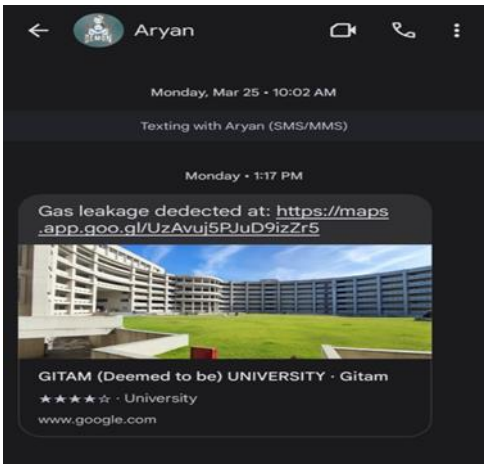


Fig 4.1 : Gas leakage alert through SMS

The above results was tells to send SMS of Gas leakage detection using SIM900A device and provide the google link in SMS. So, we can easily trace the gas leakage point.

4.2 Gas Location Detection

Fig 4.2 : Location detection of Gas Leakage

The above resuts was notify the gas leakge detectiont in the Google map with location deatills. The given location point to idea about nearest place

4.3 Gas Location Google Map

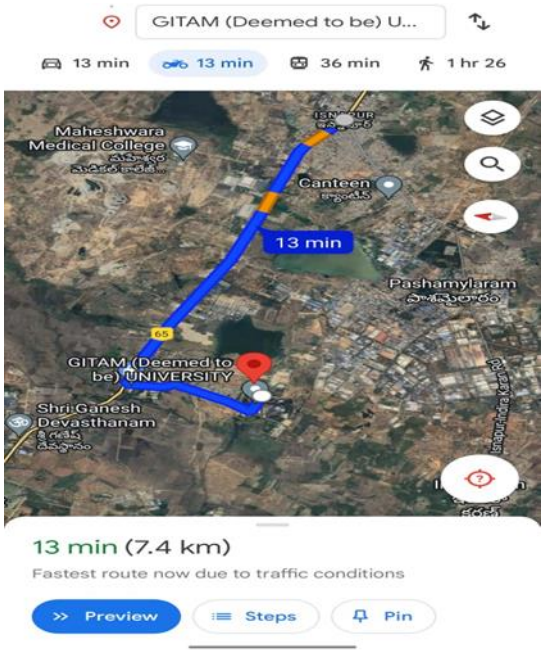


Fig 4.3 Gas Leakage Location on Google MAp

Our proposed model was effectively worked and to protect the all the assets of environment. The figure is identifying the gas leakage and send sent an SMS along with GPS location to the consumer to alert and to avoid the fire accidents. And when gas leakage was detected buzzers alert the people.

6. Conclusion

An important development in safety technology for both residential and commercial settings is the Gas Leakage Detection System, which is based on the Internet of Things. By integrating various components such as the Arduino microcontroller, gas sensor, LCD display, Wi-Fi module, buzzer, GSM module, GPS module, and DC fan, this system provides comprehensive real-time monitoring and alerting capabilities. The continuous gas detection feature ensures prompt detection of leaks, while the alarm system promptly alerts nearby individuals through the sms and buzzer notifications to designated contacts via the prescribed module. The inclusion of a GPS module enables quick localization of the system, facilitating rapid response in emergency situations. Moreover, the integration of Wi-Fi allows for remote monitoring and control, enhancing convenience and accessibility. The addition of a DC fan further mitigates potential hazards by dispersing leaked gas. Overall, this system offers a robust solution for gas leak detection and management, providing enhanced safety and peace of mind to users.

7. Future Scope

The Internet of Things-based Gas Leakage Detection System may be improved in the future. by incorporating machine learning algorithms for more accurate gas leak detection and predictive analytics to anticipate potential leaks. Integration with smart home systems and automation technologies could enable seamless integration with other safety devices, further enhancing overall safety measures. Furthermore, the development of more compact and energy-efficient components could increase the system's applicability and accessibility due to developments in miniaturization and energy efficiency.

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