Automatic Gas Leakage Detection and Fire Protection for Industrial Safety

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Keywords: Gas Leakage Detection, Fire Detection, Arduino Uno, MQ-2 Gas Sensor, Flame, Sensor, Buzzer Alert, DC Fan, Servo Motor, Water Pump, SIM800 Module, Real-Time Monitoring.

Abstract: Gas leaks and burning accidents are hazards that pose a serious threat to safety and can cause tremendous damage and loss of life this project is an Iot-based gas leakage and fire detection system based on Arduino uno an mq-2 gas sensor flame sensor buzzer dc fan servo motor water pump and sim800 module empowered by providing real-time monitoring and automatic safety interventions once a leak is detected it sends out a buzzer warning that turns on the dc fan to ventilate the gas hazard and the servo motor moves to open the ventilation to improve airflow simultaneously an sms warning alert is sent to the users using the sim800 module for real-time alertness following the incident of a fire the system turns on the water pump for extinguishing the fire and sends an sms notification by delivering an automated and timely response the system reduces human intervention to a minimum and thereby various possible explosive and fire hazards while at the same time the project proposes an economical efficient and effective safety shield for residential industrial and commercial functions reliant on IoT and automation.

1 INTRODUCTION

Fire accidents and gas handling represent serious threats to human life and property. Many mainstream monitoring methods today rely on manual interventions that may slow down and be ineffective in emergencies. Therefore, the work on this project is aimed at developing an IoT-based gas leaf and fire detection system with Arduino UNO, Alleys, Fire Brigade Sensor, Summer, DC Fan, Servomotor, Water Pump, and SIM800 modules. The system performs actual monitoring of gas concentration and fire hazards, triggers alarms, and performs safety measures accordingly. When a gas leak is recognized, the buzzer sounds, the DC fan is turned on and ventilation is opened by the servo motor. Additionally, SMS notifications are sent to the user via the SIM800 module. Therefore, notifications are guaranteed in real-time. The water pump is turned on by the fire. The combination of IoT and automation will help the project improve the safety of residential, industrial, and commercial spaces, minimize risks, and promote timely responses without human intervention.

2 LITERATURE STUDY

The literature overview reflects key improvements in IoT-based gas monitoring systems, emission recognition, and sensor networks, focusing on cost reduction, real-time monitoring, and remote. Communications. Malik et al. (2020) and Kumar et al. (2019) an examples of research findings showing the combination of IoT and sensor technologies for inexpensive and scalable gas recognition solutions, particularly for smart city environments. Alan M John et al. (2017) and Swapnil Kadam et al. (2024) highlight the importance of reliable communication in ensuring immediate response to gas leaks. Furthermore, Sharma et al. (2018) and Khan et al. (2017) highlight the importance of reliable sensor networks and IoT platforms to ensure accuracy and reliability. However, there are areas where current technologies remain, such as energy efficiency, integration of artificial intelligence, and detection of multi-GA, which offers a range of future innovations. Overall, these studies shape the improvements in safe and efficient housing and industrial and urban gas monitoring systems.

Literature research is modifying the development of gas monitoring and leak recognition systems with

E., P., R., V. K., T., A. and P., L.
Automatic Gas Leakage Detection and Fire Protection for Industrial Safety.
DOI: 10.5220/0013879200004919

In *Proceedings of the 1st International Conference on Research and Development in Information, Communication, and Computing Technologies (ICRDICCT'25 2025) - Volume 2*, pages 150-154
ISBN: 978-989-758-777-1

a special focus on IoT and GSM-based solutions. Jagtap et al. (2016) propose a GSM-based LPG gas weight and leak detection system. This focuses on the integration of gravity measurement and long-distance arms for safety improvements. Similarly, Shrivastava et al. (2013) introduce a GSM-based gas claver recognition system, highlighting the use of GSM technology for real-time notifications, avoiding dangerous accidents. Gupa et al. (2016) Contribute to the area using an IoT-based intelligent gas monitoring and alarm system. This demonstrates the power of IoT for real-time data recording and analysis. Furthermore, Khan et al. (2018) investigate gas leak detection with the help of IoT devices. This focuses on how IoT improves identification efficiency and response time. Together, these studies highlight the need for IoT and GSM integration for effective gas monitoring, leakage recording, and remote notification. Energy efficiency, multi-GA recognition, and sophisticated AI integration are areas of future research and innovation despite such research.

3 PROPOSED SYSTEM

The IoT-based gas leaf and fire detection system aims to be an automated real-time security concept for implementing gas leak detection and fire service associations. The system includes a combination of Arduino UNO and alleyway interface (MQ-2), flame sensor, summer, DC fan, servo motor, water pump, and SIM800 module. The alarm system (Summer) opens the ventilation outlet via a servo motor to turn on the fan and hand over gas when the alley sensor detects the gas mirror to a minimum. Send an SMS alarm to the user via the SIM800. This means that users will be noticed immediately. If flame recognition occurs through the flame sensor, the water pump will start. Industrial and commercial institutions.

4 METHODOLOGY

The methodology of the Arduino UNO-based gas clever recognition system includes a combination of various components to facilitate monitoring, detection, and automated actions in real time. The system starts from an alleyway, identifying leaks and sending signals to the Arduino Uno -microcontroller. In the event of a gas leak, the Arduino triggers a buzzer to notify the user, indicating that the GSM module (SIM800) sends an SMS alarm to a pre-programmed contact. At the same time, the DC fan is turned on, and the surface and diluent gas concentration. When the fire sensor captures the flame, the Arduino operates the servo engine to close the gas valve to stop another leak and switch the water pump to extinguish the fire. The system is programmed to automatically operate to respond quickly to gas leaks and fire threats. Arduino always pursues sensors and adjusts the actuator. This provides a powerful and stable solution for the detection of gas leaks and emergency responses. This approach uses IoT functions for remote notifications and combines several security measures to maximize user security and reduce risk. Figure 1 shows the IoT-Based Fire and Gas Detection System Block Diagram.

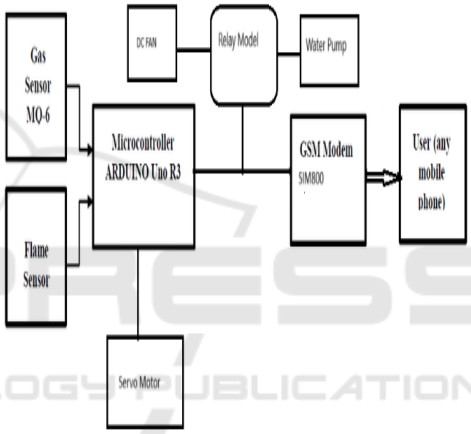

Figure 1: IoT-Based Fire and Gas Detection System Block Diagram.

4.1 Advantages

Observe early warnings and prevention - the system constantly monitors gas and reacts after recognition, preventing the possibility of an accident. The engine and water pump are activated at the same time with less manual intervention. Effect.Reduced Possibility of Explosion and Fire Damage - The system minimizes the risk of explosion and fire damage by activating gas leakage gas activated by water pumps during fire. Remote Monitoring via IoT - IoT-enabled systems allow users to send notifications even if they are not available at this location. This ensures the security of residential, industrial, and commercial buildings. Compared to traditional fire and gas safety systems. Mode; Maintenance is very low, providing uninterrupted security 24 hours a day.

5 SYSTEM IMPLEMENTATIONS

5.1 Hardware Requirements

5.1.1 Gas Sensor

Generally, the valley presents four pens on an Arduino board. On this board, two send performance-aware data, one sends it to the Arduino UNO. This is a very reasonable and effective semiconductor alley module with analog and digital outputs. This module uses MQ2 smoke and flammable alleys to recognize gas. No external components are required. The VCC and floor needles simply need to be connected and ready to go straight away. Thresholds are defined in a simple configuration via potentiometers. The MQ2's smoke and flammable alleyways can easily connect to any microcontroller, including the Arduino. Figure 2 shows the Gas Sensor.

Figure 2: Gas Sensor.

5.1.2 Servo Motor

Servo motors are small and accurate rotary drive elements for controlling the angular position, speed, and acceleration of mechanical elements. It consists of a DC or AC motor, a position search device, and a steering circuit. These are mostly used when precise movement control is required, such as in robotics, automation, and aviation systems. A unique feature of servo motors is that they can be converted to a specific angle determined by the input signal. Controls the position of the actuator via pulse width modulation or PWM signals that specify the angle the engine needs to rotate. In gas and leak recognition systems, the servo engine controls the opening and closing of the valve that unlocks the gas line when a leak occurs. Their reliability, efficiency, and smallness make them perfect for this application.

5.1.3 Processing Board

This is a microcontroller that typically has a user development environment that compiles and provides programs for the microcontroller. Arduino boards are used in detail by enthusiasts, students, and experts to develop interactive projects and prototypes in a variety of fields, including robotics, home automation, wearables, IoT applications, and more. The beautiful thing about the Arduino platform is based on a user-friendly IDE or integrated development environment developed to allow for a simplified version of the C++ programming language. Users who minimize programming backgrounds can write and upload programs through this IDE. Arduino boards are available in a variety of shapes and sizes with a variety of skills to meet the requirements of your project. Many digital and analog input start needles can be used to connect various electronic devices such as sensors, actuators, and more. Figure 3 shows the Arduino Uno R3 SMD.

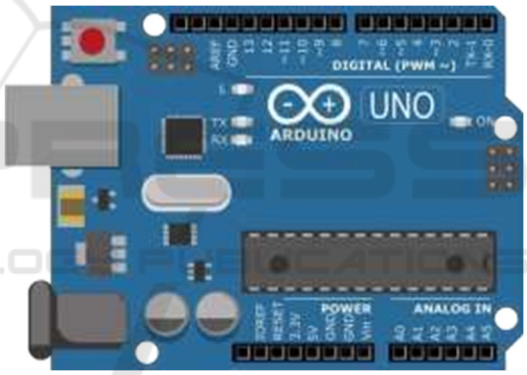

Figure 3: Arduino Uno R3 SMD.

5.1.4 Buzzer

Figure 4: Arduino Buzzer.

The buzzer provides an audible alert when an object is detected, enhancing the system's user interface. It helps to alert the user of potential obstacles or hazards. Figure 4 shows the Arduino Buzzer.

5.1.5 Flame

Flame sensors are the heart of the system used to recognize fire by capturing and capturing the presence of flames. Flame sensors recognize distinctive aspects of flame light, infrared radiation, or ultraviolet rays, depending on the type of flame

sensor. A fiery detector. Figure 5 shows the Arduino Flame.

Records specific frequencies of UV (Ultra Violet) and/or IR (Irtra-Red) to recognize burning fire. The radiation produced by the flame is classified into unique regions of the frequency/wavelength die detector and only works in these regions to reduce false alarms.

Figure 5: Arduino Flame.

5.1.6 Water Pump

A DC motor pump is a pump that uses direct current (DC) to move fluids. DC motor pumps can be powered by a battery, solar power, or a DC motor. Figure 6 shows the Arduino Water Pump.

Figure 6: Arduino Water Pump.

5.1.7 SIM800L V2

The SIMCOM SIM800L V2.0 GSM/GPRS Module is an Arduino-compatible quad-band GSM/GPRS module. It facilitates the integration of the advantage of these modules is that they operate at VCC and TTL series levels using a 5-V voltage. Therefore, you can directly interface it with an Arduino or any other basic system at a 5V voltage. Many GPRS/GSM modules are available on the market, necessitating the use of a 5-V regulator and level converter circuit. However, the SIM800L V.2 GSM/GPRS module features a built-in control circuit and a TTL level converter. Below is a sample project based on SIM800L V.2 that demonstrates how to control relays using SMS controllers. It allows you to easily toggle and turn off various devices at home, such as lamps, fans, and more. Figure 7 shows the SIM800L V2.

Figure 7: SIM800l V2.

5.2 Software Requirements

5.2.1 Arduino Ide

The Arduino Integrated Development Environment (IDE) is a software application used for writing, compiling, and uploading code to Arduino microcontroller boards. It provides an intuitive and user-friendly platform for programming Arduino projects, even for those with minimal coding experience. Figure 8 shows the Arduino IDE Software Interface.

Figure 8: Arduino IDE Software Interface.

6 FUTURE SCOPE

There may be other sensors that need to be integrated into the system and may be connected to temperature and pressure sensors. Therefore, IoT gas recognition systems can be integrated into Smart Home Automation Systems over the next few years. This integration ensures that cutoffs and emergency protocols are triggered in the event of a gas leak, improving security to reduce human intervention.

7 RESULT AND ANALYSIS

Gas leakage and fire prevention systems provide operational security and protection of personnel, property, and the environment in industrial applications dealing with gas use or manufacturing.

The system integrates gas recognition sensors in leak detection and alarm systems to alert you of various means of fire control, such as sprinklers and gas agents. Effective implementation requires early detection and therefore should provide a quick response to gas leaks and fires, minimizing the risk of injury, damage, and production downtime. Figure 9 shows the Kit Structure.

Figure 9: Kit Structure.

8 CONCLUSIONS

IoT-enabled gas detection and fire extinguishing technology based on Arduino UNO addresses security issues related to environments susceptible to gas escape and fire disasters. The system includes a variety of sensors, DC fans, engine provisions, water pumps, and GSM communicators providing summer, real-time monitoring, automatic action, and remote access. Alleyways raise alarms when certain gas leaks occur, but fire detection guarantees immediate effectiveness when stopping the fire. Energy savings are completed with the automatic shutdown feature, and the device will be turned off as soon as the threat is finished. In addition, the SIM800 GSM is enabled without going out on the site. General security with complete solutions for gas leaks and fires. This continues to live with this system.

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