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Smart Gas Regulator Using GSM

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Abstract - *Gas leakage is a serious issue since it can result in accidents and other dangers in both industrial and residential settings. Gas leakage detection systems are frequently placed in vulnerable regions to stop such events. These systems use sensors to find LPG leaks and send SMS notifications through GSM to let people know about the problem. The gas sensor will activate and send a signal to the microcontroller to turn on the LED and buzzer, alerting the user, if the amount of LPG in the air exceeds a predetermined level. The amount of gas left in the cylinder is also monitored by a level sensor, and if a fire leak is discovered, the relay will immediately turn off the gas supply to prevent further danger.*

Key Words: Arduino, GSM (Global Systems for Mobile Communications, LPG (Liquid Petroleum Gas), MQ-2 Gas Sensor, LED (Light Emitting Diode), LCD (Liquid Crystal Display), Servomotor.

1. INTRODUCTION

LPG plays an essential role in our daily lives, particularly in cooking. It is a cost-effective fuel compared to other options, making it a popular choice. One of the most significant advantages of using LPG is its ability to replace chlorofluorocarbons, which are known to harm the ozone layer. LPG comprises 55% butane, 45% propane, and small amounts of isopentane and olefins. It is stored in liquid form in a cylinder, and the odorless butane and propane are made detectable by adding ethyl mercaptan to the cylinder. LPG is lighter than water and burns in a mixture of LPG-air between 1.8% and 9.5%. LPG cylinders are available in various sizes, ranging from 4kgs to 450kgs. Ascertaining the gas level inside the cylinder can be challenging during daily use. To address this issue, we suggest an effective method to monitor the LPG level in the cylinder. This method would eliminate the need for advance or delayed booking of cylinders.

2. LITERATURE REVIEW

S. Koushanfar describe the process of integrating the sensor nodes into a network and the challenges that must be overcome to ensure accurate measurements. This versatile platform uses infrared laser spectroscopy to detect and measure many gas species in concentrations from parts per million to billion (ppm-ppb). High-resolution gas sensing technology has been challenging to incorporate into small, low-power, replicated sensors suitable for wireless sensor networks (WSNs) due to the significant differences in size, cost, and power consumption compared to traditional gas sensing devices that possess the same sensitivity and specificity [1].

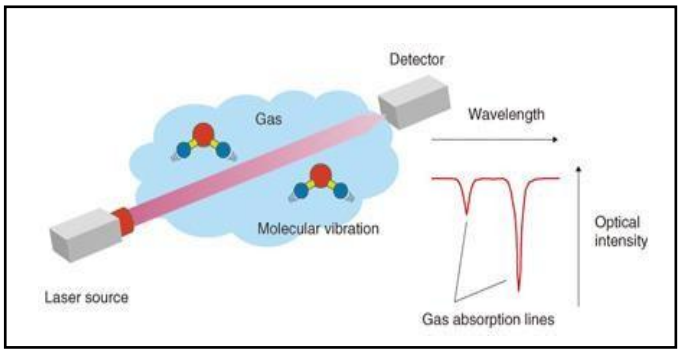

Fig-1: LaserSPECKs Technology.

Brush, A. J. have long been fascinated by the idea of smart houses, and have worked hard to develop home automation systems. The main purposes of home automation systems were energy management and security, but there were several obstacles in the way of their widespread acceptance, such as their high cost, complexity, and compatibility concerns. The results of the study suggest several areas for future research, such as developing methods to install home automation without requiring structural changes, creating straightforward security settings that users can easily configure, and facilitating the integration of home devices [2].

N. S. G. B. D. Jolhe suggest that Gas Measurement Monitoring System is an intelligent solution designed to enhance the convenience and safety of LPG gas consumers. Additionally, the system offers a real-time gas measurement monitoring feature that enables consumers to check the estimated time till the next refill, consumption history, and gas level through a mobile application or web portal [3].

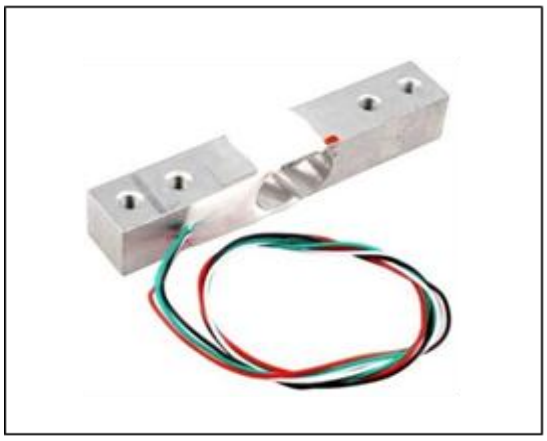

Fig -2: Load Cell.

P. Meenakshi Vidya research on LPG gas for cooking and heating, an autonomous LPG leakage detection and hazard avoidance system adds an extra degree of security. It can aid in avoiding any risks brought on by gas leaks and provide the home's residents piece of mind. So, in this system LPG leak sensor detects and the information is sent to the user via short message service (SMS). At the same time, a GSM module warns the customer and activates the alarm and exhaust fan. The method also has the added benefit of using a load cell to continuously check the level of LPG in the cylinder and a GSM module to automatically book the cylinder [4].

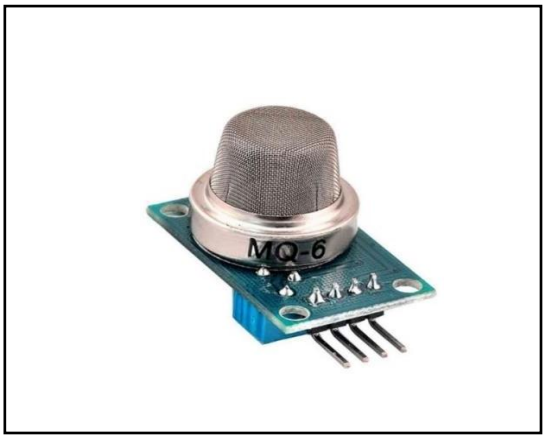

Fig-3: MQ-6 Gas Sensor.

S. Sivajothi Kavitha used a wireless system for detecting gas leakage in homes is equipped of three main components: The receiver module, the GSM/GPRS MODEM, and the gas leakage and level detection and transmission module. he LPG and natural gas concentration change is detected by the gas leakage detection and transmission module, and when it rises above a threshold point, an audio-visual alert is triggered. In addition, it transmits an alert message to the mobile device. To determine the weight of the cylinder at the time of dispatch and throughout use, the level of the LPG is continuously monitored [5].

Fig-4: GSM Module.

Snehal Godse and Sneha Gurgule presents the system's design and implementation, along with experimental results to show that the proposed system is accurate in detecting gas leakage and monitoring the gas level in real-time. The authors suggest that the proposed system can be used in households, industries, and gas distribution agencies to improve safety and convenience. LPG gas is the maximum generally used Domestic gasoline in each household. It can explode if inhaled in large amounts and is dangerous if its concentration rises. The MQ3 gas sensor is used to detect the gas, and the awareness is expressed in ppm. The consumer is notified when the awareness exceeds the desired amount and is encouraged to take appropriate action [6].

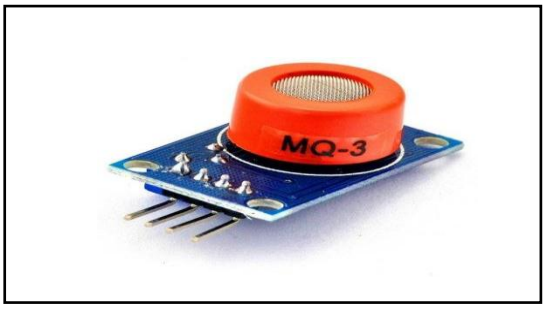

Fig-5: MQ-3 Gas Sensor

3.EXISTING METHOD

L.P.G leakage occurs when the faulty regulation, poor handling of the gas appliances and poor monitoring of the LPG cylinder. This may lead to the factors of occurring this type of disaster. This gas leakage when caught with air it becomes highly flammable and potentially explosive. This level of disaster can convert anything into ashes in a radius of 50 meters.

There are several existing models are there in the market which can detect the gas leakage and turn on the buzzer or the LED indicators. Most of them uses the same gas sensors for detection of any leakages, and most of them uses Load cell for detection of the level of the gas present in the cylinder.

In the existing version the Arduino Uno is the microcontroller that's the principal unit of the circuit. As in keeping with our block diagram an analog temperature sensor is attached to the microcontroller. And here the drawback is they are using Bluetooth for alerting the client. And, the readings monitored by sensor directly sent to the client from the device so the client should be there in the range of 50 meters from the device. Even though there are Buzzer and RGB LED alerting system, it is still an uncompleted model, moreover most of these models are custom built that is, they can only use by one who built or designed it and it is not possible to use by multiple persons.

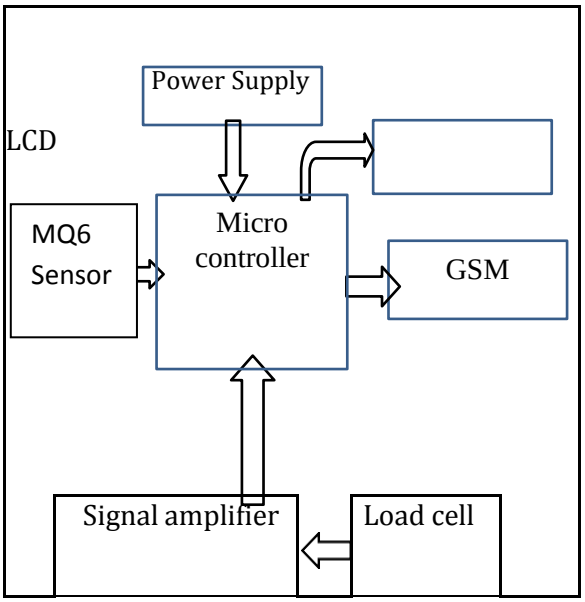

Fig-6: Block Diagram of existing model.

The main components used in the existing method was,

- Power Supply 5v.
- ARDUINO-UNO microcontroller.
- Load Cell.
- MQ6 Sensor.
- LCD.

4.PROBLEM IDENTIFICATION AND SOLUTION

In most of the existed models in gas leakage area, is that most of them lack of shutting down mechanism. None of them consists of an element which is used for cutting down the passage of the gas into the gas pipe in case of any leakages. Moreover, none of us can in person go and shut down the gas valve if there exists any fire leakage. A detail description of the existing model is shown in block diagram, notice there are only indicators which warns us about the leakage but no relays which turn of the passage of the gas.

Thus explains the existing model has several drawbacks such as lacking of the shutting down mechanism. So, the future work of this method is by using Photo diode sensor and Servo motor, these can eliminate the limitation of the existing model. And explains the advancements and improvements in the indicators and buzzers. These are the features added to our proposed system.

The proposed system with the Photo diode sensor and Servo motor can significantly improve the functionality of the existing model. The Photo diode sensor can detect the presence of light and can trigger the Servo motor to shut down the system when it detects a lack of light. This mechanism ensures that the system is automatically shut down when the light source is not available, preventing any damage to the system.

Fig-7: Flame sensor for Fire detection

Fig-8: Servomotor for Shutting down gas flow.

5. PROPOSED SYSTEM

The proposed Smart Gas Regulator is an improved version of a gas indicator that offers several benefits. It incorporates a flame sensor that can detect any fire or flame leakages in the vicinity of the gas cylinder. A relay or servo motor is used to shut off the gas supply automatically if the flame sensor detects any fire. This feature provides enhanced safety and helps prevent potential accidents.

When the flame sensor detects any fire, it sends a signal to the Arduino Microcontroller, which then triggers the shut-off operation. The Arduino Microcontroller sends a signal to the input of the Servo motor, which then turns its motor wing by 90 degrees. This action shuts down the passage of gas flow, ensuring safety in case of a fire.

The important components in proposed method are,

- MQ-2 Gas sensor (Gas Leakage Detection).
- Load Cell sensor (Level of the gas / Weight of the cylinder).
- Photo Diode sensor (Fire leakage Detection).
- 5v Power supply.
- GSM Module.
- LED indicators.
- Buzzer.
- LCD Display for level and real time sensing data.

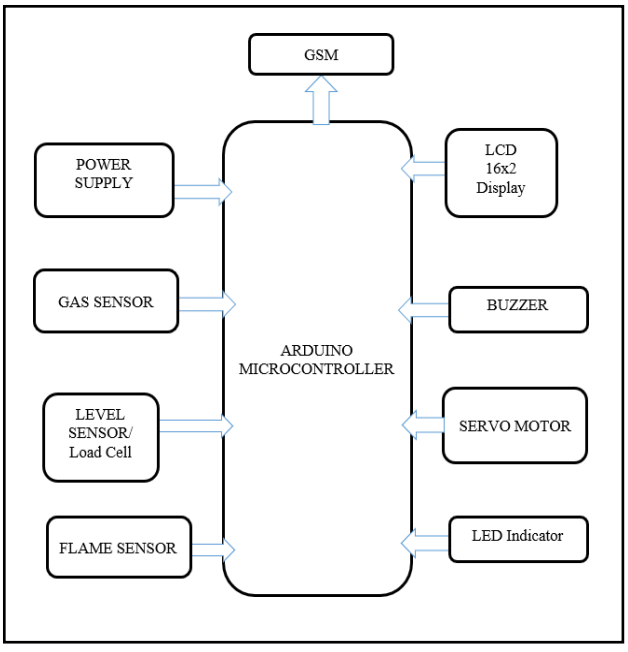

Fig 9: Block diagram of Proposed Module.

This proposed system mainly the advancement of the existing model which can eliminate lot of gas related problems in both industrial and domestical. Earlier we notice that existing models are lacking of shutting down mechanism so here is a proposed model to remove that limitation. The Flame sensor (Photo diode sensor) here acts as a sensing device for fire/flame leakage detection near the gas cylinder. Servo motor here was introduced to shut down the passage of the gas in the gas pipe, only if it detects any fire by the Flame sensor. Another improvement can be observed in the indicators both in LED and Buzzer.

6. IMPLEMENTATION

A. Hardware Implementation

The first step is to sense the presence of gas using a gas sensor. This sensor detects the concentration of gas in the environment and sends the data to the microcontroller. The microcontroller then sends an SMS to the user's phone number alerting them of the presence of gas. This is achieved using a GSM module that is connected to the microcontroller. In the event of a gas leakage, the microcontroller sends a signal to an LED and a buzzer to alert the user. The LED and buzzer provide a visual and audible warning to the user. The smart gas regulator must also be able to sense a fire. This can be done using a photodiode sensor or a flame sensor. In the event of a fire, the microcontroller sends a signal to an LED and a buzzer to alert the user. The LED and buzzer provide a visual and audible warning to the user. To prevent the spread of the fire, the smart gas regulator must be able to turn off the gas flow. This can be done using a servomotor that is connected to the gas valve. The microcontroller sends a signal to the servomotor to shut off the gas valve, thus preventing any further gas leakage. Once the fire has been extinguished, the smart gas regulator can be reset by the user. This is done by pressing a reset button on the regulator, which allows the gas flow to resume.

Along with all these real times sensing network another sensor also takes the part of Arduino working time which is Load Cell. Load Cell is used to calculate the real time weight of the gas cylinder, it also sends the data to Arduino by analog signals, so additional ADC is required in our Module. Weight will get displayed on the 16x2 LCD display. And whenever the weight of the cylinder gets reduced by the certain limit say 30% the it sends an alert to the registered mobile through an SMS using GSM technology.

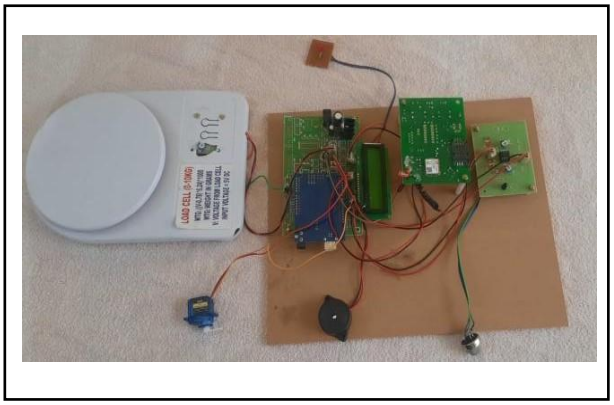

Fig 10: Hardware circuit of the device.

B. Hardware Requirements

- 5v Power Supply.
- Arduino Controller.
- GSM module.
- Photodiode Sensor.
- Buzzer.
- LCD Display.
- LED indicator.
- Servomotor.
- Loadcell.

C. Software Implementation

The Gas leakage detection using GSM Technology is a usefulapplication that can be implemented using an Arduino Uno microcontroller. This project involves the integration of various sensors such as Load sensors, Gas detection sensors, and Flame sensor, along with an LCD, LED, and buzzers to detect and alert users of any gas leakage. The microcontroller processes the input from the sensors and provides output through the LCD display and sound alert systems. The GSM technology allows the user to receive SMS alerts on their mobile phone in case of any gas leak detected by the sensors. This software application provides a reliable and efficient way to detect gas leaks and prevent accidents.

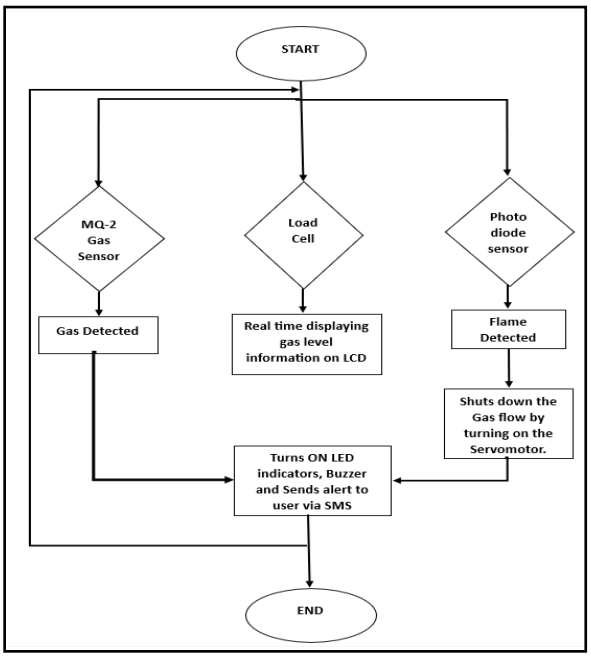

Fig 11: Flow chart of System design

The Arduino Uno microcontroller makes it easy to integrate and control various sensors and components, making it an ideal platform for such projects. The Gas leakage detection using GSM Technology, Load sensors, Gas detection sensors, Flame sensor, LCD, LED buzzers project can be implemented using Arduino Uno software.

The software can be developed using the Arduino Integrated Development Environment (IDE) which provides a user-friendly interface to write, compile and upload the code to the Arduino board. The software can be developed in C++ programming language using libraries and functions specific to the components used in the project. For example, the Adafruit Industries provides libraries for gas sensors, flame sensors, LCD, and LED displays, and buzzer. These libraries can be included in the code to control the sensors and display the output. The software code can be divided into different functions such as initializing the sensors, reading sensor data, displaying sensor data on the LCD, and sending SMS alerts using GSM technology. The code can also include conditional statements and loops to provide decision-making capabilities to the microcontroller. Once the code is developed, it can be uploaded to the Arduino Uno microcontroller using a USB cable. The microcontroller can be connected to the sensors and other components using wires and a breadboard. The GSM module can also be connected to the microcontroller using serial communication. After the hardware setup is complete, the software can be executed on the microcontroller to detect and alert users of any gas leak.

V1. RESULT

The hardware and software development for the Smart Gas Regulator is now complete. To achieve the desired outcome, we will connect the adapter of the Arduino Uno and then wait for a GSM request to register the user's mobile number.

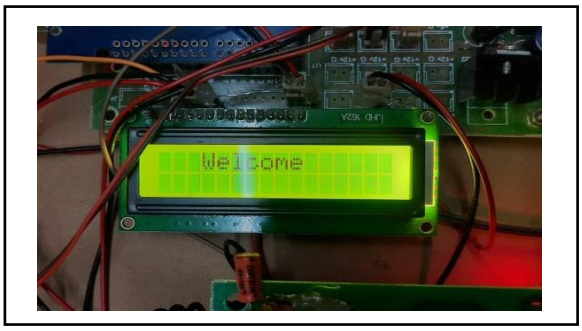

Fig-12: Welcome message on LCD.

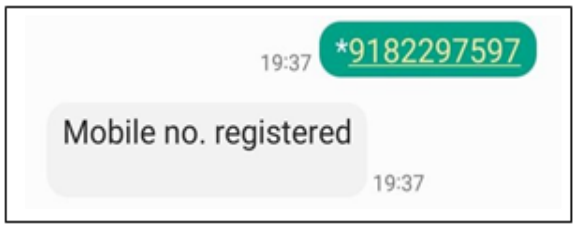

Fig 13: Shows the registration of the user through GSM.

Once the user's mobile number has been successfully registered with the GSM network, a message with the text 'reg' is sent to the user's mobile device. This triggers the LCD display to show the percentage level of gas present, as well as any indications of fire or gas leaks. The LCD display shown in Figure 11 illustrates how the display appears after it has transitioned from its initial state. Please note that the letters 'F' and 'G' are used to indicate the presence of fire and gas leakages, respectively.

Fig-14: Initial display of the LCD.

Please take note that the indicators labeled 'F' and 'G' are currently not illuminated, indicating that there are no signs of fire or gas leaks. To demonstrate how the gas regulator responds to gas leaks, we introduced gas towards the MQ-2 sensor to better observe its reaction.

Fig-15: Shows the reaction on detection of Gas leakage.

After introducing gas towards the MQ-2 sensor, the 'G' indicator on the LCD display was illuminated, indicating the presence of gas. In the second figure below, you can see an SMS that was sent to the mobile number registered with the GSM network. Next, let's introduce flame near the setup and observed the behavior of the module.

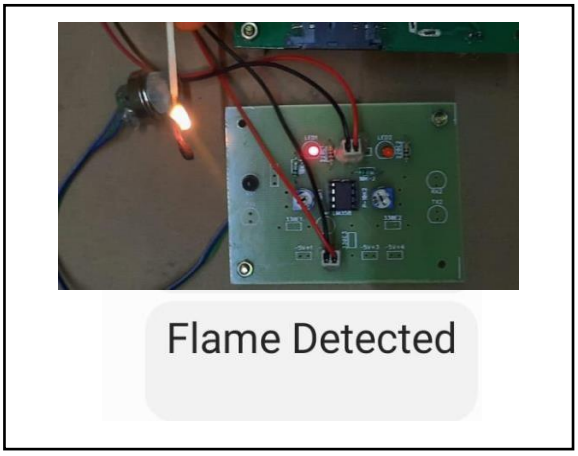

Fig-16: Shows the behavior of the setup if fireis introduced.

When the module successfully detects the presence of fire or gas, both the buzzer and LED indicator will be activated. In the case of fire detection, an additional mechanism is activated which shuts down the gas flow through the servomotor. It's worth noting that the user will be informed about the detection of flames through an SMS sent to their registered mobile number via the GSM network.

Fig-17: Load Cell

Fig 18: Shows the SMS at various gas levels.

The load cell is utilized in this method to measure the current weight of the gas cylinder in real-time. Our model is designed to create three weight limits in terms of percentage. If the gas level falls below 25%, it is considered empty, and a message is sent to the user with the tag 'Empty' to indicate the remaining gas level. Similarly, if the gas level rises above 35%, a message with the tag 'Medium' is sent to indicate the remaining gas level. Lastly, if the gas level goes beyond 90%, a message with the tag 'Full' is sent to inform the user of the remaining gas level.

The Smart Gas Regulator Using GSM is a versatile technology with applications across a wide range of industries. In domestic kitchens, it can ensure the safe and efficient use of gas appliances, while in hotels and restaurants, it can help prevent accidents and improve operational efficiency. The technology can also be used in mining areas to detect gas leakages, enhancing safety for workers, and reducing the risk of explosions. In commercial buildings, the smart gas regulator can help optimize gas consumption and reduce costs. The use of this technology is not limited to land-based operations, as it can also be used in transports such as airplanes to ensure the safe and efficient use of gas as a fuel source. The oil and gas industries can also benefit from the smart gas regulator, which can help monitor and control gas usage across production facilities, reducing the risk of accidents and improving efficiency. Ultimately, the Smart Gas Regulator Using GSM is a valuable tool for enhancing safety, efficiency, and cost-effectiveness in a range of industrial settings.

CONCLUSION

In conclusion, this gas leakage and fire detection system is designed to achieve multiple objectives, including real-time monitoring of gas levels, and displaying them on an LCD display, sending SMS alerts at different gas levels, detecting gas and fire leakages, and alerting users through a buzzer and LED indicator. Moreover, the system also has an effective mechanism to shut down the passage of gas in case of a fire leakage to prevent further damage. Other advantages of the system include easy user registration, effective gas leakage damage protection, easy SMS alerts on mobile devices about the remaining gas level in the cylinder, and a contactless shutting down mechanism to prevent injuries. Overall, this system provides a reliable and efficient solution for gas safety and monitoring, ensuring the safety of users and their surroundings.

FUTURE SCOPE

Gas leakage detection systems have a vast potential for continuous improvement and advancements in the future. There are various areas of development that can be explored, such as integrating with IoT devices, allowing users to monitor their homes or businesses from anywhere in the world and receive alerts when a gas leak occurs. By integrating AI algorithms, the system can automatically detect the source of the gas leak and take appropriate measures to mitigate the risk. The use of WSN technology can help detect gas leaks in remote areas and communicate this information to a central system or authorities for prompt action. Overall, with the help of new technologies, we can improve safety standards and prevent potential accidents.

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