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Gas Leakage Detection with Notification Alert and Auto Cut-off Valve

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Abstract: Good safety procedures must be put in place in places of employment and education since safety is important in today's environment. The safety model now in use in businesses and industries is modified by this work and can also be applied in residences and commercial buildings. Installing a gas detector in susceptible areas is single path to take preventative action against the risk of gas leaks. A gas detector, which is frequently a component of a safety system, is a gadget designed to identify the existence of gases within a given space. A gas detector that has the ability to alert nearby operators should be alerted to a potential leak so they can either address or evacuate the area. Numerous gases have the potential to be dangerous to organic life, including humans and animals, which makes this kind of equipment crucial. It is necessary to prevent containment into any region where gas shouldn't be present. Leaks are highly dangerous since even a tiny leak has the potential to gradually accumulate an explosive concentration of gas. Testing with a gas detector is the sole means by which users can identify gas leaks, today's gas detectors are less effective in their use. It is risky since gas leaks need to be detected as soon as possible. Because of this, the gas detector with notifies device was created to avoid explosions or fires from happening in buildings. As long as there is a power source, this type of gas detector will continuously detect gas. The Arduino UNO microcontroller was utilized in this project to interpret sensor input and transmit an SMS alert to a GSM module, allowing for user communication. Until the gas concentration reaches a harmful level, the buzzer will continue to ring. These projects have the advantage of preventing fires before they start, which can occur from cooking unsupervised without human monitoring or gas leak explosions.

Introduction: These days, gas leaks are a major issue that can be found in a diversity of settings, as well as homes, businesses, and automobiles such as buses, cars, and compressed natural gas (CNG). It has been observed that hazardous mishaps are caused by gas leaks. Liquefied petroleum gas, also known as propane, is a combustible blend of hydrocarbon gases that finds use as fuel in a diversity of settings, as well as homes, hostels, businesses, cars, and vehicles. Its valuable qualities comprise a high calorific value, minimal smoke and soot production, and minimal ecological impact. Because of its extreme inflammability, liquid petroleum gas (LPG) can catch fire even when it is some distance away from the leak. The main chemical components of this energy source are propane and butane, both of which are extremely combustible. These gasses are easily combusted. In recent years, there has been an increase in the number of fatalities brought on by gas cylinder explosions. One incident when a gas leak caused an accident is the Bhopal gas catastrophe. Such explosions are caused by worn-out regulators, outdated valves, and inadequate inspection of gas cylinders, inadequate cylinder quality, and insufficient knowledge in handling gas cylinders. Thus, in order to keep people safe, gas leaks need to be

found and fixed. LPG has an odorant added to it, like ethane thiol, to help most people find leaks quickly. That being said, certain individuals with diminished senses of smell might not be able to depend on this built-in safety precaution. A gas leak detector becomes essential and contributes to safety.

Literature Survey:

E. Jebamalar Leavline, D. Asir Antony Gnana Singh, B. et all... Has established a device for discovery of gas detection combined with the arrestment medium of gas force stopcock to evade any explosion due to it. The advanced device used transmitter and receiver connived with the microcontroller programming. The advanced arrangement has enforced and tested to conclude that the working of the system depends upon the attention of gas available in the system. Luay Fraiwan, Khaldon Lweesy, et all… has advanced a microcontroller model for detection of gas in unrestricted terrain using detectors. The test affect products the audio and video alarm to warn the mortal and sends a SMS to the stoner. The detector has outstanding perceptivity mutual with a quick retribution time. In susceptible locations, Ashish Shrivastava has created and built a system that can identify gas leaks and automatically shut them off. The device detected the concentration of gases like propane (C3H8) and butane (C4H10) using a highly sensitive sensor. An integrated GSM (Global System for Mobile Communication) module alerts the user via SMS. By applying a little quantity of smoke close to the sensor and seeing that the buzzer sounds noisily and the message appears on the display, the constructed system was tested and found to function satisfactorily. S. Sivajothi Kavitha, projected home gas detection system including of 3 main modules: the gas leakage and level recognition, and the receiver module. The gas recognition and transmission module monitors variations in the absorption of natural gas and LPG, and when such variations above a certain threshold, it triggers an audio-visual alert. Moreover, it sends the mobile device an additional alarm message. Once the cylinder is about to be vacant, the auto renewal system is alerted.

R. Naresh Naik, planned a system that makes whole cylinder booking deprived of human interference. The projected system weighs the cylinder uninterruptedly, and if it reaches a certain threshold, it immediately notifies the authorized LPG agent, enabling them to deliver the LPG cylinder on schedule. The Arduino Mega used to monitor any LPG gas leaks and warn the user to take caution to prevent mishaps. Author 1 projected system, that defines the detection and monitoring of the LPG gas is identified via MQ – 5 sensors. In the event that a gas leak is discovered, the alarm message will be shown on the LCD and the buzzer will sound. Additionally, it will notify the system or application owner when monitoring gas based on the cylinder mass, which is determined by the load sensor. Author 2 proposed system, uses the push bullet for the quick transfer of the data of the message using the Wi-Fi module which purposes when there is seepage of gas which is linked to the Arduino UNO. Author 3 projected system, the detector that is used to descry LPG gas is MQ – 6, for methane gas, the detector used is MQ – 4, and benzene gas is detected by the detector using MQ–135 independently. PPM will be the format in which the detector affair is handed. Also, ESP32 is employed for communication transferring and entering. Author 4 proposed system, the application is for the displaying of the gas where it sends the message. MCUs are used as sensors, with load sensors always keeping an eye on the cylinder. Ubidots will be used to display and check the weight if it is less. Author 5 anticipated system, where the LPG gas management is planned for the low cost. Along with detection and monitoring, the system also calculates the temperature and humidity concentration.

Block diagram:

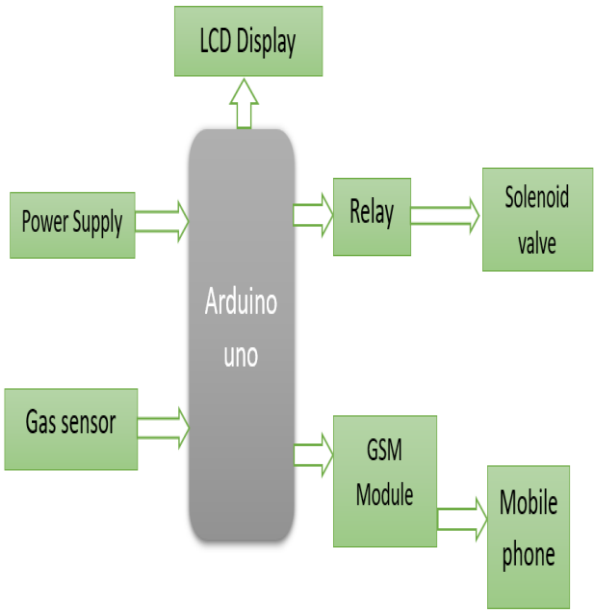

Fig1: Block diagram of gas leakage detector using GSM

Components required:

Gas leakage detection systems are crucial for ensuring safety in environments where the presence of gases like methane, propane, or other flammable gases poses a risk. The system you described utilizes various components to create a comprehensive gas leakage detection and alert mechanism.

Arduino Uno: The Arduino Uno assists as the central control unit of the scheme. It processes data from the gas sensor, manages the display on the LCD, and controls the relay and GSM module based on the detected gas levels.

MQ2 Gas Sensor: The MQ2 gas sensor is a crucial component for detecting various gases in the surrounding environment. It is sensitive to a range of gases and provides analog signals proportional to the gas concentration. In this system, it primarily focuses on detecting flammable gases.

GSM 800C Module: The GSM 800C module is integrated for remote communication. When the gas sensor detects a predefined threshold level, the Arduino activates the GSM module to send an alert message to a predefined phone number. This feature enables real-time notifications, allowing prompt action to be taken.

LCD I2C Display: An I2C-enabled LCD display is used for local monitoring. It provides a user-friendly interface to view real-time gas concentration levels. The I2C communication protocol simplifies the wiring and allows for efficient data transfer between the Arduino and the LCD display.

Relay: The relay is employed to control external devices based on the gas detection. In this system, it could be connected to a cutoff valve that controls the flow of smoke. If a dangerous level of gas is detected, the relay could be used to trigger the solenoid valve, shutting off the gas supply and preventing potential hazards.

LM317 Adjustable Regulator: The LM317 adjustable regulator is likely used to regulate the voltage supplied to the gas sensor and other components. It ensures a stable power supply, preventing voltage fluctuations that might affect sensor readings or the proper functioning of other electronic components.

Solenoid Valve: The solenoid valve, when triggered by the relay, shuts off the gas supply. This is a critical safety feature, as it helps prevent the release of additional gas into the environment in the event of a leakage, minimizing the risk of fire or explosion.

Working principle:

Gas Sensors: The core component of the system is the gas sensor, which can detect the presence of specific gases in the environment. Common gas sensors include MQ series sensors, which are sensitive to various gases such as methane, propane, and butane. These sensors operate on the principle of resistance change in the presence of target gases.

Microcontroller: A microcontroller, like Arduino or Raspberry Pi, acts as the brain of the system. The gas sensor is connected to the microcontroller,

which reads the analog or digital signal from the sensor. The microcontroller processes this information to determine the gas concentration in the environment.

Auto Cutoff Relay: To implement an auto cutoff mechanism, a relay is used. The relay is connected to the gas supply line and controlled by the microcontroller. When the gas concentration surpasses a predefined threshold, the microcontroller triggers the relay to cut off the gas supply, preventing further leakage.

GSM Module: For remote communication and notification alerts, a GSM (Global System for Mobile Communications) module is employed. This module enables the system to send SMS alerts to designated phone numbers in the event of a gas leak. The microcontroller communicates with the GSM module, providing it with the necessary information to send alerts.

Working Steps: Gas Sensing: The gas sensor continuously monitors the air for the presence of gases. It generates a signal proportional to the gas concentration, indicating whether it's within safe limits. Microcontroller Processing: The microcontroller reads the sensor's signal and processes the data. It compares the gas concentration with predefined safety thresholds.

Threshold Check: If the gas concentration exceeds the safe limit, the system proceeds to the next steps.

Auto Cutoff Activation: The microcontroller triggers the relay to cut off the gas supply. This immediate action helps prevent further gas leakage and mitigate potential risks.

SMS Alert Generation: Simultaneously, the microcontroller activates the GSM module to send SMS alerts. The message typically includes details about the gas leak and the current gas concentration.

Alert Transmission: The GSM module communicates with the mobile network to transmit the SMS alerts.

Users receive real-time notifications about the gas leak on their registered mobile numbers.

User Response: Upon receiving the alert, users can take appropriate action, such as evacuating the premises or contacting emergency services.

Results and discussion:

The gas sensor, ever vigilant, constantly measures the surrounding air for the target gas molecules.

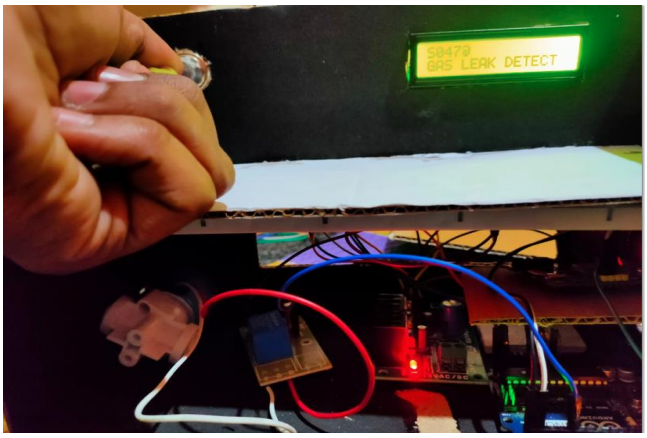

Fig2: Display Notification

If the sensor detects a concentration exceeding the safe threshold, it triggers an alarm signal to the Arduino. The Arduino, upon receiving the alarm, quickly activates the relay. The relay, in turn, energizes the solenoid valve, causing it to close and effectively block the gas flow simultaneously, the Arduino leverages the GSM module to send an SMS alert to preprogrammed mobile numbers, informing them of the potential danger.

Fig3: Message on mobile display using GSM

The LCD display, acting as a silent alarm, illuminates with a warning message or elevated gas level reading, further reinforcing the situation's urgency. This gas leak detection system, with its intelligent combination of sensors, actuators, and communication modules, offers a valuable tool for enhancing safety and ensuring peace of mind. While limitations exist, the potential benefits far outweigh them, making it a worthwhile investment for protecting yourself and your loved ones from the dangers of gas leaks.

Future Work:

Looking ahead, there are several avenues for future work to enhance and expand upon our gas leakage detection system. Firstly, exploring additional sensor technologies to improve detection accuracy is crucial. Incorporating machine learning algorithms can further refine the system's ability to distinguish between false alarms and actual gas leaks. Additionally, enhancing the connectivity of the notification alert system to include mobile applications or cloud-based platforms would provide users with more flexibility and control. Furthermore, conducting long-term field tests in various environmental conditions can help validate the system's robustness and adaptability.

Conclusion:

In conclusion, although there are numerous gas sensors that are improved than our design in means of technology but they're constantly used in plant or oil painting and gas point. Linked to our design, it's precise to use at any place. From former exploration, there is an absence of any installed safety device at house, and given the numerous instances of houses succumbing to fire hazards over time, it is imperative to proactively prevent the initial stages leading to a fire outbreak.

References:

1. E. Jebamalar Leavline, D. Asir Antony Gnana Singh, B. Abinaya and H. Deepika, “LPG Gas Leakage Detection and Alert System” International Journal of Electronics Engineering Research, vol. 9, no. 7, pp. 1095-1097, 2017.
2. Fabien Chraim, Yusuf Bugra Erol, Kris Pister, “Wireless Gas Leak Detection and Localization” IEEE Transactions on Industrial Informatics, vol. 12, pp. 768-779, April 2016.
3. Luay Fraiwan, Khaldon Lweesy, Aya Bani-Salma, Nour Mani, “A wireless home safety gas leakage detection system”, 1st Middle East Conference on Biomedical Engineering, pp. 11-14, 2011.
4. Ganesh D, Anilet Bala.A, “Improvement on Gas Leakage Detection and Location System Based On Wireless Sensor Network”, International Journal of Engineering Development and Research, vol. 3, pp. 407-411, 2015.
5. T. Arpitha, Divya Kiran, V. S. N. Sitaram Gupta, Punithavathi Duraiswamy, "FPGA-GSM based gas leakage detection system", 2016 IEEE Annual India Conference (INDICON), pp. 1-4, 2016.
6. Arijit Banik, Bodhayan Aich, Suman Ghosh, “Microcontroller based low cost gas leakage detector with SMS alert”, 2018 Emerging Trends in Electronic Devices and Computational Techniques (EDCT), pp. 1-3, 2018.
7. Chen Yueping, Gan Fangcheng, Zhang Yongxian, “Design and Realization of Fire Alarm System Based on CAN Bus”, 2007 8th International Conference on Electronic Measurement and Instruments, pp. 1-832 - 1-836, 2007.
8. Haibing Hu, Gang Wang, Qixing Zhang, Jinjun Wang, Jun Fang, Yongming Zhang, “Design wireless multi-sensor fire detection and alarm system based on ARM”, 2009 9th International Conference on Electronic Measurement & Instruments, pp. 3-285 - 3-288, 2009.
9. Huide Liu, Suwei Li, Lili Gao, Tao Wu, “About automatic fire alarm systems research”, 2010 2nd IEEE International Conference on Information Management and Engineering, pp. 419 – 421, 2010.
10. Chun-yuan Lian, “Design of intelligent fire alarm system based on GSM network”, Proceedings of 2011 International Conference on Electronics and Optoelectronics, vol. 1, pp. V1-393 - V1-396, 2011.