JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Automatically Gas Leakage Detection System by using SMART BOX

Akash Kumar Agrahari
Electronics and Communication Engineering
United College of Engineering and Research
Naini, Prayagraj
akashagrahariritik@gmail.com

Srishti Kesarwani
Electronics and Communication Engineering
United College of Engineering and Research
Naini, Prayagraj
kesarwanidiksha73@gmail.com

Harshita Jaiswal
Electronics and Communication Engineering
United College of Engineering and Research
Naini, Prayagraj
harshitajais19@gmail.com

Ravindra Singh (Assistant Professor)
Electronics and Communication Engineering
United College of Engineering and Research
Naini, Prayagraj
rsinghecs@gmail.com

***Abstract*—In the realm of today's advancing technologies, automation and intelligence are on the rise. We have implemented a system capable of autonomously detecting chemical leaks, fire sources, and gas leaks. Over recent years, there has been a notable increase in fire incidents within various industries, chemical plants, and hazardous goods storage ports in India. These accidents often involve the dispersion of hazardous and toxic gases, posing significant challenges for firefighting and rescue operations. Consequently, firefighter fatalities occur frequently. This monitoring system, designed for the detection of poisonous and harmful gases, is specifically tailored for use in firefighting and rescue sites operated by fire forces. It establishes a transmission network, deploys monitoring terminals, and utilizes data processing software to ensure the safety of firefighters in such locations.**

Keywords—fully automated, cloud storage, GSM, GPS, exhaust fans.

I. INTRODUCTION

In recent times, there has been a troubling increase in domestic hazards caused by highly flammable gas leaks, leading to subsequent fire accidents. These life-threatening incidents are becoming more frequent, primarily due to the lack of adequate advance warning systems. Our main goal is to develop an alarm system that is both affordable and energy-efficient, providing residents with comprehensive security alerts in case of a gas leak and indicating the concentration levels of the gases. Additionally, the system evaluates the level of danger and takes appropriate measures to prevent fires through a relay mechanism activated via wireless communication. In today's world, safety is of utmost importance when planning and constructing homes, palaces, industries, and cities. Unfortunately, a significant number of individuals still lose their lives each year due to gas cylinder explosions or fires in residential settings, industrial facilities, or other locations. Furthermore, the increase in temperature poses significant risks to both human well-being and the environment. These tragic accidents are often attributed to many gas users lacking proficiency in handling gas safely. Currently, this issue has become a prominent concern across various sectors, including technical, economic, and agricultural. Every project faces constraints, such as budget, space, and time limitations. From this perspective, our project offers several advantages:

- It serves as a practical and cost-efficient real-world solution.
- It provides precise information.
- It utilizes a less complex circuit design.
- It has no adverse environmental impact and is unaffected by physical conditions.

In summary, our project tackles the urgent issue of gas leaks and fire hazards by providing an affordable, energy-efficient, and comprehensive warning system, thus emphasizing safety in various settings.

II. LITERATURE REVIEW

Authors of [1] suggested that their goal was to develop a gas monitoring system along with an automated cylinder booking system for residential purposes. They utilized the MQ-4 gas sensor to identify any gas leaks, sending the data to an LCD monitor for display, triggering a buzzer for alerts, and transmitting the information to the appropriate authorities through a GSM module. Furthermore, they integrated a load cell to enable the automatic booking of gas cylinders.The Authors of [3] have proposed that this article outlines the creation of a straightforward electronic apparatus which evolved into a high-pressure gas meter. It employs a high sensitivity, high-temperature sensor designed for propane and butane. The primary system comprises a GSM module along with components such as Arduino, MQ6 gas sensor, LCD, and

stepper motor to transmit SMS alerts upon gas detection. The research endeavors to narrow the divide between electronic devices and sophisticated gas meters while enhancing safety in cases of LPG leaks. The authors of [2] propose that this paper offers a glimpse into job monitoring design utilizing the Internet of Effects (IoE). It entails the utilization of gas detectors (MQ-5) to gather data and transmit it to the data hub. This gas detector has the capability to detect gas pollution even in varying atmospheric conditions. The entire system is overseen by Arduino (UNO-1), serving as the central controller. Upon detecting gas, the detector will activate an alarm through a buzzer and showcase the alarm location on the TV screen. The Authors of [5] introduced a novel approach in this paper, outlining a fresh method for detecting LPG utilizing an Arduino-based system. The system is engineered to forestall adverse incidents by issuing an LPG alarm through the integration of an MQ-6 LPG sensor and an Arduino-based processing mechanism. It categorizes water flow into low, medium, and high groups, presenting this data in numerical format alongside fuel rate and temperature. This study carries significant implications for enhancing household safety. The Authors of [4] have highlighted the significant threat posed by LPG leaks in both modern homes and manufacturing facilities, emphasizing the potential life-threatening consequences if not promptly detected and addressed. Our design aims to tackle this critical issue head-on. Our systems are engineered to immediately shut off gas flow upon detection and trigger alarms to alert neighbors. Furthermore, immediate notifications regarding gas leaks are sent to authorized personnel, ensuring swift response and accountability. By integrating these elements, our program is tailored to enhance safety by swiftly mitigating the risks associated with LPG leaks, thereby safeguarding lives and preventing damage to structures and equipment. Our solution addresses the pressing issue of LPG leakage in residential and commercial settings, providing an automated response that shuts off gas, activates alarms for immediate awareness, and alerts authorized personnel for rapid intervention.

III. BACKGROUND AND RESEARCH METHODOLOGY

A. Block Diagram:

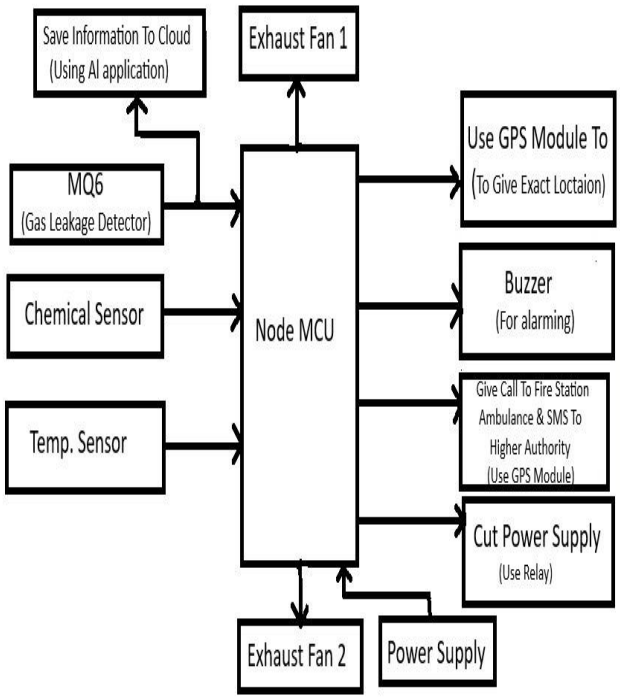

Fig. 1. Overall working diagram of the proposed system.

B. Logic Diagram:

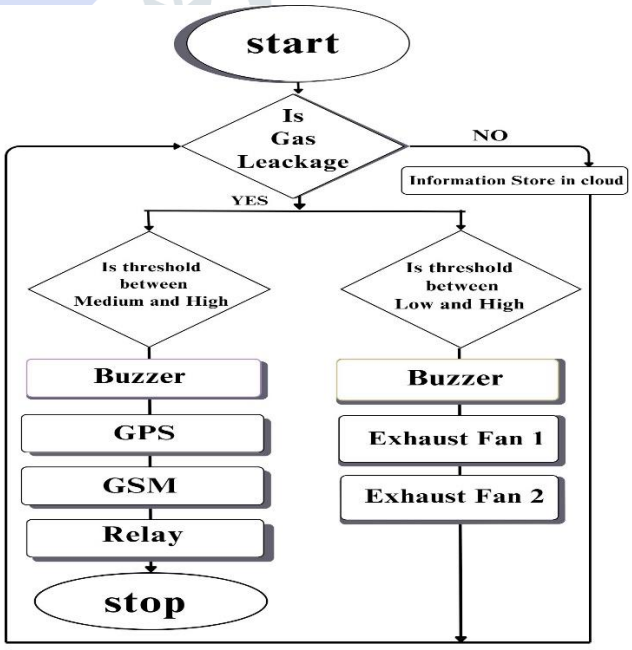

Fig. 2 shows a flowchart of the proposed system.

IV. REQUIRED HARDWARE

A. MQ-2 Gas Sensor :

MQ2 Gas sensor is a Metal Oxide Semiconductor (MOS) type Gas Sensor. Mainly used to detect the LPG and Butane gas concentration in the air either at home or in

industry. This sensor contains a sensing element, mainly aluminum-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh.

Fig. 3. MQ-2 Gas sensor

B. *Node MCU :*

The full form of Node MCU is Node Micro Controller Unit. Node MCU is a mini microcontroller. It has 30 pins containing TXD, RXD with wi-fi chips. It has one analog pin and nine digital pins. It works at 3.3-5 volt. It has a USB port used as input. It is an open-source IoT platform.

Fig. 4. NODE MCU

C. *GSM (SIM900A) :*

GSM module is a communication device between a computer and a GSM modem. GSM module is a wireless module, designed for mobile communication over the GSM network. This module requires a SIM card to enable connection to the system. Its highest supply voltage is 4.5 volt, and the lowest supply voltage is 3.4 volt and is programmed by AT commands.

Fig. 5. GSM Module

D. *DHT11*

The DHT11 senses, measures, and reports both moisture and air temperature. Using a capacitive humidity sensing element and a thermistor, the sensor can determine the humidity and temperature values. The humidity range is from 20 to 80% with 5% accuracy, and the temperature range is from 0 to 500C with a 2-degree accuracy.

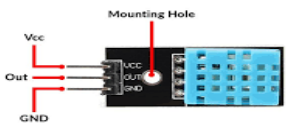

Fig. 6. DHT 11 Temperature Sensor

E. *Buzzer:*

A buzzer is an audio signaling device. It can be mechanical, electromechanical, electronic, etc. A buzzer speaker is basically a tiny speaker that can connect directly to a microcontroller. By applying an electric signal at the right frequency, it can make a sound.

Fig. 7. Buzzer

V. PROPOSED WORK

In an age characterized by technological advancement and uninterrupted operation, the need for robust and intelligent systems to address critical security concerns remains paramount. Among these challenges lies the identification and mitigation of pollution hazards that pose threats to human life, property, and the environment. This underscores the significance of our latest innovation, the "SMART BOX," which leverages the capabilities of Node MCU, GPS, GSM, and Cloud Storage.

The SMART BOX efficiently detects gas leaks with precise accuracy, enabling real-time monitoring and immediate alarm notification via telephone communication. This ensures prompt intervention and risk mitigation. Through the integration of hardware and artificial intelligence technologies, our initiative aims to enhance security protocols, reduce response times, and provide comprehensive solutions to gas-related issues in diverse commercial and residential environments.

VI. WORKING

The plan includes gas and chemical detectors, microcontrollers, IOT modules, alarm systems and cloud storage algorithms. The MCU microcontroller needs a power supply in the range of 7-12 volts; This can be designed using many things such as step-down transformers, rectifiers, filters and voltage regulators; all of these are now available as simple eight adapters.

The main platform we chose to build this project is Node MCU, which offers us an easy way to write good and simple code. It is also suitable for beginners as it has good features such as cost-effectiveness, cross-platform compatibility, simple and understandable operating environment, open source and plug-in software, and user-friendliness. Node MCU is a microcontroller

You can easily operate it by connecting it to your computer with a USB cable or by connecting it with an AC-DC adapter or battery. Considering these features, it has become a good choice for the design of our project. Signal conditioning of Node MCU is done by taking the signal from the sensor and using it as input to the microcontroller. The test results are then displayed on the LCD screen. This can be used to warn people in dangerous places such as a workplace, factory or home. Additionally, a buzzer will sound to warn people of danger.

Additionally, the system sends an SMS notification to the factory manager whose number is registered on the SIM card

of the GSM modem. The content of the readings taken depends on the amount of gas leakage in the area monitored by the sensor. Integration of GPS technology can accurately identify and indicate the location of gas leaks in a business or residence.
All of this information is stored to the cloud for the estimate data of the leakage and for further protection.

VII. PROTOTYPE

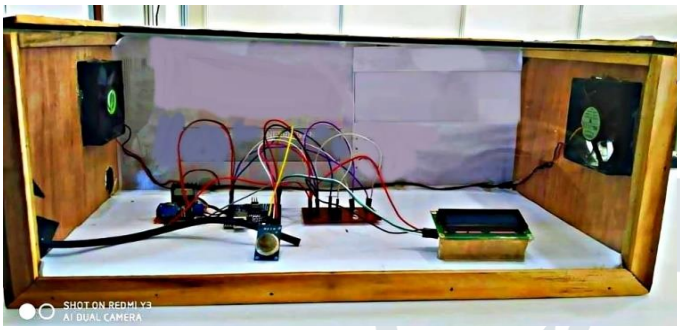

Fig. 8. Prototype.

VIII. FUTUER SCOPE

In the project's future development, there are plans to integrate cloud-based data analysis to enhance the system's service and accuracy. Additionally, there is consideration for creating a robot capable of detecting both gas and electricity, which could be utilized to identify gas leaks in pipelines.

IX. CONCLUSION

This paper outlines the development and deployment of a gas leakage detection system. Various studies on gas leakage detection systems were examined and summarized. It was observed that some existing research neglects to consider cost-effectiveness for implementing gas leakage detection in individual/domestic settings and is not easily adaptable. This research has made progress by incorporating an embedded system to notify users via multiple mobile phones when a leak is detected. The system utilizes a highly sensitive MQ-2 gas sensor to trigger a buzzer alerting people of the leak, and it also sends an SMS stating "Gas Leakage Detected" from the SIM800 GSM Module as a backup to inform the appropriate authority or facility owner. This design has the potential to be adopted, funded, and implemented due to its ability to significantly reduce accidents associated with LPG leakage

X. REFERENCES

[1] Shruti Bhoir1, Snehanjali Goregaonkar2, Prof. Shilpa Satre“ IoT Based Gas Detection System” International Journal of Engineering Science and Computing, April 2017. Volume 7 Issue No.4

[2] Online Monitoring of Green House Gas Leakage in Industries Angel College of Engineering and Technology, Tirupur, Tamil

[3] Michael Barr. "Embedded Systems Glossary". Neutrino Technical Library. Retrieved 2007-04-21. 2. Heath, Steve (2003). Embedded systems design. EDN series for design engineers (2 Ed.). Newness.p.

[4] W. Yi, W. Ke-Jia, W. Qi and T. Feng, "Measurement of CH4 by differential infra-red optical absorption spectroscopy," 2009 9th International Conference on Electronic Measurement & Instruments, Beijing, 2009, pp. 1–761–1– 766

[5] D. S. Simbeye, "Gas Leakage Detection System (GLDS)," Tanzania Journal of Engineering and Technology, vol. 34, 2017.

[6] https://en.wikipedia.org/wiki

[7] https://hai.stanford.edu/sites/default/files/2020-09/AI

[8] Zhang, X. (2006). Statistical Leak Detection in Gas and Pipelines. pipes and pipelines international, vol 68 .no 4, 20-30
ss

[9] Tarun Joseph, Kirti Tyagi, Dr. Y.S.Rao “Portable gas Detection Device With Warning System “in 2019 Global Conference for advancement in Technology(GCAT) Volume 6, Issue 3, May-June-2020, ISSN (Online): 2395-566X.

[10] M. Santiputri and M. Tio, loT-based Gas Leak Detection Device, 2018 International Conference on Applied Engineering (ICAE), Batam, Indonesia, 2018, pp. 1-4, doi: 10.1109/INCAE.2018.8579396