IOT-BASED INTELLIGENT GAS LEAKAGE DETECTOR WITH SMART ALERT SYSTEM

[1]Mr.M.VENKATESAN, [2]S ARUN KUMAR S, [3]K M ARISH KM, [4]S KAVIN RAAJ , [5]S KIRANKUMAR
[1]Professor, [2]UG scholars, Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering (AUTONOMOUS), Hosur

ABSTRACT

The presence of a natural gas leak within a household carries the potential for fires and poses a risk of natural gas poisoning. Similar to how we approach other hazardous energy sources such as electricity and gasoline, it is crucial to exercise caution when dealing with natural gas exposure. To prevent potential hazards and dangerous situation, identified a smart gas detection system for rapid and accurate detection of gas leaks. The proposed gas leakage detection system combines advanced sensor technology, real-time monitoring, and automated alert mechanisms to ensure timely identification and response to gas leaks.The MQ2 sensor helps in detection of gas leakage. The MQ2 sensor possesses the capability to detect a wide range of gases, including methane, propane, carbon monoxide, and hydrogen. This versatility makes it an invaluable tool in ensuring safety and protecting against potential hazards and early identification of gas leaks. The collected data is analyzed using sophisticated algorithms to distinguish between normal background gas levels and potential leaks. NodeMCU, equipped with its Wi-Fi capabilities, functions as the central control unit of the system. The NodeMCU gathers real-time data from the gas sensors, constantly monitoring gas levels. It processes this data and sends it to the cloud or a central server using its internet connection.The system's ability to monitor in real-time ensures that any gas leaks detected are quickly reported to the relevant personnel or authorities through automated alerts. The fast notification system allows for quick actions, reducing the risks of accidents, saving lives, preventing property damage, and mitigating harm to the environment.

Keywords: CNG/LPG, Gas Sensor, Exhaust Fan, Stepper Motor

I INTRODUCTION

The usage of LPG gas has become vast in today's world LPG is used for various purpose in home, in industries and in other commercial areas. LPG is inflammable mixture of hydrocarbon gases like propane and butane. The loss of this gas can be dangerous and these gases have to be monitored. It is odourless gas due to which Ethanol is added as powerful odorant, so that leakage can be easily detected. Gas leakages are one of the major reasons behind fire accidents. The system automatically detects gas leakages. The system efficiently avoids the chances of any fires accidents which could have been caused due to gas leakage. We use ARM cortex along with gas sensor to detect CNG/LPG gas presence along with 2 fans, buzzing alert and display based circuitry interfaced to Arm cortex to develop this accident avoider system. The ARM Microcontroller have less number of transistors and these are cost sensitive and high performance devices and these are cost sensitive and high performance devices. The ARM Microcontroller have less number of transistors and these are cost sensitive and high performance devices. One of the most advanced form of these microcontrollers is a cortex controller, it is mostly used in wireless communication technologies and other embedded system due to benefits such as low power consumption, etc. ARM Cortex is enhanced for low cost an energy efficient Microcontroller. It is a high performance 32-bit processor which offers significant benefits to the developers. The ARM Microcontroller runs at 100 MHz frequency and high performance therefore it supports the high level languages

II LITERATURE REVIEW

Automatic LPG detection and hazard controlling (2014) P. Meenakshi Vidya, S. Abinaya, G. Geetha Rajeswari, N. Guna presented This study designs an air purification system with gas sensors and an ARM Cortex-M microcontroller for real- time air quality management. Smart Gas Cylinder Using Embedded System (2014) K. Padmapriya, Surekha, Preethi introduced this paper reviews embedded systems for gas leak detection, evaluating various technologies, including ARM Cortex solutions, and their impact on performance. LPG leakage monitoring and multilevel alerting system (2013) C.Selvapriya, S. Sathyaprabha, M. Abdul Rahim introduced this paper presents a smart gas leak detection system with automatic air exhaust, using ARM Cortex microcontrollers to enhance leak detection and air management.

III EXISTING SYSTEM

Gas detection systems range from basic manual setups to advanced automated and smart solutions. Traditional systems rely on gas sensors to detect leaks and require manual intervention to shut off gas supplies, often accompanied by alarms. In contrast, automated systems enhance safety by integrating automatic shutoff valves and ventilation fans that respond immediately to gas detections, reducing the need for human action. Smart systems further improve safety by incorporating IoT-enabled sensors and cloud-based monitoring, allowing for remote oversight, real-time alerts, and detailed data analysis. Industrial systems, designed for high-risk environments, offer high sensitivity and comprehensive safety measures to meet stringent standards. Smart gas detection systems represent the next frontier in this technology, leveraging the power of the Internet of Things (IoT) to provide real-time monitoring, remote
alerts, and advanced data analytics.

These systems use cloud-based platforms to enable operators to oversee gas levels and system performance remotely, ensuring continuous surveillance regardless of location. Smart sensors can also generate detailed usage data, which can be analysed for predictive maintenance, helping prevent issues before they arise and enhancing the system's efficiency over time. By offering real-time alerts via mobile apps or control systems, smart systems ensure that operators are always informed of potential hazards, even in remote or complex environments. In high-risk industrial sectors—such as chemical manufacturing, oil and gas, and mining—gas detection systems are designed to meet stringent safety standards and offer a high degree of sensitivity to detect a broad spectrum of hazardous gases at even trace concentrations. These systems often integrate with other safety measures, such as emergency shutdown procedures, automatic ventilation, and advanced alarm systems, to provide a comprehensive safety solution. With the ability to meet rigorous regulatory requirements and operate in challenging conditions, industrial gas detection systems are critical in preventing accidents, protecting human health, and safeguarding equipment.

IV DISADVANTAGES

Design and implementation require specialized expertise in embedded systems and integration, increasing development time. While ARM Cortex is efficient, the overall system (sensors, actuators) may still require significant power, posing challenges in energy-limited environments. Higher initial and maintenance costs due to advanced sensors, actuators, and microcontroller-based systems.

V BLOCK DIAGRAM

The system you described can be explained through a block diagram with the flow of components and the interactions between them. Below is a detailed explanation of the block diagram based on your description**,** Power Supply (DC Adapter): The system is powered by a DC adapter that provides a certain voltage (typically 12V or 9V) to the circuit. The adapter is connected to a Voltage Regulator that converts the higher voltage to a stable 5V DC, which is needed for the operation of the components. Voltage Regulator (5V) The Voltage Regulator ensures that the system receives a steady 5V power supply. This 5V is split into two lines: One 5V line powers the STM ARM Cortex-M3 Microcontroller. Another 5V line powers the Gas Sensor Module, LCD Display, Buzzer, Servo Motor, and the Fans. STM ARM Cortex-M3 Microcontroller: The STM ARM Cortex-M3 Microcontroller acts as the central processing unit of the system. It receives input from the Gas Sensor Module to detect the presence of gas. Based on the gas detection input, it processes the data and sends signals to other components like the Buzzer, Servo Motor, Fans, and LCD Display. Gas Sensor Module: The Gas Sensor Module continuously monitors the surrounding air for the presence of gases like LPG or CNG. Upon detecting a gas leak, it sends a signal to the ARM Cortex-M3 to trigger an action. The gas sensor is responsible for providing real-time data, which is critical for the system to function efficiently. LCD Display: The LCD Display is connected to the microcontroller and shows system status, such as warnings for gas leakage, and any actions being taken (e.g., "Gas Leak Detected", "Turning Off Gas Supply"). This helps users visualize real-time data and system alerts.

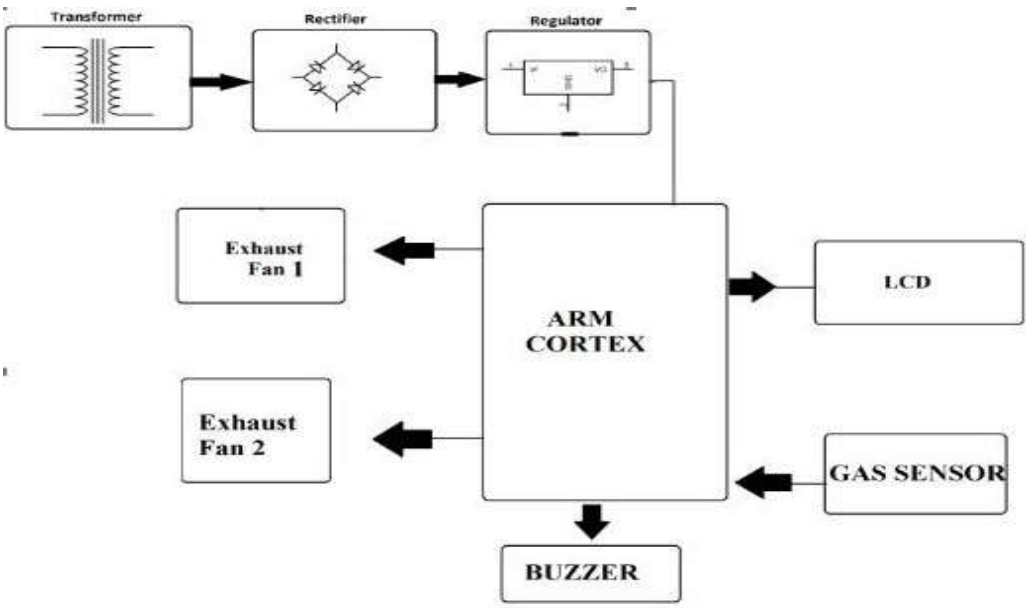


Fig.1: Basic Block Diagram of Work-Flow

VI PROPOSED METHODOLOGY

The Automated Gas Detection and Accident-Avoidance System represents a sophisticated and highly effective safety solution designed to mitigate the risks associated with gas leaks in environments utilizing CNG and LPG. By leveraging state- of-the-art gas detection sensors, intelligent fan-driven ventilation, and automated control through a high-performance ARM Cortex

microcontroller, the system ensures rapid and reliable identification of gas leaks, triggering immediate safety protocols. The system's ability to autonomously manage gas leak responses such as activating exhaust and intake fans, shutting off the gas supply, and issuing real-time alerts eliminates human delay and reduces the risk of catastrophic events such as fires, explosions, or toxic exposure.

Moreover, its scalable architecture allows for seamless integration into both industrial facilities and residential applications, offering flexibility in deployment. The system's real-time monitoring capabilities, coupled with multichannel alert notifications, ensure that relevant stakeholders are promptly informed, enabling timely intervention. By automating critical safety actions and providing continuous monitoring, this system not only enhances operational efficiency but also establishes a new standard in proactive gas safety management, significantly improving the protection of personnel, assets, and property.

VII ADVANTAGES

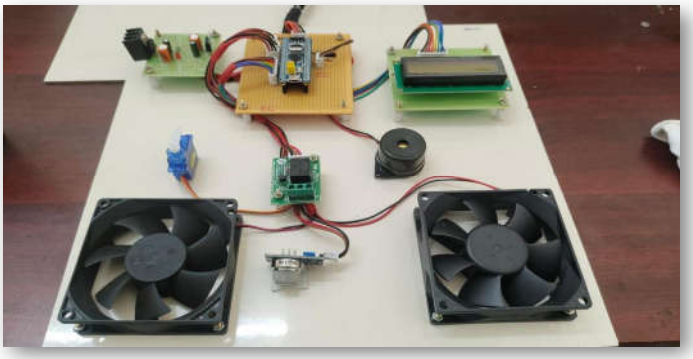
The system instantly detects CNG/LPG leaks using sensitive gas sensors, triggering rapid safety responses. Dual-fan system expels hazardous gases and introduces fresh air to ensure safe ventilation without manual intervention. Efficient, real-time processing and control of gas sensors, fans, and shutoff mechanisms for quick and reliable responses. Automatically halts gas flow to prevent further leakage, minimizing the risk of fire or explosion. Provides real-time alerts to operators and safety personnel, with the option for remote monitoring for enhanced oversight.

VIII APPLICATION

Industrial Facilities: Ensures safety in factories, refineries, and warehouses using CNG/LPG for equipment or heating. Commercial Buildings: Protects kitchens, restaurants, and hotels from gas leaks in cooking or heating systems.

Residential Homes: Provides gas leak detection and ventilation in homes using LPG/CNG for cooking or heating. Transportation: Applied in CNG/LPG-powered vehicles and fleets for real-time leak detection and safety.

IX RESULT AND CONCLUSION



In conclusion, our proposed automated gas detection and accident- avoidance system offers a comprehensive solution to mitigate the risks associated with gas leakages, which are a major cause of fires and explosions. By automatically detecting gas leaks, the system activates exhaust fans to expel hazardous gas and introduce fresh air, while simultaneously sending an alert to shut off the gas supply. Utilizing an ARM Cortex microcontroller, gas sensors, and fan mechanisms, along with alert and display circuitry, the system effectively enhances safety and reduces the

potential for accidents caused by gas leaks.

X FUTURE SCOPE

The future scope of the Gas Leak Detector with Automatic Air Exhaust Using ARM Cortex includes integration with IoT for remote monitoring, real-time alerts, and predictive maintenance. Advances in sensor technology will enable multi-gas detection and improved sensitivity, while AI and machine learning can optimize responses based on environmental conditions and predict potential leaks. The system could be integrated with smart home ecosystems and building automation systems, enhancing automated safety actions. Additionally, it can expand to detect other gases, such as hydrogen and propane, and be adapted for a wider range of industries, including transportation and agriculture, improving overall safety and efficiency across diverse applications

XI REFERENCES

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