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DESIGN THINKING APPROACH AND IMPLEMENTATION OF IOT BASED GAS DETECTION SYSTEM

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Abstract
An Internet of Things-based Smart Liquefied Petroleum Gas Leakage Detector system using the ESP8266 Node MCU Module is created and evaluated in this study. The system monitors and regulates gas levels using a MQ-6 sensor, an IR flame sensor, a solenoid valve, a buzzer, and the blank application. The sensor response of the device at various distances was tested using experimental techniques. A 7 cm maximum detectable distance was discovered. The average gas values were determined to be 5467 PPM, 1052.6 PPM, 798 PPM, 557.4 PPM, 489 PPM, 387.2 PPM, 231.4 PPM, 152.4 PPM, 141.8 PPM, and 121.6 PPM at 1 cm, 2 cm, and 10 cm, respectively. The outcomes demonstrated that the system is successful in controlling and monitoring gas levels. To enable real-time detection and monitoring of hazardous gases, these systems include gas sensors, IoT connectivity, a centralised monitoring system, and user interfaces. These systems offer continuous monitoring, quick reaction to gas leaks, improved data analysis, and increased operational efficiency by utilising modern analytics and remote accessibility. In general, IoT-based gas detection systems are essential for assuring safety, preventing mishaps, and safeguarding people and property in a variety of contexts.

Keywords:
Bread board; Gas sensor; Node MCU

1.Introduction

Safety at industrial locations where CNG and LPG are used should always come first. Gas leakage has historically been a significant issue for the industrial sector, residential regions and gas-powered vehicles like CNG (Compressed Natural Gas) buses, autos, etc. Security refers to the degree of defence against threats and losses. In order to ensure that there is enough time to prevent many potential threats, the assistance of this technology is required to deliver an early warning notice. Every time and anywhere flammable gas is utilised, there is a risk of leaking, endangering life and property. Therefore, creating a low-cost gas leakage detector over the course of a few years aids in reducing this risk. Leaks of flammable gases (LPG or methane) in residences and companies (mostly oil and gas) have been the cause of several accidents. With the aid of the application connected to the Node MCU, the people have been made aware of the GAS leakage. In order to alert users of a gas leak, we are connecting the Node MCU to the BLYNK application in this instance. IoT-based gas detection systems provide real-time monitoring and detection of hazardous gases using networked sensors, IoT networking infrastructure, a central monitoring system, and user interfaces. These systems provide continuous monitoring, quick reaction to gas leaks, improved data analysis, and increased operational efficiency by utilising modern analytics and remote accessibility. In general, IoT-based gas detection systems are essential for assuring safety, preventing mishaps, and safeguarding people and property in a variety of environments.

2. Background of the Study

IoT-based LPG Gas Monitoring System by The various IoT-based LPG gas monitoring systems that have been suggested in the literature are surveyed in this research. The writers go over the various sensor and connectivity technologies as well as data analytics methods employed in these systems. Reddy, S.S.R. (2022). MQ-2 Sensor Based Gas Leakage Monitoring and Alerting System by An IoT-based gas leak monitoring and alerting system is presented in this study. The system makes use of a GSM module, a MQ-2 gas sensor, and an Arduino microcontroller. Real-time gas leak detection is possible, and an SMS alarm can be delivered to the user's phone. Reddy, S.S.S. (2021). IoT-based hazardous gas leakage detection and controlling system by IoT-based hazardous gas leakage detection and controlling system using microcontroller and GSM module. A gas sensor, a GSM module, and an Arduino microcontroller are all used in the system. Real-time gas leak detection is possible, and a notification can be sent by SMS to the user's phone. N.E. Mastorakis, A. Mahalingam, and R.T. Naayagi. (2021)

3. Technologies Used

3.1 C

A general-purpose programming language for computers is called C. Dennis Ritchie invented it in the 1970s, and it is still quite popular and influential. The capabilities of the targeted CPUs are clearly reflected in C's features by design.

3.2 C++

High-performance apps can be made using the cross-platform language C++. Bjarne Stroustrup created C++ as an addition to the C language. Programmers have extensive control over memory and system resources thanks to C++.

4. Hardware Used

4.1 Node MCU

An open-source electronics platform called Node MCU is built around the ESP8266 system-on-a-chip (SoC). It is a popular option for Internet of Things projects since it combines Wi-Fi capabilities with a microcontroller. A simple-to-use programming platform for creating IoT applications is offered by the Node MCU board.

Fig.1: NODE-MCU

4.2. Gas Sensor (MQ-6)

Detecting and measuring the concentration of particular gases in the immediate environment is the function of a gas sensor. Gas sensors are essential for a number of applications, such as industrial safety, environmental monitoring, and gas leak detection in private residences.

Fig. 2: Gas sensor

4.3 Bread Board

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Breadboard and Jumper Wires: The Arduino Uno, light sensor, and LED/light control module must all be connected using a breadboard and jumper wires. They offer the circuit with the required electrical connectors.

Power source: The Arduino Uno can be powered by an external power source or a USB connection. Make that the Arduino board and any connected components have a proper power source.

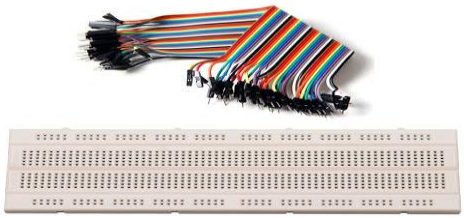

Fig. 3: Bread board

5. The Working of the System

Gas sensors are placed in the region to be monitored in a strategic manner. These sensors can pick up on a wide range of gases, including poisonous and flammable ones.

Data Gathering: The gas sensors continuously track the environment and gather data on gas concentrations in real-time. The sensors turn the gases' amounts into electrical impulses after measuring them.

Wireless Transmission: Using a communication module, the gathered data is wirelessly communicated from the gas sensors to a central processing unit (CPU). This module makes data transmission easy and makes sure the sensor network is connected.

Alert Generation and Notification: The CPU generates alerts when it notices unusual gas concentrations that could be a sign of a gas leak. These warnings may be transmitted to designated individuals or building management systems, or they may take the form of audio alarms, visual cues, or notifications.

Remote Control and Monitoring: The IoT-based solution supports remote control and monitoring. Through mobile applications or web interfaces, users can get real-time data on gas concentrations and get notifications. This remote accessibility improves security and makes it possible to respond quickly, even from a distance, to gas leaks.

6. Conclusion

In this study, a design for a sensor-based automatic gas leakage detector with a control and alarm system has been put forth. This gas detector is a low-cost, low-power, lightweight, portable, safe, user-friendly, effective, multi-featured, and straightforward solution. Not only will gas leak detection be important for our health, but it will also help our economy grow because gas leaks not only contaminate the atmosphere but also waste gases, which is bad for business. The proposed method will only cost USD 10, which even the poorest individuals may afford. It is apparent from the accessible literature that not enough has been done to develop a smart gas detection system. Future upgrades will include more sophisticated features that will provide customers additional security and comfort. The development of smart gas sensors has greatly expanded the range of applications for them as a result of the widespread use of mobile devices. Over the next few years, the market is anticipated to be primarily driven by the requirement to ensure worker safety.

7. Future Work

The potential of IoT-based gas detection systems includes enhanced sensor technology, predictive analytics, connectivity with smart home and building systems, and industrial applications for worker safety and environmental monitoring. It may also involve real-time data interchange, better data

visualisation, and integration with emergency response systems. As technology advances, these systems might become more accessible, expandable, and environment-adaptive.

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