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Intelligent Gas Leak Monitoring and Alert System with Blynk IoT Platform

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Abstract: The frequent monitoring and control of the workplace atmosphere is essential to prevent dangerous situations and maintain a clean air environment, particularly in industrial settings or homes dealing with gas or liquefied petroleum gas (LPG), which is derived from petroleum. Gas leakage can pose serious health risks, making it crucial to implement safety measures. To address this issue, we propose an Internet of Things (IoT)-based gas leak detection system to solve this problem. The system utilizes Node MCU ESP32 Wi-Fi as the microcontroller and employs a combustible gas sensor (MQ4) to detect the presence of methane (CH4), carbon monoxide (CO), and compressed natural gas (CNG). The microcontroller used is a Node MCU ESP32 Wi-Fi. Methane concentrations between 200 ppm and 9,500 ppm can be detected with the MQ4 sensor. The MQ4 determines the gas concentration by observing the sensor's voltage output, and the ESP32 sends this information to the Blynk IoT platform via an android phone. Utilizing the Thingspeak IoT Platform, the data is visualized. Additionally, a fan will start to run as soon as a leak appears, along with an unsettling hum.

Keywords: Natural gas (LPG), Alert mechanism, Thingspeak, Blynk central platform

1. Introduction

Safety is one of the most vital elements of human life. Safety can be described as being mindful of risks and dangers that may exist in and around human circumstances that could result in physical harm or even death. The safety of many homes and lives is threatened by a variety of threats and potential hazards. A risk and potential threat is a gas leak, which could cause significant harm where the person is [2].

LPG is made up of a mixture of the extremely combustible chemical butane and propane. Due to the fact that it is an odorless gas, a strong odorant called ethanethoil is added to make leaks easier to detect. LPG From 0.72% to 10.74% of all cooking incidents, gas leaks have increased. Since the former is more prone to crack, which could result in leaking, the 5-kg small LPG cylinder with the burner placed directly over it and without the use of a rubber tube is believed to be safer [3]. Consequently, a trustworthy system that is employed for domestic and industrial purposes to detect and display gas leakage detection.

The simple gas leak detector is an easy-to-use device that is used to detect gas leaks. If a leak occurs, an equivalent message is transmitted by way of a buzzer, and since it is Wi-Fi powered, it is capable of broadcasting messages to the stakeholders about the LPG leak through the Blynk application, which is based on the internet. In this study, an online computer application was developed to locate leakage points and serve as an automatic supervisor in outlying areas [4].

The environment will be regularly checked for leaks in this research paper's system. If any leakage is discovered, it will alert the user via a buzzer, the ESP32 wifi microcontroller, and an iOS IoT application. The user will also be informed of the environmental factors affecting the gas level at that installation location via Blynk (as was already described). The gas level variety that takes data from the gas sensor is illustrated via data visualization on the Thingspeak IoT platform [1]. The proposed system is used to detect the leaking of hazardous gases, a microprocessor-based system with the gas sensor MQ4 is proposed in this work as a way to detect the leakage of dangerous gases. The system has an LCD display to illustrate the leakage. The gas sensor used in this system is economically priced, has good sensitivity, and responds quickly. A GPRS SMS will be immediately delivered to the appropriate people or family members if any leakage is detected.

2. Literature Review

In [2], To warn individuals of the presence of toxic gas, a gas leak detection system was developed. The device makes use of a SIM900 GSM/GPRS gateway and an Arduino UNO. to send an SMS to the appropriate person's mobile as a warning.

In [4], the butane-based lighters used for the system's practical testing are an element in LPG. The results of the tests show that the prototype works as intended, distinguishing between low and high gas leakage levels and providing users with the required audio-visual warning indications. The system's development cost

was considerably lower than the price of commercially available gas detectors on the market.

The author of [6] suggested a prototype for IoT-based gas detection that makes use of the Proteus design suite. For data visualization, he uses the Blink IoT platform exclusively. In his conclusion, he asserts that the system is effective since the suggested technique wirelessly sends alert notifications to the user, making it possible for the user to instantly connect the devices using a Smartphone from any location.

In [7], the suggested system can be equipped with a switching circuit and an electromechanical solenoid valve that, should there be a gas leak, can stop the flow of gas from the source. By adding a temperature measurement system to be utilized for temperature adjustment, which can be done through the microcontroller to decrease the amount of false positives and false negatives, the system can be further improved.

In [8], the suggested IoT and cloud technologies are used in the gas leak detection system to provide a more effective and efficient way to discover gas leaks. Through the integration of a GPS module and a smoke sensor, the system is able to recognize gas leaks, locate them, and detect smoke. The proposed system also incorporates extra security features, such as fire sensors, and the sensor data may be stored in the cloud for later use and analysis. Last but not least, With the use of this technology, harmful situations can be avoided and lives can be saved through thorough gas leakage detection. Due to ongoing innovations in IoT and cloud technology, we may soon see even more significant advancements in gas leakage detection systems.

3. Techniques used for Gas Detection

The following techniques used for gas leakage detection:

A) A robot-based gas leakage detector: Uses an autonomous robot to detect and indicate the presence of gas. A small mobile robot that can find gas leaks in potentially harmful places is shown in the prototype. Whenever a gas leak occurs in a certain area, the robot instantly detects the data and sends it to the Android smartphone using a wireless connection like Bluetooth. For Android-based cellphones, an android application that can directly accept data from robots through Bluetooth might be employed. Every time there is a gas leak, the application issues a warning and an indication.

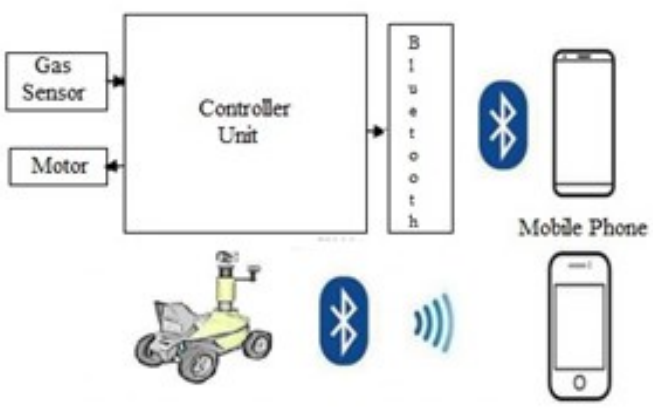

Fig. 1: Robot – based gas leakage detector

B) Gas leakage detector based on GSM:-

A gas sensor for LPG is utilized to detect leaks, and an Arduino Uno is used to provide the results in SMS for human notification. The sensor senses iso-butane, propane, and other gases with great sensitivity and a short response time.

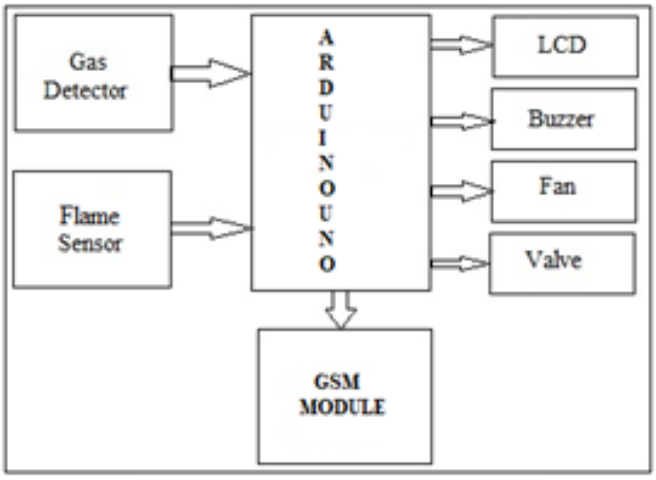

Fig. 2: GSM – based gas leakage detector

C) **IoT based gas leakage detector:-** The ESP2866 nodeMCU is typically utilized in this form of gas leak monitoring as both a microcontroller and a wifi module. The system logs the value of the LPG leak level on an IoT platform (which may be a cloud platform or application), and the awareness message is sent to the smartphone over wifi using an IoT application like the Blynk IoT application platform). Figure 3 depicts this prototype.

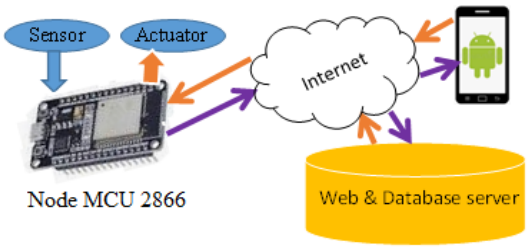

Fig. 3: IoT-based gas leakage detector

4. Components for Proposed System

In this paper, the hardware components used

- Node MCUESP32-Wi Fi
- MQ4 Sensor
- Fan
- Valve
- Buzzer
- Thingspeak ioT
- Transistor 2SB514
- Blynk Central Platform

5. Design Methodology:-

Data from the gas sensor MQ-4 will be transmitted to the controller (ESP32) through pin number GPIO 18. The proposed method made use of the Blynk App for iOS. The controller (ESP32) will then use (Wi-Fi) technology and the Blynk Application, which works with both Android and IOS operating systems, to send a text message warning of a gas leak. By connecting the buzzer to the microcontroller's GPIO 12 , an alarm will sound at the same time as the fan is operating to circulate fresh air around the area and remove gas leaks. A transistor functions as a switch that turns on and off.

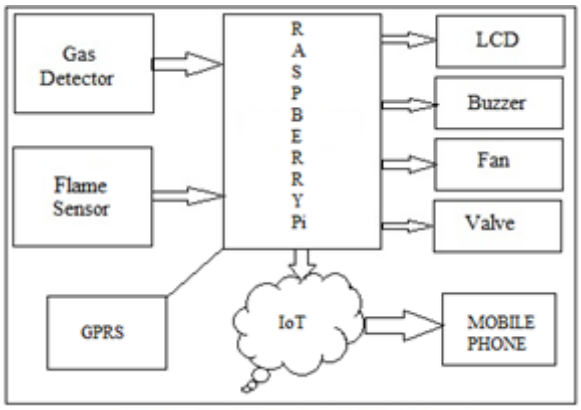

Fig. 4: Iot-based gas leakage detector – Block Diagram.

6. Principles for Proposed System:-

a) Blynk Platform:-

The Internet of Things (IoT) connects devices to the internet network so that users can remotely control them through websites, mobile applications, codes and algorithm structures for artificial intelligence problems. IoT can be used as a security system, a system for industrial usage, or a smart home control to turn on lights or other items for use in the home. For instance, to operate a completely automatic industrial machine, to open or close the main building gate, or even to manage communication and internet ports. IoT technology enables more activities. Large government buildings or industrial complexes often have a lot of lighting. Sometimes workers fail to switch them off at the end of the workday. Allowing the security to manage the building's lights using IoT clouds or applications could save energy. Blynk is an IoT platform that supports both iOS and Android and works with a range of microcontrollers, including Node MCU (ESP), STM32, Arduino, and Raspberry Pi.

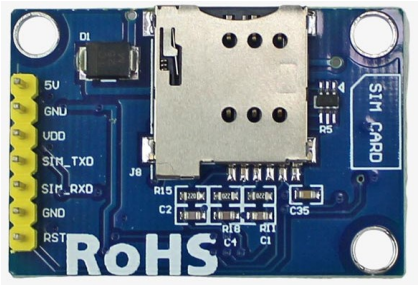

Fig. 5. GPRS Module

b) **Operations:-** There are two power sources in this system. The power supply powers the fan by acting as a transformer to reduce high voltage (220 volts) to low voltage (9 volts). The controller (Wi-Fi Node MCU ESP32) and the other components of the circuit are powered by the second source, a rechargeable battery (3.3V – 5V).

The transistor and the fan are also connected to the relay.

Smoke and gas are both detected by the MQ4 sensor. If there is no gas leak detected, the LED displays green in normal operation. It will alert the raspberry pi microcontroller once it detects smoke. When a gas leak is discovered, the Raspberry then transmits a signal to the buzzer, LED, and GPRS, turning the LED red. Using NodeESP32, it will transfer data to an LCD display.

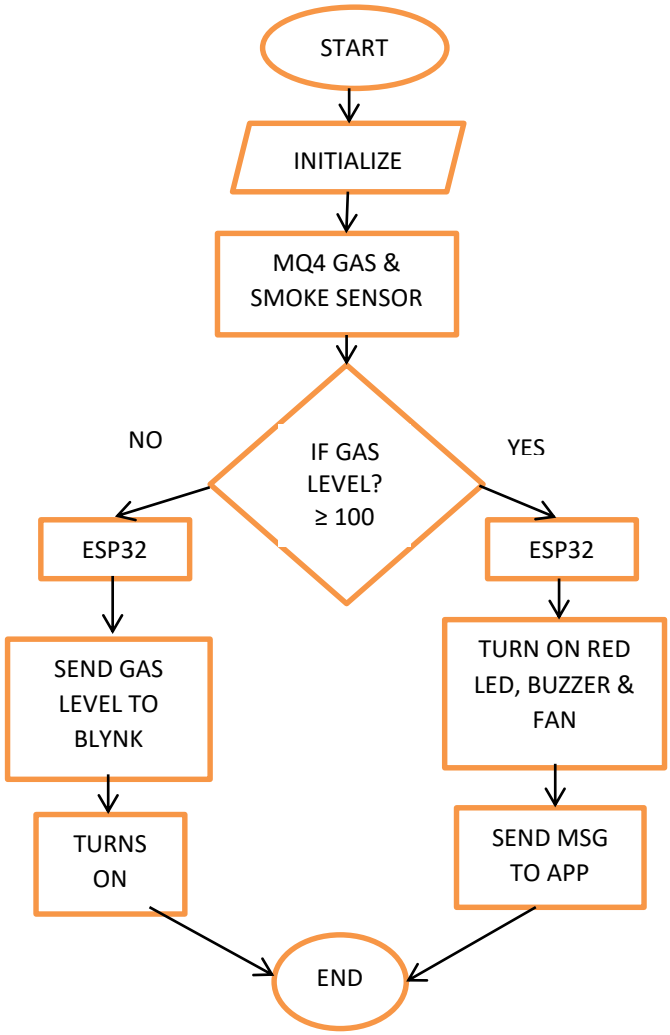

Fig. 6 Flow chart of the proposed system

7. Result for Proposed System:-

When a gas leak occurs, a notification is sent to a mobile phone. Using the Blynk app, a gas leak was discovered. As illustrated in Fig. 7 and 8, gas leakage exceeds ≥100 and the gas level surpasses the threshold limit indicated in Table 1.

Table 1
Gas Detection Threshold

MQ4 Device Reading	Status
<100	Zero gas leaks
≥100	Gas leak discovered

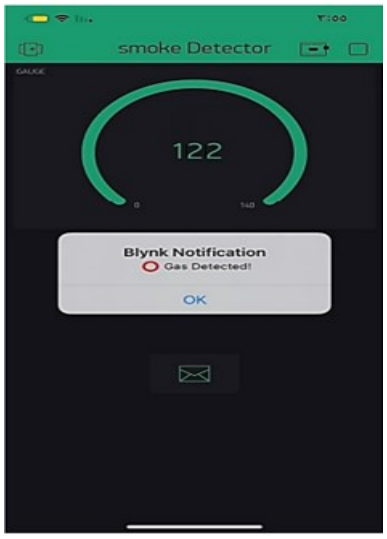

Fig. 7. App notification for gas leakage case

Fig. 8. App notification for no gas leakage case

8. Conclusion:-

This study describes an Internet of Things (IoT) method for detecting gas leaks at low concentrations. The leak is located using the MQ-4 gas sensor. The device transmits a ESP32 NodeMCU microcontroller receives a signal. The microcontroller then performs the function of a cellphone by sending an active signal to another externally connected device.

Sending several messages to the Blynk program, possibly one message per second, demonstrates the NodeMCU's usefulness. This is quicker than other IoT platforms like the Thingspeak IoT platform, which records gas sensor data and transmits notifications every 20 seconds. The NodeMCU's programming could be altered to control the frequency of warning signals sent. The atmosphere is less accident-prone because of the ease with which devices like exhaust fans may be controlled.

The NodeMCU microcontroller also lowers the cost of the system. The technology is incredibly practical because it is easy to use and regulate. Additionally, this article describes a gas leak detection system that utilizes two IoT platforms: the Blynk Central IoT application to alert the concerned party and the Thingspeak IoT cloud for data collection and viewing.

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