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LPG Leakage Detection and Disaster Prevention System

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Abstract

Liquid petroleum gas (LPG) is a fuel that is commonly used in household and commercial settings, it can be dangerous if not handled appropriately. The goal of the "LPG Leakage detection and disaster prevention system" project is to develop a comprehensive method for detecting LPG gas leaks and preventing potential disasters. The project makes use of a buzzer, a DC motor, a water pump, a MQ2 gas sensor, and a fire sensor, among other parts. To give real-time notifications over the internet via the Telegram API, an IoT application based on the ESP32 microcontroller is also included. The MQ2 gas sensor, which is in charge of detecting the presence of LPG gas, it serves as the system's primary input. When a gas leak becomes apparent, the system activates the buzzer and the DC motor to ward off any LPG gas that may be present in the environment and notify the user of the potential risks. This makes it possible to take immediate measures to reduce the risk of a gas explosion. This project also covers the potential for fire outbreaks unrelated to gas leaks in addition to gas leak detection. A fire sensor is incorporated into the system to address this problem. If a sudden fire is detected, the fire sensor triggers the water pump, representing a sprinkling system designed to extinguish the fire promptly. This approach enhances the safety measures and ensures the protection of life and property. The ESP32 microcontroller is used to create an IoT application that will improve the system's functionality. Through this application, the system can be remotely monitored online. The Telegram API notifies the user's device when there are fires or gas leaks. User's will have the ability to get real-time notifications even when they are not physically present at the system's location, so disaster prevention measures can be taken in a timely manner.

Abbreviations

LPG – Liquified Petroleum Gas

IoT – Internet Of Things

API – Application Programming Interface

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Introduction

The LPG Leakage Detection and Disaster Prevention System project seeks to address the possible risks posed by LPG leakage. LPG is a fuel that is frequently used in residential and commercial settings, but it can be dangerous if not handled properly due to its high flammability. The goal of this project is to create a system that can promptly and accurately identify LPG leaks in order to stop them from growing into larger, potentially disastrous incidents. It also shows a system where, if fire is detected, it is extinguished using a submersible water pump. Sensors will be strategically positioned throughout the system to detect any LPG vapours. Through a safe connection, the sensors will transmit this data to a central control unit. In the event of a leak, the control unit will analyse the data and take necessary safety procedures, such as warding off the LPG present in the atmosphere using a DC motor, activating a buzzer, and, in case of a sudden fire, using a water pump to demonstrate a sprinkling system. The Project "LPG leakage detection and disaster prevention system" having an application of IoT improves the functionality of this project. The recent event in our city is an example of an accident caused by gas leakage that occurred in Hyderabad at Kings Restaurant, Mehdipatnam. In summary, the Project "LPG leakage detection and disaster prevention system" will be useful in improving the safety of LPG usage and lowering the risk of explosions and other hazardous events. It will act as an example for other businesses and organisations seeking to improve the safety of their operations and protect their employees, customers, and communities.

Literature Review

This section reviews a few study findings that are relevant to the identification of gas leaks. "A Wireless Home Safety Gas Leakage Detection System" was the title of the paper that the authors Luay Friwan, Khaldon Lweesy, Aya Bani-Salma, and Nour Mani presented in November 2011. The work "Development of multipurpose gas leakage and fire alarm system" was given in 2013 by the authors Nivedita S. and Padmavathy A. The primary objective of the paper is to create an electronic system that can detect smoke and gas leaks and display the level visually using LEDs. The system wirelessly operates a relay to turn off the mains in the event of excessive concentrations of gas or smoke being detected. This eliminates a significant risk of a fire mishap and also sounds an audible alarm. Wireless transmission allows the analogue voltage values of the detected smoke and gas levels to be periodically presented on a computer screen. The system has an advantage over current systems in that it is a battery-powered, intelligent standalone module that doesn't need human involvement. The authors, Ankit Sood, Babalu Sonkar, Atul Ranjan, and Mr. Ameer Faisal, presented a paper titled "Microcontroller-Based LPG Gas Leakage Detector Using GSM Module" in the months of April to June 2015. In this study, the system uses a gas sensor to detect LPG (liquefied petroleum gas) leaks and then connects to the GSM to send an SMS notification to the person. The gas sensor detects a gas leak when the amount of LPG in the air rises above a specified point and its output becomes low. The microcontroller notices this and simultaneously turns on the buzzer and LED. After that, the system notifies the user by sending an SMS to the designated mobile phone.

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Additionally, we came across a recent paper 'IoT-Based Low-Cost Gas Leakage, Fire, and Temperature Detection System with Call Facilities' was written by Sourav Debnath, Samin Ahmed, Suprio Das, Abdullah-Al Nahid, and Anupam Kumar Bairagi and published in 2022.

Methods and Materials

The MQ-2 gas sensor, a semiconductor gas sensor, is employed in the presented paper. It is capable of detecting a wide range of gases, including smoke, propane, methane, hydrogen, and carbon monoxide. The determining element of the MQ-2 gas sensor is comprised of the semiconductor tin dioxide (SnO2) material. The gas molecules are adsorbed onto the sensing element's surface when it is exposed to a gas, changing the SnO2 material's electrical conductivity. The concentration of the gas in the air directly relates to the change in conductivity. The built-in heater of the MQ-2 gas sensor heats the sensing element to a high temperature in order to function. A variable resistor governs the heater, allowing the temperature to be changed according to the type of gas being detected. The electrical conductivity of the SnO2 material develops when the sensor element heats up, making it more sensitive to the gas being detected. For LPG, the sensor has a detection concentration scope of 300 to 5,000 ppm. The block diagram for the LPG Leakage Detection and Disaster Prevention System is shown in Figure 1. The fire sensor is an additional input that can detect fire and activate a 5V DC submersible small water pump to extinguish it out. This project's brain is the ESP32 microcontroller. It performs the function of the central processing unit, processing data from multiple input devices like the gas sensor module and fire sensor module to trigger the appropriate responses to stop any potential threat. The ESP32's integrated Wi-Fi and Bluetooth connectivity make it a good choice for IoT applications. The microcontroller can then use this connection to the internet to relay data to our Telegram application, which we are using to receive notifications. IoT helps to enhance precautions for safety and send out notifications as necessary. When a potential threat, such as an LPG gas leak, is discovered, an effective and quick message is made possible by integrating the Telegram API with an IoT device such as the ESP32 microcontroller. Our project benefits from using the Telegram API in a number of ways. The ability to seamlessly integrate our system with the well-known Telegram chat platform, first and foremost, ensures efficient and reliable communication. We can quickly deliver notifications to users in real-time, informing them of potential LPG gas leaks and fire detection, by utilising the Telegram API. For live view monitoring, an ESP32 CAM is employed.

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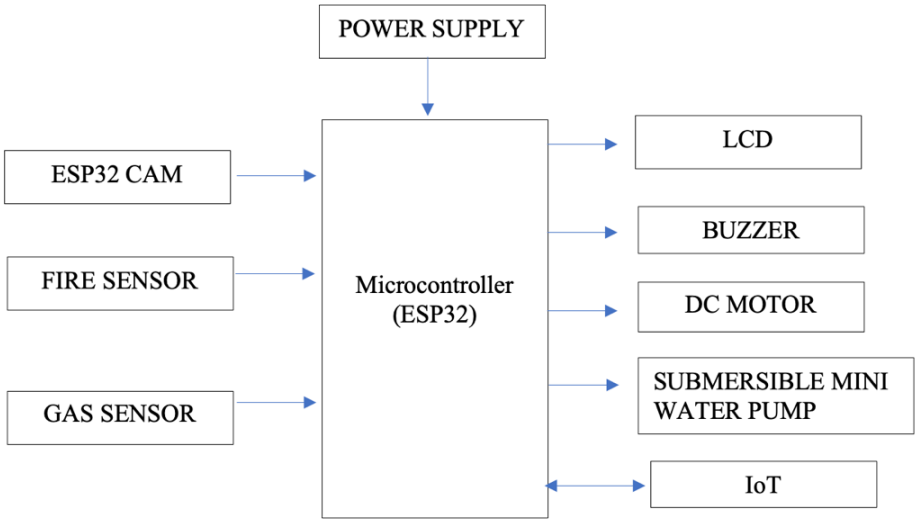

Figure 1 – Block Diagram of LPG Gas Leakage Detection and Disaster Prevention System

Several pieces of hardware are required to create an LPG leakage detection and disaster prevention system that uses sensors. The necessary components, together with their quantities and prices in Indian rupees, are shown in Table 1. The system expenses a total of 1599 rupees, which is quite reasonable. The necessary parts for constructing an LPG Leakage Detection and Disaster Prevention System are shown in Figure 2.

Table 1: Required Components, Quantity, and price

EQUIPMENT	QUANTITY	PRICE (INR)
Power Supply	1	200
ESP32 Cam	1	450
Fire Sensor	1	55
Gas Sensor	1	200
ESP32 Microcontroller	1	380
16x2 LCD	1	199
Buzzer	1	20
DC Motor	1	55
Submersible Mini Water Pump	1	40
		TOTAL: 1599

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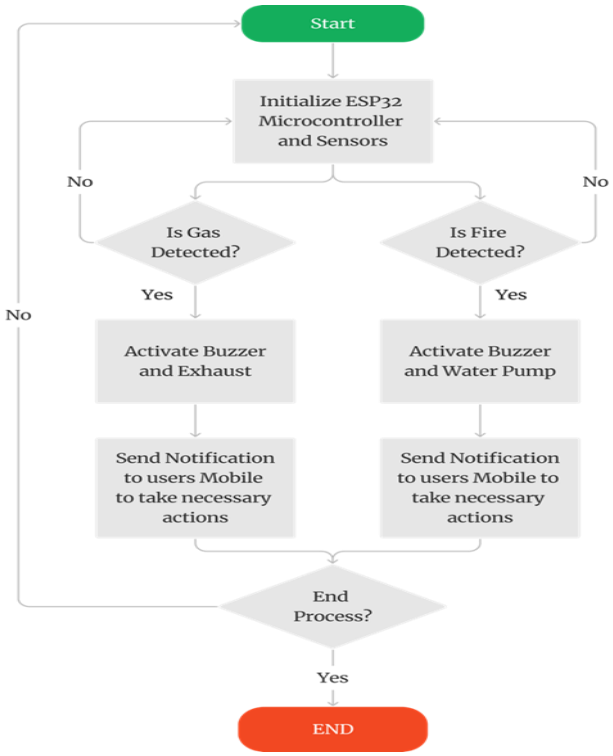
Figure 2 – Required Components for development

Flowchart



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Result & Analysis

The "LPG Leakage Detection and Disaster Prevention System" project achieved a working system that can identify LPG (liquefied petroleum gas) gas leaks in enclosed spaces and prevent potential disasters. A microprocessor activates the buzzer and sends an alert notification to the user's mobile device through the internet when the system's sensors detect the presence of LPG. In order to prevent the presence of LPG in the air, the system also activates the ventilation system. In the event of a fire becoming apparent, the system activates the fire control system, which we carried out using a submersible water pump.

The project's output is a fully functional prototype that has undergone thorough testing and validation to guarantee its effectiveness and dependability. The outcome should show the project's capacity to prevent potential disasters brought on by LPG leakage and give customers early warning so they may take the necessary precautions to avoid harm. Fritzing was used to create the schematic diagram in Figure 3.

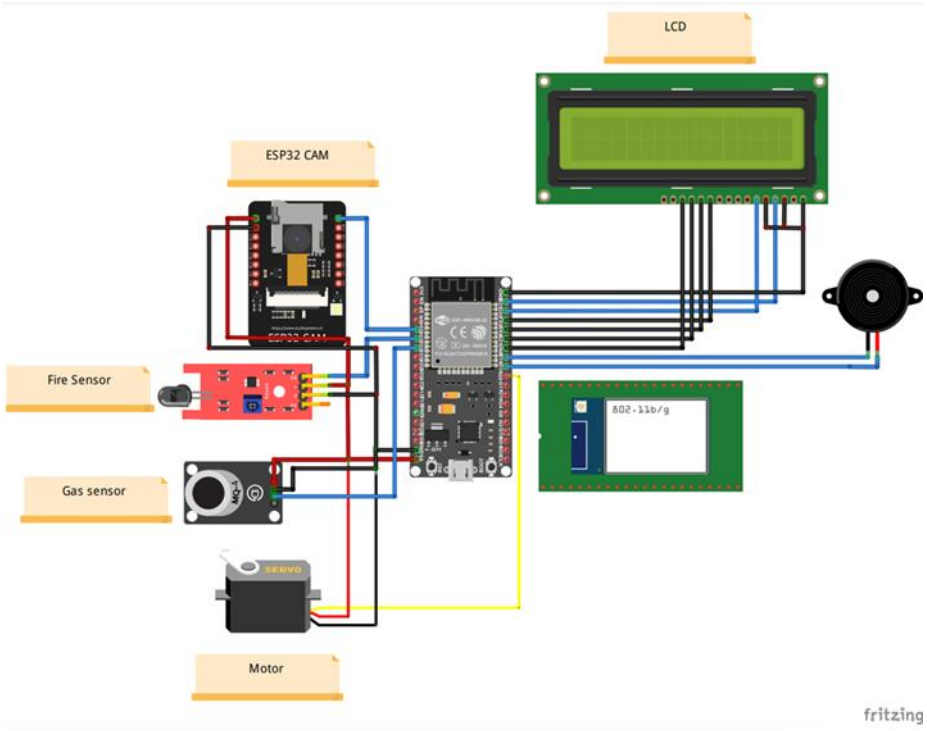

Figure 3 – Schematic Diagram designed using fritzing application

Future Work

There are a number of probable future features for the LPG gas leakage detection and prevention system, which now includes IoT, a buzzer, a fire sensor, and a water system for extinguishing the fire. Modern artificial intelligence algorithms could be used to boost the system's predictive powers, allowing it to learn from prior data and spot trends in gas leakage and prevention. Advanced communication protocols that enable the system to link with other home automation systems for improved integration and control are another potential

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possibility. Additional sensors for detecting various chemicals or other environmental factors that could endanger occupants could also be added to the system. Finally, the LPG gas leakage detection and disaster prevention system has a wide range of potential uses.

Output Result

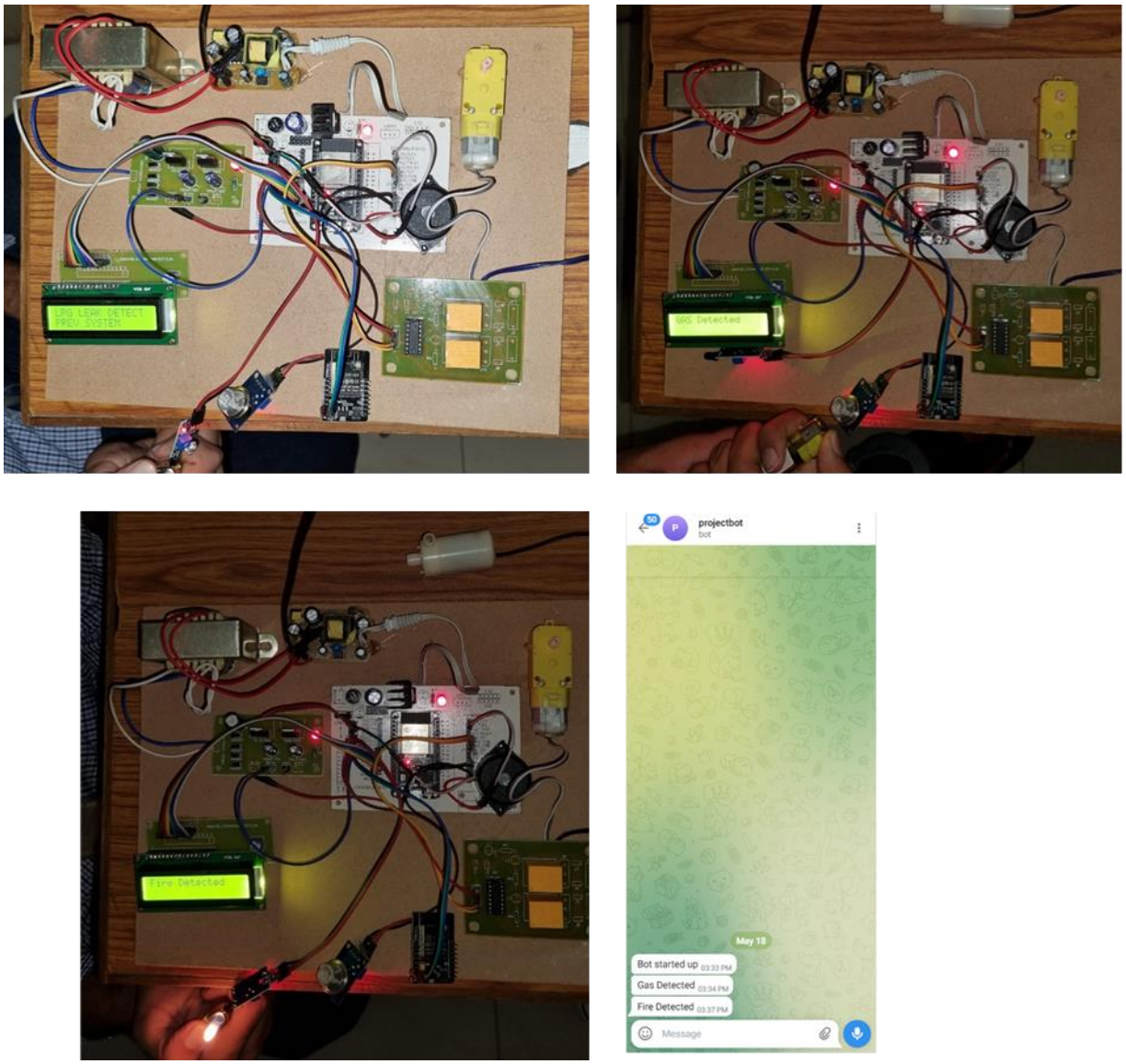

Figure 4 – Outputs received, gas detection, fire detection, System Notifications

Conclusion

This paper proposes and discusses the design of The project **"Lpg Leakage Detection And Disaster Prevention System"** has been successfully designed and tested. It has been developed by integrating features of all the hardware components used.

In the future, the gas leakage detection and disaster prevention system will be integrated with more advanced features to offer users increased safety and peace of mind. The growing

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popularity of handheld devices has led to significant advancements in smart gas sensors, expanding their potential uses. The demand for workplace safety is expected to be a significant.

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