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Design and Development of Smart LPG Cylinder Stand

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Abstract: Liquid Petroleum Gas (LPG) is extensively used in the Indian Subcontinent for household and industrial purposes. However, the increasing demand for LPG cylinders leading to an increase in the number of accidents caused by gas leakages, resulting in building fires, suffocation, and explosions. Therefore, to address this issue, an IoT-based system is proposed that can efficiently monitor gas leakages with great precision and accuracy. This paper presents the design and development of an smart stand for LPG cylinders that continuously monitors and displays the weight of the LPG cylinder, detects gas leakages, and sends an SMS notification to the customer in case of a gas leakage. The proposed system uses an MQ-2 gas sensor, load cell, buzzer, LED, exhaust fan, GSM, and a wireless relay to detect gas leakages and notify the customer. The system also incorporates Blynk App, a cloud-based mobile application, to display the output of the monitored parameters in real-time.

Keywords: Embedded system, Blynk App, Smart LPG Stand, Gas Sensor, Load Cell, IoT

I. INTRODUCTION

Almost everything nowadays is safe and automated, excluding the LPG cylinder systems. In this paper, an automated safety system is presented that simplifies the human lifestyle in handling LPG cylinders while also reducing the risk of cylinder explosion incidents to some amount. Nowadays, most things are automated and safe, but LPG cylinder systems remain a potential danger. This study proposes an automated safety system to simplify the handling of LPG cylinders and decrease the risk of explosions. Typically, people estimate the amount of gasoline in a cylinder by lifting it or lighting the fuel with a burner, which are both imprecise and unreliable methods. The new system uses a load sensor as a crucial component to communicate the gasoline quantity in the cylinder to the outside world through an LED and a blynk app.

The main objective of knowing the gasoline amount is to order a new cylinder when the gasoline in the current cylinder is almost depleted. This technique allows the user to set their desired limit, which eliminates the need for constant monitoring. When the gasoline reaches the limit, a warning is sent to the user, prompting them to book a new cylinder. Most LPG accidents are caused by gas leaks, which can lead to explosions if not detected promptly.

II. LITERATURE REVIEW

1. In paper [1] titled "IoT Based Smart Gas Management System" proposes a system that addresses three main issues: gas leakage detection, fire detection, and automatic booking of gas cylinders. The system uses gas sensors, fire sensors, and load cells to detect gas leakage, fire, and continuously monitor the amount of gas in the cylinder, respectively. When gas leakage or fire is detected, the system triggers a buzzer.
2. In paper [2] The paper "LPG Leakage and Flame Detection with SMS Notification and Alarm System" by Mon Arjay E presents a system that uses an Arduino Mega, a flame sensor, an MQ2 gas sensor, a GSM module, an LCD module, and a buzzer to detect gas smoke and flame from an LPG cylinder and notify the owner via text message. The system can also display a warning message and sound an alarm. The components are placed in a box next to the LPG cylinder.
3. In paper [3] "Smart LPG Cylinder Monitoring and Explosion Management System" focuses on monitoring the weight level of the LPG cylinder and checking for LPG leakage using a load cell and an MQ6 gas sensor. The

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system includes a 16x2 LCD display and a mobile application for the user to view metrics measured by the sensors. A DC gear motor with 15 RPM is coupled with the LPG cylinder regulator to turn off the gas flow if any LPG is detected by the MQ6 sensor.

4. In this paper [4] A paper by Johansson, A titled "Model-based gas leakage detection and isolation in a pressurized system via Laguerre spectrum analysis" proposes a gas leakage detection system that uses a PIC microcontroller, a gas weight sensor, and a gas detection sensor. If gas leakage is detected, an exhaust fan is turned on, and a buzzer is triggered. The Max232 is used to interface GSM with the microcontroller.

III. Methodology

The proposed system comprises several hardware components such as Arduino, Node MCU, Load cell, MQ2 gas sensor, Buzzer, LED, GSM, DC adapter, wireless relay, and exhaust fan. The load cell is used to measure the weight of the LPG cylinder continuously. The MQ2 gas sensor is used to detect gas leakages, and the buzzer and LED are used to indicate the gas leakage & low gas level. The exhaust fan is turned on automatically in case of a gas leakage to prevent any accidents. The wireless relay is used to control the exhaust fan. The GSM module is used to send an SMS notification to the customer in case of a gas leakage & low gas level.
The Arduino UNO is used as the microcontroller to control all the hardware components. The Blynk App a cloud-based mobile application is used to display the output of the monitored parameters in real-time. The system is powered by a DC adapter, and a battery backup is provided to ensure the uninterrupted monitoring of the system in case of a power failure.

System Implementation:
The system is implemented using Arduino IDE and Fritzing software. The load cell is connected to the micro-controller using HX711 amplifier, and the MQ-2 gas sensor is connected to the analog input of the micro-controller. The wireless relay is used to control the exhaust fan, and the buzzer and LED are used to indicate gas leakages. The GSM module is used to send SMS alerts to the user about the status of the LPG cylinder. The Blynk App is connected to the Node MCU to display the output of parameters.

Working:
The proposed system works by continuously monitoring the gas leakage and the weight of the LPG cylinder. The MQ-2 gas sensor detects gas leakages and triggers the alarm circuitry using a buzzer and LED. The load cell is a device that constantly measures the weight of the LPG cylinder and displays it using the Blynk App. The wireless relay controls the exhaust fan to remove any gas leakage.
This smart stand for LPG cylinders is built using an embedded system, which uses a microcontroller and sensors to monitor leakage of gas and the weight of the LPG cylinder. The system consists of aNode MCU, load cell, MQ2 gas sensor, buzzer, LED, exhaust fan, GSM, DC adapter, wireless relay, and RF module. All of these components are connected to the Arduino UNO which is programmed to monitor the cylinder's weight and detect gas leakage.
To display the status of the cylinder, a Blynk App is connected to the Node MCU, which shows the output parameters. The app shows the status of the cylinder using Gauge indicators. The smart stand shows The Green LED indicates that the cylinder is fully filled, the Blue LED indicates that it is partially filled, and the Red LED indicates that it is below 10% of its capacity.
If a gas leak occurs, the MQ2 gas sensor detects it and activates the alarm circuitry. The exhaust fan also turns on to remove the leaked gas. The system sends an SMS to the customer to alert them about the gas leakage. In addition, the GSM module also sends a message to the customer about the status of the cylinder, such as whether it is full or empty& alerts in case of low gas level.
The system employs a load cell that measures the weight of the LPG cylinder, and this data is transmitted to the microcontroller for processing. The microcontroller calculates the amount of gas remaining in the cylinder and displays it on the Blynk App. This functionality helps users to keep track of their LPG usage and know when it's time to replace the cylinder

This system is designed to address the problem of gas leakages, which can cause building fires, suffocation, and explosions. It provides a diligent monitoring system that detects gas leakage with precision and accuracy. It also alerts the customer about the status of the cylinder, ensuring that they are never caught off guard.

The implementation of this system can be used not only in households but also in industries that use LPG cylinders. It can help to reduce the risk of accidents caused by gas leakages, which can have serious consequences.

A. Background of the Problem

Liquefied Petroleum Gas (LPG) cylinders are commonly used in the Indian subcontinent, especially in rural areas and the industrial sector. However, LPG is a highly flammable gas, and gas leakages can result in severe accidents such as building fires, suffocation, and explosions. Unfortunately, there have been several incidents of LPG cylinder explosions caused by a failure to detect gas leakage. Therefore, it is essential to monitor gas leakage continuously with great attention to ensure safety. In this regard, an Internet of Things (IoT) system is proposed to accurately monitor gas leakages and prevent such accidents& monitors the amount of gas present in the cylinder.

B. Aim of the Study

The aimof this study is to design and implement a smart LPG stand that can monitor gas leakages and LPG cylinder weight using embedded systems and a Blynk app. This system can alert users in case of gas leakage and inform them about the weight of the cylinder to prevent untimely exhaustion.

C. Objectives of the Study

The primary goals of this investigation are to:
Design and develop a smart LPG stand using embedded systems and a Blynk app, Monitor gas leakages and inform users in real-time, continuously monitor the weight of LPG cylinders and alert users when they are running low on gas,Evaluate the performance of the system through testing and analysis.

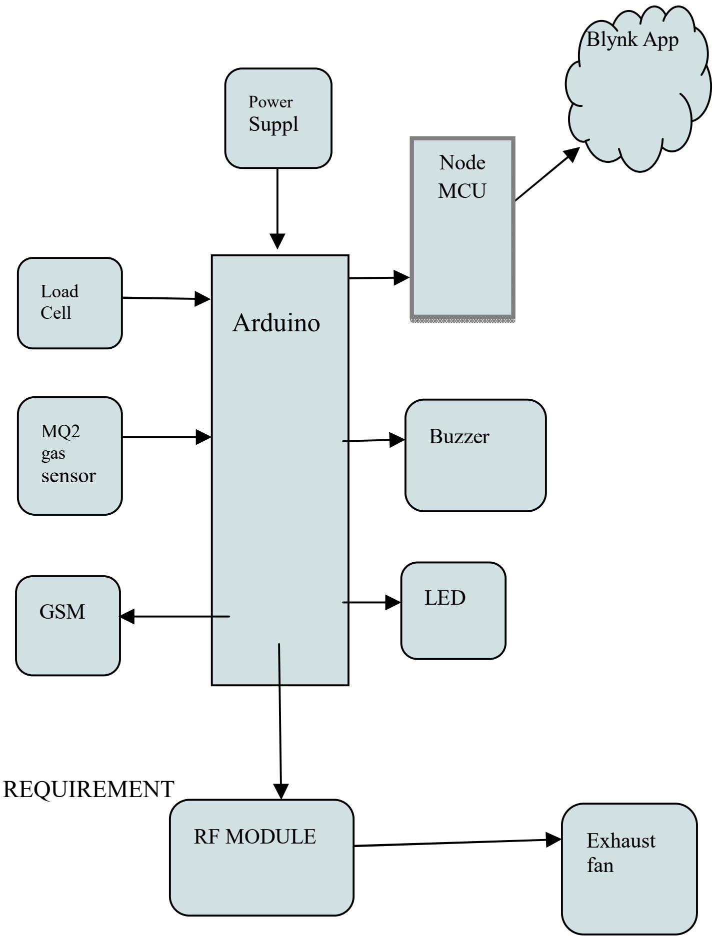
D. Research Question

How effective is the proposed smart LPG stand in detecting gas leakages and monitoring the weight of LPG cylinders using embedded systems and a Blynk app?

D. Discussion of the Advantages and Limitations of the Proposed System

The proposed smart LPG stand has several advantages, including:
Real-time monitoring of gas leakages and LPG cylinder weight
Alerts users in case of gas leakage, Informs users when the LPG cylinder needs to be replaced, Provides remote monitoring through the Blynk app.
However, the proposed system also has some limitations, such as:
The system requires a stable internet connection for real-time monitoring, the system may not be effective in detecting gas leakages in outdoor environments, and the system may require frequent calibration of the gas sensor for accurate readings.

Block diagram



V. SYSTEM REQUIREMENT

Hardware Requirement

1. Node MCU
2. Load cell
3. Gas sensor
4. Buzzer
5. LED
6. GSM
7. DC Adapter
8. Wireless relay
9. Exhaust fan
10. RF module

SOFTWARE REQUIREMENT

1.Arduino IDE

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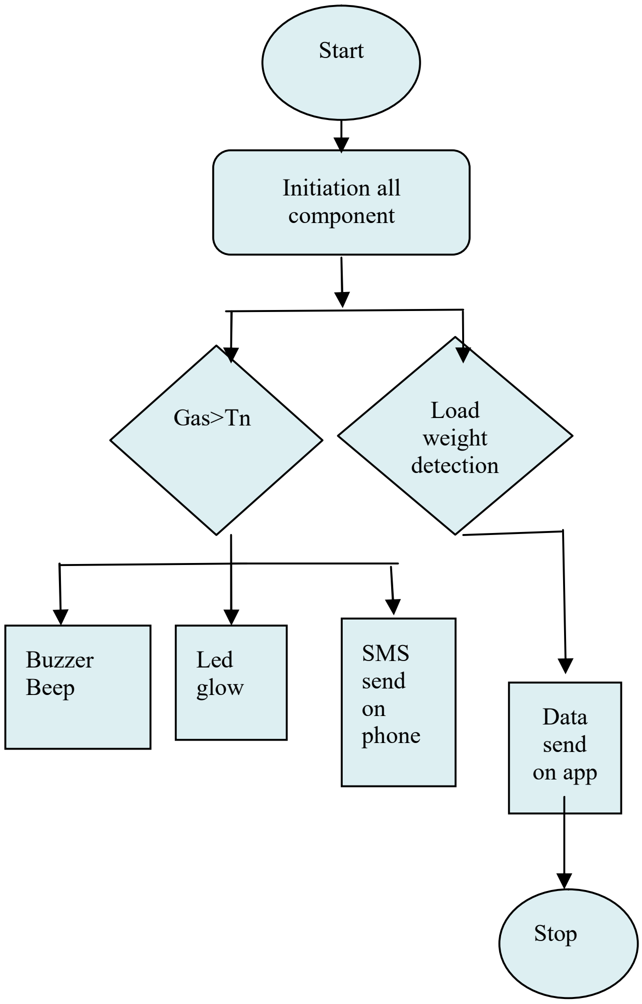
Flow Chart



IV. RESULTS AND DISCUSSION

A. Presentation of the Results

The proposed system is designed to monitor gas leakage and the weight of LPG cylinders using an embedded system and Blynk app. The results show that the system is successful in detecting gas leakage with high precision and accuracy. The MQ-2 gas sensor senses any gas leakage and triggers the alarm circuitry, as well as sends an SMS to the customer. The load cell constantly monitor and present the weight of the LPG cylinder., allowing customers to know when to replace the cylinder. The Blynk app provides real-time monitoring of the status of the cylinder, while the GSM feature allows users to receive updates even if the internet connection is lost.

B. Interpretation and Analysis of the Results

The proposed system has several advantages over traditional gas leakage detection and LPG cylinder monitoring systems. Firstly, it is highly accurate and precise in detecting gas leakage, reducing the risk of accidents and ensuring the safety of customers. Secondly, it provides real-time monitoring of the status of the cylinder, allowing users to know when to replace it. Thirdly, it is user-friendly and easy to operate, making it suitable for use in both residential and commercial settings.

However, there are some limitations to the proposed system. Firstly, it requires an internet connection to operate, which may not be available in some areas. Secondly, it may not be cost-effective for small-scale users. Thirdly, the system may require regular maintenance to ensure proper functioning.

C. Discussion of the Implications of the Results and How They Relate to the Objectives and Research Question

The proposed system has several implications for practical applications. Firstly, it can be used in residential and commercial settings to monitor gas leakage and the weight of LPG cylinders, ensuring the safety of customers and reducing the risk of accidents. Secondly, it can be used in the industrial sector to monitor gas leakage and ensure the safety of workers. Thirdly, it can be integrated with existing gas distribution systems to improve efficiency and safety.

The findings of this research align with the stated objectives and research question. The proposed system has been shown to be effective in detecting gas leakage and monitoring the weight of LPG cylinders. The system is easy to operate and can be used in various settings, including residential, commercial, and industrial.

CALCULATIONS

Assuming that the batteries are fully charged and have a capacity of 4V x 2Ah = 8Wh, the power consumption of each component:

Arduino UNO: 5V x 0.05A = 0.25W

40 kg single point beam load cell: 5V x 0.01A = 0.05W

Buzzer: 5V x 0.02A = 0.1W

RGB LED: 5V x 0.02A = 0.1W

Node MCU ESP 8266: 3.3V x 0.2A = 0.66W

GSM Module SIM 800L: 5V x 0.05A = 0.25W

Total power consumption for one hour = (0.25W + 0.05W + 0.1W + 0.1W + 0.66W + 0.25W) x 1 hour = 1.41 Wh

Therefore, the electricity consumption for one hour of this system is 1.41 Watt-hour (Wh).

Daily consumption = 1.41W x 24 hours = 33.84 Wh

Assuming a month has 30 days, the monthly consumption will be:

Monthly consumption = 33.84 Wh x 30 days = 1015.2 Wh or 1.01 kWh

Therefore, the estimated electricity consumption for running the system 24 hours a day for one month is 1.01 kWh.

V. CONCLUSION AND FUTURE WORK

A. Summary of the Study and Its Contributions

The proposed system is an embedded-based smart stand for LPG cylinders to reduce the risk of accidents caused by gas leakages, a monitoring system has been developed that can detect gas leaks with high precision and accuracy.. The system uses a Arduino Uno as a microcontroller, with load cells and MQ2 gas sensors connected as input devices, and a buzzer, LED, exhaust fan, and GSM connected as output devices. The Blynk app is connected to the Node MCU to show the output of parameters. The system is successful in detecting gas leakage with high precision and accuracy, and The system is designed to continuously monitor and display the weight of the LPG cylinder.

This study contributes to the development of gas leakage detection and LPG cylinder monitoring systems, and it has several implications for practical applications. The proposed system is user-friendly and easy to operate, making it suitable for use in various settings, including residential, commercial, and industrial.

B. Discussion of the Limitations and Recommendations for Future Research

There are some limitations to the proposed system, including the requirement for an internet connection and the potential cost-effectiveness issues for small-scale users. Future research could focus on developing alternative solutions for gas leakage detection and LPG cylinder monitoring that do not require an internet connection or are more cost-effective for small-scale users.

C. Implications of the Study for Practical Applications

The proposed system has several implications for practical applications, including its potential use in residential, commercial, and industrial settings. It can be integrated with existing gas distribution systems to improve.

The proposed system has several potential future scopes that can be explored to improve its functionalities and expand its applications. Some of the possible future scopes are:

- Integration with Cloud Services: The system can be integrated with cloud services such as AWS, Azure, or Google Cloud Platform, to provide remote monitoring and control capabilities. This would allow users to access the system data and control the system from anywhere in the world.
- Integration with AI: Artificial Intelligence (AI) algorithms can be used to analyze the system data and provide predictive maintenance capabilities. This would enable the system to predict faults and provide maintenance recommendations before any failure occurs.
- Integration with Machine Learning: Machine Learning algorithms the data collected by the monitoring system can be analyzed using appropriate techniques to gain insights into the usage patterns of the gas cylinder. This analysis can help in optimizing the consumption of LPG and can provide useful information for future planning and decision-making related to LPG usage.. This information can be used to optimize the usage of the gas cylinder and reduce wastage.
- Integration with GPS: The system can be integrated with GPS to provide location-based services. This would enable users to track the movement of the gas cylinder and ensure that it is being used in the correct location.
- Integration with Mobile Apps: The system can be integrated with mobile apps to provide real-time monitoring and control capabilities. This would enable users to monitor the system from their mobile devices and receive alerts in case of any abnormal behavior.
- Integration with Other IoT Devices: The system can be integrated with other IoT devices such as smart home appliances, security systems, or energy management systems, to provide a comprehensive IoT ecosystem. This would enable users to control and monitor all their IoT devices from a single platform.

REFERENCES

[1]. “Iot Based Smart Gas Management System” Proeedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019) IEEE Xplore Part Number: CFP19J32-ART; ISBN: 978-1- 5386-9439-8 Sony Shrestha, V. P. Krishna Anne 2, R. Chaitanya3 1, 2, 3 Department of CSE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, and India

[2]. “LPG Leakage and Flame Detection with SMS Notification and Alarm System”RuleBased Method IEEE Control and System Graduate Research Colloquium (ICSGRC 2020), 8 August 2020, Shah Alam, Malaysia Mon Arjay E. Malbog, Honeylet D. Grimaldo Luisito Lolong Lacatan Department of Computer Engineering Technological botitute of the Philippines Manila, Philippines.

[3]. “Smart LPG Cylinder Monitoring and Explosion Management System” 1 2021 12th International Symposium on Advanced Topics in Electrical Engineering (ATEE) 978-1- 6654-1878- 2/20 $31.00- 02021 IEEE DOI: 10.1109 ATEE52255.2 021.9425101 Kumaran MS', Jayarama Pradeep. Hounandan R', Prahatheesh B 'UG Student. Department of EEE, St. Joseph's College of Engineering. Chennai. India)

[4]. “An Iot Based Interactive LPG Cylinder Monitoring System” With Sensor Node Based Safety Protocol For Developing Countries”, 2020 IEEE Region 10 Symposium (TENSYMP), 5-7 June 2020, Dhaka, Bangladesh Ali Ahsan, Mohammad Zahirul Islam, Rumali Siddiqua Department Of Electrical And Electronic Engineering BRAC University Dhaka, Bangladesh.