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Development of a Smart LPG Monitoring and Automatic refill system

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Abstract: ***In today's households, hotels, and industries, Liquefied Petroleum Gas (LPG) is commonly used for cooking. However, the risk of LPG leakage is a major concern as it poses dangers to users and society. To address this issue, placing a gas leak detector near the source is considered the most effective method to prevent these risks. Additionally, users often struggle with gauging the gas remaining in cylinders, leading to inconvenience. To solve these challenges, this project proposes a unique solution combining LPG leakage detection, real-time monitoring of cylinder levels, and automated booking through SMS to distributors. The system also includes an alert feature using SMS notifications and a loud buzzer to immediately notify users of potential leaks and prevent accidents. This proposed system offers continuous gas level monitoring, rapid event response, and accurate leakage detection, distinguishing it from current solutions.***

I. INTRODUCTION

In our daily lives, LPG cylinders play a vital role. One of the primary applications of LPG is its substitution for chlorofluorocarbons, which cause ozone-depleting damage to the ozone layer. Despite being one of the most commonly used fuels, LPG has an explosive range of 1.8%–9.5% volume of gas in the air. It is categorized into three classes based on the weight of LPG in the cylinder: household, commercial, and industrial. The household class of LPG cylinders contains 14.2 kilograms of LPG, while the commercial and industrial classes contain 19 and 35 kilograms of LPG, respectively.

With the increasing demand for LPG, users are required to pre-book their LPG cylinder at least a month before delivery. Often, users struggle to determine the remaining quantity of LPG in the cylinder, leading to inconvenience. In such circumstances, an efficient method to monitor the LPG level within the cylinder is necessary, ensuring users are informed about the LPG level.

This paper addresses the detection of gas leakage and the monitoring of gas levels in the cylinder, as well as the automatic booking of a new LPG cylinder. The sensor used in this system is versatile, with high sensitivity and a fast response time. Additionally, the gas sensor can detect other gases, including cigarette smoke. When gas is detected, the sensor's output is sent to the microcontroller, activating the buzzer. Furthermore, when the weight measured using the load sensor becomes critically low, an alert is sent to the user, and a new LPG cylinder is automatically booked. The primary application of this proposed system is to overcome shortcomings such as delays and the need for consumers to pre-book LPG cylinder

II. PROPOSED SYSTEM

Our proposed solution comprises a comprehensive system aimed at detecting gas leakage from cylinders and offering real-time updates on gas levels via an LCD. In the event of a gas leak, immediate notifications, such as SMS messages and calls, will be sent to the user via a GSM module. Additionally, a servo motor will activate to rotate the gas regulator by 90 degrees, effectively stopping the gas supply to prevent further leakage. Simultaneously, an alert sound from a buzzer will provide immediate auditory notification. Furthermore, our system incorporates a load cell to precisely measure the weight of the cylinder, with this data prominently displayed on the LCD screen.

When the gas level drops below a predefined threshold, a notification will be sent to the user, indicating the need for a refill. Simultaneously, the system will automaticallyinitiate the booking process for a new cylinder on behalf of the user, ensuring an uninterrupted gas supply.

To provide a more fulfilling user experience and ensure complete environmental monitoring, we aim to enhance our services."our solution integrates a DHT sensor to monitor temperature and humidity levels. These data will be displayed on the LCD screen and made accessible via the Blynk app, enabling remote

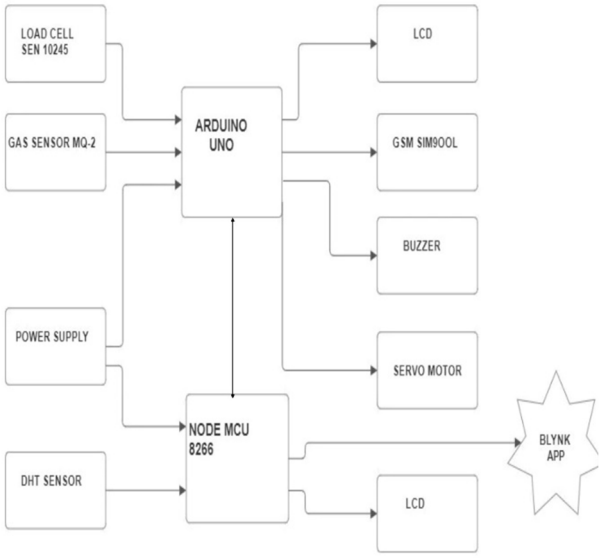

FIG.1.Block diagram of the system monitoring and control.

Additionally, all sensor values, including gas levels, weight, temperature, and humidity, will be conveniently displayed on a dedicated webpage, providing users with easy access to crucial system information.

III. METHODOLOGY

The system incorporates a highly sensitive gas sensor to identify LPG leaks, triggering immediate response mechanisms to mitigate potential hazards. Real-time sensor readings are portrayed on an LCD screen, accompanied by a warning message in case of a gas leak to alert nearby individuals. Utilizing a GSM module, the system dispatches SMS messages and initiates calls to the user's registered number, ensuring swift notification of the gas leak. Furthermore, a servo motor linked to the gas regulator automatically shuts off the gas supply upon leak detection, preventing further leakage.

A. Gas Level Monitoring and Display

A load cell is employed to gauge the weight of the LPG cylinder, enabling precise monitoring of gas levels. Real-time updates on gas levels are exhibited on the LCD screen based on weight measurements from the load cell, facilitating easy gas usage monitoring.

B. Automated Gas Booking System

The system is pre-programmed with a threshold value representing the minimum acceptable gas level. When gas levels dip below this threshold, the system initiates a booking process. Through the GSM module, an automated SMS is dispatched to the gas supplier to book a new cylinder, ensuring a seamless refill process without user intervention.

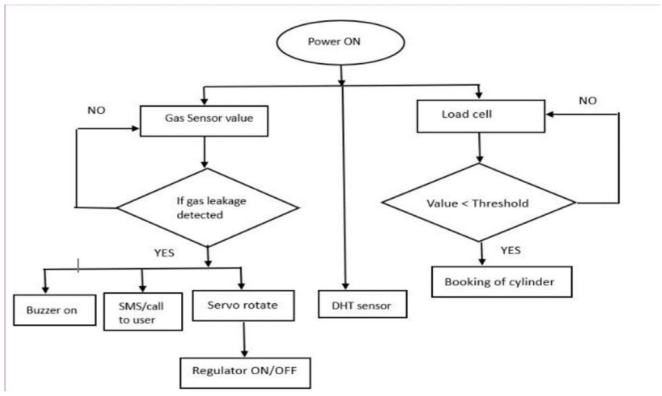

FIG.2.System workflow

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C. Temperature and Humidity Monitoring Module

This module integrates a DHT sensor to monitor temperature and humidity levels in the surroundings. The DHT sensor continuously detects temperature and humidity, with the system processing this data. The information is then showcased on the LCD screen for local viewing and is also accessible through the Blynk app for remote monitoring.

D. Web Interface Module

The system features a web interface module enabling users to access real-time data from various sensors via a web page. This interface exhibits information such as gas level, temperature, humidity, and cylinder weight. Users can conveniently monitor these parameters from any internet-enabled device, enhancing convenience and accessibility.

IV. SYSTEM IMPLEMENTATION

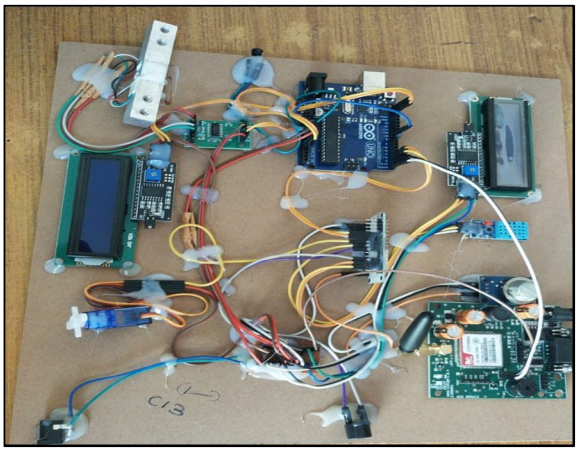
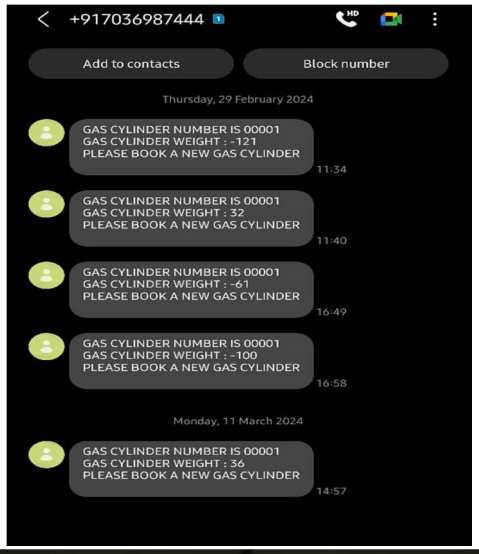


FIG.3..Prototype of the proposed system

1) *NodeMCU ESP8266:* This programmable microcontroller serves as the central processing unit. It gathers data from the sensors, interprets the information, and can wirelessly transmit it to a designated platform (website or mobile app) for real-time monitoring and potential control actions.
2) *Arduino Uno:* While not essential for all implementations, the Arduino Uno can be a valuable tool in some scenarios. Its user-friendly nature and robust design make it suitable for managing and processing sensor inputs and actuator outputs, potentially offloading some tasks from the NodeMCU.
3) *Gas Sensor (MQ-6):* This specialized sensor acts as the system's safety watchdog. It detects the presence of LPG gas in the environment. Upon detecting a leak, it triggers an immediate response from the system, which could involve activating an alarm, sending notifications, or shutting off gas flow (depending on the system design).
4) *Load Cell (SEN-10245 or equivalent):* This component plays a crucial role in monitoring the LPG level. By measuring the weight of the cylinder, the system can estimate the remaining gas quantity. This information can be used to trigger automatic refill alerts or displayed on the monitoring platform.
5) *DHT Sensor:* Included for measuring temperature and humidity levels in the environment, the DHT sensor provides crucial readings for assessing gas cylinder storage conditions and ensuring safe operation.
6) *Buzzer (KY-006):* Acting as an audible alert system, the buzzer notifies nearby individuals of potential gas leaks or other safety concerns requiring immediate attention
7) *GSM Module (SIM800L or equivalent):* This communication module acts as the system's voice. In critical situations, it allows the system to directly contact the user. For instance, if a gas leak is detected or the gas level dips below a predefined threshold, the GSM module can automatically send SMS alerts or even initiate phone calls to ensure the user is promptly informed and can take necessary action
8) *LCD Display:* Displaying real-time data from various sensors, including gas concentration levels, cylinder weight, and environmental conditions, the LCD screen provides a user-friendly interface for monitoring system status.
9) *Servo Motor:* In case of gas detection, the servo motor is activated to rotate 90 degrees, mechanically turning off the attached gas regulator. This action halts gas flow, preventing further leakage.

V. RESULTS



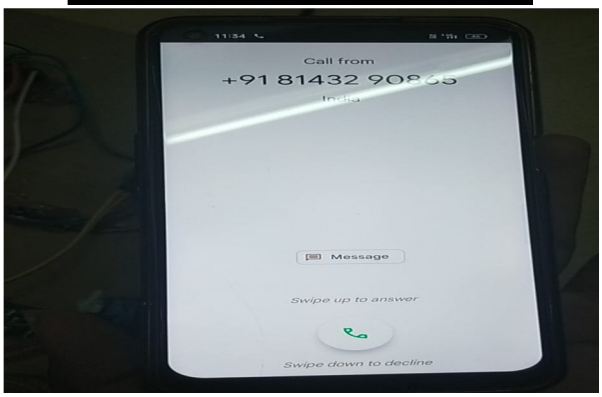


FIG.4. SMS alert on user mobile

This system utilizes an integrated GSM module to send alerts directly to the user's mobile phone in case of a gas leak. The notification includes both a text message (SMS) and a phone call to the pre-registered mobile number. This ensures you receive the alert promptly, regardless of whether you're actively using your phone or not. The beauty of this system is its broad compatibility. As long as your phone can receive calls and SMS messages, it can work with this gas leak detection system.

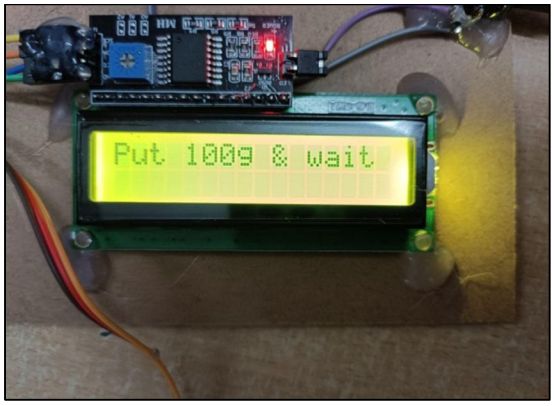


FIG.5.Output on the LCD display before putting load on the Load Cell

During system startup, the LCD display will prompt "Please place 100g and wait." This message indicates the load cell is currently unloaded. The system continuously monitors weight, but without a reference point, it cannot determine the LPG level. Placing a small weight, like 100 grams, helps the system calibrate itself and establish a baseline for accurate weight measurements

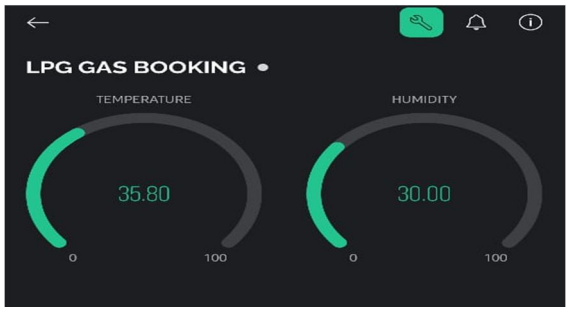


FIG.6.DHT Sensor linked with Blynk APP

Before connecting your ESP8266 board and DHT sensor to display readings on the Blynk app, you'll need to configure the app, within the Blynk app's project interface, add two widgets: a Gauge for temperature readings and a Label for humidity values. These widgets will present the sensor data from your ESP8266 in a user-friendly format on your smart phone or tablet.

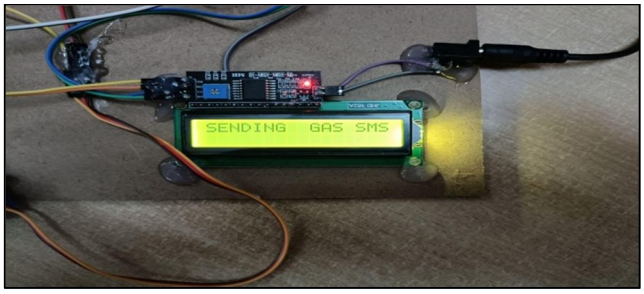


FIG.7.SENDING GAS SMS," is displayed on the LCD screen to alert

FIG.8.Message display after gas leakage in LCD

The system acts swiftly to address a gas leak. An immediate message "SENDING GAS SMS" appears on the LCD screen, alerting those nearby. Simultaneously, an SMS notification is sent to the user's registered phone, ensuring they are instantly informed of the critical situation

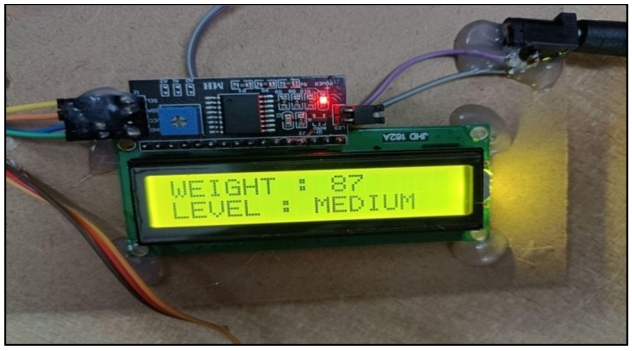


FIG.9.Output on the LCD display after putting load on the load cell

At system startup, the LCD display reflects the detected weight. In this case, the message "WEIGHT: 187" indicates the load cell is registering some weight. Since the weight value (187) falls within a predefined range, the system displays an additional message "LEVEL: MEDIUM," providing an estimate of the remaining LPG in the cylinder.

VI. CONCLUSION

Building a Smart LPG Management System with Automatic Refill Scheduling represents a game-changer in LPG management, significantly enhancing safety, efficiency, and user convenience .the system provides a holistic solution for controlling and supervising LPG consumption. With sensitive gas sensors and rapid response mechanisms in place, the system effectively addresses safety concerns linked with gas leaks, ensuring swift detection and mitigation of potential hazards. Real-time monitoring of gas levels empowers users to manage their consumption effectively. while the automated booking system streamlines the refill process, eliminating need for manual intervention. Furthermore, the inclusion of temperature and humidity monitoring introduces an additional layer of environmental awareness, enabling users to optimize their surroundings for both comfort and safety

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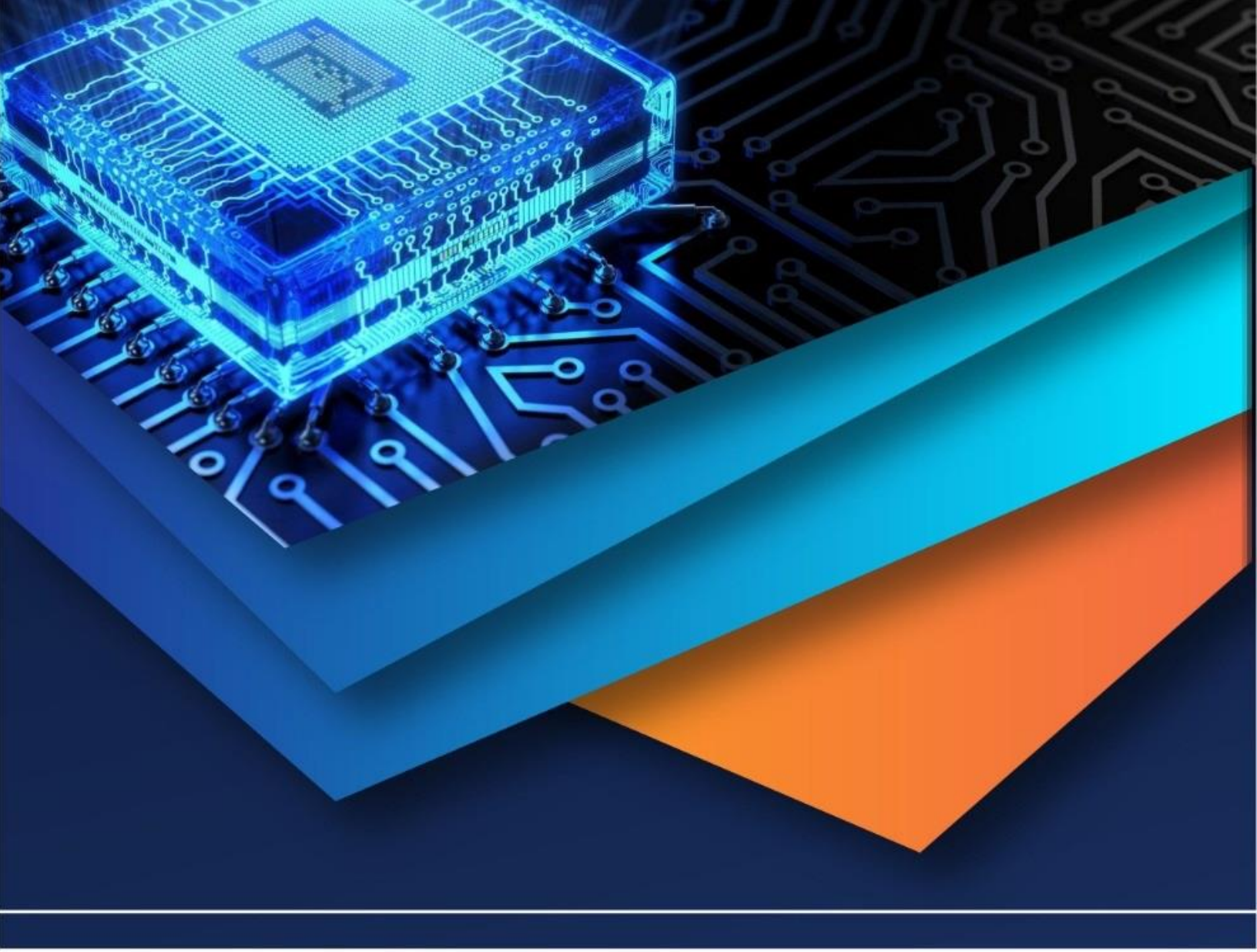

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