IOT BASED SMART LPG RESTRAIN SYSTEM

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

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ABSTRACT

Liquefied petroleum gas (LPG), a common household fuel is nowadays used by common people around the nation. But it produces significant risks not only in case of leakage, but also it is very difficult to predict when the gas cylinder will get over and to change with the new cylinder. The existing systems often rely on manual detection for leakage and real-time monitoring capabilities. Thus this project is proposed for the real-time monitoring of the gas level and also to detect the leakage of the gas by using weight detecting sensor (Load Cell) and with MQ2 sensor. When the gas reaches a reserved state, it alerts the user with an notification and also the automatic booking of the new cylinder can be carried out using IoT. Initially, a simple technique is used to determine the remaining gas level in the cylinder i.e. the normal weight of the full cylinder is programmed into the system. The weight of the gas remaining is then calculated by subtracting the current amount of gas from the stored value. Once the gas level reaches $3/4^{th}$ of its initial value this alerts the user by sending the alert message. When the gas is depleted completely the application books the cylinder automatically and notifies the user with the booking information. The real time usage levels are monitored and stored using ThingView. The stored information is displayed in the form of a graph, by which the user can be aware of the usage patterns by using a PWA (Progressive Web Application). Also, if any leakage occurs, it is detected using the MQ2 sensor, it alerts the user with a warning message as well as with the beep sound and it automatically shutdowns the regulator immediately. Thus, this project aims to improve safety for LPG users by providing a comprehensive and automated leak detection solution.

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LIST OF ABBREVATIONS

IoT	Internet of Things
IDE	Integrated Development Environment
LPG	Liquified Petroleum Gas
GSM	Global System for Mobile Communications
PCB	Printed Circuit Board
GND	Ground
NPM	Node Package Manager
HMR	Hot Module Replacement
SMS	Short Messaging Service
LCD	Liquified Crystal Display
MCU	Micro Controller Unit

CHAPTER 1
INTRODUCTION AND PROBLEM STATEMENT

1.1 INTRODUCTION

Liquefied petroleum gas, also referred to as liquid petroleum gas (LPG or LP gas), is a fuel gas which contains a flammable mixture of hydrocarbon gases, specifically propane, n-butane and isobutane. It can sometimes contain some propylene, butylene, and isobutene.

LPG is used as a fuel gas in heating appliances, cooking equipment, and vehicles. It is increasingly used as an aerosol propellant and a refrigerant, replacing chlorofluorocarbons in an effort to reduce damage to the ozone layer. When specifically used as a vehicle fuel, it is often referred to as autogas or even just as gas.

Varieties of LPG that are bought and sold include mixes that are mostly propane, mostly butane and, most commonly, mixes including both propane and butane. In the northern hemisphere winter, the mixes contain more propane, while in summer, they contain more butane. In the United States, mainly two grades of LPG are sold: commercial propane and HD-5. These specifications are published by the Gas Processors Association (GPA) and the American Society of Testing and Materials.

LPG is commonly used among the nation because of its following advantages

- They can be burnt directly.
- They can be transported easily through pipelines.
- They are clean fuels and do not give smoke when burnt.

- They give a lot of heat energy when burnt.

The common disadvantage of using the LPG is cost and safety. So enhance the safety and to prevent from gas leakage and accidents caused by it, from cooking to heating, underscores the importance of ensuring their efficient and uninterrupted supply by automatic booking of cylinder. Traditional methods of monitoring gas levels often suffer from inefficiencies and lack real-time insights, leading to inconvenience and potential safety hazards. Recognizing these challenges, this project introduces a novel solution that harnesses the power of advanced sensor technology and Internet of Things (IoT) connectivity to revolutionize gas cylinder management.

By integrating weight detecting sensors into the system, users can now monitor gas levels in real-time with unparalleled accuracy. This continuous monitoring not only ensures timely replenishment but also minimizes the risk of unexpectedly running out of gas. Furthermore, the implementation of IoT enables seamless communication between the gas cylinder and the user's smartphone, facilitating instant alerts and notifications when gas levels approach critical thresholds.

Moreover, the project goes beyond mere monitoring by incorporating intelligent features such as automatic cylinder booking. When gas levels drop below a predefined threshold and manual booking is not initiated, the system autonomously schedules a cylinder booking, thereby eliminating the need for user intervention and ensuring uninterrupted gas supply

Safety is paramount in gas handling, and this project addresses this concern comprehensively by integrating gas leak detection capabilities. Utilizing state-of-the-art MQ2 sensors, the system can promptly identify and respond to potential

gas leaks, mitigating the risk of accidents and safeguarding both property and lives. In the event of a detected leak, the system triggers immediate alerts, accompanied by audible warnings, and automatically shuts down the gas supply to prevent further escalation of the situation and also sends a waring message to the user's phone.

The project has its own software application where the user can monitor the gas level in real time and alerts the user in a mobile if any gas leak and low level of Gas detected so the user can know it by app wherever the user is. The app also has the feature of shut off the valve remotely through the app

This project represents a significant advancement in gas cylinder monitoring and management, offering a comprehensive and user-centric solution that enhances convenience, safety, and efficiency in gas handling. For residential use, the system's innovative features promise to redefine the way we interact with and manage gas cylinders, setting new standards for reliability and peace of mind.

1.2 PROBLEM STATEMENT

Traditional LPG gas cylinders pose significant safety risks due to leaks, fires, and explosions. These incidents can cause injury, property damage, and even fatalities. Manual shut-off valves require human intervention, which may be delayed or impossible in emergency situations. Manual gas level detection is impossible to determine the accurate gas level in a cylinder so it could lead to unexpectedly exhausted. Also manual booking of the gas cylinder may be delayed in some instances. The user can also forgets to turn off the gas valve in some circumstances which can be remotely done through the Application. So to overcome such issues this project has been developed.

1.3 PURPOSE OF THE PROJECT

The purpose of this project is to develop a comprehensive gas cylinder management system that addresses the inefficiencies and safety concerns associated with traditional monitoring methods. By leveraging advanced sensor technology, Internet of Things (IoT) connectivity, and intelligent algorithms, the system aims to provide accurate real-time monitoring of gas levels, automate the booking process for timely replenishment, promptly detect and respond to gas leaks, visualize consumption patterns for informed decision-making, enable users to manage all gas-related activities through a dedicated mobile application, and empower users to remotely turn off the gas valve manually for added safety and convenience. Additionally, the project aims to foster sustainability by optimizing gas usage and minimizing waste. Ultimately, the project seeks to revolutionize gas cylinder management, enhancing convenience, safety, efficiency, and environmental responsibility for users across residential sectors.

CHAPTER 2
LITERATURE SURVEY

2.1) DESIGN GAS LPG LEAK DETECTION SYSTEM BASED ON INTERNET OF THINGS

Author : Erika Lety Istikhomah Puspita Sari et al.(2023)

The document discusses the design of a Gas Leakage Monitoring System using IoT technology to prevent accidents caused by gas leaks. The system includes NodeMCU ESP8266, MQ-2 gas sensor, and Firebase for real-time data transmission. The advantage is reliable data transmission through Firebase connection tests ensures efficient operation. The drawback of the system dependence on internet connectivity may pose a risk if the connection is unstable.

2.2) INTELLIGENT LPG GAS LEAK DETECTION TOOL WITH SMS NOTIFICATION

Author: Muhammad Siddik Hasibuan et.al.(2019)

This research focus on LPG Gas Leak Detection Tool with SMS notification. The gas detection system provides early detection of LPG gas leaks, enhancing safety, SMS notifications to alert owners of potential gas leaks and buzzer alerts for immediate audible warnings, ensuring quick action in case of a leak. Drawback of this research on GSM network for SMS notifications may pose a challenge in areas with poor network coverage and sensor malfunctions or failures, leading to false alarms or missed detections.

2.3) IOT BASED LPG GAS LEVEL DETECTION & GAS LEAKAGE ACCIDENT PREVENTION WITH ALERT SYSTEM

Author: Zaw Lin Oo et.al (2021)

This research focuses on LPG gas monitoring and detection systems using the SmartGas platform, Arduino UNO R3 microcontroller, and MQ-6 gas sensor. The study aims to prevent gas leakage accidents by implementing gas detection and alert systems. The implementation includes load cell technology with an HX711 amplifier for gas level measurement and Twilio cloud API for SMS alerts. The disadvantage of the system is that it does not include a fire accident prevention system for gas leakage detection, which could be a critical safety feature to prevent potential hazards in case of a gas leak.

2.4) IOT BASED LPG GAS LEAKAGE DETECTOR

Author: Prof. Pranay Meshram et.al.(2019)

The system integrates an Arduino kit with components such as an MQ5 gas sensor, LED light, buzzer, and Wi-Fi module. By leveraging the IoT ecosystem, the system enables real-time monitoring and alerts for gas leaks. The system aims to prevent fire accidents and ensure household safety. It doesn't have any control measures when human is not available.

2.5) IOT-BASED LPG GAS LEAKAGE DETECTION AND PREVENTION SYSTEM

Author : Pushpendra Kumar Pateriya et.al.(2021)

The project focuses on developing a Smart Gas and Fire Detection System using Arduino, MQ-9, and ARM7 systems to prevent gas leakage incidents. Using using an exhaust fan to lower the concentration of gas and 16*2 LCD display for

the response of all sensors. The cons are risk of false alarms triggering unnecessary alerts and Risk of false alarms triggering unnecessary alert.

2.6) IOT BASED LPG LEAKAGE ALERTING AND ACCIDENT PREVENTION SYSTEM

Author: K.Sai Krishnaveni et.al.(2020)

The project aims to address the issue of gas leakage in industrial and residential settings by proposing a system that can detect, alert, and block electrical power supply. By cut off power the system minimizes the risk of gas explosions and fire incidents. The main drawback of this project human interaction to turn off the gas supply when the user is not available it may risk

2.7) IOT GAS LEAKAGE DETECTOR AND WARNING GENERATOR

Author: Bader Farhan Alshammari et.al.(2020)

This paper presents an industrial monitoring system design using the Internet of Things (IoT) for gas leakage detection. The system utilizes a gas sensor (MQ-5) to capture information and post it into a data cloud. Controlled by an Arduino (UNO-1), the system detects gas leakage and raises an alarm supported by an LCD display. The design includes a PCB with various components and a Wi-Fi connection for efficient data transmission. The system may have limitations in detecting gas leaks in certain environmental conditions.

2.8) GAS LEAKAGE DETECTOR AND MONITORING SYSTEM

Author: Yekini N. Asafe et.al.(2022)

This research project focuses on the development of a gas leakage detection and monitoring system using a microcontroller, gas sensor, GSM

module, LCD display, and buzzer. The system aims to enhance safety measures by detecting gas leaks and alerting users promptly. The software design involves coding in C++ on Arduino IDE. The gas leakage detection systems lack remote monitoring and automatic shutoff capabilities, which can delay response times in emergencies.

2.9) LPG MASS MONITORING SCALE WITH AUTOMATIC GAS LEAKAGE DETECTOR SYSTEM

Author: N N Mohd Noor et.al (2022)

The paper presents the development of an LPG Mass Monitoring Scale with Automatic Gas Leakage Detector System to enhance safety in LPG usage. The system utilizes sensors, microcontrollers, and SMS alerts to monitor gas levels and detect leaks. The main disadvantage of the system is the reliance on technology, which may fail or malfunction, leading to inaccurate readings or missed alerts. and the effectiveness may be limited in areas with poor internet connectivity or unreliable power supply, affecting its ability to send timely notifications.

2.10) LPG GAS LEAKAGE DETECTION USING IOT

Author: Arun Manhas et.al.(2021)

This paper presents a system that utilizes IoT technology for efficient gas leakage detection and alerting. The system includes NodeMCU, LPG gas sensor module, and buzzer. Implementation involves the integration of a stepper motor, GSM module, microcontroller, exhaust fan, LED, buzzer, and gas sensor module. Data monitoring can be done through a website or application, enabling timely responses to prevent potential hazards. This system aims to enhance safety measures and prevent accidents caused by gas leaks

2.11) LPG WEIGHT AND LEAKAGE MONITORING SYSTEM USING IOT

Author : Satyanarayana Kotha et.al.(2023)

This study presents a system for monitoring LPG gas weight and detecting leaks using IoT technology. The objective is to enhance safety by alerting users about gas leaks and low gas levels. The system offers a automated solution for continuous monitoring and safety measures in LPG gas usage. The disadvantages of the system include the initial cost of developing the system. Also the system may require periodic maintenance to ensure its continued effectiveness.

2.12) SENSOR-BASED GAS LEAKAGE DETECTOR SYSTEM

Author : Mohammad Monirujjaman Khan et.al.(2020)

The article discusses a sensor-based gas leakage detection system designed to automatically detect, alert, and control gas leaks using the MQ-6 gas sensor and Arduino UNO R3. Future work involves adding functions for monitoring gas usage and notifying emergency services.

2.13) SMART LPG GAS LEVEL DETECTION AND SAFETY SYSTEM USING IOT

Author: Rohith Naidu V(2020)

This project utilizes IoT technology to create a system that detects gas leakage and monitors LPG gas levels. It involves components such as NodeMCU, MQ2 gas sensor, load cell, and Firebase cloud integration. The system can be controlled through a mobile application and automatically shuts off the gas valve in case of a leak. The system's effectiveness may depend on regular maintenance and calibration to ensure accurate detection.

2.14) RECENT ADVANCEMENTS IN LIQUEFIED PETROLEUM GAS SENSORS

Author: K. Aishwarya et.al.(2021)

This research discusses the importance of gas sensors in detecting LPG leakage to prevent fire and explosion risks. It highlights the mechanisms involved in gas sensing, such as receptor and transducer functions. The use of doping materials like Al and Ni in SnO_2 is mentioned to enhance sensor sensitivity. Nano-heterojunction materials are identified as beneficial for reducing potential barrier height and improving sensor performance.Also it mentions the use of graphene composites with metal oxides to enhance sensor response. Ongoing research aims to improve gas sensor performance through various materials and methods, including perovskite structures and nanocomposites.

2.15) LPG GAS LEAKAGE MONITORING AND ALERT SYSTEM USING ARDUINO

Author: Ayesha Siddikaet.al.(2018)

The project focuses on the development of an LPG Gas Leakage Monitoring and Alert System using Arduino technology. The system aims to detect gas leaks, display alerts on an LCD, activate a buzzer, and send SMS notifications via a GSM module. The drawback of this project is additional gas sensors may be required to detect leaks at various levels in different settings, increasing complexity and cost and the system's reliance on GSM modules for communication may be network connectivity issues, affecting the timely delivery of alerts in case of gas leaks.

2.16) A CRITICAL REVIEW ON LPG GAS LEAKAGE DETECTION AND MONITORING SYSTEM

Author: Rosniza ramli et.al.(2021)

The paper explores the development and improvement of gas leakage detection and monitoring systems. Gas leakage detection systems have limitations such as sensitivity issues in detecting gas sources placed far away, especially in open areas. Factors like wind conditions can affect the accuracy of gas detection. Additionally, power outages can interrupt the system's functionality. Users may still need to manually turn off the gas valve in case of a leak if they are away from home, which poses a safety risk.

2.17) A REVIEW ON MICROCONTROLLER BASED LPG GAS LEAKAGE DETECTOR

Author: Vasudev Yadav et.al.(2016)

The paper presents a review on a Microcontroller based LPG Gas Leakage Detector system. It discusses the use of sensors with high sensitivity for gas detection, interfacing with microcontrollers for monitoring, and mobile communication for alerting. Various leak detection techniques are explored, emphasizing the importance of selecting suitable methods based on property protection goals and technological advancements. The study aims to enhance safety measures against gas leaks through advanced detection and notification systems.

2.18) AN IOT BASED FRAMEWORK OF LPG REAL TIME GAS LEAKAGE DETECTION AND CONTROLLING

Author: Sandeep Bhatia et.al.(2022)

The paper focuses on the development of a prototype for continuous

monitoring of LPG gas leakage using electronic sensors. Real-time data is transmitted over the internet using the Xively platform. MQ5 sensor is used for leakage detection. The system may have limitations in detecting gas leaks in certain conditions or environments. So maintenance and calibration of sensors and devices may be required to ensure accurate detection.

2.19) DESIGN & IMPLEMENTATION OF LPG GAS DETECTOR USING GSM MODULE

Author : Geetha Loshali et.al. (2017)

This project focuse on developing a gas detection and response system. The system incorporates features such as an alarm, status display, and automatic shut-off of the gas supply using solenoid valve to enhance safety measures. Various methods for detecting gas leaks, including SMS alerts, power and gas supply cut-off, and the integration of a GSM module. The drawbacks are dependency on power supply and maintenance required.

2.20) DESIGN OF AN AUTO DISCONNECTING REGULATOR AND SAFETY SWITCH TO PREVENT DOMESTIC GAS LEAKAGES

Author : R. M. I. U. Rajapaksha et.al.(2020)

This project highlights the importance of automated security systems in smart homes, focusing on the need for LPG fire security systems. The system includes an automatically disconnecting regulator, a control circuit for switching off power in case of gas leakage, and a transceiver unit for communication. Components such as gas sensors, microcontrollers, GSM modules, and Bluetooth modules are integrated to automate the system. The drawback of this project it reliance on technology such as Bluetooth and sensors may introduce potential points of failure.

2.21)DEVELOPMENT OF LPG LEAKAGE DETECTOR SYSTEM USING ARDINO WITH INTERNET OF THINGS(IOT)

Author : M.Abdul Hannan et.al.(2018)

The project focuses on developing a system for detecting LPG leakage using Arduino and IoT technology. The system incorporates a gas leakage sensor, Wi-Fi module, and Arduino microcontroller to send warning messages through email. By utilizing Internet of Things technology, the system enhances safety measures by alerting users about potential hazards of gas leaks. The system may not be suitable for areas with unreliable internet connectivity.

2.22) EARLY WARNING OF LEAKING LPG GAS THROUGH SHORT MESSAGE SERVICE (SMS) AND LOUDSPEAKER TOOL USING ARDUINO UNO

Author: Novi Rahayu (2020)

The research focuses on developing a Gas Leak Detection System using Arduino Uno and MQ-6 Sensor for gas leaks. The system includes features such as buzzer alarms, LED lights, speakers, and SMS notifications to alert homeowners in case of a gas leak. The system may have limitations in detecting gas leaks at longer distances also maintenance and calibration of the system may be required to ensure consistent performance.

2.23) GSM BASED GAS LEAKAGE DETECTION SYSTEM

Author: Ashish Shrivastava et.al.(2013)

This paper introduces a design utilizing a gas sensor to automatically detect and prevent gas leaks. The system includes components such as the MQ-6 gas sensor, microcontroller, stepper motors, buzzer, LCD, GSM module, and RF link. Upon detecting gas leakage, the system activates external devices, sends

alerts via SMS, and shuts off gas supplies. The system also incorporates stepper motors to control power and gas supplies. RF transmission is used for communication, and the GSM module allows for multiple SMS alerts to be sent. Gas leakage detection systems may not always respond to low gas concentrations.

2.24) GSM-BASED LPG (LIQUIFIED PETROLEUM GAS) LEAKAGE DETECTION AND ALERT SYSTEM

Author: Wildan Abdullah et.al.(2023)

The system utilizes the MQ-6 sensor for gas leakage detection and provide warnings to users through SMS and cellular calls. Additional features include monitoring gas levels and GSM credit balance. Implemented using Arduino Mega 2560.

2.25) HOME AND INDUSTRIAL SAFETY IOT ON LPG GAS LEAKAGE DETECTION AND ALERT SYSTEM

Author: Zainal H. C. Soh et.al.(2019)

This project focuses on developing a gas leakage monitoring system using IoT technology to detect and alert homeowners about potential gas leaks. Various sensors, including MQ-2 gas sensor, are utilized to monitor gas levels and send alerts via SMS to mobile devices. The drawbacks are dependency on internet, limited interface complexity and maintenance.

CHAPTER 3
SYSTEM ANALYSIS AND PROPOSED SYSTEM

3.1 EXISTING SYSTEM

The existing system provides the minimal safety measures, but it won't be a solution for the problem caused by the gas leakage. The safety measures which are provided by the existing system like switching on the exhaust fan, shut down the entire current supply of the house, opening the windows etc… But these can't be the permanent solution for the problem and moreover this can leads to the wastage of the LPG since the existing system concentrates more to avoid the explosion but it doesn't controls the leakage. The system integrates gas sensors capable of detecting LPG concentrations, a microcontroller unit for data processing and decision-making, and a communication module for transmitting data to a central monitoring unit or cloud platform. Upon detecting abnormal gas levels, the system triggers alerts via SMS, email, or push notifications to notify users or relevant authorities, enabling prompt action to mitigate potential risks. A user-friendly interface, accessible via a mobile application or web dashboard, allows users to monitor the LPG system status in real-time, access historical data, and manage alerts remotely. Through its robust hardware and software components, the proposed system enhances safety, optimizes LPG usage, and provides peace of mind to users in residential environments.

3.1.1 DISADVANTAGES

- Leak detection methods have drawbacks such as long detection times for external techniques.
- Mathematical model-based systems may not perform well at low flow rates.

- Some technologies may require further development to address issues like explosion protection and legal considerations.
- Potential for gas leakage leading to explosions and fire hazards.
- Relies on continuous power supply for operation, may fail during power outages.
- Regular calibration and sensor replacement needed for accurate detection.
- Gas sensor MQ-6 has a range of 800-5000 ppm, may not detect lower gas levels.

3.2 PROPOSED SYSTEM

This project aims for the real-time level monitoring of the household LPG cylinder by using weight detecting sensor (Load Cell) and when the gas reaches a reserved state, it alerts the user with an pushover notification and also the automatic booking of the new cylinder can be carried out using IoT. Initially, a simple technique is used to determine the remaining gas level in the cylinder i.e. The normal weight of the full cylinder is programmed into the system. The weight of the gas remaining is then calculated by subtracting the current weight from the stored value. Once the gas level reaches $3/4^{th}$ of its initial value this alerts the user by sending the alert message. When the gas is depleted completely the application books the cylinder automatically and notifies the user with the booking information. The real time usage levels are monitored and stored using thingview. The stored information is displayed in the form of a graph, by which the user can be aware of the usage patterns by using a PWA (Progressive Web Application). Also, if any leakage occurs, it is detected using the MQ2 sensor, it alerts the user with a warning message as well as with the beep sound and it automatically shutdowns the regulator immediately. Thus, this project aims to improve safety

for LPG users by providing a comprehensive and automated leak detection solution. Moreover the overall safety measures are improved in this project when compared with the existing ones. Here the entire system gets automated and therefore no human intervention would be required this shows that it can able to reduce the risks for explosions within the household environment.

3.2.1 ADVANTAGES OF THE PROPOSED SOLUTION

- **Enhanced Safety**: By continuously monitoring LPG levels and detecting leaks in real-time, an IoT-based system significantly enhances safety by minimizing the risk of fire or explosion due to gas leaks.
- **Early Detection of Leaks**: IoT sensors can detect even minor leaks promptly, allowing users to take immediate action to address the issue before it escalates into a potential hazard.
- **Remote Monitoring and Control**: Users can remotely monitor LPG levels and system status via a mobile application or web dashboard. They can also receive alerts and take necessary precautions, even when they are away from the premises.
- **Optimized Resource Management**: By accurately measuring LPG consumption and providing insights into usage patterns, an IoT-based system enables users to optimize resource management, avoid wastage, and plan refills more efficiently.
- **Cost Savings**: Through better resource management and early leak detection, an IoT-based system can lead to cost savings by reducing LPG consumption, minimizing repair costs associated with leakages, and avoiding potential property damage.

- **Environmental Benefits**: Reduced LPG consumption and leak prevention contribute to environmental sustainability by minimizing greenhouse gas emissions and preventing soil and water contamination.
- **User Convenience**: The user-friendly interface of IoT applications allows users to easily monitor and manage their LPG systems from anywhere, eliminating the need for manual intervention and enhancing overall convenience.
- **Compliance with Regulations**: IoT-based systems can help users comply with safety regulations and standards related to LPG usage by providing continuous monitoring and documentation of system performance.
- **Scalability and Flexibility**: IoT-based solutions are highly scalable and adaptable to various environments and user requirements. Additional sensors or features can be easily integrated into the system as needed.
- **Peace of Mind**: With constant monitoring and proactive alerting, users can enjoy peace of mind knowing that their LPG systems are being monitored and managed effectively, reducing stress and anxiety related to safety concerns.

CHAPTER 4

SYSTEM DESIGN

4.1 PROPOSED ARCHITECTURE

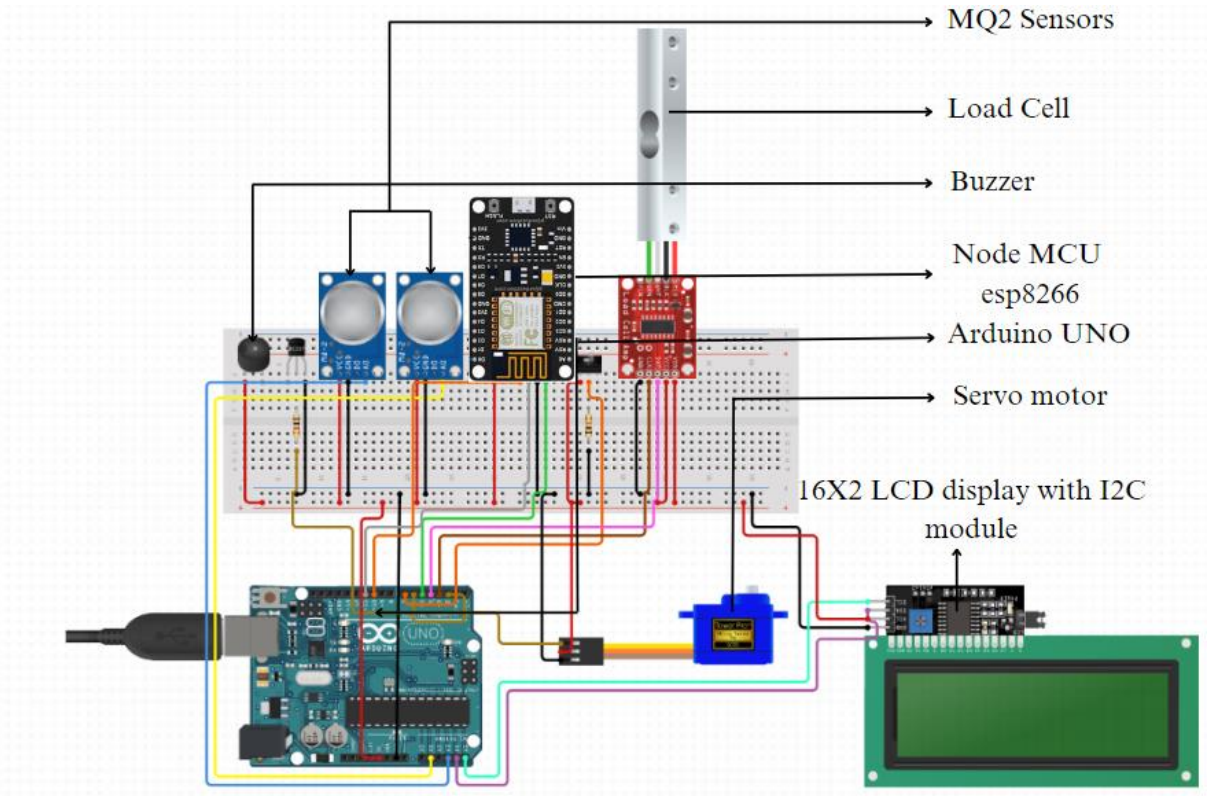

Fig 4.1 Architecture Diagram

4.2 ARDUINO UNO R3:

The Arduino uno is a one of the micro controller band based on ATMEGA328. The Arduino board is started at interaction design institute ivera and invented by Massimo Benzi in Italy. This Arduino controller board consist of number of input, output, ground and power supply pins. Arduino board is easily connected to pc with the help of a USB cable, and give the supply using AC-DC adapter or a battery to get started. It has 14 digital input/output pins and it has a 16MHZresonator, a USB connection, power jack. The Arduino is software based

project and it has printed circuit board, we can easily interface Arduino with other electronic components according to our use and it is also low cost. The Arduino board is started at interaction design institute ivera and invented by Massimo Benzi in Italy. It also provide on board storage.

Fig 4.2 Arduino UNO R3

4.4 Node MCU:

Node MCU is an open-source firmware and development kit. It includes firmware that runs on the ESP8266 Wi-Fi SoC from espress if Systems, and hardware which is based on the ESP-12 module. ESP8266 comes up with 2 switches one is reset and flash button. It has 4 power pins VIN pin for input power supply, three 3.3V pins for output power supply and 3 GND pins. Esp8266 Node MCU has 17 GPIO pins and 2 UART interfaces, i.e. UART0 and UART1 for asynchronous communication. There are three control pins on the esp8266, The enable pin (EN), the reset pin (RST) and the wake pin. ESP8266 chip works when the enable pin is high. When the enable pin is low, the chip works on minimum power. Reset pin is used to reset the chip. The TX pin of this is connected with RX of arduino uno and RX is connected with TX of arduino for data transfer.

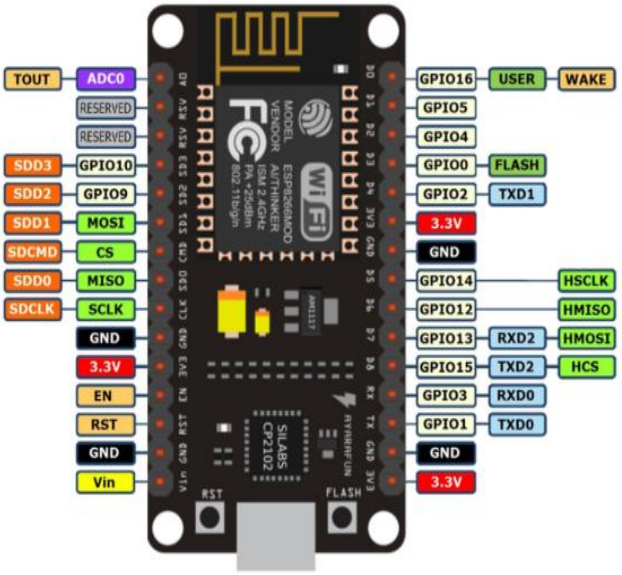

Fig 4.4 Node MCU

4.5 MQ2 Sensor:

The MQ sensor full form typically refers to "Methane/CH4 Quality Sensor". MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.It is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

Fig 4.5 MQ2 Sensor

4.6 SERVO MOTOR:

Servo motors are devices that can rotate to a specific angle or position. They can be used to move robotic arms, steering wheels, camera gimbals, etc. Servo motors have three wires: power, ground and signal. The power wire is usually red and should be connected to the 5V pin on the Arduino board. The ground wire is usually black or brown and should be connected to a ground pin on the board. The signal wire is usually yellow or orange and should be connected to a PWM pin on the board. It works like this: The microcontroller sends out PWM signals to the servo, and then the embedded board in the servo receives the signals through the signal pin and controls the motor inside to turn. As a result, the motor drives the gear system and then rotates the shaft after deceleration.

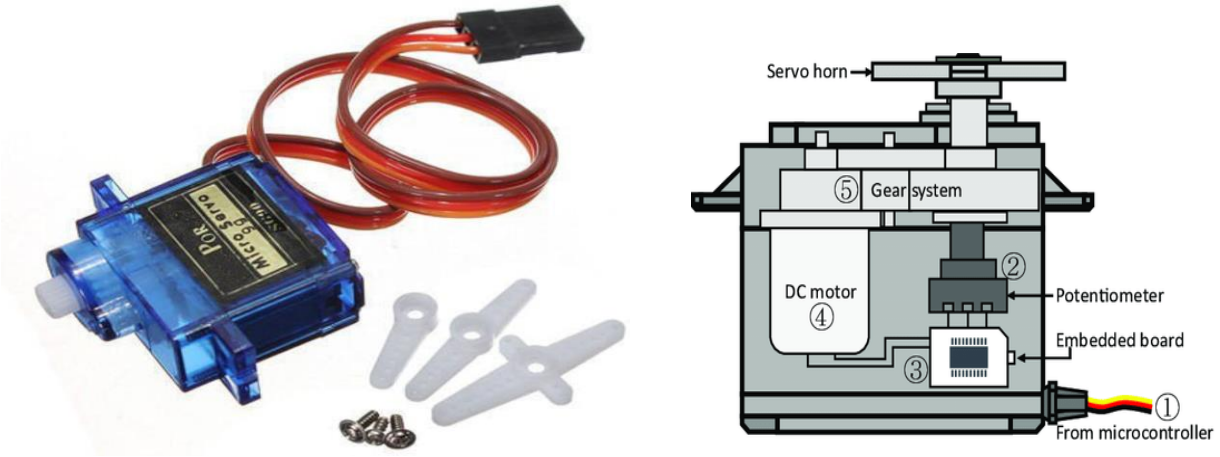

Fig 4.6 Servo Motor

4.7 16x2 LCD DISPLAY WITH I2C MODULE:

A 16×2 LCD display is a liquid crystal display that can show 16 characters in each of its two rows, providing a total of 32 characters of information. It's commonly used to display alphanumeric information in various electronic devices. I2C Module has a inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. The I2C module has a contrast adjustment pot on the underside of the display. This may require adjusting for the screen to display text correctly. I2C Module is a parallel to serial converter compatible with LCD2004 and LCD1602. By using this module, LCD can be interfaced with using only 2 wires.

Fig 4.7 16x2 LCD Display with I2C module

4.8 LOAD CELL:

A load cell is a transducer device specifically designed to measure the force applied to it, converting the mechanical force into an electrical signal, typically in the form of voltage or current. Load cells are widely used in various industries for weighing, pressure measurement, and structural monitoring applications. They are crucial components in industrial weighing systems, providing accurate and reliable weight readings for different types of equipment and material. Load cell specifications include accuracy, capacity, linearity, sensitivity, temperature

range, material, and construction. These factors ensure the device's performance and reliability in different environments and applications.

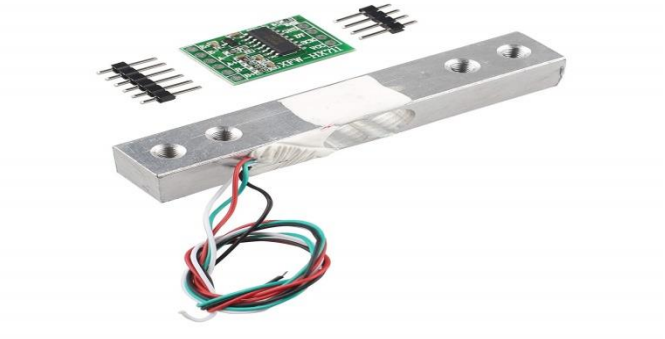

Fig 4.8 Load Cell

4.9 BUZZER:

Passive buzzer it consist of 3 male header pins. It generate tones between 1.5 to 2.5kHz by switching it on and off repeatedly at different frequencies either using delays or PWM. A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short).It consist of 3pins ground (GND), signal(IN) and power(VCC).

Fig 4.9 Buzzer

CHAPTER 5

SYSTEM REQUIREMENTS

5.1 HARDWARE SPECIFICATIONS

- **CPU** **:** Intel core I3 – 1115G4 @ 3.00GHz 3.00 GHz
- **Operating System:** Windows 8 or above
- **RAM** **:** Minimum 4GB
- **Hard Disk** **:** Minimum 256 GB

5.2 SOFTWARE SPECIFICATIONS

- Node Package Manager (NPM)
    - React JS
    - Firebase CLI
- Arduino IDE
- Visual Studio Code

CHAPTER 6
SYSTEM IMPLEMENTATION

6.1 MODULE DESCRIPTION

- Gas Leakage Detection
- Real-time Weight Monitoring

6.1.1 Gas Leakage Detection:

The gas leakage detection module is designed to ensure comprehensive safety measures against potential gas leaks. It incorporates an MQ2 sensor known for its sensitivity to various gases such as LPG, propane, methane, and smoke. Upon sensing an increase in gas concentration ranging from 200 to 10000 ppm beyond the predetermined threshold, indicative of a potential leak, the module triggers an alarm sequence. The buzzer emits a loud audible alert to user, To take a prevention from the accident, drawing immediate attention to the presence of hazardous gases. Simultaneously, it turn off the gas regulator to cut off the gas connection and the GSM module sends warning messages to designated recipients, including the user, providing real-time notifications about the detected gas leak.

These messages contain crucial information regarding the type of gas detected, and recommended safety measures to follow. With its multi-layered approach to gas leak detection and alerting, this module offers a robust solution for ensuring the safety and well-being of occupants in residential, commercial, and industrial settings.

6.1.2 Real-time Weight Detection

This is the primary load cell sensor used for detecting the weight or mass of the LPG gas cylinder. a load cell i.e. weight sensor will be kept below the LPG cylinder. Load cells are devices that convert force or weight into an electrical signal. In this case, the load cell measures the weight of the LPG gas cylinder, which decreases as the gas is consumed. The output signal from the load cell is usually very low and needs to be amplified and conditioned for further processing. An amplifier or signal conditioner is used to increase the strength of the signal and make it suitable for processing by the microcontroller or other digital components. microcontroller convert the digital weight reading into the normal weight and analyze whether the weight value is higher than the minimum value or lower than the minimum value, if it is lower than the minimum weight value then it sends the user a notification about a low Gas level.

The weight detected in the load cell will be processed and the weight will be displayed in LCD screen and The Arduino code reads the weight data from the load cell via the HX711 module and convey to the user as a notification. The LCD screen should display the corresponding LPG level, and the GSM module should successfully send real-time notifications to the user's mobile phone.

6.2 SOFTWARE SPECIFICATIONS

This system uses a number of frameworks which are integrated together to perform a unified system

6.2.1 Platform and Language:

The technology that we chose is React.js. It is a popular JavaScript library for building user interfaces, developed by Facebook. It is renowned for its component-based architecture, which allows developers to break down complex UIs into smaller, reusable components. React.js utilizes a virtual DOM (Document Object Model) to efficiently update and render UI components, resulting in improved performance and a seamless user experience. Additionally, React.js promotes the use of declarative programming, enabling developers to describe the desired UI state and allowing React to handle the underlying logic of updating the DOM.

Node Package Manager(npm) is a widely used package manager for JavaScript, primarily known for its role in managing dependencies and packages for Node.js applications. It serves as a central repository for thousands of packages and libraries that developers can easily integrate into their projects.

When it comes to using npm with React.js, npm plays a crucial role in managing React.js dependencies and project setup. Developers can use npm to install the React.js library along with any additional packages or tools required for their React provides various utility libraries for state management or routing. npm simplifies the process of setting up a React.js development environment by providing easy access to these essential tools and libraries, empowering developers to quickly bootstrap new projects and focus on building innovative UIs.

React.js, when utilized in the context of Progressive Web Applications (PWAs), offers a modern, responsive, and engaging web experiences. With its component-based architecture and virtual DOM rendering, React.js enables developers to build PWAs that deliver a native app-like feel on the web. Features such as service workers for offline caching, push notifications for re-engagement, and responsive design principles for seamless usability across devices

Thingview is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to Thingview from your devices, create instant visualization of live data, and send alerts.. Here the analog data from the hardware source is first sent to the nodeMCU 8266 and then using this nodeMCU the data is further transferred to the thingview database which can be visible to the user with their own login credentials.

Another notable feature of Thingview is that it can be helpful to monitor the real-time usage of the LPG with the help of a graph, also when there is any leakage discovered the pushover notification is triggered to the user’s personal mobile. And this application makes them to monitor the usage patterns and the leakage from remote places.

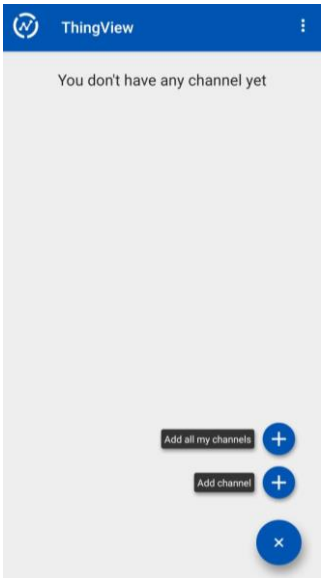

Fig. 6.1 Login Page

This is the login page of the thingview application in which the user can add his/her own channel with the help of their own login credentials which they have been created for their real-time monitoring of LPG.

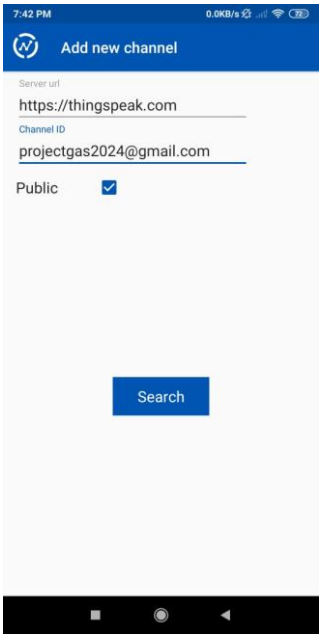

Fig. 6.2 User Creation

This image describes the login credential of the user which was already created by the admin to enter into the application.

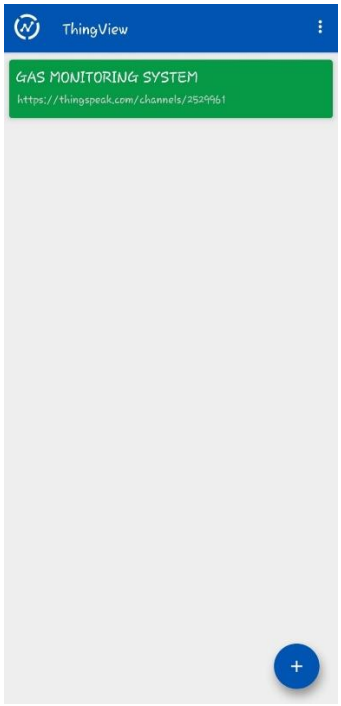

Fig. 6.3 Getting into the channel

The above screenshot describes the page after entering the login credentials of the user in which their database was included with the entire integration of the hardware modules.

CHAPTER 7

RESULTS AND DISCUSSION

7.1 SNAPSHOT

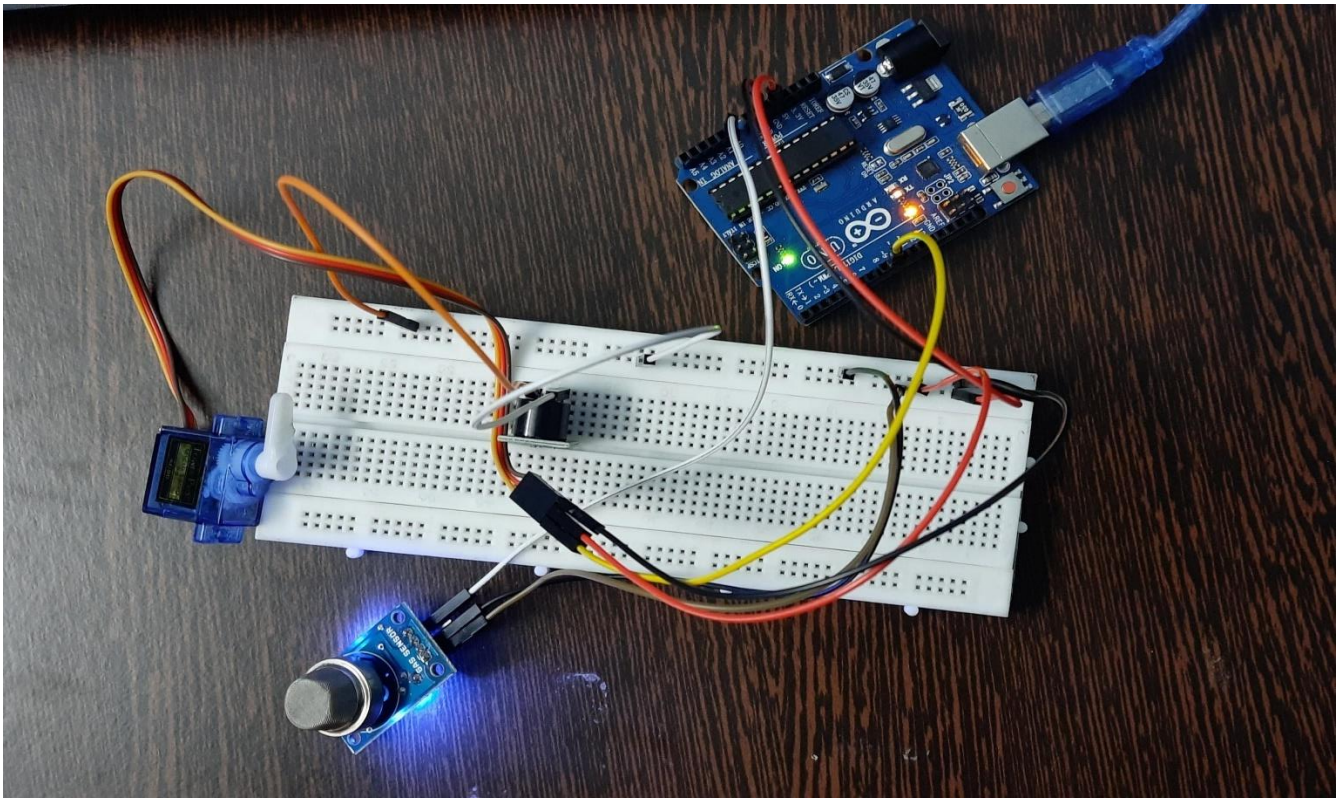

Fig 7.1 LPG Leakage Controller

The figure shows the LPG leakage controller. A continuous monitoring device used to monitor that if there is any leakage present from the connection, if any leakage gets detected then the servo motor which is connected here will turns off the regulator of the cylinder to avoid any risk.

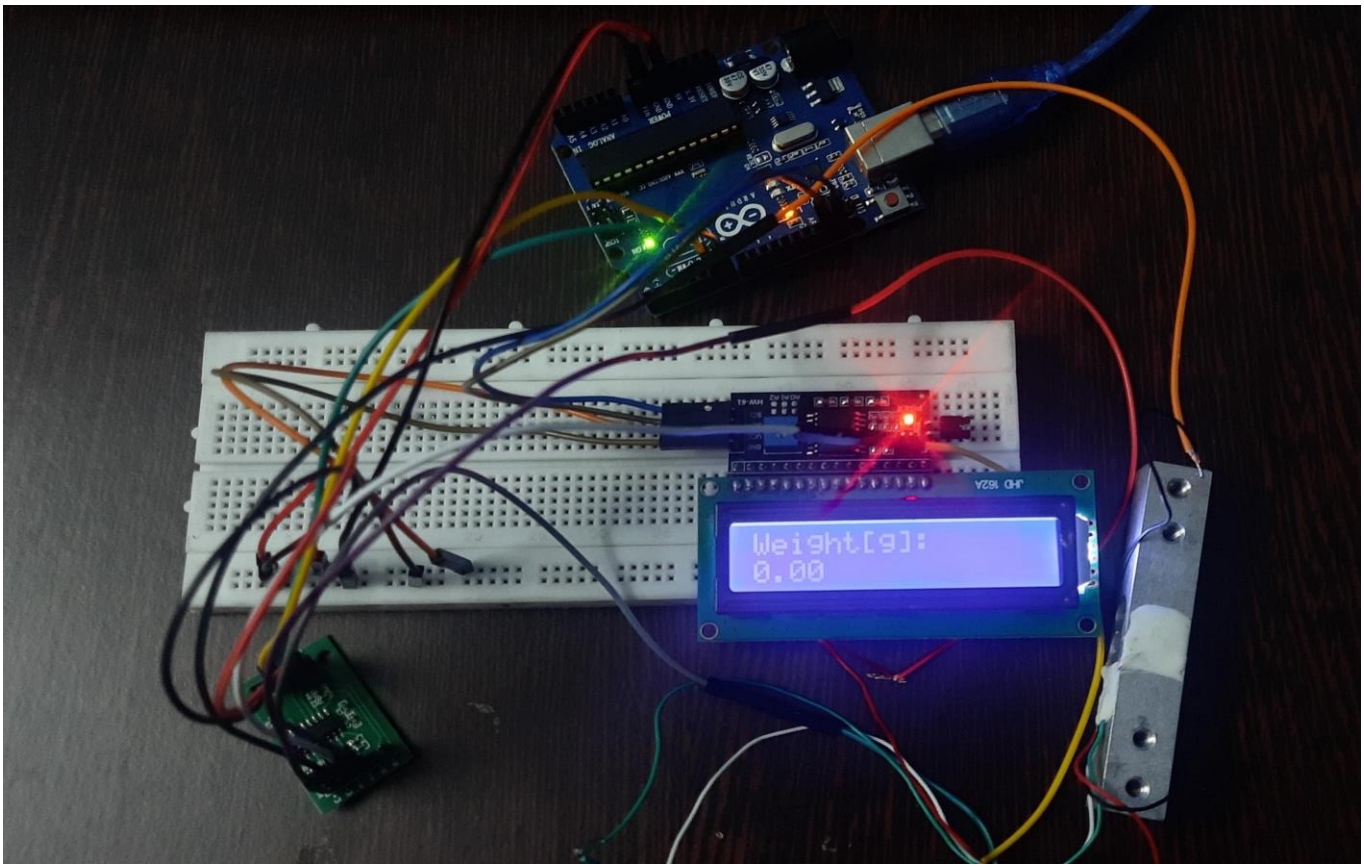

Fig 7.2 Real-time weight monitor

The above figure describes the real-time gas level monitoring. Here the load cell which is connected to the system will continuously monitors the weight of the cylinder and intimates the user by displaying the available gas percentage by the LCD display as well as the application which is connected with this system.

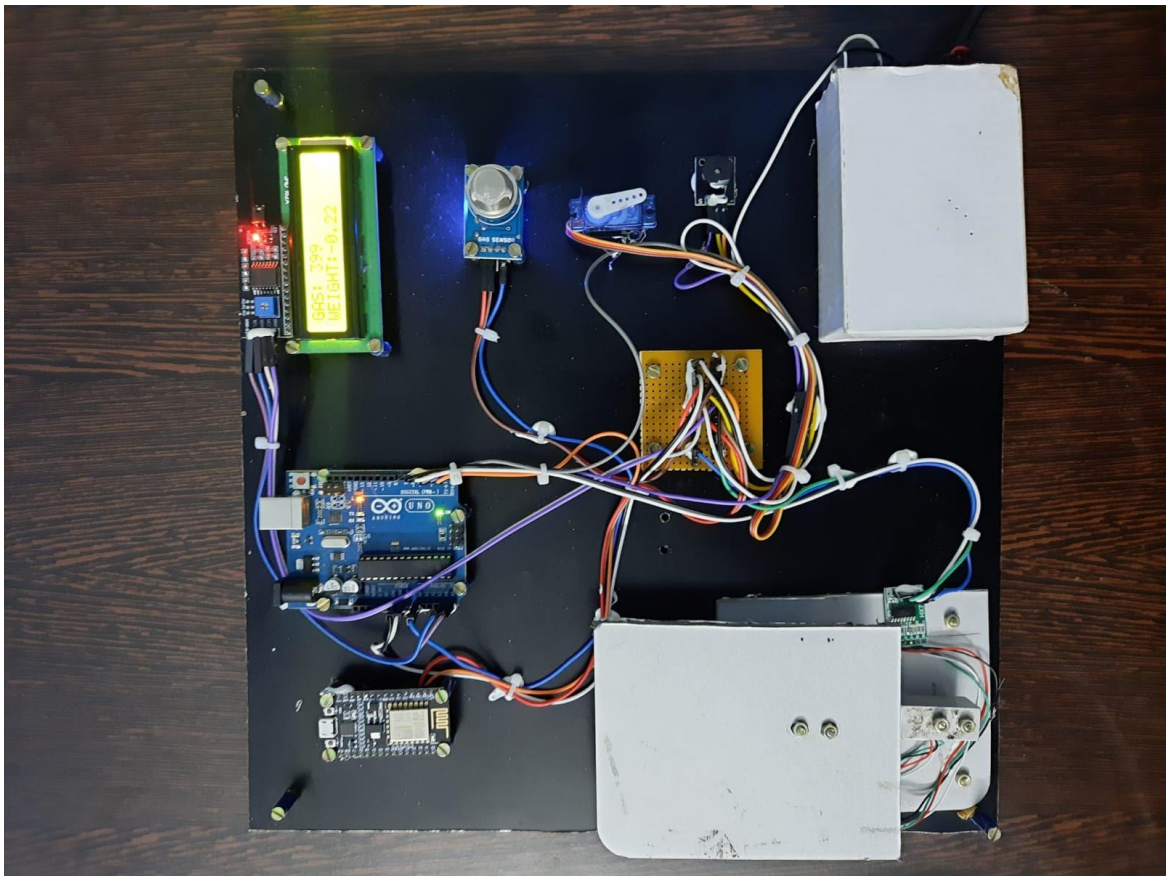

Fig. 7.3 Hardware Result

The figure shows the LPG gas monitoring system which includes weight monitoring, leakage control. This system is tested with the different weights of the objects to determine the exact weight levels and also an accurate results have been provided and the leakage module also checked accordingly with the consideration of the atmospheric air concentrations and it also works accordingly.

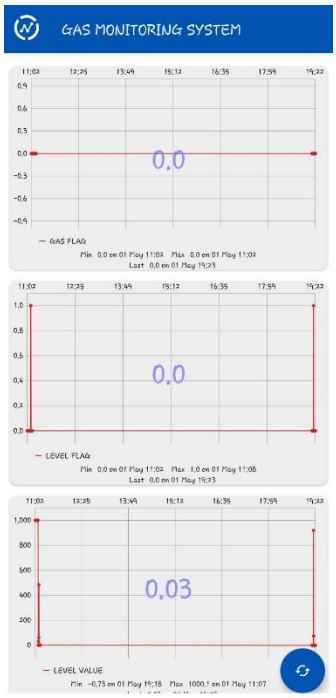

Fig 7.4 Dashboard of the application

This snapshot describes the real-time monitoring of the LPG. The three graphs described here is the three fields as gas, level and level value. Gas flag describes whether the gas is discovered by the module if the value given is 1 then it states that it is not working the value 0 stats that it is working properly. The level flag given here mentions whether the cylinder is placed or not using the values 0 and 1 as previous flag. The level value describes the real-time usage of the gas.

CHAPTER 8
CONCLUSION AND FUTURE ENHANCEMENT

8.1 CONCLUSION

A real-time monitoring system is developed to provide clearer and point-to-point perspective for the household gas connection. This system displays the available gas percentage with the help of monitoring unit; it will be more helpful for the users to identify the remaining gas percent and also the system is designed for the automatic booking of a new cylinder when it gets exhausted completely and also it will intimate the user using the application and a message is sent to the user as pushover notification. And here the special feature which is included for the safety measure is that it continuously monitor for the leakage and if any leakage is found with the help of MQ2 sensor then the servo motor which is connected with the regulator valve will automatically gets closed and therefore no gas van flow through the system and it will be more helpful to avoid explosions. This system also stores all the data in the computer for future inspection.

8.2 FUTURE ENHANCEMENT

In the future, the development of a real-time monitoring system for LPG gas and leakage detection using IoT technology coupled with a Progressive Web Application (PWA) holds immense potential for enhancing safety and convenience in both residential and commercial settings. Future enhancements to this system could include the integration of advanced machine learning algorithms for predictive analytics, enabling the system to forecast potential gas leaks or equipment failures based on

historical data and environmental factors. Additionally, incorporating artificial intelligence (AI) techniques for anomaly detection and pattern recognition can further enhance the system's ability to accurately identify and mitigate safety risks in real time.

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