A
Project Report
On

Design and Development of Smart LPG Stand

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING

by

Ayush Deshmukh
Abhishek Wankhade
Amit Varma
Aniket Kalore
Kartik Ghatmal

under the guidance of

Prof. P T Patokar

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon-444203 (M.S.)
(Recognised by AICTE, accredited by NBA, New Delhi, NAAC, Banglore & ISO 9001:2000)
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Certificate

This is to certify that the project report entitled **"Design and Development of Smart LPG Stand"** is hereby approved as a creditable study carried out and presented by

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Acknowledgement

It is our utmost duty and desire to express gratitude to various people who have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement and help provided to us by then. There are a number of people who deserve recognition for their unwavering support and guidance throughout this report.

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We would like to thank all teaching and non-teaching staff of the department for their cooperation and help. Our deepest thank to our parents and friends who have consistently assitted us towards successful completion of our work.

– Projectees

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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 has led 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 implementation 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

Contents

List of Figures

List of Tables

Chapter 1

INTRODUCTION

1.1 Overview :

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. Almost everyone estimates the quantity of gasoline in the cylinders by lifting it or igniting the fuel with a burner. Both are unreliable and imprecise methods of determining the amount of gasoline in cylinders. By utilizing a load sensor as a key component, this system communicates the quantity of gasoline existing in the cylinder to the outside world via an LCD.

The primary purpose of identifying the amount of gasoline is to book a cylinder when the gasoline in the cylinder runs out. This technique has the benefit of not requiring the user to constantly monitor the amount of fuel. Every user will be able to set their limit. When the gasoline reaches the limit, it sends a warning to the user, informing them that their fuel is about to run out and that they should book a new cylinder. The majority of LPG mishaps are caused by gas leaks, which can cause explosions if not detected.

The Internet of Things (IoT) has transformed the way we interact with the physical world. It has enabled the creation of smart systems that can monitor and control various processes in real-time. One such application is the monitoring of gas leakages, which is crucial for ensuring the safety of households and commercial buildings. Gas leakages can lead to fatal accidents, including building fires, suffocation, and explosions. Therefore, it is essential to develop a system that can detect gas leakages with precision and accuracy and alert the customers in real-time.

In this paper, we present an IoT-based system that monitors gas leakages in LPG cylinders with great precision and accuracy. The proposed system consists of a smart stand for LPG cylinders that continuously monitors the weight of the cylinder, detects gas leakages, and sends an SMS notification to the customer in case of a gas leakage. The system uses various hardware components such as MQ-2 gas sensor, load cell,

buzzer, LED, exhaust fan, GSM, wireless relay, and a microcontroller to detect gas leakages and notify the customer. The system also incorporates a cloud-based mobile application called Blynk App to display the output of the monitored parameters in real-time.

The proposed system addresses the problem of gas leakages, which can cause severe accidents, by providing a diligent monitoring system that detects gas leakage with precision and accuracy. The system is designed to continuously monitor the gas leakage and weight of the LPG cylinder, ensuring that the customer is alerted in real-time. The load cell measures the weight of the cylinder and displays it on the Blynk App, helping the customer know when to replace the cylinder. The MQ-2 gas sensor detects gas leakages and triggers the alarm circuitry using a buzzer and LED. The wireless relay controls the exhaust fan to remove any gas leakage, and the GSM module sends an SMS to the customer to alert them about the gas leakage.

The proposed system is built using an embedded system, which uses a microcontroller and sensors to monitor gas leakage and the weight of the LPG cylinder. The system comprises several hardware components, including an Arduino UNO, Node MCU, load cell, MQ2 gas sensor, buzzer, LED, exhaust fan, GSM, DC adapter, wireless relay, and RF module. All these components are connected to the Arduino UNO, which is programmed to monitor the cylinder's weight and detect gas leakage.

The 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.

1.2 Background and Significance of the Problem :

LPG is one of the clean fuels. It is most widely being used in India. It is being used for household purposes as well as for industrial purposes also. In case of household use it is mostly used in kitchen for cooking, whereas in case of industrial purpose it is being used in various industrial processes such as gas cutting, gas welding, metallurgical industries, steel plants, glass cutting, pharmaceutical industries and many more. Apart from this the gas cylinders are also used in schools, colleges, hospitals, hotels and restaurants and many other places. In the past years the demand for use of LPG has

increased sustainably and will continue to rise. But with the increase in demand for use of LPG the rate of accidents caused due to it have also increased in the past few years. The majority of the accidents are due to the explosion of LPG cylinders. But, sometimes a very small quantity of gas leakage is unnoticed and is responsible for the further major accident. This project discusses the solution to it. The other problem which is faced by the users of LPG cylinder is the untimely emptying of the cylinder. We have used the Blynk App in this project.

Liquefied Petroleum Gas (LPG) cylinders are widely used in the Indian subcontinent, with increasing demand in rural areas and the industrial sector. However, LPG is a highly flammable gas, and gas leakages can lead to accidents, such as building fires, suffocation, and explosions. There have been numerous cases of accidents due to LPG cylinder explosions, some of which were caused by negligence in detecting gas leakage. Monitoring gas leakage requires continuous diligence and attention. To address this problem, an Internet of Things (IoT) system is proposed that monitors gas leakages with great precision and accuracy.

1.3 Aims of research work study :

The purpose of 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.

1.4 Objectives and scope of the work :

The main objectives of this study 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
- Monitor the weight of the LPG cylinder and inform users when it needs to be replaced
- Evaluate the performance of the system through testing and analysis

1.5 Organization of the Project :

The project report is organized into several sections. The first section is the introduction, which provides an overview of the project, the problem statement, the objectives, and the methodology.

The second section is the literature review, which defines IoT and its applications, reviews previous studies on gas leakage detection systems and LPG cylinder monitoring systems, and discusses similar systems that use embedded systems and Blynk app. It also discusses the advantages and limitations of the proposed system.

The third section is the methodology, which describes the components used in the system, provides a detailed explanation of the system design and block diagram, describes the software used, and explains the testing process and results

The fourth section is the results and discussion, which presents the results, analyzes and interprets them, and discusses their implications and how they relate to the objectives and research question.

The fifth section is the conclusion and future work, which summarizes the study and its contributions, discusses the limitations and recommendations for future research, and explains the implications of the study for practical applications.

The sixth section is the references, which lists the sources cited in the paper.

The seventh section is the appendices, which includes diagrams, tables, or other supporting materials, as well as code snippets or other technical details that could not be included in the main text.

Chapter 2

LITERATURE REVIEW

2.1 Introduction :

A. Definition of IoT and its applications

IoT stands for the Internet of Things, which refers to a network of devices that are connected to the internet and can communicate with each other. IoT has various applications in industries, homes, and cities.

B. Review of previous studies on gas leakage detection systems and LPG cylinder monitoring systems

Several gas leakage detection systems and LPG cylinder monitoring systems have been developed in the past. However, most of these systems are not reliable and accurate.

C. Review of similar systems that use embedded systems and Blynk app

There are several similar systems that use embedded systems and the Blynk app. These systems are effective and reliable in detecting gas leakage and monitoring LPG cylinder level.

D. Discussion of the advantages and limitations of the proposed system

2.2 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?

2.3 Conclusion drawn from literature review :

The proposed system has several advantages such as real-time monitoring, automatic alerts, and ease of use. However, the system may face limitations such as false alarms and limited range.

2.4 Scope of this research work :

The scope of this research work is to design and develop a smart stand for LPG gas cylinders that can effectively monitor gas leakage and cylinder weight to ensure the

safety and convenience of users. The proposed system makes use of embedded system technology and IoT to detect gas leakage and send alerts to users via SMS. It also monitors the weight of the LPG cylinder and provides real-time updates on the cylinder status through a Blynk app. The smart stand for LPG gas cylinders has the potential to significantly reduce the risks associated with gas leakage and untimely cylinder exhaustion. The system can be used by households and small businesses that rely on LPG cylinders for cooking and heating purposes. Moreover, the use of IoT technology allows for remote monitoring of the system, making it convenient for users to keep track of their LPG cylinder status.

Further research could explore the integration of additional sensors or features that can enhance the functionality of the smart stand, such as temperature sensors or automatic cylinder replacement systems. Additionally, the system could be adapted for use in other industries where gas leakage monitoring is critical, such as the oil and gas sector.

1. In paper [1] "Iot Based Smart Gas Management System", In this paper the system deals with three major issue gas leakage detection fire detection and automatic booking of gas cylinder this system makes use of gas sensors , fire sensors and load cell to detect the gas leakage , fire and continuously monitor the amount of gas in cylinder respectively , buzzers starts beeping on detection of gas leakage of fire .

2. In paper [2] "LPG Leakage and Flame Detection with SMS Notification and Alarm System" Mon Arjay E they have developed a system that can detect gas smoke and flame from the lpg cylinder and can notify the owner via the text messages applying rule based approach .The System can display also a warning messege and can alaram the owner using a buzzer. The unit can Detect the gas smoke and flames from the lPG tank and can alert the owner using a text messege the components used are aurdino mega flame sensir mQ2Gas Sensor , GSM Module LCD module buzzer the systemws placed beside the lpg cylinder the Components were placed in box Where all the modules can be mounted and placed properly .

3. In paper [3] "Smart LPG Cylinder Monitoring and Explosion Management System" The paper focuses on complete monitering of the weight level of the LPG cylinder and checks for LPG leakage from the cylinder utilise measured signal from the load cell and the MQ 6 gas sensor various integration have been provision namely 16*2 LCD to LED is a mobile application the 16*2 LCD 2 display the weight of the

cylinder and the percentage of the LPG remaining inside the cylinder. Before it is the Red Light LED and Green control LED and Red will indicate the level of the LPG in the cylinder is low and green LED for vice versa mobile application is used for the user to lively view the matrics that are measured by the sensors. The DC gear motor with 15 RPM is couple with the LPG cylinder regulator which will turn the position to of state when any LPG detected by the MQ 6 sensor.

4. In this paper [4] "Model-based gas leakage detection and isolation in a pressurized system via Laguerre spectrum analysis" Johansson, A the gas leakage detection system is designed using PIC microcontroller. The gas weight sensor is used to measures the weight of cylinder. The gas detection sensor is used to detect gas leakage if any. In case of gas leakage exhaust fan is turned on. The Max232 is used to interface GSM to microcontroller, buzzer indicates gas leakage.

Chapter 03

METHODOLOGY

3.1 Methodology :

The proposed gas leakage detection and LPG cylinder monitoring system has the potential to provide a reliable and efficient solution to ensure the safety of households and industrial setups. This system makes use of the IoT technology which is rapidly gaining popularity in various industries due to its ability to provide real-time monitoring and control of devices remotely.The system utilizes a Node MCU board and various sensors to detect the presence of gas leaks and monitor the weight of the LPG cylinder. The system is designed to be connected to the internet using Wi-Fi, and the data obtained from the sensors is transmitted to a cloud-based platform. The platform is designed to process the data and generate alerts and notifications in case of any gas leaks or anomalies in the weight of the LPG cylinder. The system can be accessed remotely using a Blynk mobile application installed on the user's smartphone.The literature review has shown that there are existing systems that utilize similar technology for gas leakage detection and LPG cylinder monitoring. However, these systems have limitations such as high cost, complexity, and lack of real-time monitoring capabilities. The proposed system addresses these limitations by utilizing cost-effective components, providing a simple and user-friendly interface, and enabling real-time monitoring and control of the system.The methodology section of the report provides a detailed explanation of the components used in the system, the system design, and the testing process. The results and discussion section presents the findings of the testing process and analyzes the implications of the results for the objectives and research question. The report concludes with a summary of the study's contributions, limitations, and recommendations for future research, as well as the implications of the study for practical applications.

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.

3.2 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 continuously monitors 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 gas leakage and the weight of the LPG cylinder. The system consists of a Node 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.

In case of a gas leakage, the MQ2 gas sensor senses it, and the corresponding alarm circuitry is activated. 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 load cell measures the weight of the cylinder and sends the data to the microcontroller. The microcontroller then calculates the weight of the remaining gas in the cylinder and displays it on the Blynk App. This feature helps the customer to know when 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

3.3 Arduino Code Overview:

```
Start
Read load cell value
If load cell value < 10% capacity
  Turn on buzzer
  Display red light on RGB LED
  Send SMS alert for gas refill
Else
  Display green light on RGB LED
Read gas sensor value
If gas sensor detects gas
  Turn on exhaust fan
  Display red light on RGB LED
  Send SMS alert for gas leak
Else
  Turn off exhaust fan
  Display weight on RGB LED with appropriate color
  If weight < 50% capacity
    Display yellow light on RGB LED
```

End

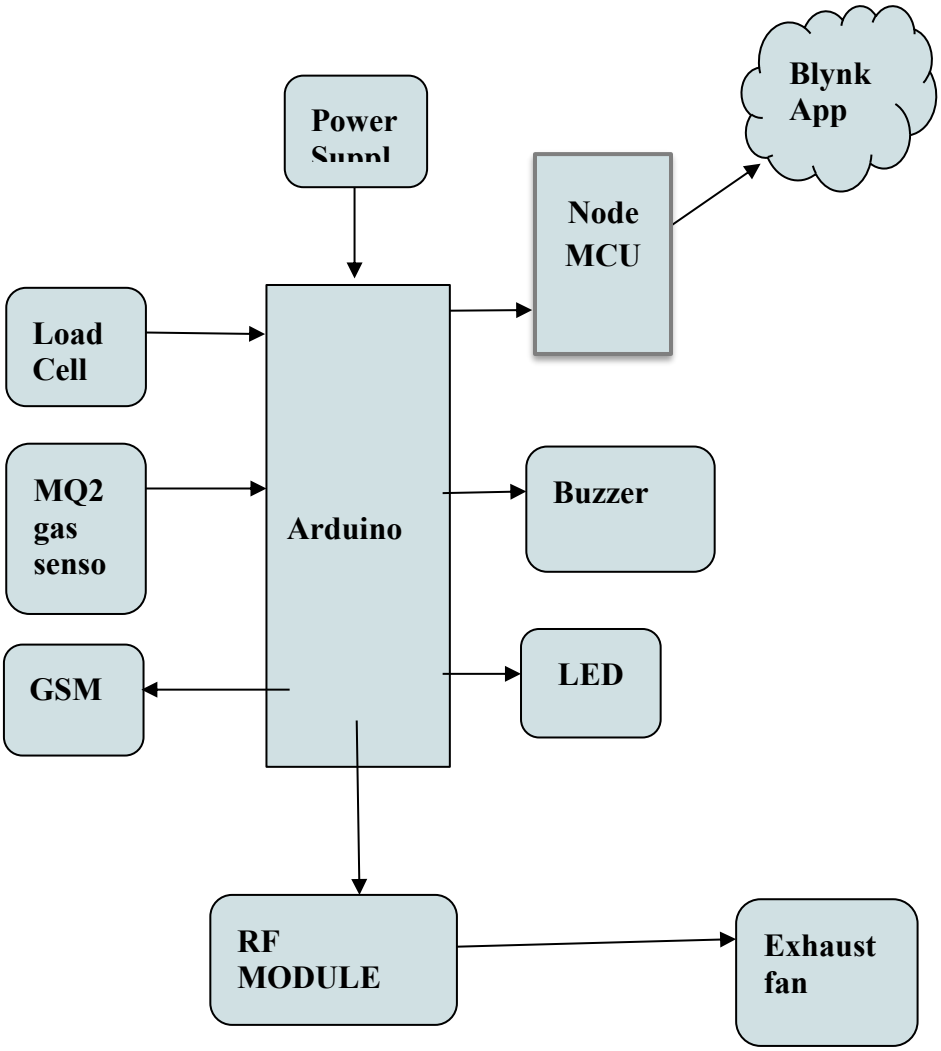


Fig 3.1 Block diagram

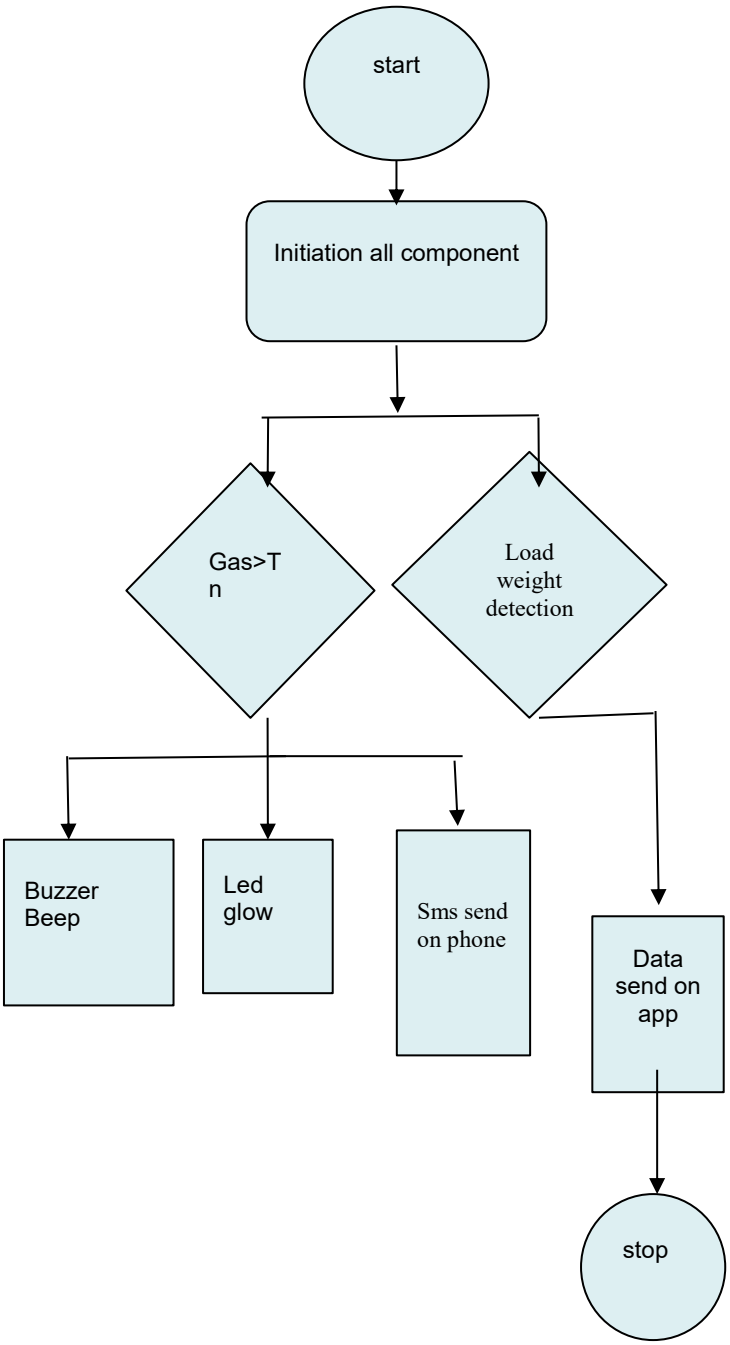


Fig 3.2 Flow chart

Chapter 04

COMPUTER SIMULATION

4.1 CAD Model

Software : Solid works 2021SolidWorks 2021 is a 3D computer-aided design (CAD) software that is widely used in engineering, design, and manufacturing industries.

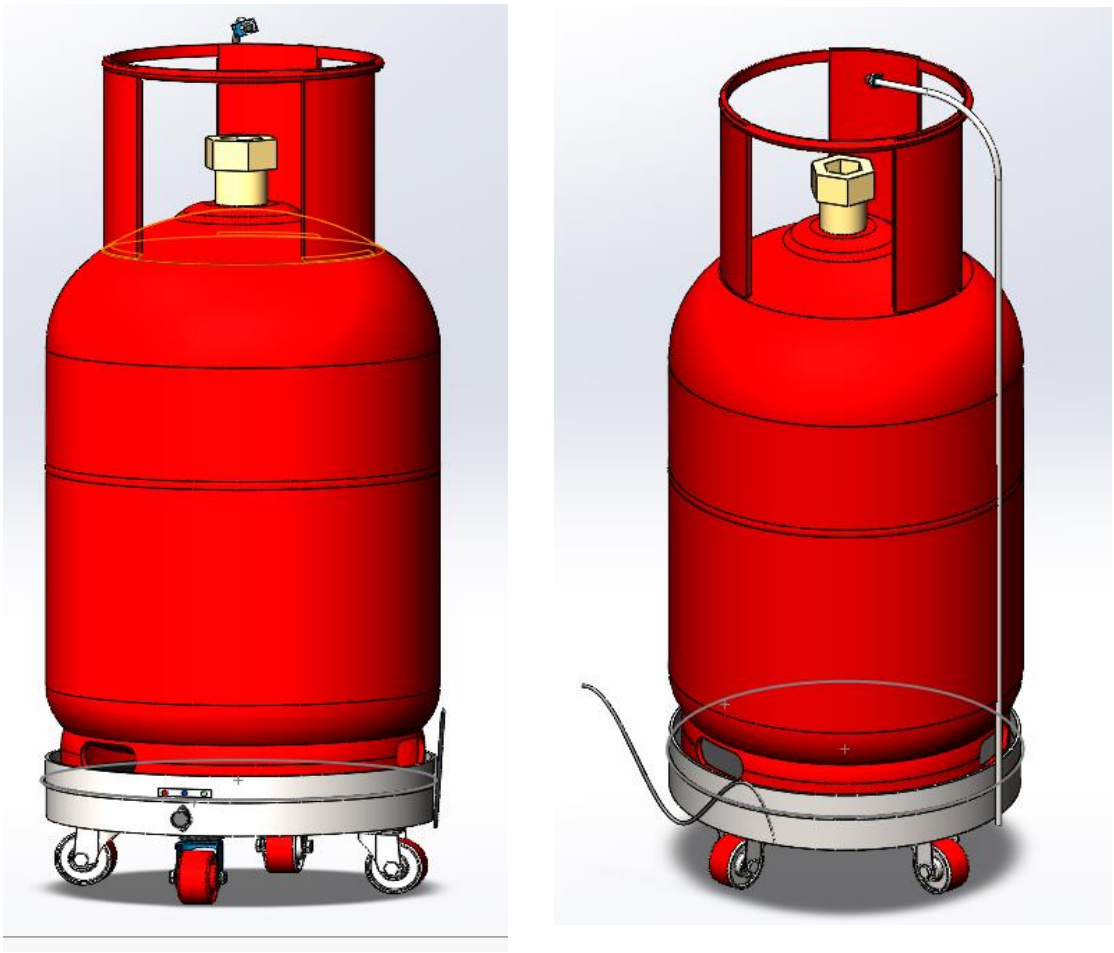


Fig 4.1 CAD Model Front View

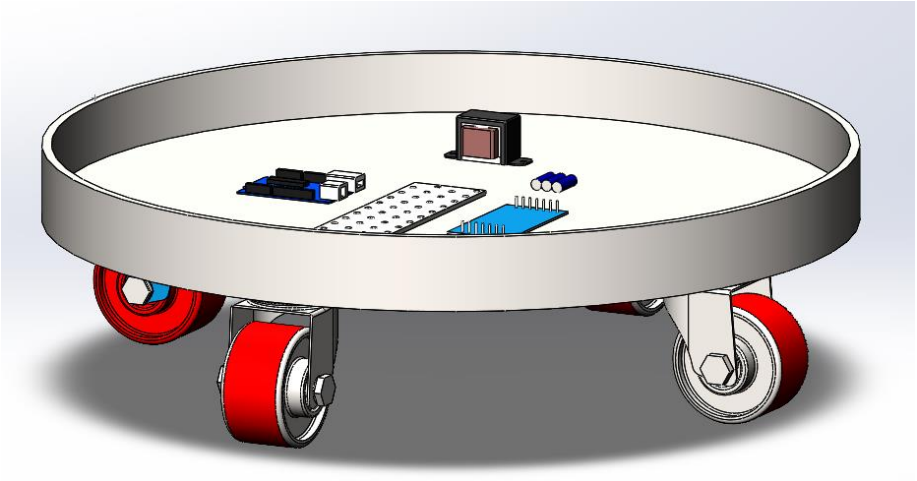
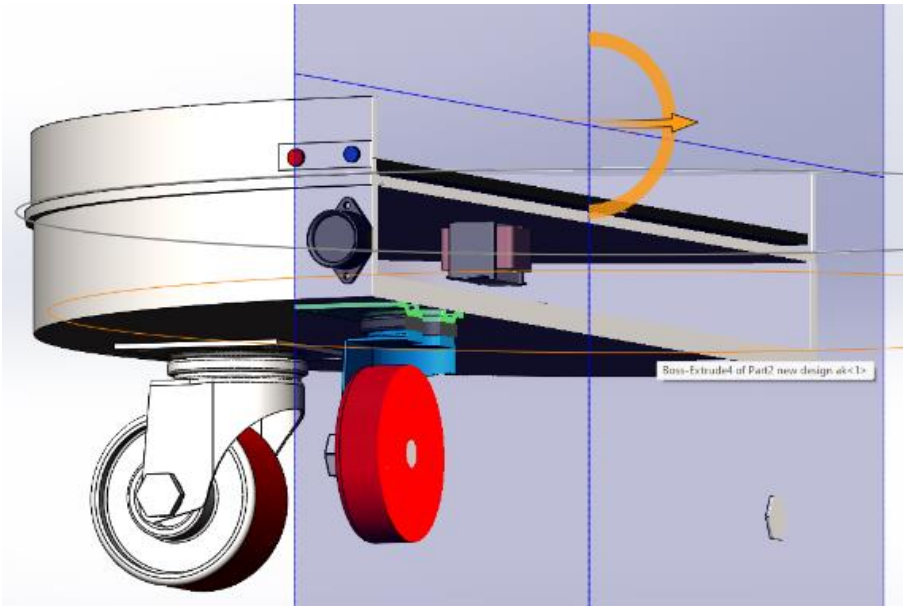


Fig 4.2 CAD Model Side View



. **Fig 4.3 CAD Model Cut Section**

4.1 Tinkercad Simulation

Tinkercad is a browser-based 3D design and simulation tool used for educational purposes, such as teaching electronics and programming to students. It is a simple yet powerful tool that allows users to create and simulate 3D designs using various electronic components. The tool also includes a drag-and-drop code editor for programming the electronic components in the design. Tinkercad is free

to use and provides a platform for beginners to learn about 3D design and electronics in a fun and interactive way.

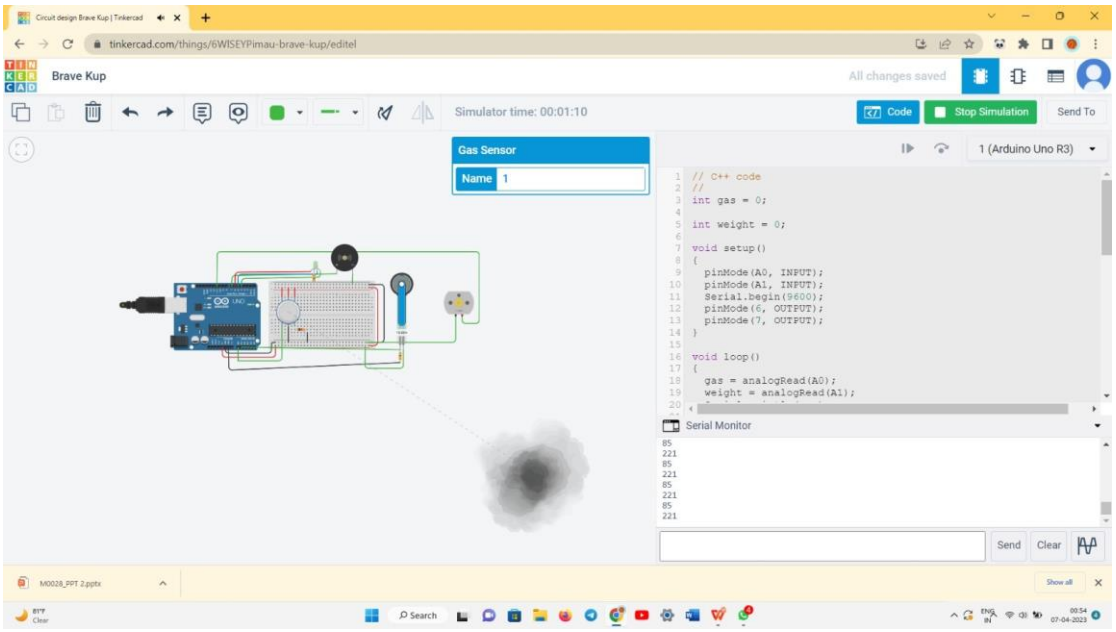


Fig 4.4 Tinkercad Simulation Gas Testing

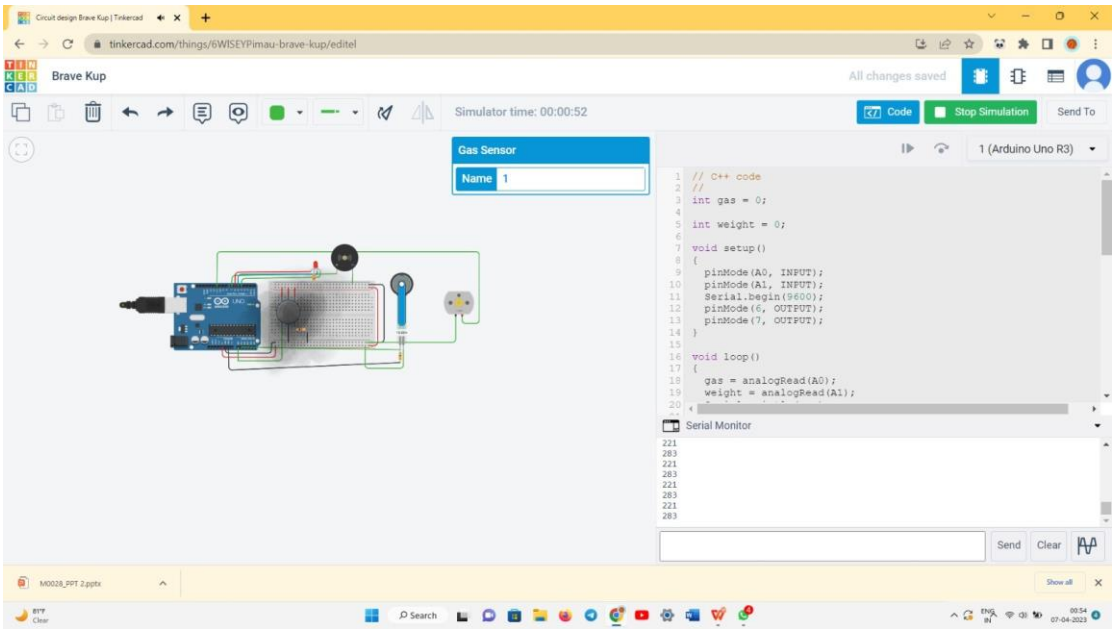


Fig 4.5 Tinkercad Simulation Load Cell Testing

Chapter : 5

DESCRIPTION OF COMPONENTS

5.1 Aurdino UNO

Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It can be programmed with the Arduino Software (IDE) and can be used for a variety of electronics projects, including robotics, home automation, and more. The board is designed to be easy to use, even for beginners, and has a large community of developers and enthusiasts who share their projects and knowledge online.

Fig 5.1 Aurdino UNO

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA

- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz

5.2 Node MCU

Fig. 5.2 Node MCU

Node MCU is a popular open-source IoT platform based on the ESP8266 Wi-Fi chip. It is an all-in-one board that integrates GPIO, PWM, IIC, 1-Wire, and ADC interfaces. The board can be programmed using the Lua scripting language or the Arduino IDE, making it easy for developers to create IoT applications and devices. The Node MCU board has a small form factor and is compatible with a variety of sensors and actuators, making it ideal for prototyping and testing. The ESP8266 chip used in the Node MCU has a built-in Wi-Fi module that allows the board to connect to the internet and communicate with other devices over Wi-Fi. The board has a USB port that can be used for power supply and programming, and it can also be powered by an external power supply.Node MCU is widely used in home automation, smart agriculture, industrial automation, and other IoT applications. Its ease of use and versatility make it a popular choice among developers and hobbyists who want to create IoT devices and applications.

- Processor: The NodeMCU is based on the ESP8266 chip, which has a 32-bit RISC CPU running at 80MHz.
- Memory: It has 4MB of flash memory and 64KB of RAM.
- Connectivity: It supports 802.11 b/g/n Wi-Fi with a range of up to 100 meters. It also has a micro USB port for programming and power.
- GPIO: It has 17 GPIO pins, each of which can be used for digital input/output, PWM, I2C, and SPI.
- Analog input: It has one analog input pin that can read a voltage between 0 and 3.3 volts.
- Operating voltage: It can operate at 3.3V, and it has a voltage regulator that can accept input voltages between 4.5 and 9V.
- Programming: It can be programmed using the Arduino IDE, Lua, or MicroPython.

5.3 MQ2 gas sensor

The MQ2 gas sensor is a type of gas sensor module that can detect various gases such as smoke, propane, methane, alcohol, and hydrogen. It is a low-cost, compact, and easy-to-use sensor that operates on the principle of the gas-sensitive resistance of tin dioxide. When a gas comes in contact with the sensor's sensitive layer, its electrical resistance changes, which is measured and used to determine the presence and concentration of the gas.

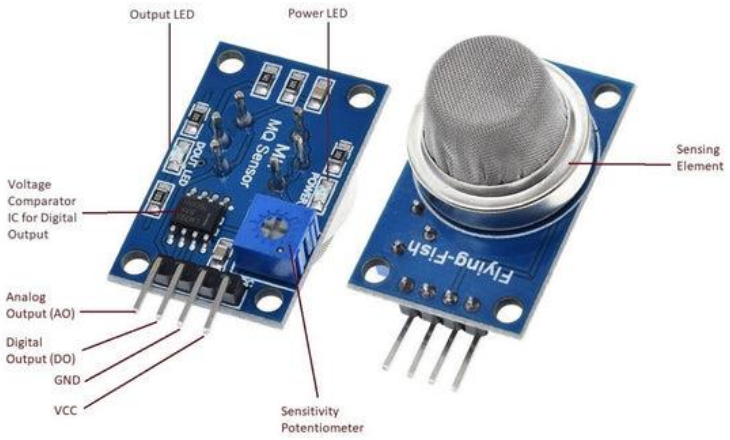


Fig 5.3 MQ2 gas sensor

Technical specifications of the MQ2 gas sensor:

- Operating Voltage: 5V DC
- Power Consumption: < 800mW
- Load Resistance: Adjustable
- Sensitivity: Adjustable
- Detection Range: 300 to 10,000 ppm (parts per million)
- Preheat Time: < 20 seconds
- Response Time: < 10 seconds
- Recovery Time: < 30 seconds
- Operating Temperature: -10°C to 50°C
- Operating Humidity: 95% RH (non-condensing)
- Dimensions: 32mm x 22mm x 27mm

MQ2 gas sensor is commonly used in gas leak detection systems, air quality monitoring systems, and safety alarms. It can be easily interfaced with microcontrollers like Arduino and NodeMCU to build a variety of IoT projects.

5.4 Load cell 40 KG

A load cell is a transducer that is used to measure force or weight. It is a type of sensor that converts the weight of an object into an electrical signal. The load cell used in this project has a capacity of 40 kg.

Fig 5.4 Load cell 40 KG

Technical specifications of the load cell:

- Capacity: 40 kg
- Sensitivity: 2 mV/V
- Non-linearity: ±0.05% F.S.
- Hysteresis: ±0.05% F.S.
- Repeatability: ±0.05% F.S.
- Creep: ±0.05% F.S./30 min
- Input Resistance: 1000 ohms
- Output Resistance: 1000 ohms
- Excitation Voltage: 5-15 VDC
- Operating Temperature Range: -10°C to 40°C
- Material: Aluminum alloy
- Protection Class: IP67

The load cell works on the principle of strain gauges. When an external force or weight is applied to the load cell, the strain gauges attached to it are deformed, causing a change in their resistance. This change in resistance is then converted into an electrical signal that can be measured by the microcontroller. The load cell is highly accurate and reliable, making it suitable for various applications, including weighing systems and force measurement.

5.5 RGB Light

RGB LED stands for Red Green Blue Light Emitting Diode. It is a type of LED that is capable of emitting light in different colors by combining different intensities of red, green, and blue light. A typical RGB LED has four pins - one for each color (red, green, blue) and a common ground pin.

Fig 5.5 RGB Led Light

Technical specifications of an RGB LED may vary depending on the manufacturer and the specific model, but here are some common specifications:

- Operating Voltage: Typically, an RGB LED operates at a voltage range of 3-5V DC.
- Current Rating: The current rating of an RGB LED depends on the individual color LEDs within it. For example, a typical RGB LED may have a red LED with a forward current of 20mA, a green LED with a forward current of 30mA, and a blue LED with a forward current of 30mA. Therefore, the total current rating of the RGB LED would be the sum of the forward currents of each individual color LED (20mA + 30mA + 30mA = 80mA).
- Power Consumption: The power consumption of an RGB LED can be calculated by multiplying the operating voltage by the total current rating.
- Color Range: An RGB LED can produce a wide range of colors by mixing different intensities of red, green, and blue light. The specific range of colors that an RGB LED can produce depends on the quality of the LED and the circuit driving it.
- Control: An RGB LED can be controlled by a microcontroller or other electronic device using pulse-width modulation (PWM) signals to vary the intensity of each individual color LED. This allows for precise control of the color and brightness of the LED.

5.6 GSM Module

A GSM module is an electronic device that allows communication between mobile devices over a cellular network. It uses a Subscriber Identity Module (SIM) card to establish a connection to the network and enables voice and data transmission.

Fig 5.6 GSM Module

Some technical details of a GSM module are:

- Frequency range: GSM modules operate on a specific frequency range, usually in the range of 850-1900 MHz.
- Voltage range: Most GSM modules operate on a voltage range of 3.4 to 4.5 V.
- Data transmission speed: GSM modules support data transmission speeds up to 9.6 kbps.
- SIM card interface: GSM modules have a SIM card interface that enables them to read and write data to the SIM card..
- SMS and voice support: GSM modules support sending and receiving SMS messages and making voice calls.
- GPRS/EDGE support: Some GSM modules also support GPRS/EDGE for faster data transmission.
- Antenna: GSM modules have an antenna for transmitting and receiving signals.

GSM modules are widely used in various applications such as remote monitoring, security systems, GPS tracking, and automation systems.

5.7 DC Adapter

A DC adapter, also known as a DC power supply, is an electronic device that converts alternating current (AC) power into direct current (DC) power. The technical specifications of a DC adapter typically include the following:

Fig 5.7 DC Adapter

- Input voltage: This refers to the AC voltage range that the adapter can accept, usually measured in volts (V) or volts alternating current (VAC). For example, an adapter might have an input voltage range of 100-240VAC.
- Output voltage: This refers to the DC voltage that the adapter delivers to the load or device it is powering. It is usually measured in volts DC (VDC). For example, an adapter might have an output voltage of 12VDC.
- Output current: This refers to the amount of DC current that the adapter can supply to the load or device it is powering. It is usually measured in amperes (A) or milliamperes (mA). For example, an adapter might have an output current of 1A or 1000mA.
- Power rating: This refers to the maximum power that the adapter can supply to the load or device it is powering, and is calculated as the product of the output voltage and current. It is usually measured in watts (W) or milliwatts (mW). For example, an adapter with an output voltage of 12VDC and output current of 1A has a power rating of 12W.
- Connector type: This refers to the type of connector on the output side of the adapter that plugs into the load or device it is powering. Common connector types include barrel connectors, USB connectors, and banana plugs.
- Efficiency: This refers to the ratio of output power to input power, expressed as a percentage. It indicates how efficiently the adapter converts AC power into DC power, with higher efficiency indicating less wasted energy and lower operating costs.

Safety certifications: This refers to the safety certifications and standards that the adapter meets, such as UL, CE, FCC, or RoHS. These certifications indicate that the adapter has been tested and approved for safety and compliance with relevant regulations.

5.8 Wireless Relay

A wireless relay, also known as a remote control relay, is a device that allows you to remotely control electrical switches or circuits from a distance. It works by receiving a signal from a transmitter or a remote control, which then activates the relay to turn on or off the connected device.

Fig 5.8 Wireless Relay

Here are some technical specifications of a wireless relay:

- Operating voltage: Most wireless relays operate on a DC voltage range of 5-12V.
- Contact rating: This refers to the maximum electrical load that the relay can handle. It is measured in terms of voltage and current, with typical ratings of 12-24V DC and 10-20A.
- Frequency: Wireless relays typically operate on frequencies of 315MHz or 433MHz.
- Control distance: The control distance of a wireless relay depends on the transmission power of the transmitter and the sensitivity of the receiver. It can range from a few meters to several hundred meters.
- Relay type: There are two main types of wireless relays - latching and momentary. Latching relays have two stable states and stay in the last state until they receive a new signal. Momentary relays switch on and off briefly when they receive a signal.

Compatibility: Wireless relays can be used with a variety of devices and systems, including lighting, fans, motors, and alarms. They are also compatible with many different types of remote controls and transmitters.

5.9 Exhaust Fan

An exhaust fan is an electrically powered mechanical fan that is used to draw out stale air and moisture from an enclosed space, such as a kitchen, bathroom, or any other area

where humidity or odors tend to accumulate. It helps to maintain indoor air quality by removing impurities and excess moisture from the environment.

Fig 5.9 Exhaust Fan

Here are some technical specifications of an exhaust fan:

- Blade Size: The blade size of an exhaust fan ranges from 100mm to 300mm. The size of the blade affects the amount of air that the fan can circulate in a room.
- Air Delivery: The air delivery of an exhaust fan is measured in cubic meters per hour (m3/h). It refers to the amount of air that the fan can move in an hour. A higher air delivery rate means that the fan can ventilate a larger area.
- Noise Level: The noise level of an exhaust fan is measured in decibels (dB). A lower dB rating indicates a quieter fan.
- Power Consumption: The power consumption of an exhaust fan varies from model to model. It is measured in watts (W). A lower wattage fan is more energy-efficient.
- Motor Speed: The motor speed of an exhaust fan is measured in revolutions per minute (RPM). A higher RPM indicates a faster fan.
- Mounting Type: Exhaust fans can be mounted on the wall or the ceiling. The mounting type of the fan depends on the location of the exhaust point.
- Material: The exhaust fan can be made of plastic, metal or a combination of both. The material used affects the durability and performance of the fan.

Additional Features: Some exhaust fans come with additional features such as a timer, humidity sensor, or remote control.

Overall, when selecting an exhaust fan, it is important to consider the technical specifications in relation to the intended use and size of the room, as well as the budget and desired features.

5.10 RF Module

RF (Radio Frequency) module is a small electronic device that transmits and receives radio signals within a certain range. In the context of the project, an RF module is used to wirelessly transmit and receive data between the LPG cylinder smart stand and the microcontroller. The RF module used in the project may vary depending on the specific model and application.

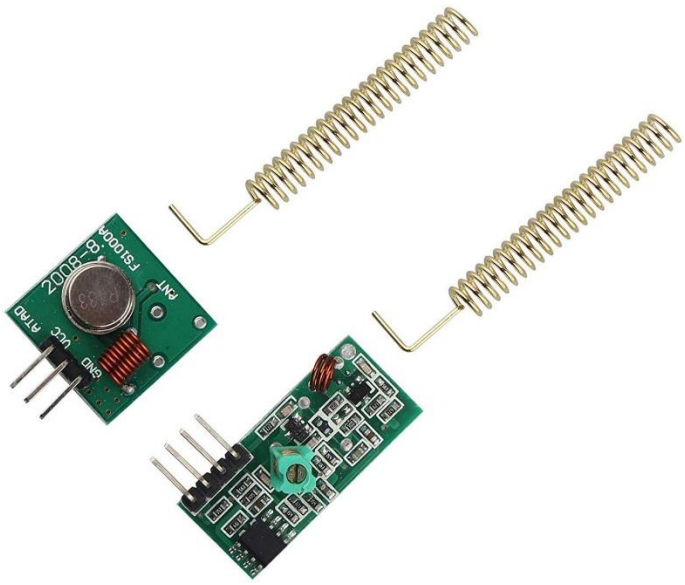


Fig 5.10 RF Module

Here are some technical specifications of an RF module commonly used in IoT projects:

- Frequency range: 433 MHz or 2.4 GHz
- Operating voltage: 3.3V or 5V
- Transmission range: Up to 100 meters or more (depending on the environment and obstacles)
- Data rate: Up to 10 kbps
- Modulation: ASK (Amplitude Shift Keying) or FSK (Frequency Shift Keying)

- Antenna type: Coil or helical antenna
- Interface: SPI (Serial Peripheral Interface) or UART (Universal Asynchronous Receiver/Transmitter)

The specific technical specs of the RF module used in the project may vary, but it is typically a low-cost, compact and easy-to-use device that can be integrated with the microcontroller to enable wireless communication

5.11 4V Battery

4V DC battery would typically refer to a rechargeable or non-rechargeable battery that outputs a voltage of 4 volts DC (direct current).

Fig 5.11 4V Battery

The specifications of a 4V DC battery would depend on the type of battery chemistry and its intended application. Here are some general specifications of common 4V DC batteries:

- Lithium-ion (Li-ion) rechargeable battery: nominal voltage of 3.7V, fully charged voltage of 4.2V, capacity ranging from a few hundred milliampere-hours (mAh) to several thousand mAh.
- Nickel-cadmium (NiCd) rechargeable battery: nominal voltage of 1.2V per cell, typically made up of 3 or 4 cells in series to achieve 4V output, capacity ranging from a few hundred mAh to several thousand mAh.

- Nickel-metal hydride (NiMH) rechargeable battery: similar to NiCd in terms of voltage and capacity, but with higher energy density and less toxic materials.
- Alkaline non-rechargeable battery: nominal voltage of 1.5V per cell, typically made up of 3 cells in series to achieve 4.5V output, widely available and inexpensive but not rechargeable.
- Zinc-carbon non-rechargeable battery: similar to alkaline in terms of voltage and capacity, but with lower energy density and shorter lifespan.

It's important to choose a battery that is suitable for your specific application in terms of voltage, capacity, discharge rate, and other factors.

5.12 Arduino Nano

Arduino Nano is a compact and versatile development board based on the ATmega328P microcontroller, which is widely used in the maker community for various DIY projects. The board has 22 digital input/output pins, 8 analog inputs, and a 16 MHz quartz crystal. It also has a USB interface for programming and serial communication with a computer.The Arduino Nano is similar to the Arduino Uno but is smaller in size and has a lower cost. It is popular among hobbyists and DIY enthusiasts for its ease of use, small form factor, and wide range of applications.

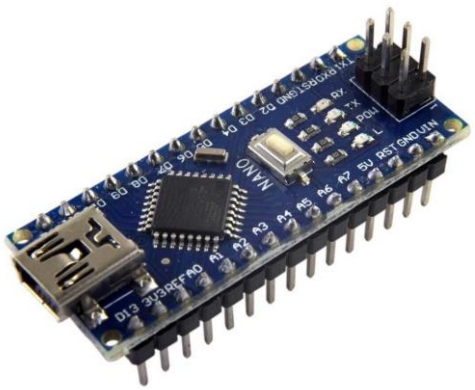


Fig 5.12 Aurdino Nano

Some of the technical specifications of the Arduino Nano are:

- Microcontroller: ATmega328P

- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Digital I/O Pins: 22 (6 of which are PWM)
- Analog Input Pins: 8
- DC Current per I/O Pin: 20 mA
- Flash Memory: 32 KB (of which 2 KB used by bootloader)
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

The Arduino Nano can be programmed using the Arduino Integrated Development Environment (IDE), which is a free software tool for writing and uploading code to the board. The IDE has a user-friendly interface and a vast library of pre-built code examples and functions that make it easy to get started with programming

5.2 Raw Materials for Stand Manufacturing

5.2.1 Plywood

Technical specifications of 12mm plywood:

- Thickness: 12mm
- Dimensions: 8ft x 4ft (2440mm x 1220mm)
- Weight: approximately 22kg per sheet
- Glue: WBP (waterproof) or MR (moisture resistant)
- Grade: B/BB or BB/CC
- Density: approximately 560kg/m^3
- Moisture content: 6-14%

Properties of 12mm plywood

- Strong and durable
- Resistant to warping, cracking, and splitting
- Easy to work with using common woodworking tools
- Can be stained or painted
- Suitable for indoor and outdoor use

- Good for use in furniture, cabinets, flooring, and other construction applications
- Technical specifications of 30cm diameter plywood:

Thickness: 12mm

- Diameter: 30cm (approximately 11.8 inches)
- Weight: approximately 200-300 grams
- Glue: WBP (waterproof) or MR (moisture resistant)
- Grade: B/BB or BB/CC
- Density: approximately 560kg/m³
- Moisture content: 6-14%

Properties of 30cm diameter plywood:

- Strong and durable
- Lightweight and easy to handle
- Can be cut and shaped to fit various applications
- Suitable for indoor and outdoor use
- Good for use in small furniture pieces, crafts, and decorative items

Fig 5.13 Plywood

5.2.2 Acrylic sheet

Technical specifications and properties of a 12mm thick acrylic sheet with a 30 cm diameter:

- Diameter: 30 cm
- Thickness: 12mm
- Material: Acrylic (also known as PMMA or Plexiglass)
- Density: 1.19 g/cm³
- Transparency: Clear
- Tensile strength: 7,000 psi (48 MPa)
- Flexural strength: 12,000 psi (83 MPa)
- Heat deflection temperature: 95°C
- Maximum continuous use temperature: 60°C
- Coefficient of thermal expansion: 7 x 10^-5 mm/mm/°C
- Water absorption: 0.2%
- Flame resistance: Self-extinguishing

Acrylic is a thermoplastic material that is lightweight, shatter-resistant, and has excellent optical clarity. It is commonly used in a variety of applications including displays, signs, glazing, and lenses. The above specifications may vary depending on the manufacturer and specific grade of acrylic used.

Chapter 6

WORKING

6.1 Working

The working of the smart stand for LPG gas cylinder involves the following steps:

- Load cell measures the weight of the LPG gas cylinder and sends the data to the Arduino Uno.
- The gas sensor continuously monitors the presence of gas around the cylinder. If it detects gas leakage, the Buzzer will start beeping, and an alert message will be sent through GSM.
- The RGB LED light indicates the level of gas in the cylinder. When the gas level is 100%, the LED will be green, and when it is 50%, the LED will be blue. When the gas level drops below 10%, the LED will turn red.
- In case of gas leakage, the Exhaust fan turns on through the RF module to remove the leaked gas.
- GSM module sends an alert message in case of gas leakage, and also sends an automatic message for LPG gas booking when the weight of the cylinder drops below 10%.
- Node MCU allows controlling the smart stand through the Blink app, which continuously monitors the gas level and sends notifications in case of low gas level or gas leakage.
- The smart stand is powered by a DC adapter and battery supply, which automatically shifts to battery supply in case of power cut.

Overall, the smart stand ensures the safety of the LPG gas cylinder by monitoring the gas level and detecting gas leakage. It also makes it easier for the user to keep track of the gas level and book LPG gas refills in advance.

6.2 Circuit Design

- Load cell 40kg should be connected to the HX711 amplifier module, which should be further connected to the Arduino Uno board.
- The MQ2 gas sensor should be connected to the Arduino Uno board.
- The buzzer should be connected to the Arduino Uno board.
- The RGB LED should be connected to the Arduino Uno board.
- The Exhaust fan should be connected to the wireless relay module, which should be further connected to the Arduino Uno board.
- The GSM module should be connected to the Arduino Uno board.
- The Node MCU should be connected to the Arduino Uno board.
- The DC adapter and battery should be connected to the Arduino Uno board via a UPS circuit for automatic switching in case of power cuts.

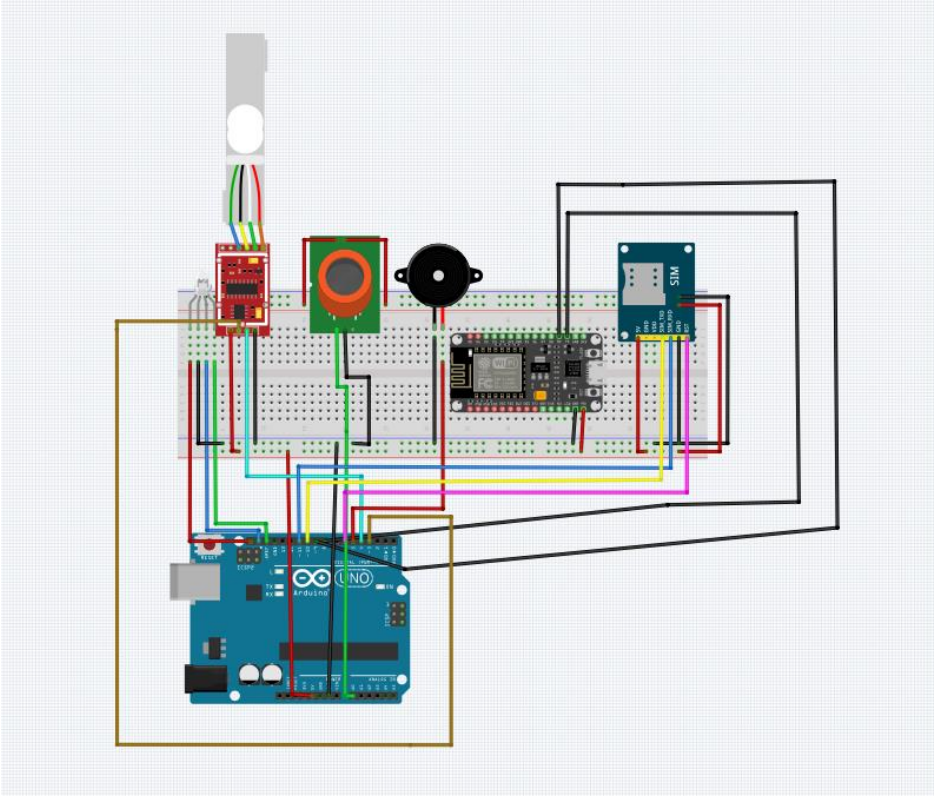


Fig 6.1 Circuit Design

Chapter 7

CALCULATIONS

7.1 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.

Chapter 8

RESULTS AND DISCUSSIONS

8.1 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 continuously monitors and displays 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.

8.2 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.

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 results of this study are consistent with the 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.

8.3 Experimental Setup

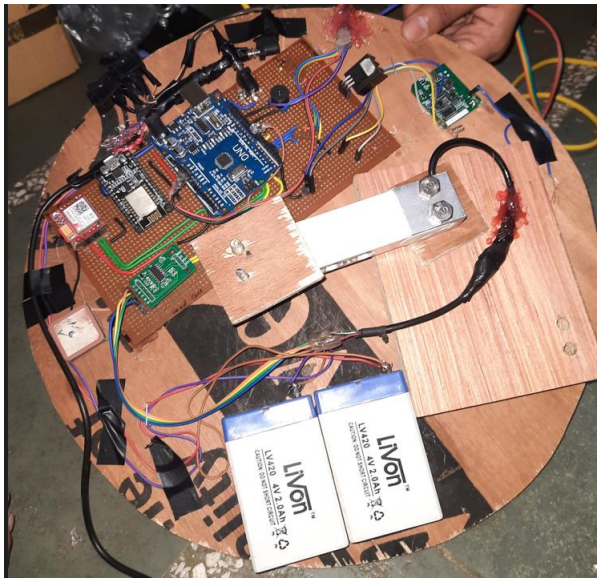


Fig 8.1 Experimental Setup Circuit view

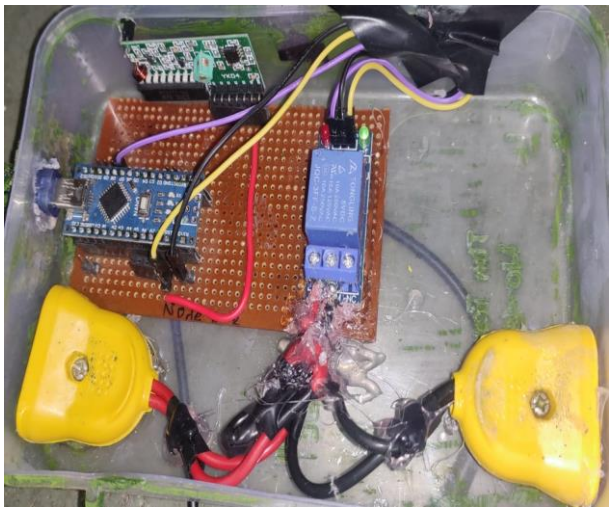


Fig 8.2 : Shows That Experimental Setup Of the proposed System

8.4 Result

When there is gas leakage it is detected an alert is given to the user and also the buzzer is turned on and the LED glow. When the gas level in the cylinder goes down below the threshold level then an alert is given to the user on Blynk App and give SMS on mobile. The mobile app screenshots are shown in fig.

Fig 8.3 LED RED

Cylinder weight is below 10%.

Fig 8.4 LED Blue Cylinder weight is above 10%

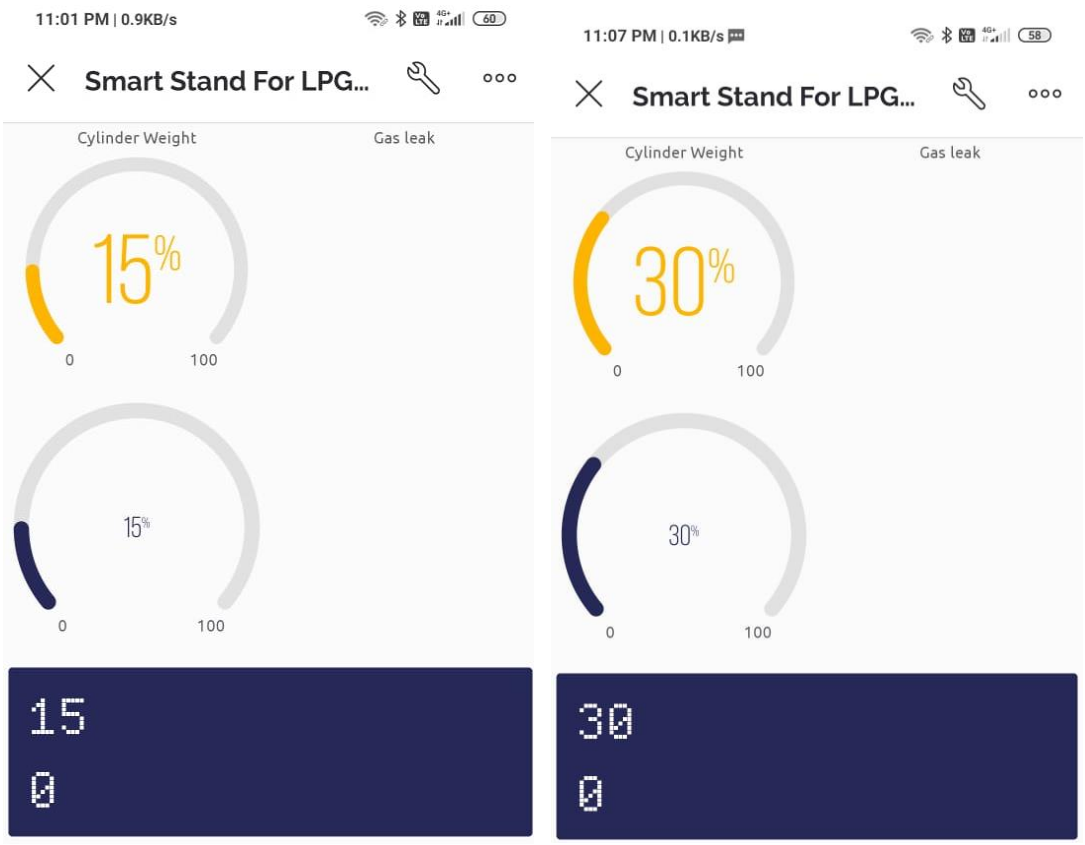


Fig 8.5 Blynk App Notification Cylinder Weight.

Fig 8.6 Cylinder 10 % Red LED & the exhaust on gas leaked detected.

Chapter 8

COST ESTIMATION

Table 8.1 Cost Estimation

Sr no.	Name of component	Specification	Quantity	Cost In Rs
1.	Aurdino Uno	ATmega328	1	430
2.	Gas Sensor	MQ 2	1	200
3.	Node Mcu	ESP32	1	400
4.	GSM Module	3G Sim Card	1	600
5.	DC Adapter	12 Volt	1	150
6.	4 V DC Battery	4 V	2	300
7.	Aurdino Nano	A4988	1	200
8.	Load Cell	HX710B	1	500
9.	RGB Light	16Mhz	1	10
10.	Capacitors	(1000µf, 100µf, 0.25 µf)		40
11.	Wheels	20 mm	2	200
12.	Switches	Feedback Switches	2	40
13.	Jumper Wires	(M-M,M-F,F-F)	50	20
15.	Wires And Cables	Standard		100

16.	Soldering Lead	Standard	40gm	60
17.	Nut & Screw	SS		50
18.	Plywood	Wood		200
19.	Acrylic Sheets			300
20	RF Module	433Mhz Wireless		200
Total Cost				3760

Chapter 9

FUTURE SCOPE AND APPLICATION

The smart stand for LPG cylinders has several future scopes and applications, including:

Home Automation: The smart stand can be integrated with home automation systems to provide remote monitoring and control of LPG cylinders. This can help to improve safety and convenience for homeowners.Industrial Applications: The smart stand can be used in industrial settings to monitor and control large LPG storage tanks. This can help to improve safety and efficiency in industrial processes.

Gas Station Automation: The smart stand can be used in gas stations to automate the process of filling LPG cylinders. This can help to reduce the risk of accidents and improve the speed and accuracy of filling operations.

Smart Cities: The smart stand can be integrated with smart city systems to provide real-time monitoring and control of LPG cylinders in public spaces. This can help to improve safety and prevent accidents.

Environmental Monitoring: The smart stand can be used to monitor environmental factors such as temperature and humidity in order to prevent leaks and other safety hazards.

Overall, the smart stand for LPG cylinders has a wide range of potential applications in both residential and industrial settings. Its ability to provide real-time monitoring and control of LPG cylinders can help to improve safety and efficiency, while reducing the risk of accidents and environmental damage.

Chapter 10

CONCLUSION

In conclusion, the Smart Stand for LPG Cylinder project aims to provide a safer and more convenient solution for storing and monitoring LPG cylinders in households and small businesses. Through the use of load cells, gas sensors, wireless communication, and other components, the Smart Stand can detect gas leakage, measure the weight of the cylinder, and provide real-time alerts and notifications to users. The project has several objectives, including enhancing the safety and reliability of LPG cylinders, reducing the risk of gas leakage and explosions, and providing an efficient and cost-effective solution for cylinder storage and monitoring.

The experimental investigation of the Smart Stand involved testing the stability, durability, and safety of the system under various conditions, including impact, fire, and gas leakage. The results of the investigation showed that the Smart Stand was able to detect gas leakage, prevent cylinder theft, and provide real-time alerts to users.However, there may be some possible errors that could arise during the development and operation of the system, such as inaccurate readings, false alarms, power failure, communication issues, and mechanical failure. Therefore, it is essential to conduct thorough testing and calibration to ensure that the system functions properly and safely.

Overall, the Smart Stand for LPG Cylinder project has the potential to revolutionize the way LPG cylinders are stored and monitored in households and small businesses, and provide a safer and more convenient solution for users.\

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