IOT BASED LP GAS LEAK DETECTION SYSTEM

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DECLARATION

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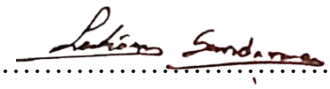
Signature of Student: …  …..

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ABSTRACT

Liquefied petroleum gas is a highly flammable substance commonly used in the home and hotel business. Here Liquefied Petroleum gas has become an essential component today. Accidents caused by gas cylinder explosions and gas leaks have increased rapidly in recent years.

Gas accidents are exacerbated by the fact that many people do not even have an understanding of the basic steps to take in the event of a gas leak. Therefore, there is a need to create a device that can automatically control a gas leak.

However, due to the failure of the existing gas leakage devices available in the market to achieve the desired results, the need for a new gas leak prevention device arose. Therefore, this project was proposed and we think an Internet of Things based Liquefied Petroleum gas leakage system would be suitable for it.

Using a solenoid valve that is not present in other projects automatically prevents gas leaks. Informs the user about gas leaks with the help of a mobile phone application. This allows him to monitor the gas leak at that point. A display warns people around the gas leak and in the event of an accident the buzzer will ring and the LED bulb will sound.

Here I used a questionnaire to get information on gas leaks, which allowed us to identify the innovations we need to use to build a gas leak prevention device and the new features that consumers expect.

In the future hope to create a mobile application with the help of Android for this project. hope to create an Application Programming Interface for this and get information through it. The end result is that in the event of a gas leak without human intervention, the Liquefied Petroleum will automatically stop the gas leak and alert the user through Internet of Things.

Key words – IOT (internet of things), MQ6(LP gas sensor), LPG (*Liquefied petroleum gas) ESp32, Arduino, LCD display, Buzzer, jumper wire.*

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List Of Acronyms

API	- Application Programming Interface.
Arduino IDE	- Arduino Integrated Development Environment
DHT11	- digital temperature and humidity sensor
ESP 32	- ESP 32 module
GSM	- GSM WiFi module
HTML	- Hypertext Markup Language
IOT	- Internet of Things
LP	- Liquefied petroleum gas
LCD	- Liquid Crystal Display
LED	- Light-emitting diode
MQ2	- Gas Sensor

CHAPTER 1 – INTRODUCTION

Technologies that use IoT mobile applications and Arduino are rapidly becoming more popular and common in the world. These applications use sensors to automatically identify and prevent accidents before they happen, reducing life-threatening property damage due to current LPG leaks. Due to their ability to operate wirelessly and without human labor, such devices are needed to reduce the damage caused by LP gas leaks in order to control the damages that occurs to people.

1.1. Background of the Study

Domestic fires are on the rise these days. Electrical accidents and gas leaks are a priority. More than 150 accidents are reported worldwide each year due to LP gas leaks. Nowadays, various projects carried out by using Arduino, ranging from simple to complicated projects. By using Arduino, there is the ability to prevent this LPG gas leak.

Although, the IoT LP gas leak detection project using Arduino will be of great help.

The purpose of this project is to identify LP gas leaks and thereby, raise public awareness and taking necessary actions for the prevention. Here, a gas sensor will be used for the detection of leakage. A voice alert, text message and program will be sent to the person concerned. Also, the solenoid valve automatically shuts off the gas supply. Therefore, this proposed project will save lives and properties due to the fires caused by gas leaks.

1.2. Problem Statement

Currently, LP gas consumption is relatively high. Therefore, the number of accidents has increased proportionally. The main reason is rapid combustion and often failure to detect a gas leak at an early stage. A gas leak can only be detected by a person who is nearby. It can cause property damages, deaths and injuries if no one is around since it is a flammable gas.

The figure below also displays the number of accidents that occurred from 2010 to 2019

Table 1:Lp gas leak and accident 1

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
leakage	76	116	160	113	98	102	85	114	147	146
Leakage and explosion (fire)	60	55	48	48	59	43	27	43	33	25
Leakage and fire (Excluding explosion)	60	45	44	43	27	31	19	35	24	27
CO poisoning and asphyxiation	8	11	8	6	3	6	9	3	7	0
Total	204	227	260	210	187	182	140	195	211	198

[1]

This research project will suggest identifying a gas leak at an early stage to prevent a leakage. Due to its usage in IoT, the user can know the information immediately. In addition to that, this project will suggest using an Arduino-based LP gas leak detection system to solve these problems.

1.3. Motivation and Significance of the Project

Property and casualties are increasing day by day due to LP gas leaks. Accidents in homes are high there. But LP gas depots or homes do not have the technology to detect a gas leak.

LP gas is used all over the world. Only in Sri Lanka, it is about 80 per cent. As a precaution, this study will propose to develop LP gas leak detection system using Arduino to minimize the risks of gas leaks.

Accordingly, the importance of this system is that it benefits the various parties.

- Life and property protection.
- No fire extinguisher required.
- Conservation of the country's resources (medical aid, etc.).
- Automatically shut off the gas leak even when no one is at home or in the LP gas storage.

1.4. Aim and Objectives of the Project

1.4.1. Aim

- ❖ To develop a device to detect and prevent IoT-based LPG gas leaks using Arduino.

1.4.2. Objectives

Currently, there is an increase in accidents due to LPG gas leaks. Therefore, this research study will achieve the following objectives with the IoT based LPG gas Leakage detection application using the proposed Arduino.

Analyze the material presented in the study and articles and produce a critical review of similar issues and programs.

- To detect LP gas leaks by MQ2 sensor
- To alert people by buzzers that sound warnings.
- To Send a SMS to the concerned personal
- To recognize data over the internet using an IoT-based web or mobile application.
- To stop gas leaks automatically by the solenoid valve.

1.5 Chapter Outlines

Chapter 2- Literature Review

What is being considered here is an evaluation of previous projects. In this section, the problems they have and the solutions proposed in the proposed project are considered.

Chapter 3 - Analysis

This section discusses the requirement analysis required to build the project, identifies the user requirement and addresses them within the proposed project, as well as the software methodology used to build the project.

Chapter 4 – Design

In this chapter, the system design process is done with project usage, block diagram, circuit diagram used in project design and also shows the interface after project completion.

Chapter 5 – System Development

This section describes each of the tasks involved in the project from the tools used to build the system, and how it is programmed and connected to the device.

Chapter 6 – Testing and Evaluation

This section examines each part of the project and describes how they work with project output images.

Chapter 7 – Conclusion and Future Work

These final chapter describes the functionality of the system and the steps it will take to improve the system in the future.

CHAPTER 2 – LITERATURE REVIEW

2.1. Introduction

A literature review is of finding, reading, analyzing, evaluating and summering. It studies research papers and seminars on a particular topic and identifies their pros and cons and makes an analytical inquiry into them. A critical review of the research conducted under the topic under consideration will be conducted.

2.2 Critical evaluation

- Theoretical views

LPG is a combustible gas. We must use it with caution. Most accidents are caused by a gas leak. The regulator can be pointed out as the main method by which gas leaks can occur. Therefore, in this project, we propose to prevent automatic gas leaks and thereby ensure consumer safety.

2.3Systems over views

Here the system is built using Arduino. It uses the IOT to connect to the Internet. IoT is an emerging trend and is widely used in the world today. Experts estimate that around 2022 billion devices using IoT will be used by 2022.In this project, we use IoT to enable the user to access the data using a web app, and in the event of a gas leak, the sensor detects the gas leak and automatically alerts the surrounding people. Alerts are also sent via SMS to the customer's mobile phone. The system also has the ability to automatically prevent gas leaks.

It uses esp32 and connects to the internet using IOT. The mq2 sensor detects gas leaks and uses lcd display, buzzer LED bulbs to warn. A solenoid valve is used to prevent a gas leak, and when a gas leak occurs, it sends a message via esp32 to the mobile phone via a web application. It has the potential to save lives and property and raise awareness of the dangers in a variety of ways.

2.4 Conceptual paragraph

The primary purpose of using this system is to detect a gas leak, protect lives and property by automatically preventing the leak and alerting others.

The important thing is that a gas leak cannot be detected by the average person at once, because it is a gas that is invisible to the naked eye. When a gas leak is detected, it can spread to a large gas leak. To prevent this, it is best to use a sensor-based system that operates automatically. It automatically prevents gas leaks and alerts people around with warning signs.

- **IOT**

The Internet of Things (IoT) refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention.

- **Mobile app**

A mobile application, most commonly referred to as an app, is a type of application software designed to run on a mobile device, such as a smartphone or tablet computer. Mobile applications frequently serve to provide users with similar services to those accessed on PCs. Apps are generally small, individual software units with limited function. This use of app software was originally popularized by Apple Inc. and its App Store, which offers thousands of applications for the iPhone, iPad and iPod Touch.

- **Mobile app vs web apps**

A native app is one that is installed directly onto the smartphone and can work, in most cases, with no internet connectivity depending on the nature of the app. Native apps are installed through an application store (such as Google Play or Apple's App Store). They are developed specifically for one platform, and can take full advantage of the device features they can work much faster by harnessing the power of the processor and can access specific hardware like GPS. In some smartphones the app can control devices and act as a controller itself. They can also incorporate gestures (either standard operating-system gestures or new, app-defined gestures). And native apps can use the device's notification system.

Web apps are not real applications; they are websites that, in many ways, look and feel like native applications, but are not implemented as such. They are run by a browser and typically written in HTML. Users first access them as they would access any web page: they navigate to a special URL and then have the option of "installing" them on their home screen by creating a bookmark to that page. Today, as more and more sites use HTML5, the distinction between web apps and regular web pages has become blurred. Web apps require internet access and its operation speeds are dependent on the quality of cell signal or the speed of the wi-fi broadband you are connected to.

2.5 Theoretical Background

The table below shows the problems that can be identified in the projects considered and the actions that can be taken in the system that we have created. Therefore, we can identify how this project will change in other projects.

01) LPG GAS LEAKAGE DETECTION USING IOT

This project is by Dr.Chetana Tukkoji and Mr.Sanjeev Kumara... N GITAM School of Technology, Bangaluru. In this system use mQ6, Temperature and humidity sensors. Therefore, can be his get good solutions in the gas leakage problem. This is system use IOT through that information transfer the web application. Those details are display use the API in the website.

The system does not send SMS messages and instead people can access information using a web application, but if a person is not on the Internet, the problem with this system is that they use a Buzzer to alert people nearby. The LED bulb alerts even the hearing impaired when a gas leak occurs, and the LCD screen also provides information in the event of a gas leak. But the problem with this project is the lack of a solenoid valve to prevent automatic gas leaks [2].

02) LPG Gas Leakage Monitoring and Alert System using Arduino.

This system is presented by siddhika and hausin, students of the faculty dept. of CSE at world university of Bangladesh, Bangladesh. The system uses the MQ6 Gas sensor, which detects a gas leak, sends a text message to the person's cell phone via the GSM module, and alerts by standers. It can also provide information to people around the area where the gas leak occurred One of the problems with this project is the inability to monitor data due to not being used in IoT, and the failure to use a solenoid valve to avoid the possibility of a gas leak if no one is around [3].

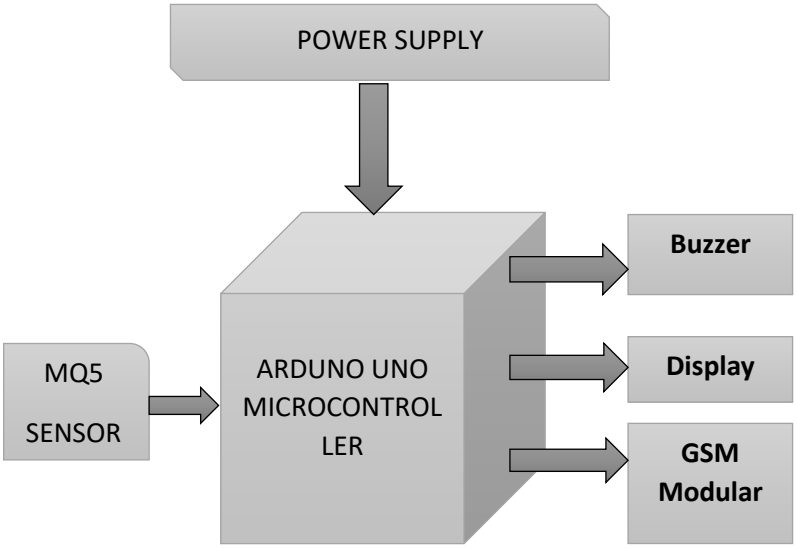

Figure 1: LPG Gas Leakage Monitoring and Alert System using Arduino

03) Microcontroller Based LPG Gas Leakage Alert System.

The microcontroller-based LPG Gas leakage alert system project is presented by manas heder and mr.sumanta shetti of JIS College of engineering in west Bengal. The project uses an MQ6 sensor that detects a gas leak. A buzzer is used to sound the alarm. A text message is sent using the GSM module, and in the event of a gas leak, a notification is sent to the mobile phone of the relevant party via SMS. In this project, as in other projects, the data is displayed on an LCD screen. IoT or solenoid valve will not be used in this project. The disadvantages of this radical proposal are small [4].

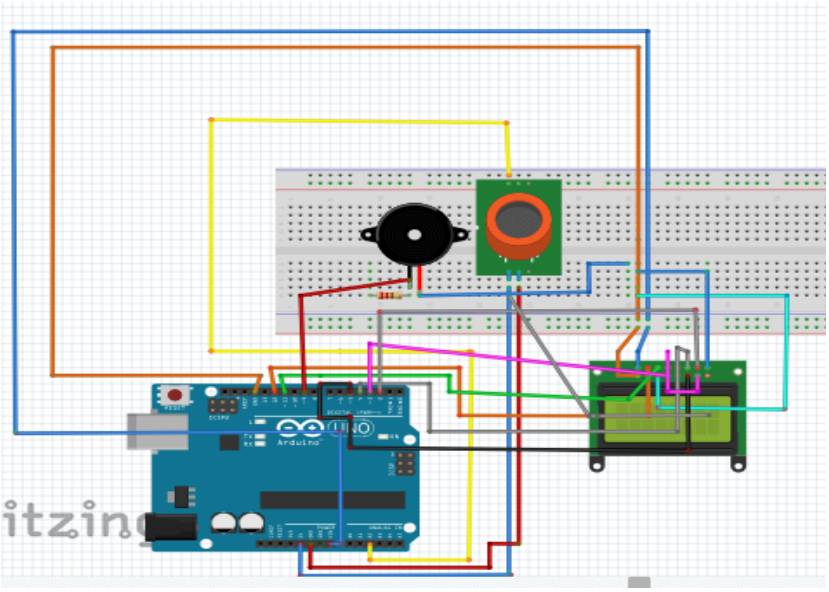

Figure 2: Microcontroller Based LPG Gas Leakage Alert System.

04) Sensor-Based Gas Leakage Detector System.

This project is presented by Mohamed Mujuke Khan, Department of Electrical and Computer Engineering, North-South University, Bangladesh. Sensor-Based Gas Leak Detector Systems The project uses the MQ6 gas sensor to detect gas leaks. The buzzer sounds an alarm and alerts people in the event of a gas leak. The LCD screen displays the gas detector as yes when a gas leak occurs and then the buzzer rings. When not on, the gas leak detector on the LCD screen is displayed as no. This project can be identified as a low-cost project.

The problem here is that due to not using the GSM model, the person is not aware of the gas leak when it is not at the scene. It is also a problem that the gas leak cannot be closed automatically without the use of a solenoid valve.

Therefore, although this project is economically advantageous, it can be identified as a weak project in terms of safety [5].

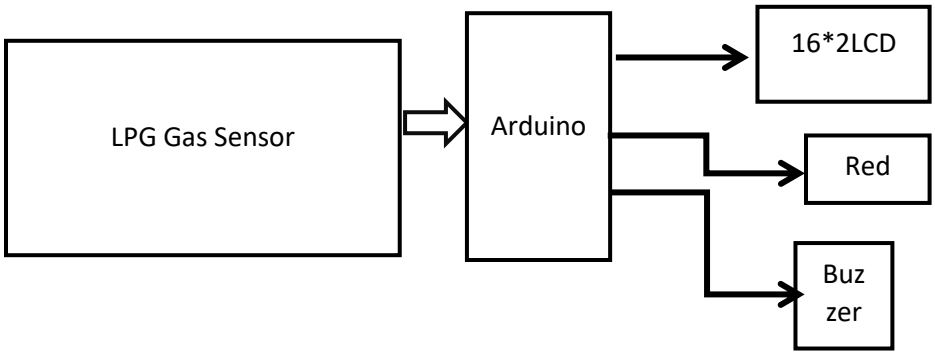

Figure 3:diagram Sensor-Based Gas Leakage Detector System

05)L PG Leakage Detection and Auto refilling Using Arduino.

Published by international of the engineering and advance technology at Alex Stanley raja, r senthil Kumar, A nandhkumar, nandakumar jv santhosh Kumar. These use the MQ6 sensor to detect gas leaks in the system and the LM 35 sensor detects temperature. Also, the special feature here is the use of HX711 sensor.

HX 711 is a specially design for the weight scales and industrial. Here an SMS message about the temperature and gas leak is sent to the customer using the GSM module. The LCD screen shows the gas leak and notifies the people around the gas leak. Although even in this system it is a problem not to use a solenoid valve to prevent gas leakage automatically [6].

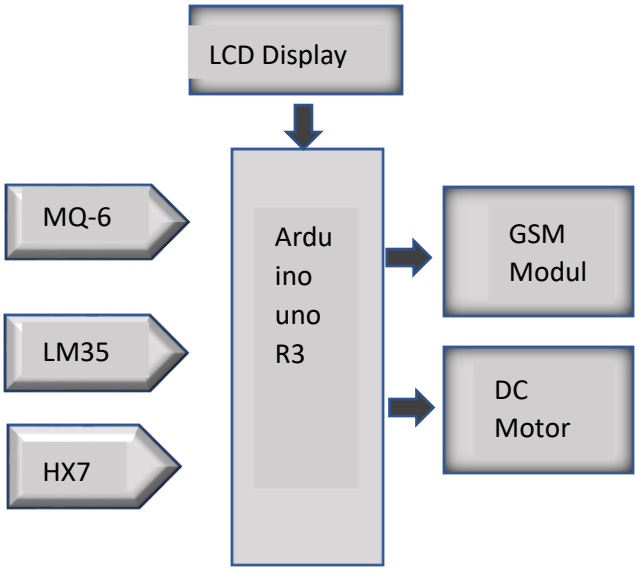

Figure 4:Diagram L PG Leakage Detection and Auto refilling Using Arduino

06) LPG Leakage Detector using Arduino with SMS Alert and Sound Alarm

LPG Leakage Detection Using Arduino with SMS Alert and Sound Alarm project presented by Rhonnel S paculanan, Israel Carino. The GSM model is used in this project as well as in many other projects. It sends an SMS to the mobile phone warning of a gas leak. The alarm is sounded with the help of a buzzer, which removes the associated people. It is also a good feature to be able to monitor the alarm even for the hearing impaired using an LCD screen. Also, the uniqueness of this project is that it closes the gas leak automatically with a solenoid valve which is not seen in other projects. It has the ability to automatically shut off the gas leak even when no one is present at the time of the gas leak. However not using IoT blocks the customer's ability to analyze data [7]**.**

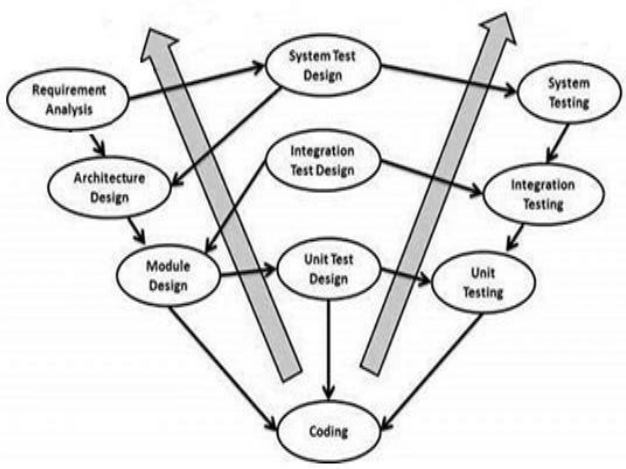

Figure 5: LPG Leakage Detector using Arduino with SMS Alert and Sound Alarm

07) LPG Leakage Detection and Alert System Using IoT.

The system was presented by student's ashok j, abinesh s, agil M, Christ teran Dhas C from the Indian Department of Computer Science and Engineering, Coimbatore insider of engineering technology. This system uses Mq6, temperature, load cell sensor. Here the mq6 sensor detects the gas leak and the temperature sensor detects the temperature and humidity. Here the weight of the gas cylinder is calculated using the load cell sensor, which identifies the volume of gas in the cylinder. This system uses IoT, which provides information about a gas leak in an Android application. This allows the user to monitor the information. As well as using a stapler motor, the cylinder button can be deactivated.

It can be used to replace the GSM module in other systems with the ESP 8266 Wi-Fi module, which connects to IOT over the Internet. This system does not use a solenoid valve and uses a stepper motor to actively stop the gas leak.

Although the problem here is that if there is a person who does not have a mobile phone associated with a gas leak, he will not be able to identify it. That is, the LCD screen does not display data or the LED bulb does not light or the buzzer does not ring. As a result, he is more likely to have an accident if he is unable to leave the place [8].

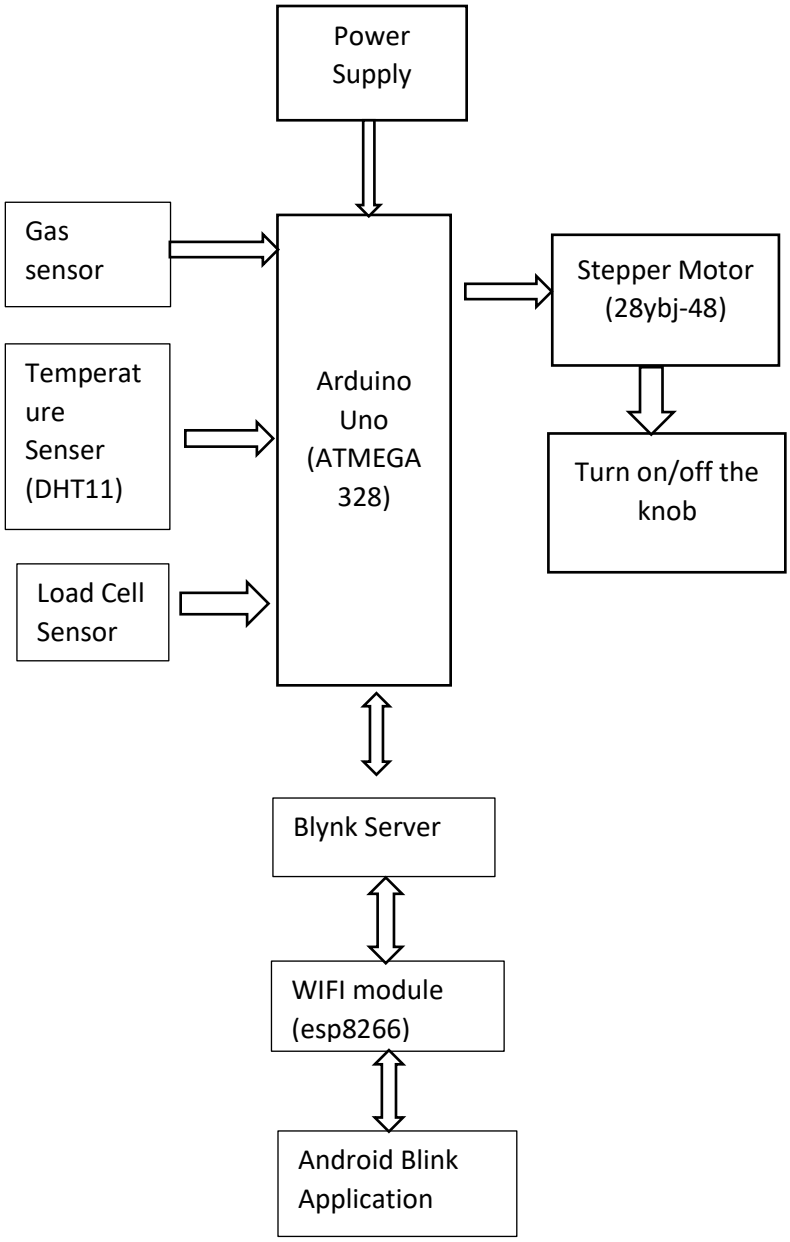

Figure 6: LPG Leakage Detection and Alert System Using IoT.

08) LPG Leakage Detection System Using Phone Calls Alerts To Prevent Accidents And Avoid Injuries.

This project is presented by students in Program in Computational Systems Modelling at the federal university of the Tocantins, Brazil. The system also uses an mq6 gas sensor to detect gas leaks. IoT is used for the system, which directs the data to a website. The user will not be able to access the information when there is no internet facility. Also, the lack of alarm does not make the people around aware. The lack of an LCD screen or LED bulb in it is a big problem for people who do not have a mobile phone to recognize the dangers. There is no solenoid valve in this and the inability of this system to prevent automatic gas leakage is also a problem [9].

09) Gas leakage detection and alerting system using Arduino Uno.

Gas leak detection and alerting system using Arduino projects presented by students Syeda bushara shahewaz and ch.Rajendra prasad studying in department of ECE, S R engineering college and school of engineering, department of ECE, S R University in India. The use of three gas sensors to detect a gas leak in the system can be seen as a special feature. Mq2, mq6 and mq135 gas sensors are used there. Delivers an SMS message to the user's mobile phone using the GSM module. It also uses a buzzer to sound an alarm in the event of a gas leak and it makes people aware. An LCD screen is also used to display information about the gas leak. Although this system does not use IoT or Solenoid valve and cannot close the gas leak automatically due to lack of solenoid valve. The problem with this project is that if no one was present at the time of the gas leak, the accident could not have been prevented *[10]*.

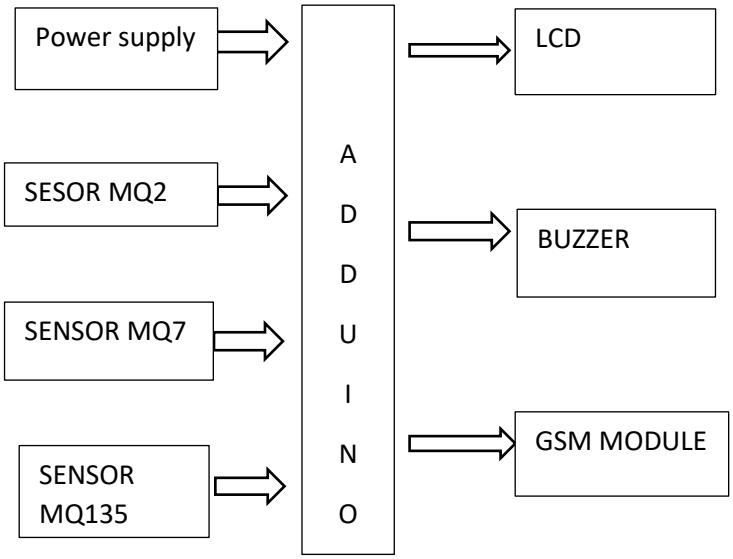

Figure 7:Gas leakage detection and alerting system

2.6 Comparison Table

Looking at the table belove, we can identify the special features in the projects considered. But in none of the projects can we see the use of all the devices used and therefore the LP gas detection system provides more security than other systems available in the market. The project will help save lives and property from accidents caused by gas leaks.

Requirement	R1	R2	R3	R4	R5	R6	R7	R8	R9	Propose projects
	Research Base System					Existing System				
Mq2 on Any Gas Sensor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Buzzer	✓	✓	✓	✓		✓			✓	✓
LCD Display	✓	✓	✓	✓		✓			✓	✓
LED	✓			✓						✓
Esp32 / GSM module	✓	✓	✓		✓		✓	✓	✓	✓
Solenoid valve / DC Motor					✓	✓	✓			✓
Web App / Mobile App	✓						✓	✓		✓

Table 1.2 Comparison Table 1

R1 - LPG Gas Leakage Detection Using IOT

R2 - LPG Gas Leakage Monitoring and Alert System using Arduino.

R3 - Microcontroller Based LPG Gas Leakage Alert System.

R4 - Sensor-Based Gas Leakage Detector System.

R5 - L PG Leakage Detection and Auto refilling Using Arduino.

R6 - LPG Leakage Detector using Arduino with SMS Alert and Sound Alarm.

R7 – LPG Leakage Detection and Alert System Using IoT.

R8- LPG Leakage Detection System Using Phone Calls Alerts to Prevent Accidents and Avoid Injuries

R9 - Gas leakage detection and alerting system using Arduino Uno**.**

2.7 Summery

There is a high level of domestic accidents. A small gas leak can cause a large explosion. Therefore, it should be detected at the earliest. LP gas detector system can be used using Arduino. An mq2 gas sensor can be used to detect gas leaks. Information on gas leaks can also be filed into a web application using IoT for this purpose. The system also has the potential to save many lives and property due to its ability to automatically prevent gas leaks

CHAPTER 3 – ANALYSIS

3.1. Introduction

In systems engineering and software engineering, requirements analysis focuses on the tasks that determine the needs or conditions to meet the new or altered product or project, taking account of the possibly conflicting requirements of the various stakeholders, analyzing, documenting, validating and managing software.

3.2. Feasibility study

A feasibility study is an analysis that considers all of a project's relevant factors including economic, technical, legal, and scheduling considerations to ascertain the likelihood of completing the project successfully.

❖ Technical Feasibility

Technical feasibility evaluates the technical complexity of the expert system and often involves determining whether the expert system can be implemented with state-of-the-art techniques and tools.

- Hardware
  - Arduino Uno r3
  - Mq6 Gas sensor
  - Solenoid Valve
  - LCD display
  - Buzzer
  - Esp. 32 Module
  - LED Bulb
  - Jumper Wire
  - 12V Battery
- Software
  - Arduino IDE
  - BLYNK server

❖ Operational Feasibility

This project is an Arduino based project and the cost is very low. That is, the IoT base LPG gas leak detection system project can be built for very little money. It is based primarily on the Arduino uno R3, MQ6 gas sensor, ESP 32 module, LCD display, buzzer and solenoid valve. This can be used to prevent accidents caused by LP gas leaks. Also, this project belongs to the category of wireless sensor networking. Basically, the information detected by the Mq6 6 air sensor is represented using the Arduino board of the LCD and LDE and the buzzer, while the esp32 module points the data to the cloud and sends SMS messages. Based on the above, this project can be implemented.

❖ Economically Feasibility

Economic feasibility, the most important is cost-benefit analysis. As the name suggests, it is an analysis of the costs to be incurred in the system and benefits derivable out of the system.

- Adequate Demand for the Selected Product.

LPG Gas is an essential component of the world today. So, the consumption of LPG Gas is increasing day by day. Accidents due to this have also increased. The incidence of loss of life and property is high.

For these reasons, LPG gas leak detection systems can be installed in homes, hotels, gas storage facilities, and all LPG gas use locations to prevent LPG gas accidents. The system can protect many people by detecting gas leaks in the device, alerting the surrounding community and automatically preventing gas leaks. Therefore, it can be predicted that there is a high demand in the market for this method.

- Availability of Raw Materials and Man Power

The electronic components required for the design of the LPG gas leak detection system can be procured locally so that the raw materials required for the system can be easily obtained. Therefore, production efficiency increases due to less time taken to find the raw material. It takes a skilled worker 4-5 hours to design one l p gas leak detection device.

Here, if these devices are mass-produced, the division of labor can reduce the number of man-hours to three or four. This is because each person is assigned a different task. Therefore, one person can excel in the work he does.

Ex- If one person is given the opportunity to connect the MQ6 Gas Sensor, he can increase production with less time and more productivity in doing just that.

- Cost Effectiveness

The value of LP gas detection devices available in the market is more than Rs. 15,000. Also, the devices do not perform as much work as in this project, and systems that use both IoT or solenoid valve technologies are rarely identified. They are also very expensive and unaffordable to consumers.

But here the cost of production and marketing cost is lower and the productivity is much higher. Therefore, this device will be a challenge to other market devices.

1. Total start-up cost
2. Financial performance of similar business
3. Income and profit

Total start-up cost

Table2: total cost 1

Equipment	Number of pieces	Amount (LKR)
ESP 32	01	1000
MQ2	01	350
LCD Display	01	650
LED Bulb	01	20
Solenoid Valve	01	2000
I2C	01	500
Jumper wire	20 or more	450
Buzzer	01	500
Relay	01	110
Electricity		100
Labor charge		700
Total		Rs.6380

2.Financial Performance of Similar Business.

Similar types of Products	Market price (LKR)
HD – 2000 Home Gas Detection	15000-40000
E – 1000 portable single Gas Detection	15000

❖ Legal Feasibility

Legal feasibility is the study to know if the proposed project conforms the legal and ethical requirements. The LPG gas extraction system can be identified as a project that supports environmental laws, health laws, safety laws and existing civil law in the country. In this case, the project is subject to environmental laws due to the absence of environmental pollution or the use of other toxic gases. Also, this project is planned in accordance with the security laws and regulations and it will not violate the existing security laws in the country. This project is subject to the Intellectual Property Act due to its construction as a new project.

Accordingly, there are no legal issues as the project is designed in accordance with the laws and regulations imposed by the Government of Sri Lanka.

Accordingly, the results of feasibility studies are as follow.

Table 5: feasibility Study 1

Feasibility Analysis	**Final status**
Technical Feasibility	Feasible
Operational Feasibility	Feasible
Financial Feasibility	Feasible
Economic Feasibility	Feasible
Legal Feasibility	Feasible

3.3 Fact-Finding Technique

Fact finding is a technique for gathering data and information that includes document sampling, research, observation, questionnaires, interviews, prototyping, and cooperative needs planning. To create and implement the current system, the system analyst employs appropriate fact-gathering methodologies. Collecting required facts is critical for using tools in the System Development Life Cycle, as tools cannot be used efficiently or effectively without adequate information extraction. In the early stages of the System Development Life Cycle, such as the system analysis phase, design, and post-implementation review, fact-finding procedures are used. Facts included in any information system can be tested based on three steps: data- facts used to create useful information, process- functions to perform the objectives and interface- designs to interact with users.

- Fixed-format questionnaires

The goal of fixed-format questionnaires is to collect information from predefined question formats. Users have the option of selecting a result from the available options. Fixed-format questions are classified into three types: multiple-choice (Yes/No) questions, rating questions (Strongly agree, Agree, No opinion, Disagree, Strongly disagree), ranking questions (numbering according to the preferences) [11].

Accordingly, the fixed format questionnaires method was selected for this proposed project. It uses questions and interviews for the proposed l p gas leak detection system project. Below are some of those questions and interview questions.

Questionnaire for the LPG Gas user.

01.Do you using LPG Gas?

02 Wherever you use LP gas?

03. What is the distance between your gas cylinder and the stove?

04) How many times a day do you use LP Gas?

05) Are you aware of the dangers of gas leaks?

06) Are you aware of the steps you can take to prevent a gas leak?

07) Would you like to use a device to automatically deactivate a gas leak?

08) Are you satisfied with the device we have proposed to prevent gas leakage?

09) Are you satisfied with using a web slide to analyze gas leak information?

3.4 Requirement Analysis

Requirement's analysis, also called requirements engineering, is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. Requirement's analysis is an important aspect of project management [12].

Feedback from Questionnaire.

Based on the use case diagram given above, the questionnaire has been prepared for the following questions and in addition, the users have been asked to comment on the need to create a new system.

01) Do you using LPG Gas?

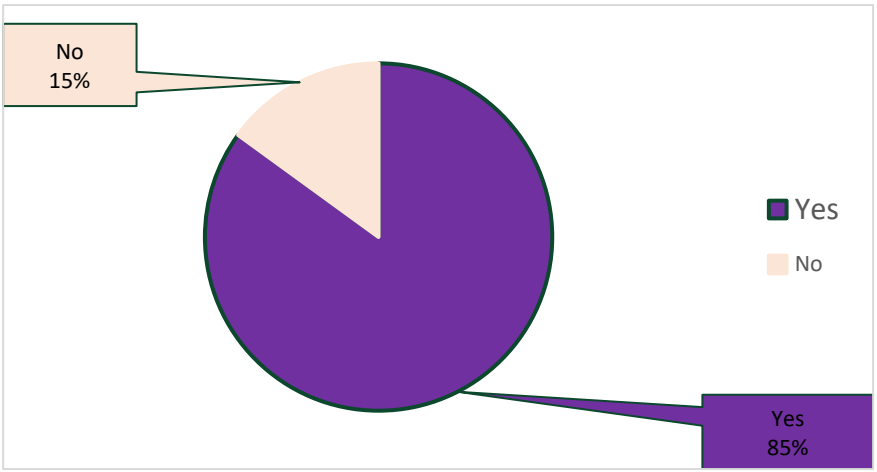

Figure 8: Question 1 chart feedback

About 85% of the people considered here consume LP gas and only about 15% not use it. Accordingly, this project can take on a very important expansion.

02) Wherever you use LP gas?

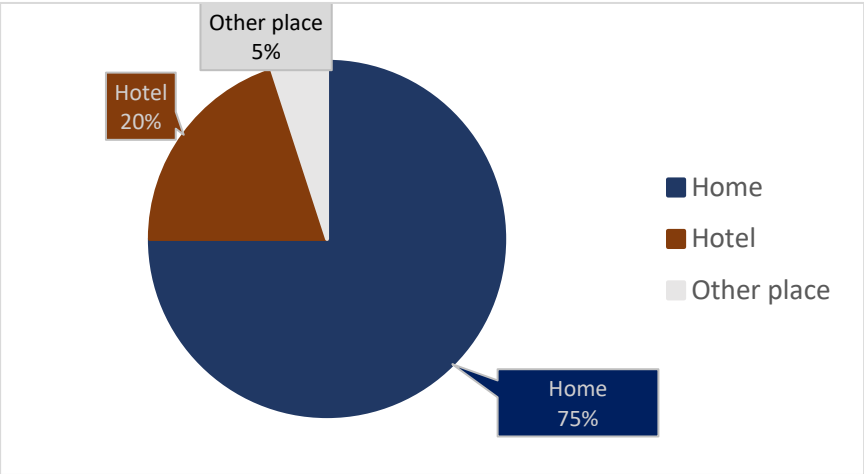

Figure 9: Question 2 chart feedback

About 75% of LP gas consumption is used by households and 20% by hotel. Elsewhere, about 5% of LP gas is used.

03) What is the distance between your gas cylinder and the stove?

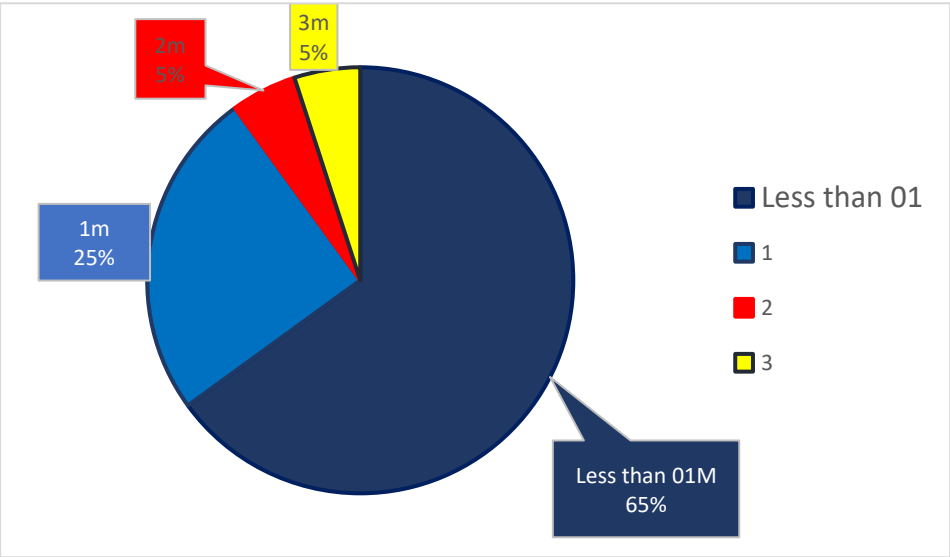

Figure 10: Question 3 chart feedback

In most of the samples considered here, the distance between the gas cylinder and the furnace is very small. It is less than 1 meter in about 65% of homes. About 25% of people use a distance of about 1m. There are 5% of used houses at a distance of 2 m 3 m. Accordingly, the distance between the gas cylinder and the stove can be identified to reduce the risk of accidents.

04) How many times a day do you use LP Gas?

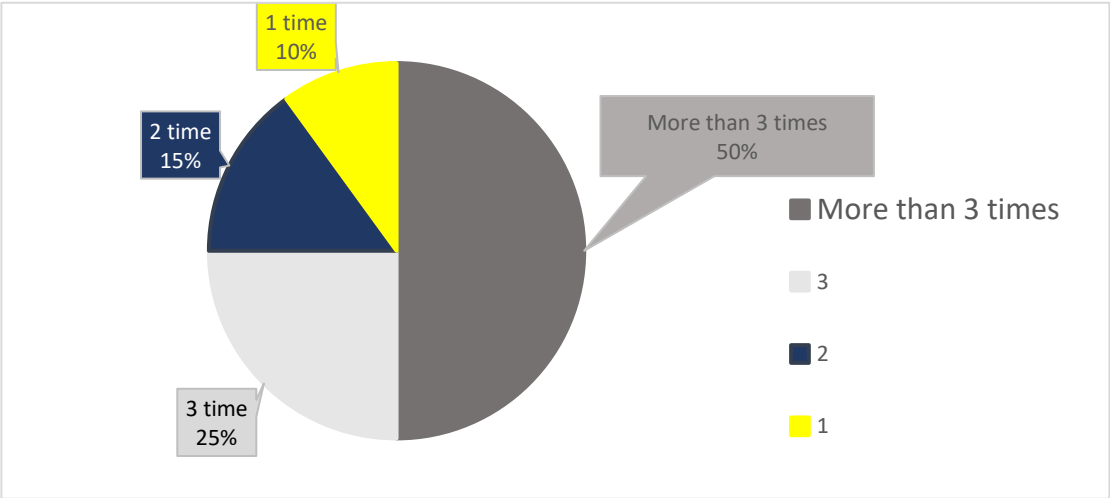

Figure 11: Question 4 chart feedback

About 50% of homes use gas stoves more than three times a day, compared to 25% of homes that use them three times a day. Those who use 2 and 1 times are about 15% and 10%, respectively.

05) Are you aware of the dangers of gas leaks?

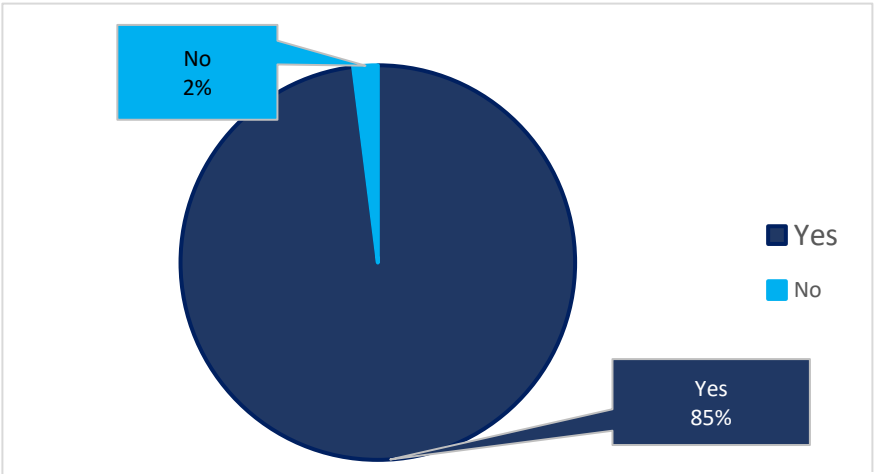

Figure 12: Question 5 chart feedback

About 98% of people are aware of the dangers of gas leaks and only 2% are unaware of it.

06) Are you aware of the steps you can take to prevent a gas leak?

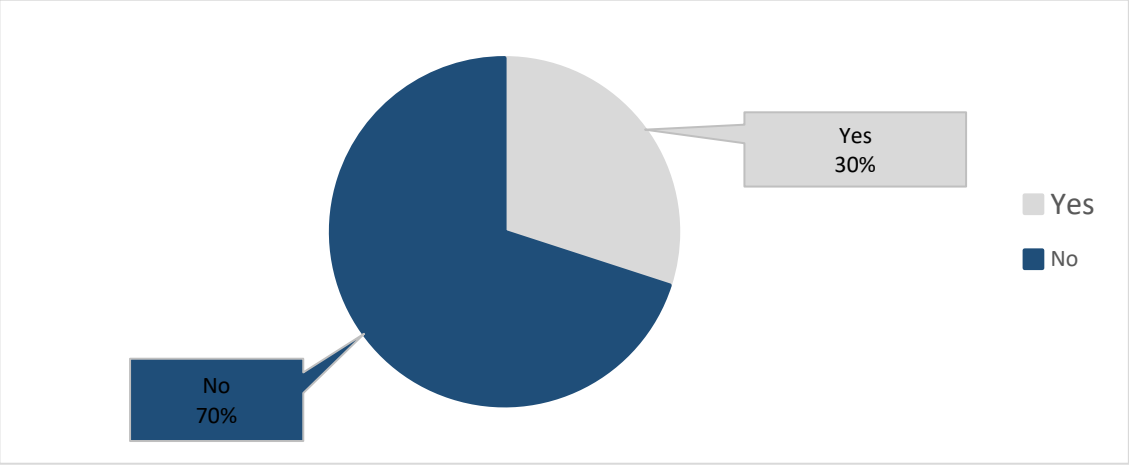

Figure 13: Question 6 chart feedback

Although many people are aware of gas leaks here, many are unaware of the steps to be taken to prevent such accidents. About 70% of people do not know how to prevent a gas leak and about 30% are aware of it.

07) Would you like to use a device to automatically deactivate a gas leak?

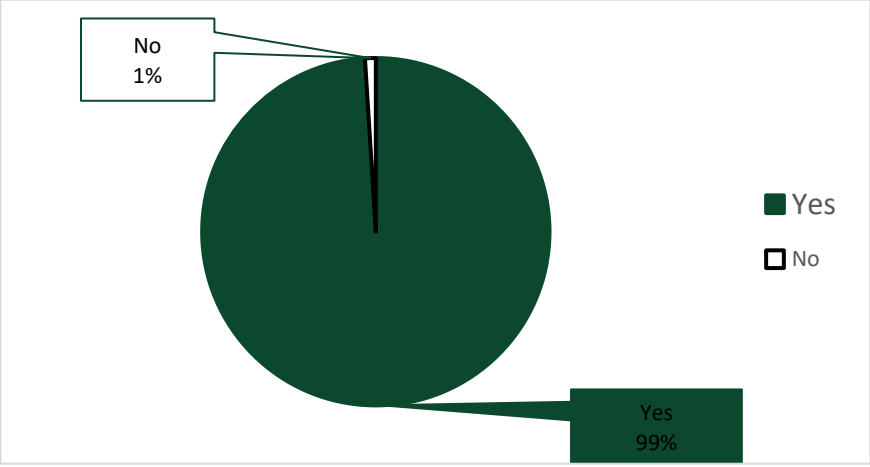

Figure 14: Question 7 chart feedback

About 99% of people would like to use a system that can automatically shut off a gas leak.

08) Are you satisfied with the device we have proposed to prevent gas leakage?

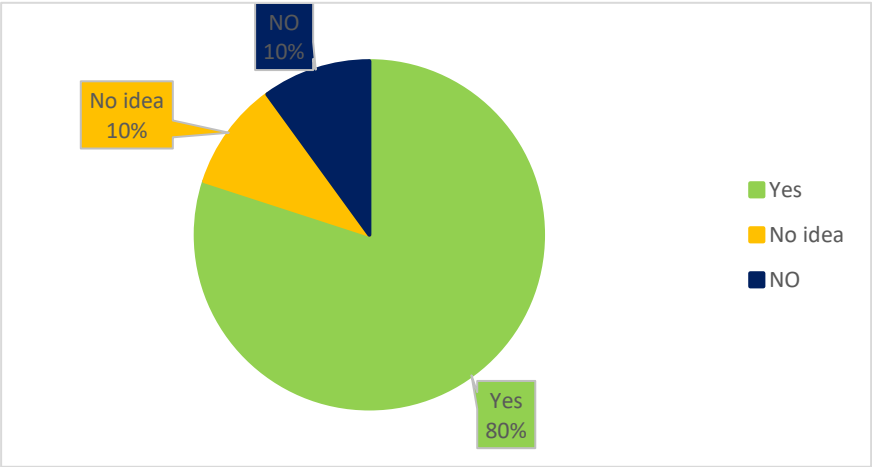

Figure 15: Question 8 chart feedback

We gave them a rough idea of the proposed project and they are about 80% satisfied with it. And another 10% had no idea. About 10% responded negatively and we received suggestions from them as well.

09)Are you satisfied with using a web slide to analyze gas leak information?

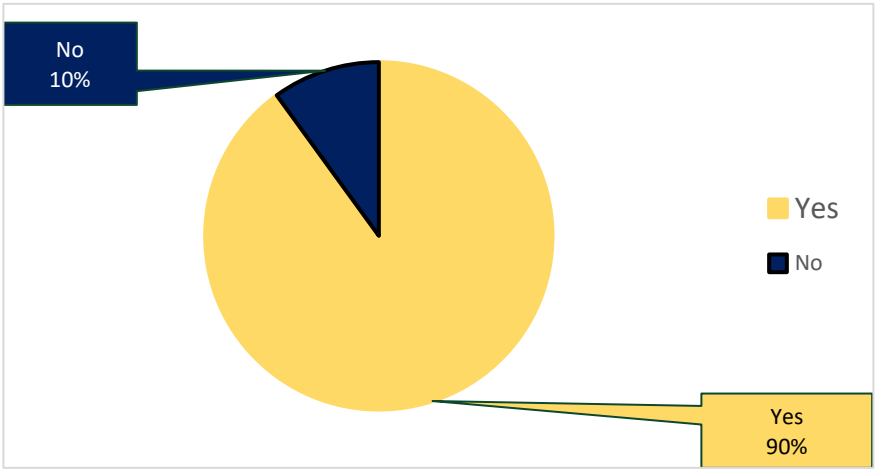

Figure 16:Question 9 chart feedback

Also, about 90% of people agreed to monitor data on gas leaks through a web application.

3.5 Functional Requirements

These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected. They are basically the requirements stated by the user which one can see directly in the final product, unlike the non-functional requirements [13].

Following are the functional requirements obtained from the interviews, literature review, and questions according to the proposed project.

- ❖ Input
    - LPG Gas Leaked
- ❖ Processes
    - Gas leak detection
    - The buzzer is functional
    - The gas leak is automatically deactivated.
    - The data obtained through the mq6 gas sensor is routed to devices connected to the ESP 32 board.
    - The data obtained is stored in the cloud using IoT.
- ❖ Outputs
    - Automatic deactivation of gas leak
    - A gas leak alert is sent to the user's mobile phone
    - The LED bulbs light up
    - Ability to go to the mobile application and analyses data.
    - The data is displayed on the LCD screen

3.6 Non-Functional Requirements

These are basically the quality constraints that the system must satisfy according to the project contract. The priority or extent to which these factors are implemented varies from one project to another. They are also called non-behavioral requirements. Non-functional Requirements define system attributes such as security, reliability, performance, maintainability, scalability, and usability [14].

Accordingly, the Non-functional requirements of this proposed project can be identified as follows.

- This device can be installed in a small space.
- Displaying information to the user under several modes (LCD, LED, mobile Application)
- Creating a mobile app that is easy to us a user who is not familiar with using in mobile app.
- The username and password can be changed by the user as required on the mobile app.
- Ensuring user safety due to automatic gas leak shutdown.

Resource Requirements

Following are the required hardware and software requirement which will be using for develop the proposed system.

Table 6: Resource requirement 1

Hardware Requirement	**Software Requirement**
• Arduino Uno	• Arduino IDE
• Liquid crystal display	• Blynk
• Buzzer	
• MQ2 Gas sensor	
• Solenoid Valve	
• Esp32 module	

3.7 Methodology for the System Development

The iterative waterfall model is being used for this project as various elements may be added in the development of this proposed project. Iterative Waterfall Model is the extension of the Waterfall model. Iterative waterfall allows to go back on the previous phase and change the requirements and some modification can done if necessary. This model reduces the developer's effort and time required to detect and correct the errors [15].

The published waterfall model will be used for this project. The waterfall model will be used for this project as it will be easy to make any changes to the previous stages during the development of the system.

Even if the system is built-in, it can be easily done in the declared waterfall model when the customer wants to make any changes.

Here hope it will be easier to create this project in this declared waterfall model system than the traditional waterfall system.

Advantages of Iterative Waterfall Model

- Iterative waterfall model is very easy to understand and use.
- Every phase contains feedback path to its previous phase.
- This is a simple to make changes or any modifications at any phase.
- By using this model, developer can completer project earlier.
- Customer involvement is not required during the software development.
- This model is suitable for large and complex projects.

Accordingly, Iterative waterfall model can be identified in the diagram below.

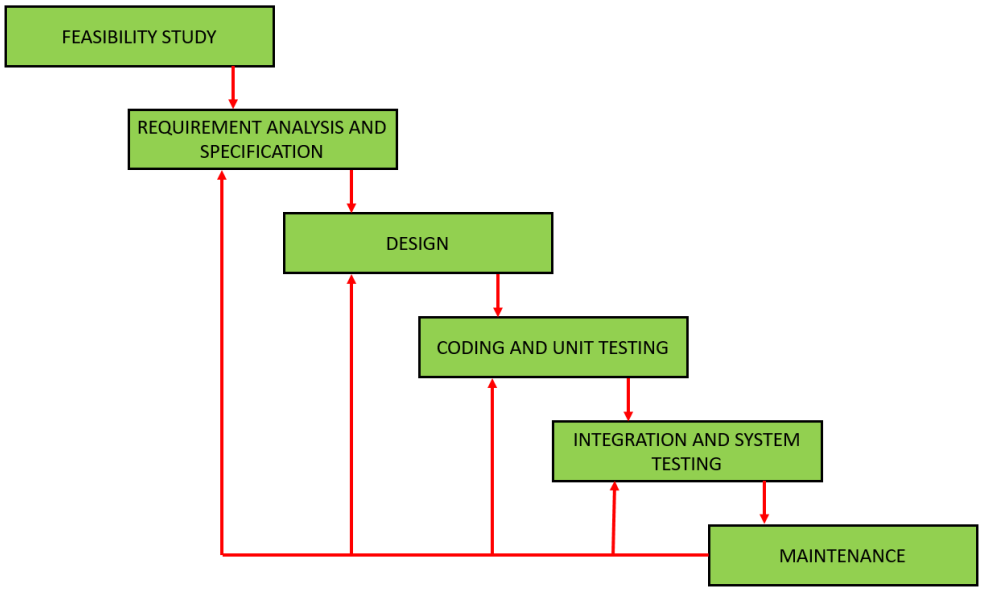

Figure18: Iterative water fall model

3.8 Summery

Discussed in this section is the feasibility study required to build this system. In feasibility studies analysis, all feasibility studies were feasible.

Needs Analysis also looked at the shortcomings of existing systems that are most needed by the customer and the market. The advantages of both functional and non-functional requirements are also considered when building the system. The system uses a repetitive waterfall model to build.

This is further discussed in Appendix A. You can refer to that section for more information

CHAPTER 4 – DESIGN

4.1 Introduction

In the design section in the design of the proposed project. The system is represented by the use case diagram, block diagram, circuit diagram, flowchart below. Accordingly, the design part is a very important part for the developer to build the system in the system design.

4.2 System Design Process

4.2.1 Use Case Diagrams

A use case diagram is used to represent the dynamic behavior of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It depicts the high-level functionality of a system and also tells how the user handles a system [16].

4.2.2 Block Diagram

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks. They are heavily used in engineering in hardware design, electronic design, software design, and process flow diagrams.

4.2.3 Circuit Diagram

A circuit diagram is a visual display of an electrical circuit using either basic images of parts or industry standard symbols. Symbol usage depends on the audience viewing the diagram. These two different types of circuit diagrams are called pictorial or schematic style [17].

4.2.4 Flow chart

A flowchart is a picture of the separate steps of a process in sequential order. It is a generic tool that can be adapted for a wide variety of purposes, and can be used to describe various processes, such as a manufacturing process, an administrative or service process, or a project plan.

4.2.5 Design Diagrams

4.2.5.1 Use Case Diagram for a Device

Here in the use case diagram, there are two actresses as user and system. The system is connected to the gas leak, solenoid valve, buzzer, LCD, LED bulb and esp32 attribute. User buzzer, LCD, LED, mobile app alert and gas valve details are associated with the attribute.

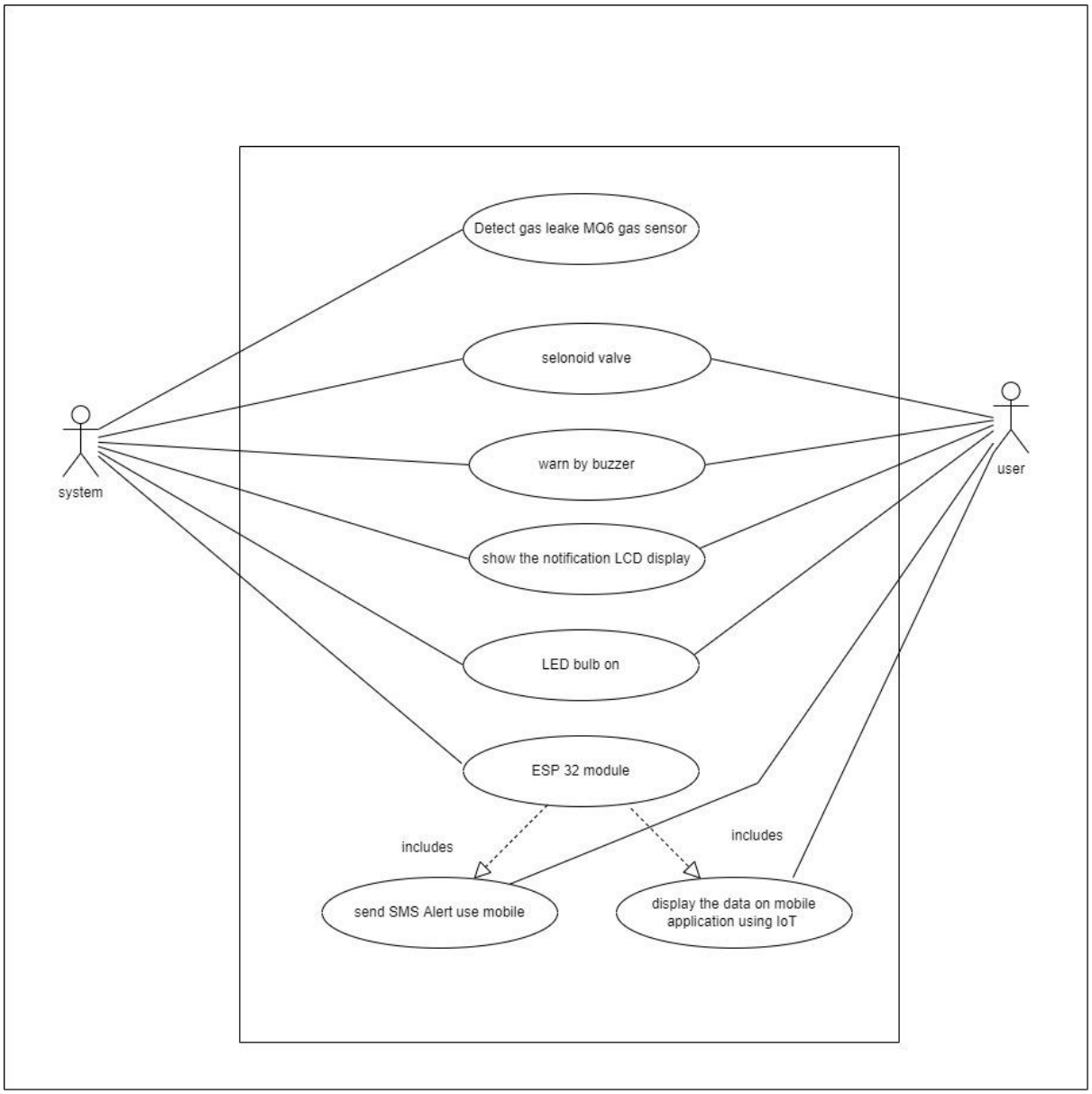

Figure 19: use case diagram

4.2.5.2 Activity Diagrams

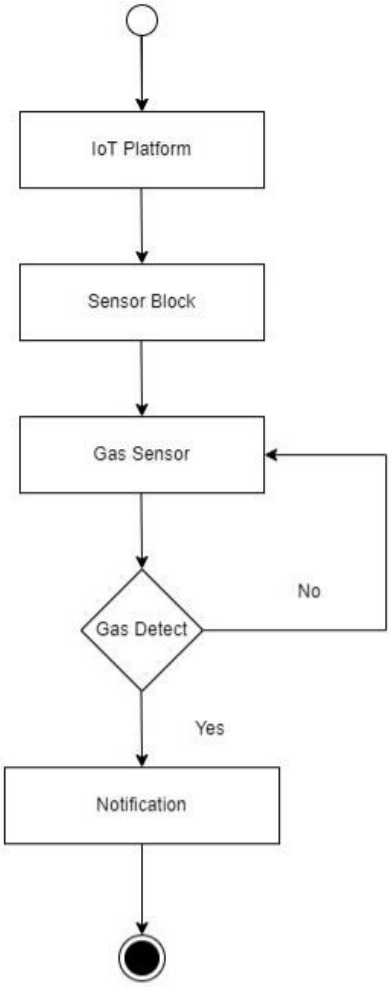

Figure 17:Activity diagram

4.2.5.3 Block Diagram

Even a person with no technical knowledge of the system can get a rough idea of a block diagram. Therefore, it is possible to get an idea of the other components of the system that are connected to the esp32 module of this system.

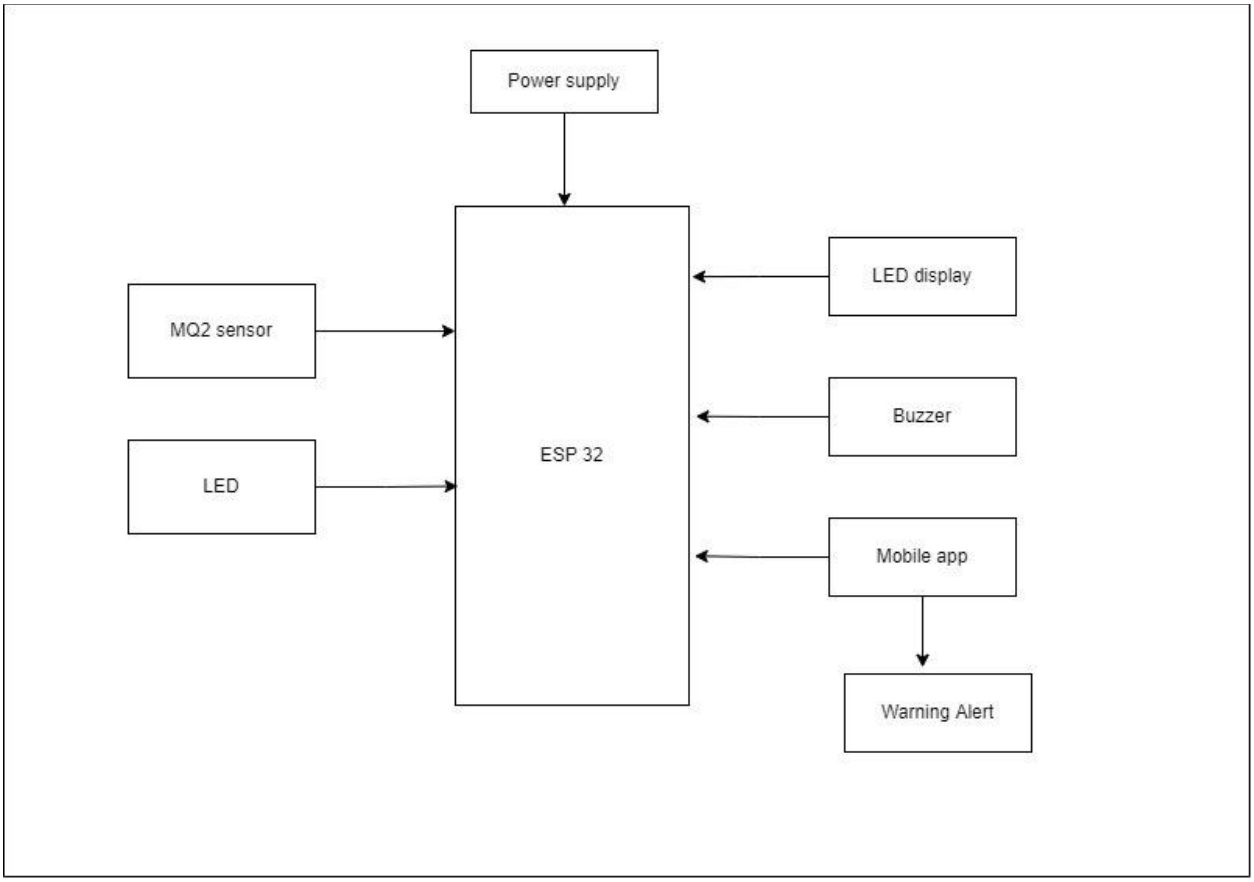

Figure 18:Block diagram

4.2.5.4 Circuit Diagram

This can be pointed out as the most necessary diagram for setting up these projects. This explains how the other LCD, LED, buzzer and solenoid valve circuits connected to the esp32 module are connected.

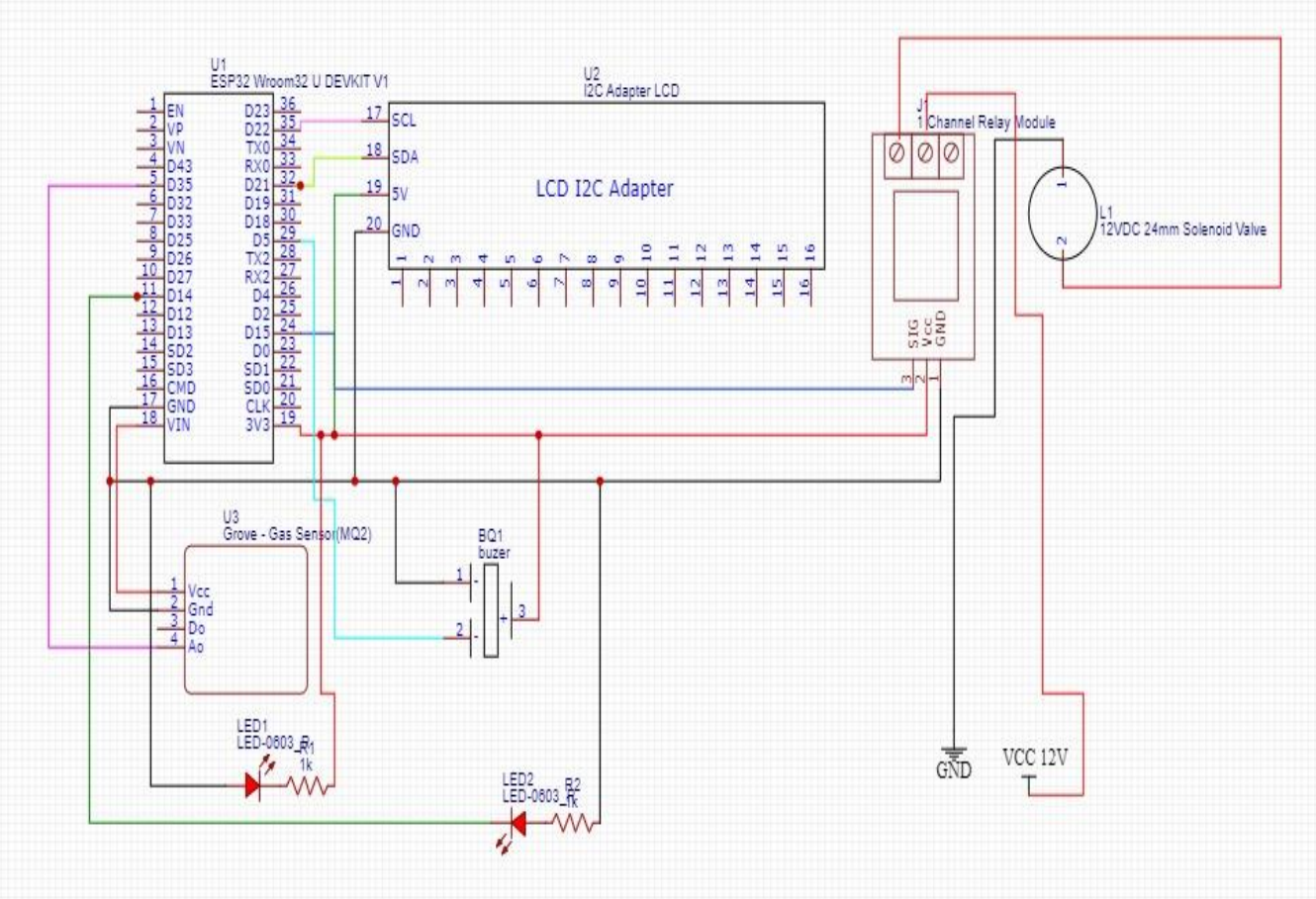

Figure 19:circuit diagram

04.3Interface Design

Liquid crystal display

In this case, if there is no gas leak, the gas value is represented as 0. If the gas leakage value is greater than 40, its gas value is represented as high and if it is less than 40, the gas value is represented as low. This is further explained in the testcase

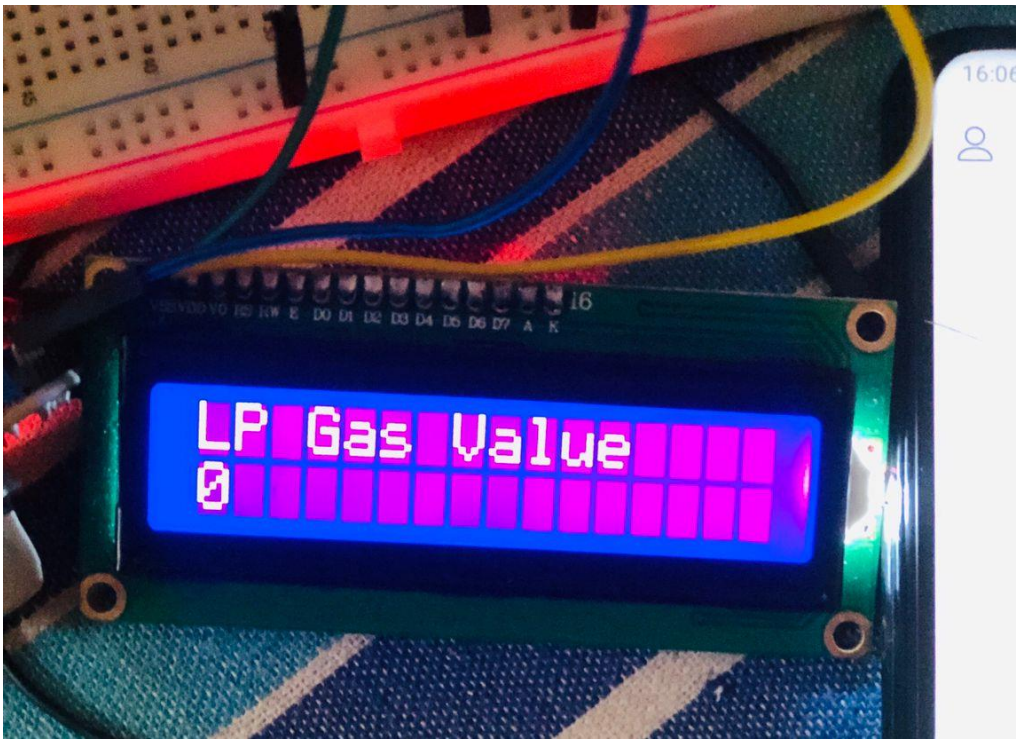

Figure 20:interface design

Mobile App

With the help of the mobile app below, the user will be alerted by the mobile app to his mobile phone in case of a gas leak. He can also study the value of the gas leak at that time through the mobile app.

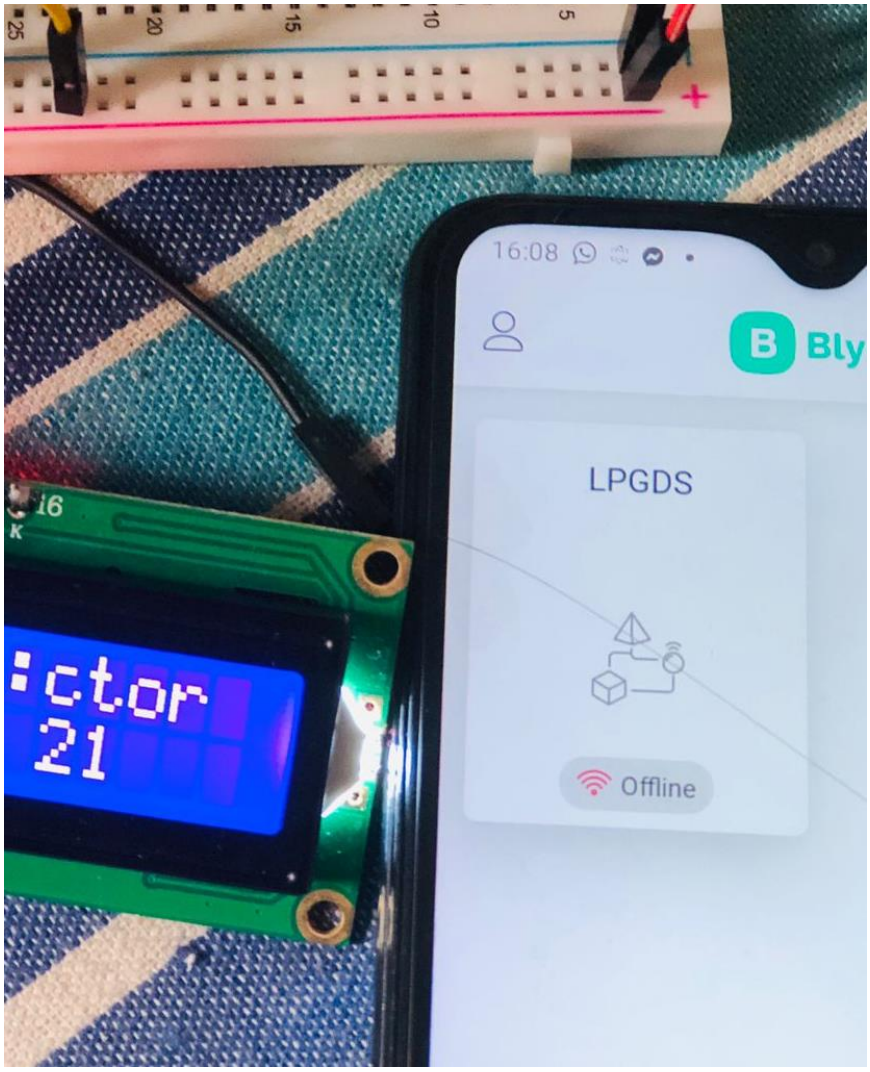

Figure 21:Mobile app

4.5 Hardware Component

ESP32 Board

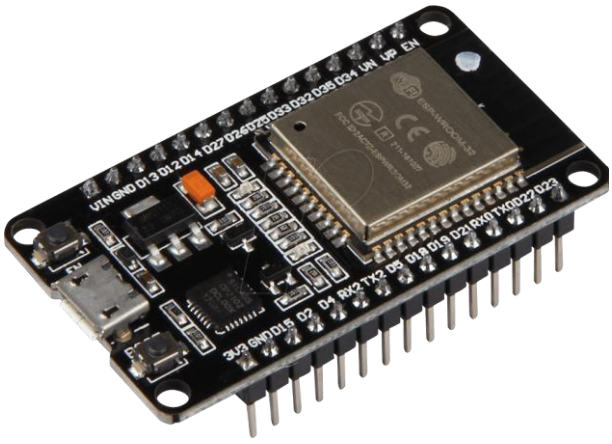

Figure 22:ESP32

ESP32 is a series of the low-cost, low-power system on a chip microcontroller. It is the ESP8266 successor. The ESP32 is loaded with lots of new features. It combines Wi-Fi and Bluetooth wireless capabilities, and it's dual-core. Everyone can find the ESP32 as a standalone module or as a full-featured development board.

• Liquid crystal display

LCD stands for Liquid Crystal Display. LCD is finding widespread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons.

• Ease of programming for characters and graphics.

• The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.

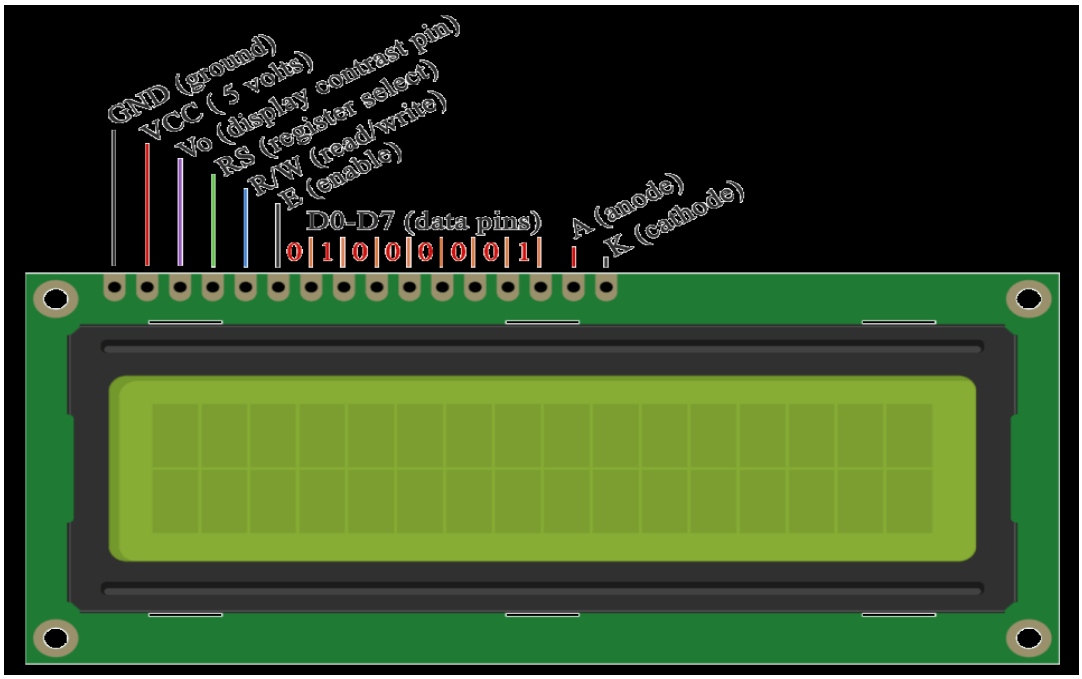

Figure 23:LCD

- **Buzzer**

A piezo buzzer is sometimes known as an Arduino buzzer. Basically, you may immediately connect to an Arduino with a little speaker. At one frequency you can make it sound a tone. The buzzer makes the reverse piezoelectric effect sound.

.

Figure 24:Buzzer

MQ2 Gas Sensor

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected.

MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm.

Figure 25.MQ2

Solenoid valve

A solenoid valve is an electromechanically operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control.

Figure 26:solenoid valve

Relay module

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

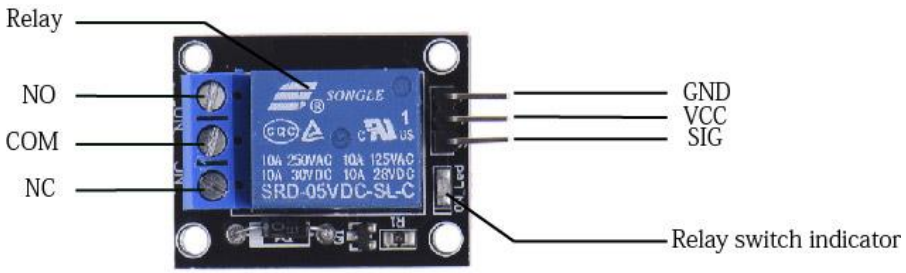

Figure 27:Relay module

4.6 Software Requirement

Arduino Integrated Development Environment

The Arduino Integrated Development Environment (IDE) includes a text editor for writing code, a message area, a text console, a toolbar with buttons for basic functions, and a menu system. It connects to the Arduino hardware, allowing it to upload and communicate with programs.

Figure 28:Arduino IDE

Blynk

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

Figure 29:Blynk

4.7 Summary

In this chapter we have considered how to design the system using the use case, block diagram and flow chat used to build the project. After the system is designed, its interface design and the hardware and software components required for it are described.

This is further discussed in Appendix B. You can refer to that section for more information

CHAPTER 5 – SYSTEM DEVELOPMENT

5.1 Introduction

Development processes transform the specification to an executable program, which are, most of the time interleaved. The system has been implemented in order to fulfil the requirements identified so far in the system analysis phase and to satisfy all the requirements of main stake holders of the system. The design patterns and technologies identified in the system designing phase were highly supported to implement the system timely and efficiently [18].

5.2 Navigation / Module Structure

The project was built using other devices, including the Esp32 and mq2 gas sensor, such as the LCD display and buzzer. Here the mq2 gas sensor captures the data in the event of a gas leak and displays it on a mobile application using IoT. It also notifies the user of a message about the warning. It also has an Lcd display to alert people around it and a buzzer to alert them. LED bulbs also alert people at the scene of a gas leak.

5.3 ESP 32 Microcontroller Initialization

MQ2 Gas Sensor

LP Gas is a gas that often causes accidents. It is highly flammable, so it should be detected before a fire and gas leaks should be avoided. It can use an MQ2 gas sensor to detect gas leaks.

LCD Display

Information about the gas leak is displayed on the LCD screen.it is associated with the ESP 32 module.

Buzzer

If the data obtained by the mq2 gas sensor is analyzed via esp 32 and gas leakage value is greater than 48, the buzzer will ring.

5.4 Development Environment

Sending data to Blynk server

In this section we will transfer data to the Blynk server and connect the ESP 32 module with the Blynk server.

```
#define BLYNK_TEMPLATE_ID "TMPLOsKuygUF"

#define BLYNK_DEVICE_NAME "LPGDS"

#define BLYNK_AUTH_TOKEN "-U3DC3CY-6eJIOzLAVQpax64UkyF7HIa"
```

Connected to the wi-Fi router

```
// Your WiFi Credentials.

// Set password to "" for open networks.

char ssid[] = "Dialog 4G 516";

char pass[] = "Lahiru@99";
```

Define the Input and output Devices pin

Below is how the pin is defined for MQ2, Led bulb, Wi-Fi bulb and solenoid valve.

```
#define MQ2_SENSOR    35

#define GREEN_LED     14

#define RED_LED       25

#define WIFI_LED      2

#define SOLENOID    18
```

System Setup

This project can be identified by the image below. This is where the LP Gas sensor takes data from the esp32 module and analyzes it through the esp32 module and displays it on the lcd screen. The information is transmitted to the Blynk app at the same time with the help of WIFI and displayed on the Blynk app. The information is represented by the buzzer and the led bulb. Also, the gas supply is automatically shut off using a solenoid valve.

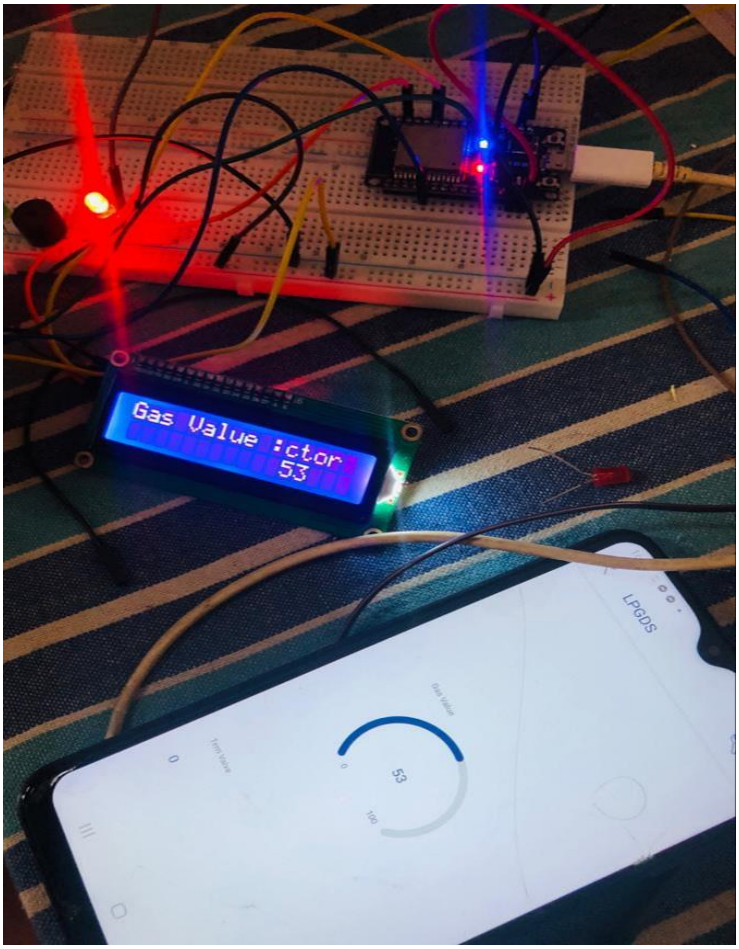

Figure 30:system setup

5.5 Tools Used

Arduino. IDE

Any programming language for a compiler that outputs binary machine code for the target processor can be used to write an Arduino application. The Arduino integrated development environment (IDE) is a cross-platform program that may be created in any language. It arose from the IDE for the Processing and Wiring programming languages. It comes with a code editor that offers text cutting and pasting, text finding and replacement, automated indenting, brace matching, and syntax highlighting, as well as one-click compiling and uploading to an Arduino board or any other compatible board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. A program written with the IDE for Arduino is called a sketch.

5.6 Graphical User Interface

Mobile App Login

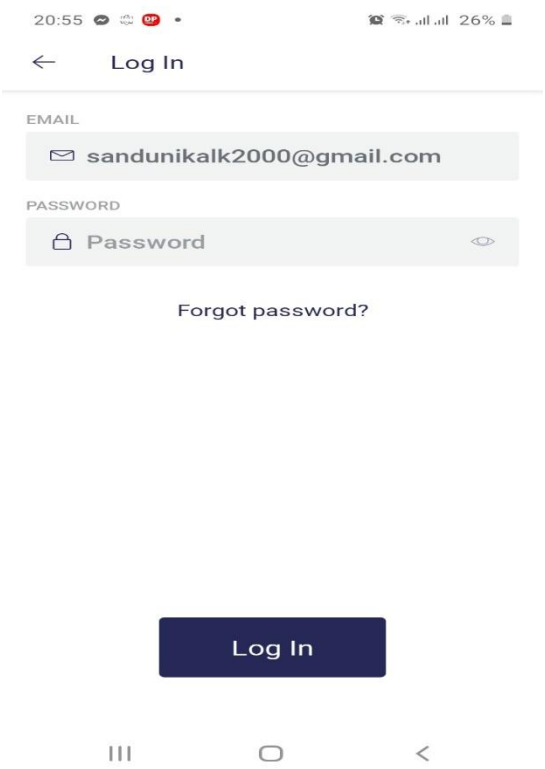

Figure 31:mobile app login

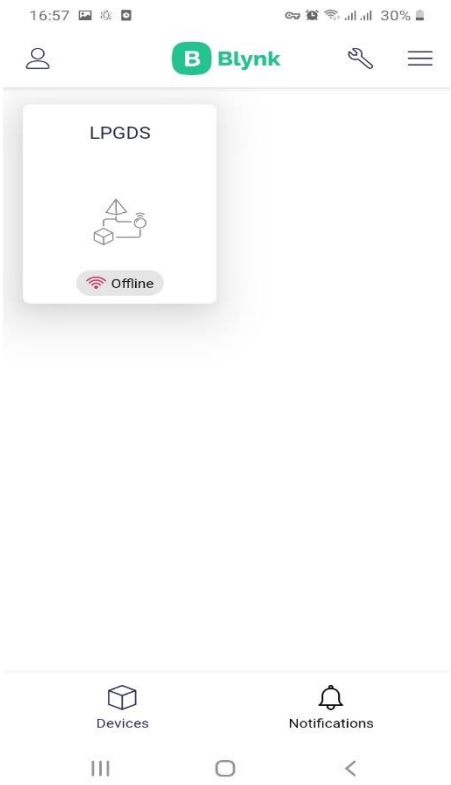

Figure 32: offline mobile app

5.7 Summary

What was considered here was what the tools to be used to build the system would do in the project. It discusses how the devices used in the construction of this system are programmed and how they relate to the project.

This is further discussed in Appendix F. You can refer to that section for more information.

CHAPTER 6 – TESTING AND EVALUATION

6.1 Performance Testing

The responsiveness of the system/application under various loads can be used to determine the system's performance. Performance testing in the Internet of Things framework is similar to traditional performance testing. IoT devices create a large amount of data, which is stored on a server and evaluated in real time to make quick choices. As a result, IoT systems must be designed to be high-performing and scalable.

6.2 Performance Testing Challenges in IoT

- The biggest challenge with IOT is its increasing complexity. Here we have a complex task of adding a new device to the system and various problems arise due to the lack of a specific protocol to connect it to a website or mobile app.
- When IOT is enabled, they run according to a command, and if at any time that command fails to respond, it can have serious consequences
- Diverse usage conditions become another obstacle altogether. While assessing the performance of an app, the stability of the end user's internet connection plays a significant role in determining test results.

Table 7. Test case 1 1

	Performance testing approach on IoT Framework
Section	IoT PT
Simulation	On devices or sensors
Protocols	To communicate, the Internet of Things employs non-standard and novel protocols.
Scale	From a few to tens of thousands of devices
Amount of data	Sends and receives a little amount of data each request, however data is transferred in real time.
Requests/Response	IoT devices make queries and receive responses, as well as making requests and responding.

6.3 Performance Test Cases

01.Test Objectives: Connect the ESP 32 board with IOT

Table 8. test case 2 1

TEST NUMBER	TEST CONDITION	RESULT	OPTIMAL
01	Identify the Cloud connection in the ESP 32 module.	When the ESP 32 module connects to the Blynk Cloud, the Wi-Fi bulb on the ESP 32 module illuminates and appears online on the mobile app. When that happens, the device can be identified as being connected to the IOT.	TRUE

- The image below shows what the ESP 32 module looks like before it connects to the cloud.

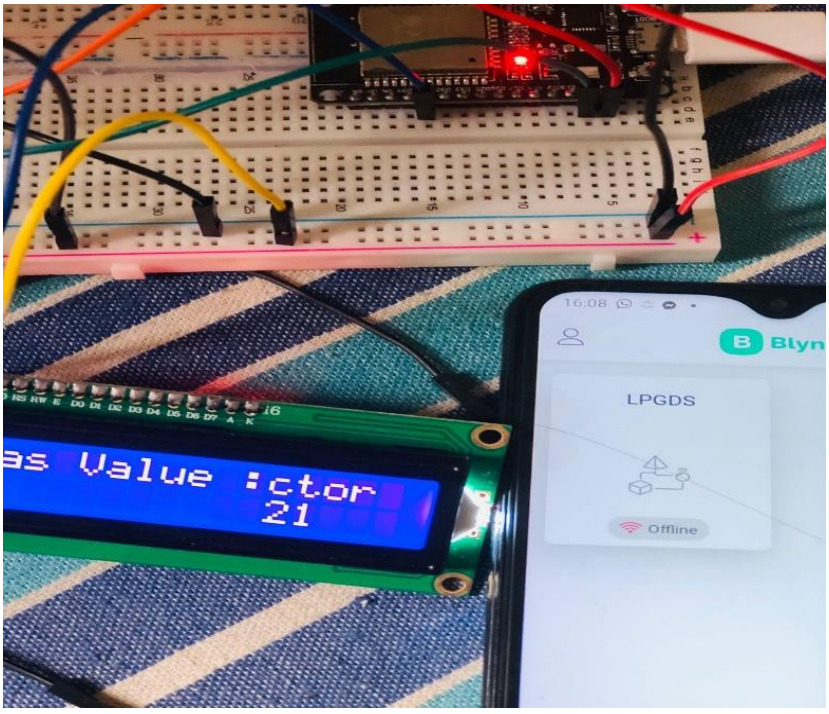

Figure 33:Test case 1

- The image below shows what the ESP 32 module and mobile app looks like after it connects to the cloud.

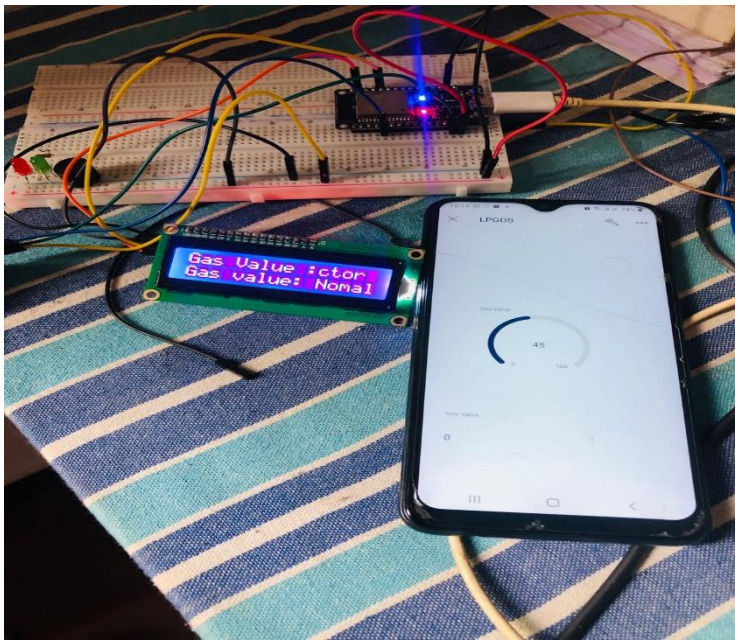

Figure 34:Test case 2

02.Test Objectives: Check the gas value and send the details in mobile app.

Table 9. Test case 3 1

TEST NUMBER	TEST CONDITION	RESULT	OPTIMAL
01	MQ2 sensor 48 =< Gas value	A message will be Send to the mobile. Gas leak data is also displayed in the mobile application	TRUE
02	MQ2 sensor 48 =< Gas value	A Message do not Send to the mobile. Gas leak data is also displayed in the mobile application	TRUE

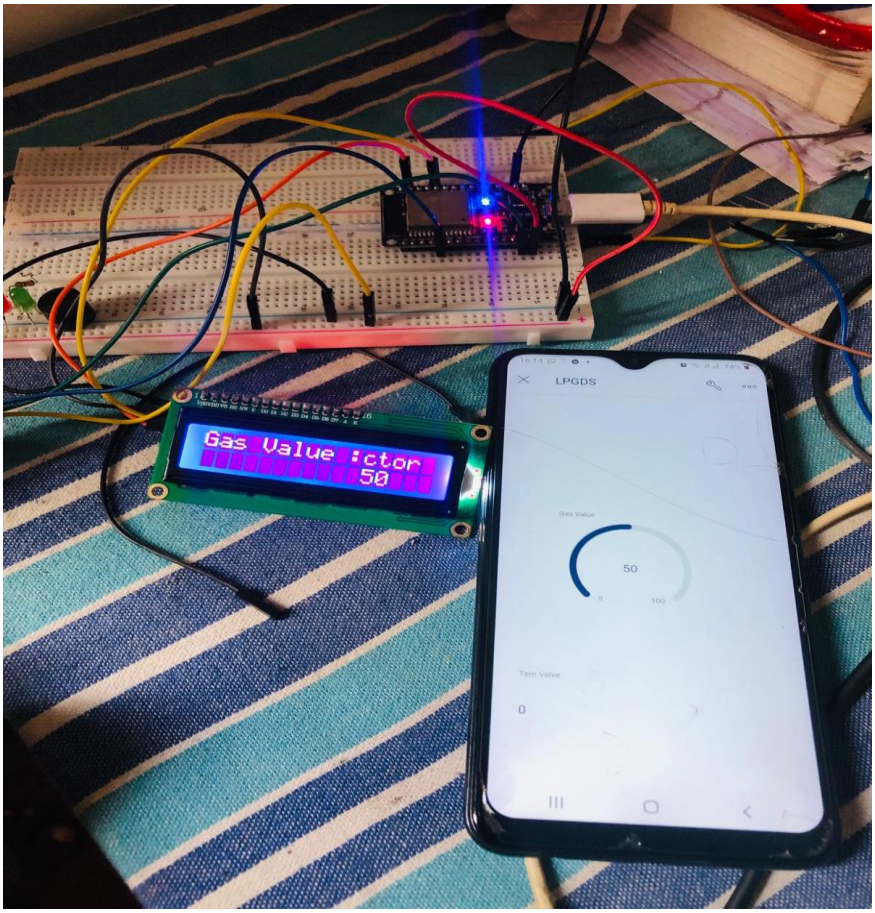

Figure 35:Test Case 3

6.4 Acceptance Testing

Following the system's completion and effective operation, the following outcomes can be included.

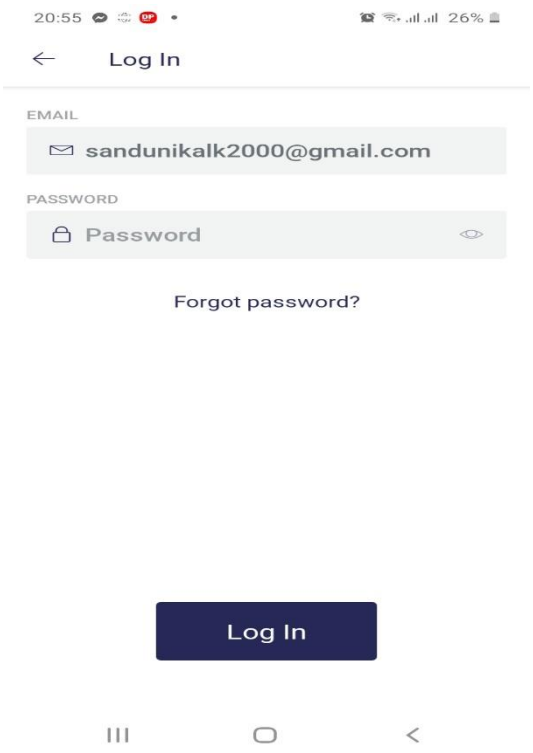

Figure 36:Accepting testing

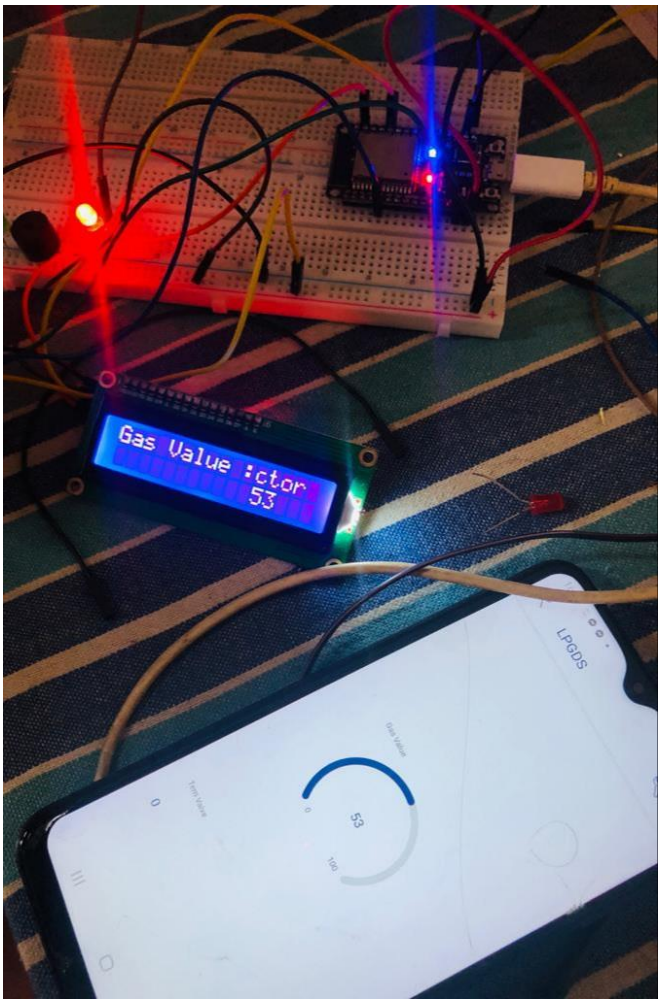

Figure 37:Accepting Testing 1

6.5 Summary

This section describes how each aspect of the project will be implemented. There the conditions affecting their operation and the factors required for them are considered and explained with the help of diagrams.

This is further discussed in Appendix E. You can refer to that section for more information.

CHAPTER 7 – CONCLUSION AND FUTURE WORK

7.1 Conclusion

Accidents due to gas leaks have been on the rise in recent times, according to reports. As a solution to this, the need for a system to prevent gas accidents has arisen in recent times. The shortcomings of the systems available in the market were identified through research. The solution to those problems is to identify the need for a system that can automatically prevent gas leaks.

Accordingly, the project will close the automatic gas leak using a solenoid valve and IoT will notify the customer in the event of a gas leak via SMS to the mobile app. Also the buzzer rings to alert the surrounding area in the event of a gas leak and the LCD screen also displays the gas leak. An LED bulb also alerts the gas hazard.

Therefore, this report describes the need for a new IOT base LP gas leak detection system and its features.

7.2 Future Plan

Although the proposed system is based on IoT, it is expected to be developed in the future using a new Android app instead of a 3rd party app. We hope to create a new API for that. It is also through the development of more hope to bring foreign exchange into the country.

Also in the future, the system will suggest we get in the electricity through the solar cells without electricity I also look forward to measuring the temperature by the Sensory DHT1 of the system. I propose to further enhance the above system in the future through such measures.

7.3 Summary

The purpose of the chapter is to describe how the system was created and the steps that will be taken to improve this system in the future.

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Appendix

APPENDIX A - SYSTEM DOCUMENTATION

Overall Description

LP Gas leak detection system is a device designed to prevent accidents caused by LP gas leakage. These devices are designed with special features. My purpose here is to prevent accidents due to gas leaks by installing this system in places where LP gas is used. It is my belief that this project can be upgraded to a commercial level.

Product Features

LCD

Uses LCD display to alert people around. It represents information about a gas leak.

IOT

Demonstrates data about the gas leak in the mobile app. It allows the user to retrieve the data at that time and analyze information about the gas leak.

Solenoid valve

A special feature is the ability to automatically prevent a gas leak. The solenoid valve automatically shuts off, preventing gas accidents even when someone is not at home.

Buzzer

Even a visually impaired person can be evacuated in the event of a gas leak due to the alarm bells ringing in the event of a gas leak. Therefore, these devices provide security to anyone.

LED

LED bulbs can detect a gas leak at a gas leak. There is a green light bulb when there is no gas leak and a red-light bulb when there is a gas leak.

Activity diagrams

Activity diagrams, which are related to program flow plans (flowcharts), are used to illustrate activities. In the external view, we use activity diagrams for the description of those business processes that describe the Page 65 of 72 functionality of the business system. Contrary to use case diagrams, in activity diagrams it is obvious whether actors can perform business use cases together or independently from one another**.**

Sequence diagram

Sequence diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help to predict how a system will behave and to discover responsibilities a class may need to have in the process of modeling a new system.

Use Case Diagrams

A use case diagram is used to represent the dynamic behavior of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It depicts the high-level functionality of a system and also tells how the user handles a system [16].

Flow chart

A flowchart is a picture of the separate steps of a process in sequential order. It is a generic tool that can be adapted for a wide variety of purposes, and can be used to describe various processes, such as a manufacturing process, an administrative or service process, or a project plan.

User Requirements

Figure 38:propose system

The above is the proposal from the users to build the LPG gas leak detector system.

APPENDIX B - DESIGN DOCUMENTATION

Use case diagram for mobile app

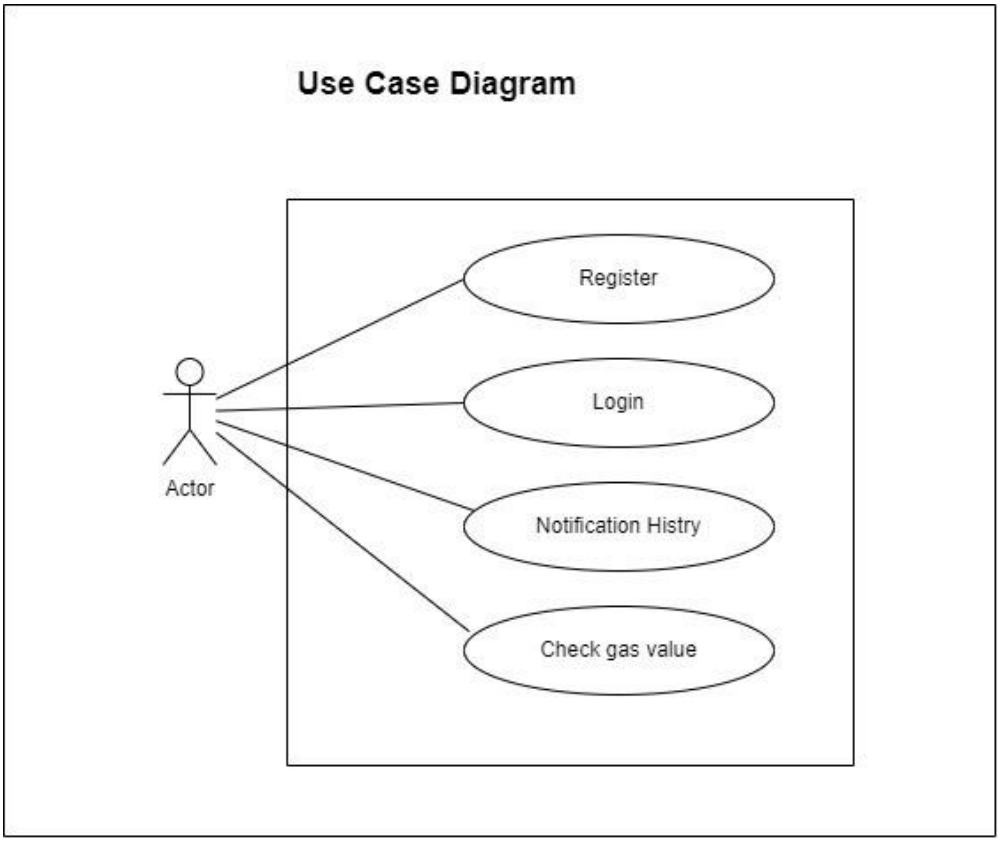


Figure 39:use case diagram

Sequence Diagrams

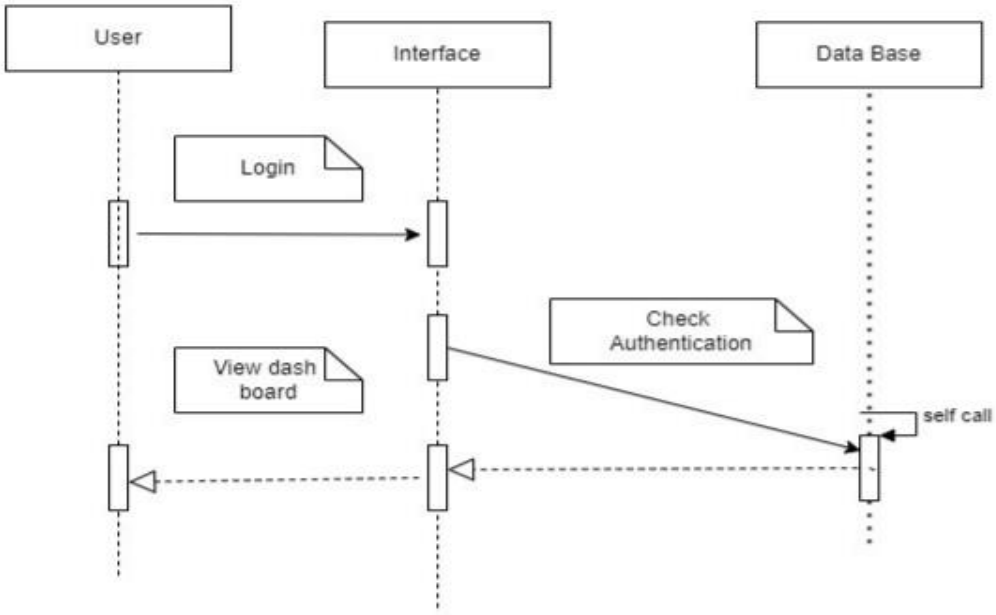


Figure 40:sequence diagram

Flow Chart

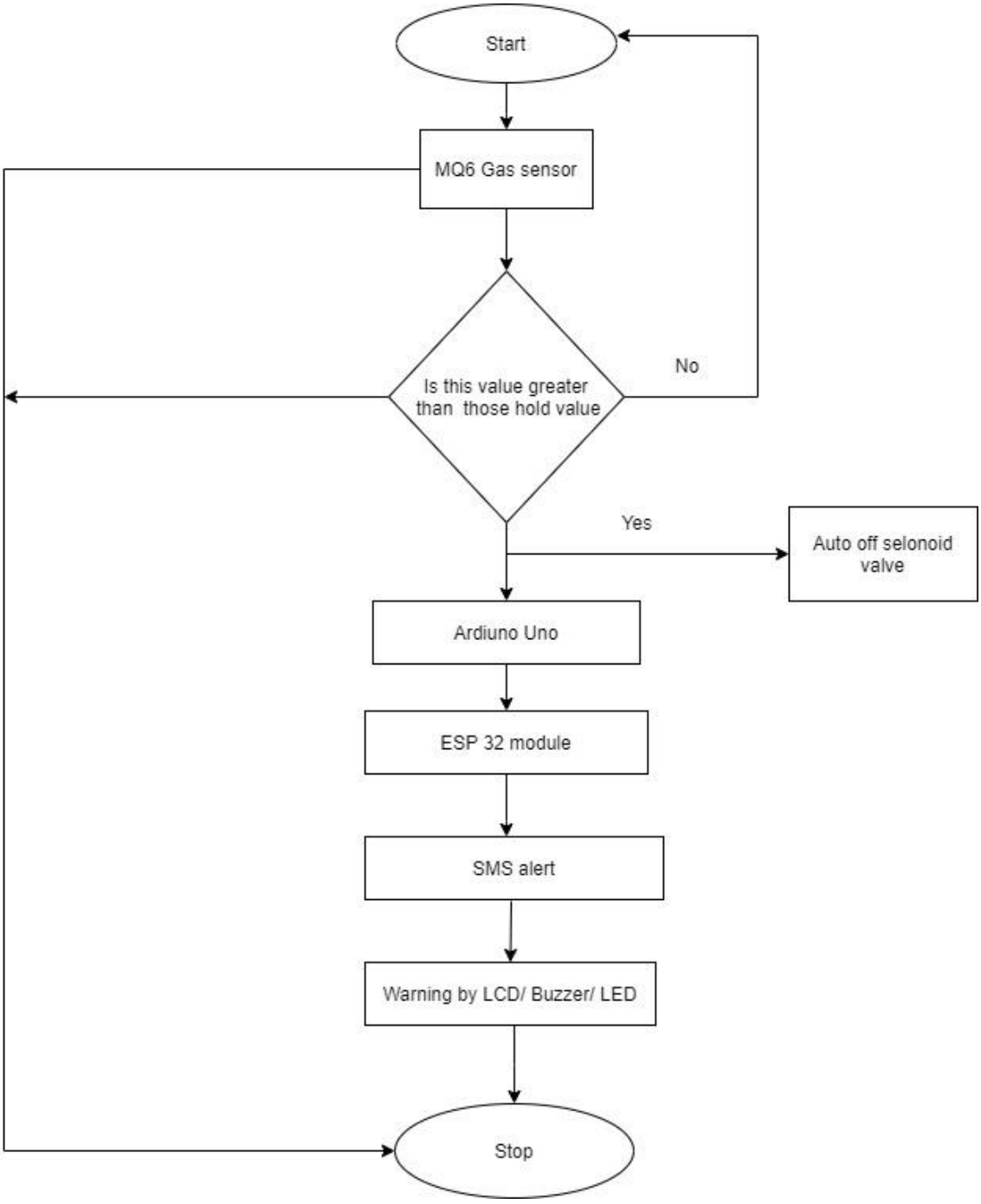
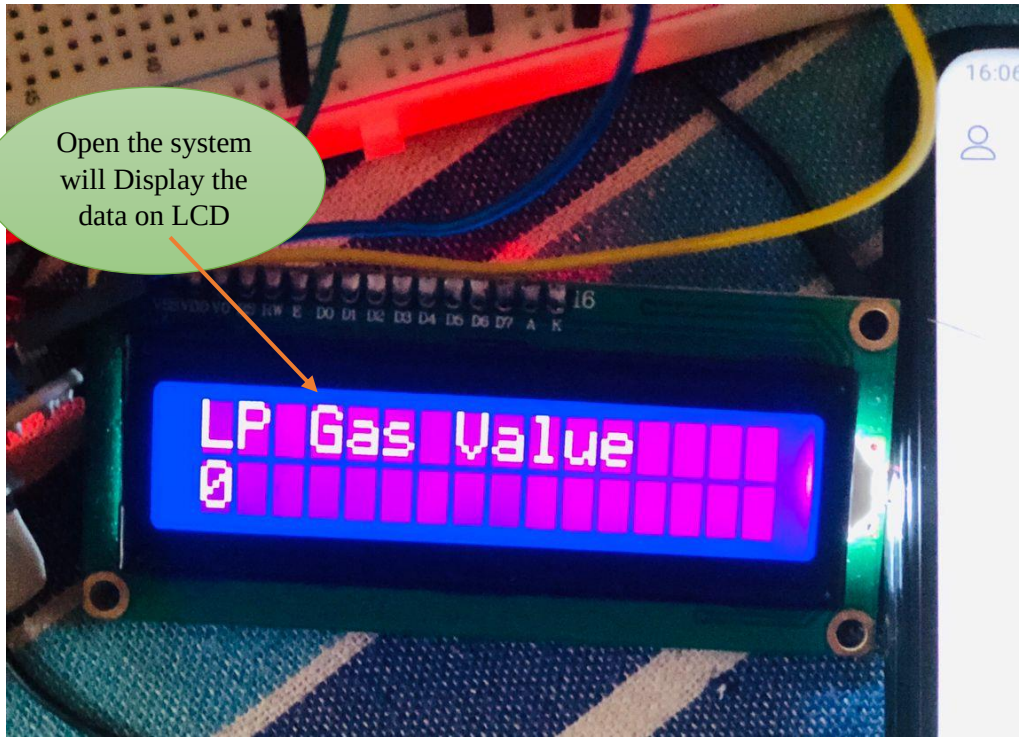


Figure 41:Flow chart

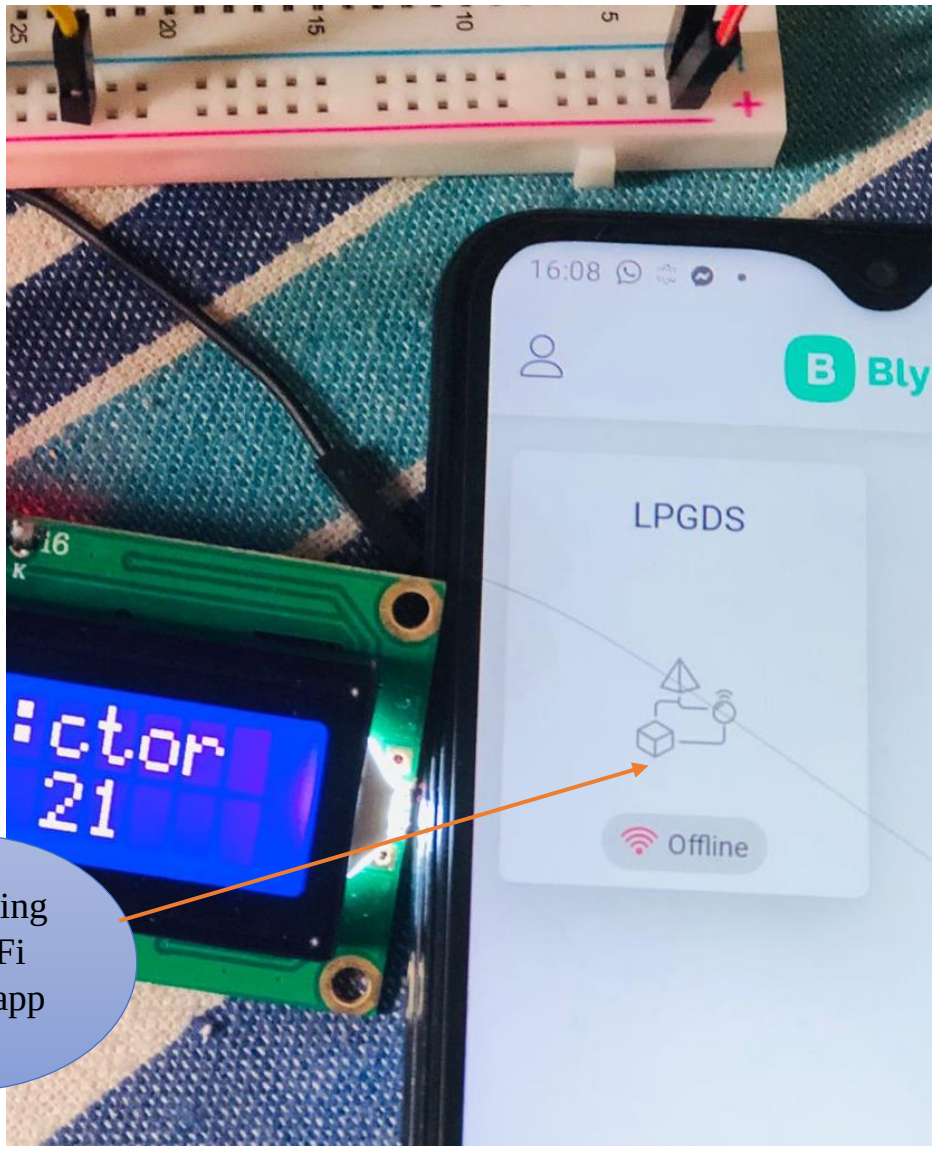
APPENDIX C – USER DOCUMENTATION

The first thing you need to do here is power up the system. You can use a 5v battery for that. This system must then be installed where the gas cylinder is located. Then connect it to the Wi-Fi router. Then connect the solenoid valve to the pipe that carries the gas from your gas cylinder to the gas stove. Then connect the adapter that comes with the solenoid valve to the 12v electrical plug in the house. Then create a new account with the help of your mobile app. You will then be able to track gas leak information in the interface we create.

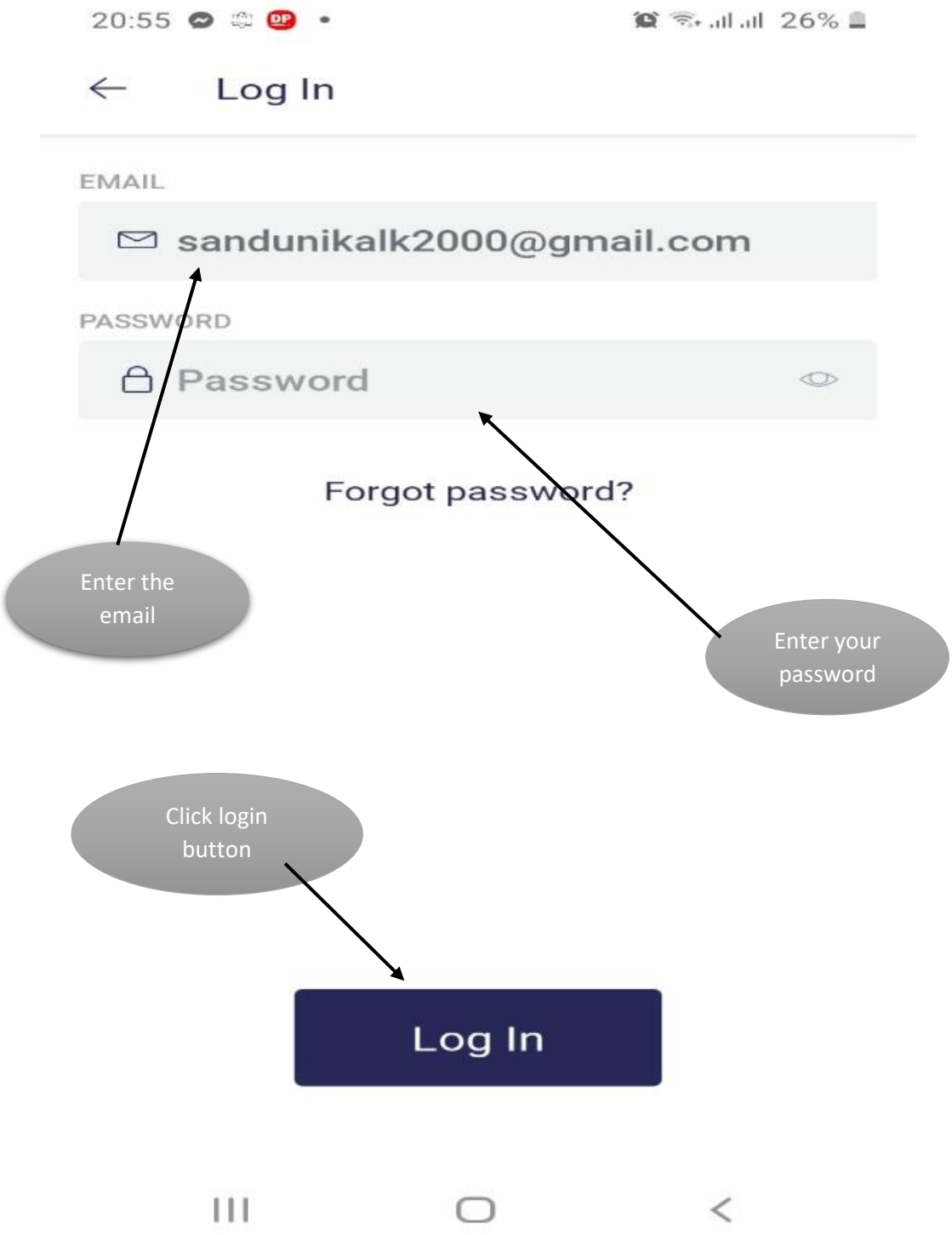
Open the system



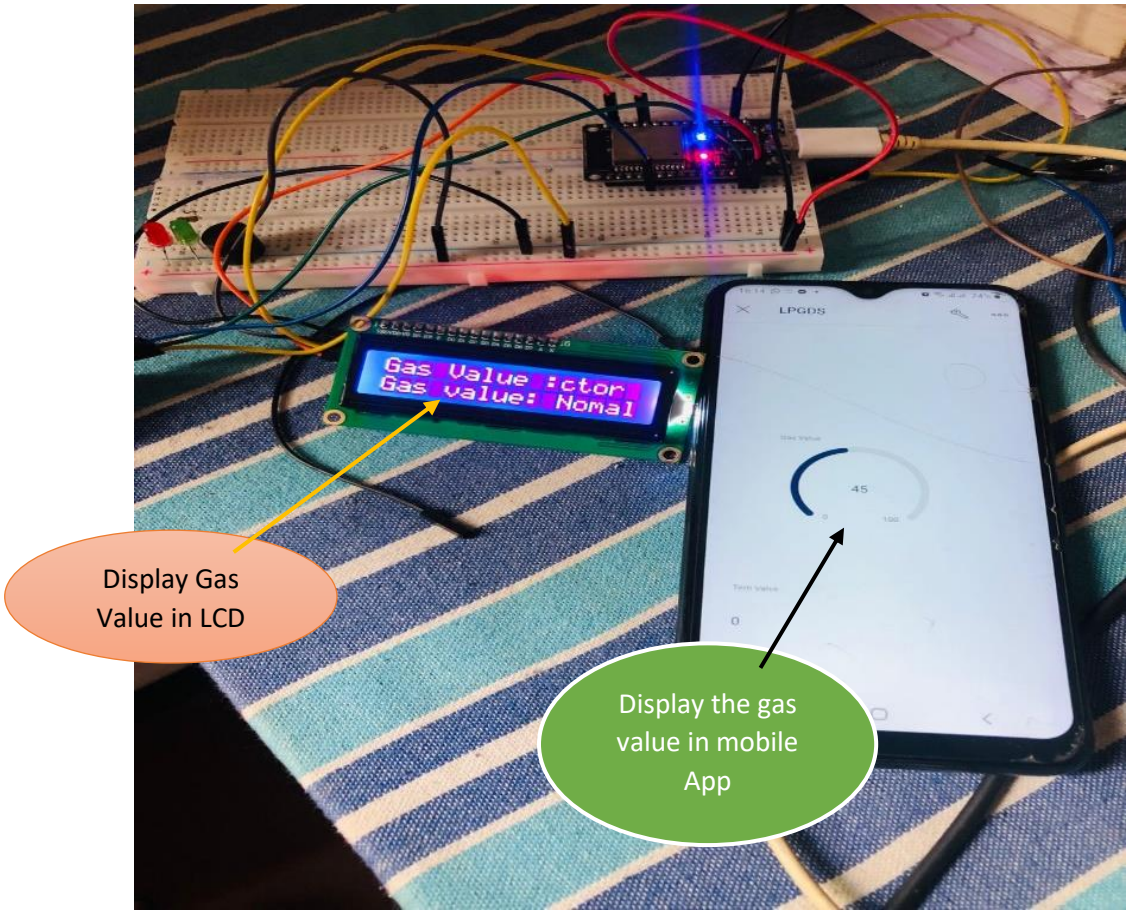
Connecting to Wi-Fi mobile app



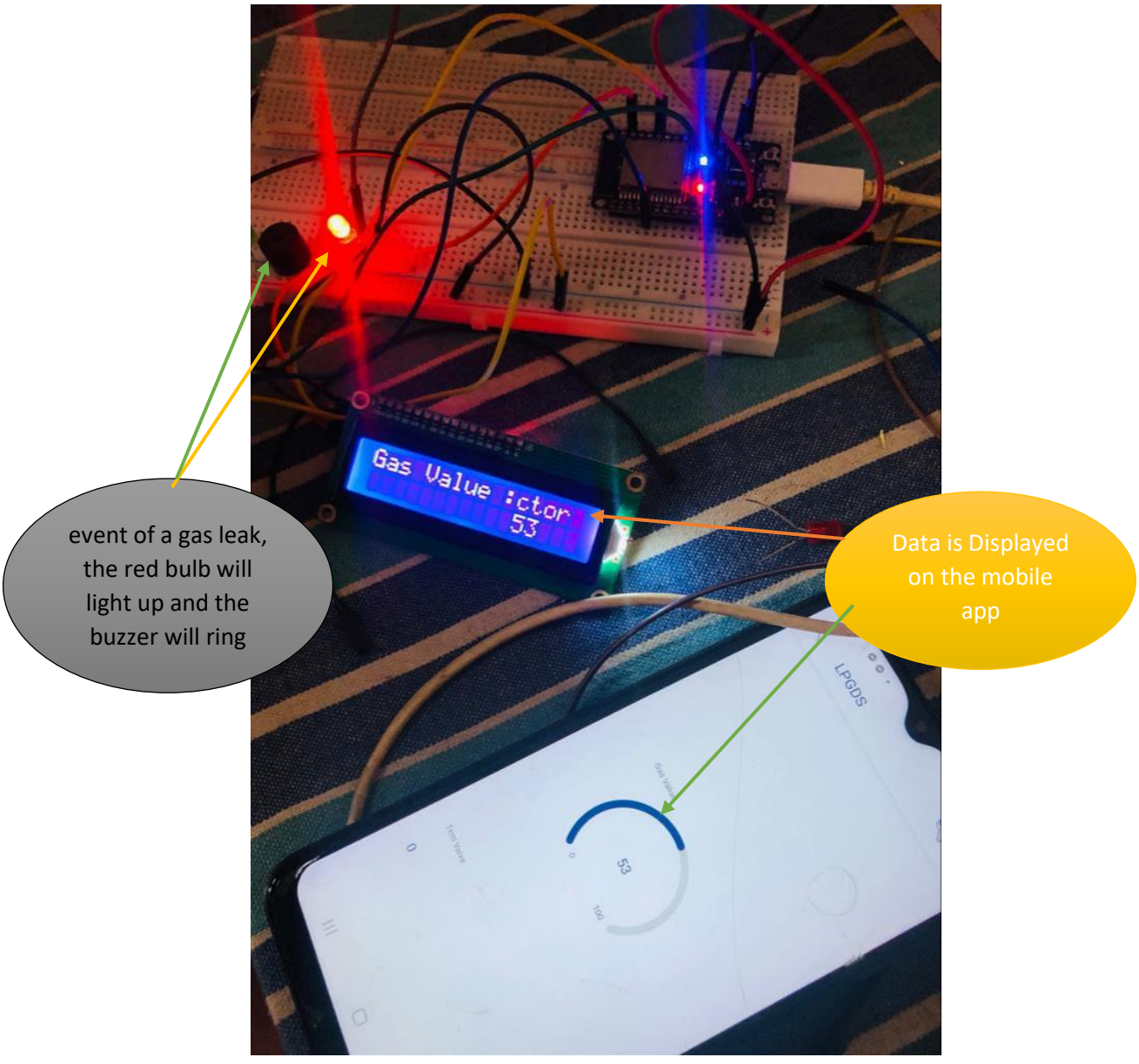
Login mobile app



Display the gas value on system and mobile app



Detect a gas leak



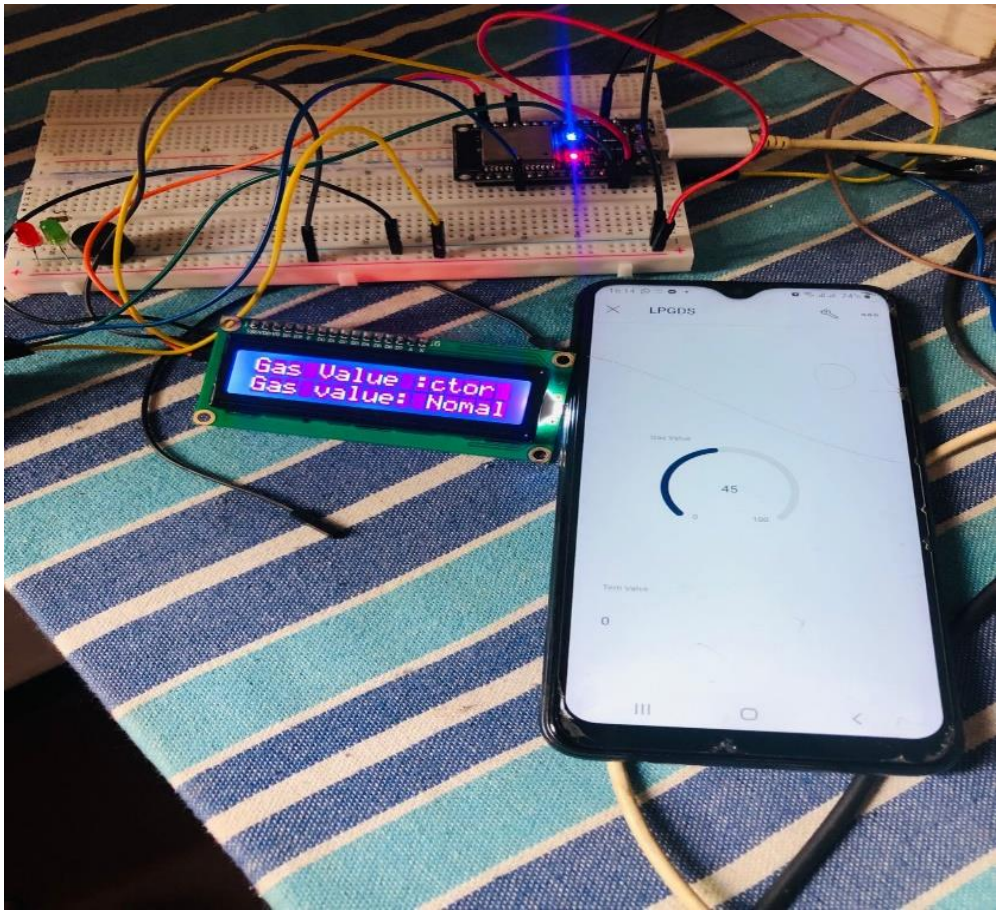
APPENDIX D- MANAGEMENT REPORT

The table below shows the estimated minimum cost of building a gas leak detection system and the minimum profit that can be obtained.

3.Income and Profit

Table 4: income

Total Expenses (For 1 Unit) LKR	Total Income (for 1 Unit) LKR	Profit (for 1 Unit) LKR
RS.6380	Rs.12500	Rs.(12500-6380) **=Rs.6120.00**



Here the user can access the data through the mobile app. There the user can get a report including the dates and times of previous gas leaks.

APPENDIX E – TEST RESULTS

03.Test Objectives: Demonstration on the LCD screen of the gas leak

Table 10: test case 4 1

TEST NUMBER	TEST CONDITION	RESULT	OPTIMAL
01	MQ2 48> gas leak	Gas Leak are normal when the value of the Gas leak is less than 48.	TRUE
02	MQ2 48=< gas leak	Gas Leak are High when the value of the Gas leak is more than 48.	TRUE

Below is a case of gas leak.

Figure 40: Test case 4

When there is no gas leak

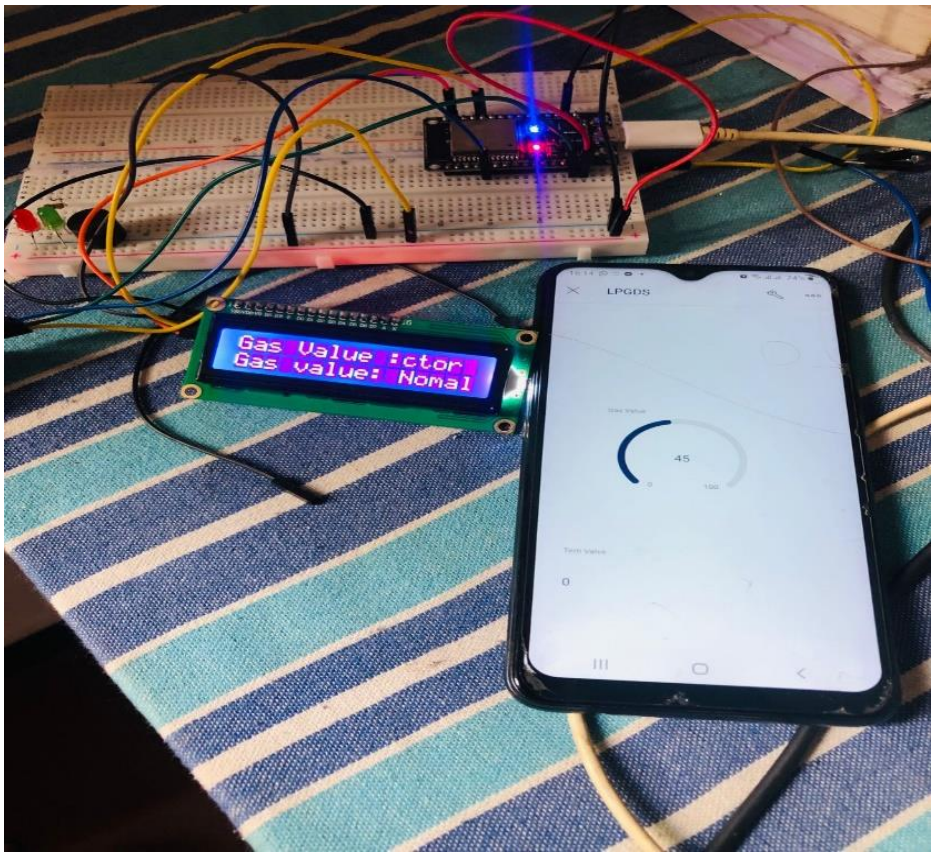
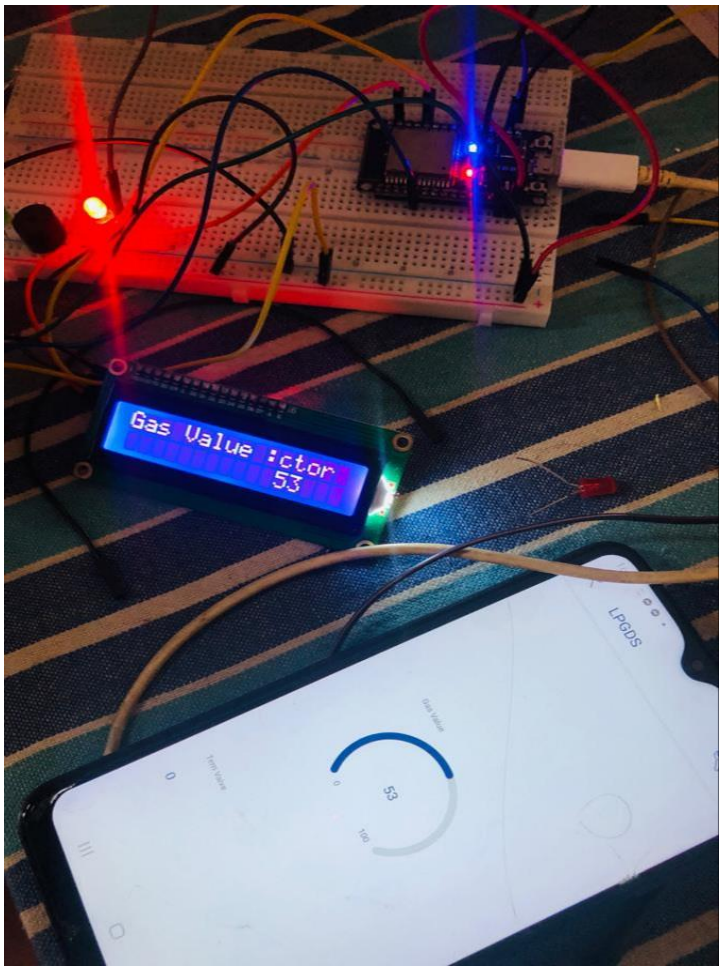


Figure 42: Test case 5

04.Test Objectives: Automatic Gas leak prevention.

Table 11 .test case 5

TEST NUMBER	TEST CONDITION	RESULT	OPTIMAL
01	MQ2 48 =< gas leak	When a gas leak occurs, the solenoid valve closes automatically and the buzzer rings and the LED bulb illuminates	TRUE


Gas Value :ctor
53
LPGDS
53

APPENDIX F – CODE LISTNING (MAJOR CODE SEGMENT)

Include libraries in ESP 32 module

The following is how libraries are included. Added libraries for LCD and Blynk and Wi-Fi module.

```
#include <LiquidCrystal_I2C.h>

#include <WiFi.h>

#include <WiFiClient.h>

#include <BlynkSimpleEsp32.h>

LiquidCrystal_I2C lcd(0x27, 16,2);

BlynkTimer timer;
```

Mq2 gas sensor

This MQ2 Sensor, the gas leak is forwarded to Blynk through ESP32 through the project. The MQ2 gas sensor retrieve the data and check the value in the if condition. In then display data on the LED bulb and the LCD screen.

```
void getSensorData()
{
  MQ2_SENSOR_Value = map(analogRead(MQ2_SENSOR), 0, 4095, 0, 100);
  if (MQ2_SENSOR_Value > 50 ){
    digitalWrite(GREEN_LED, LOW);
    digitalWrite(RED_LED, HIGH);
     lcd.setCursor(0, 1);
      lcd.print("Gas value: High");

  }
```

Lcd Display

The data obtained by the gas sensor is displayed on the LCD display via esp32. Here the gas value and other information are displayed on LCD screen.

```
lcd.clear();// clear previous values from screen
lcd.print("LP gas Detector ");
lcd.setCursor(0,0);
lcd.print("Gas Value: ");
lcd.setCursor(11,1);
lcd.print(MQ2_SENSOR_Value);
delay(2000);
```

Pin mode defines

Here the pin mode defines whether the sensor, bulb, solenoid valve and buzzer is input – output**.**

```
pinMode(MQ2_SENSOR, INPUT);
pinMode(SOLENOID_PIN, OUTPUT);
pinMode(Buzzer, OUTPUT);
pinMode(GREEN_LED, OUTPUT);
pinMode(RED_LED, OUTPUT);
pinMode(WIFI_LED, OUTPUT);
```

Define the variable sensor and IOT app

```
int count =0;
int MQ2_SENSOR_Value = 0;
bool isconnected = false;
char auth[] = BLYNK_AUTH_TOKEN;
#define VPIN_BUTTON_1    V1
#define VPIN_BUTTON_2    V2
```

Check the connected to the IOT

```
void checkBlynkStatus() { // called every 2 seconds by SimpleTimer
  isconnected = Blynk.connected();
  if (isconnected == true) {
    digitalWrite(WIFI_LED, HIGH);
    sendData();
    Serial.println("Blynk Connected");
  }
  else{
    digitalWrite(WIFI_LED, LOW);
    Serial.println("Blynk Not Connected");
  }
}
```

Buzzer /LED /Solenoid valve

If the value of the data obtained by the gas sensor is more than 50, the buzzer will ring. If it is less than 50, the bulb will turn green.

```
void getSensorData()
{
  MQ2_SENSOR_Value = map(analogRead(MQ2_SENSOR), 0, 4095, 0, 100);

  if (MQ2_SENSOR_Value > 40 ){
    digitalWrite(GREEN_LED, LOW);
    digitalWrite(RED_LED, HIGH);
      digitalWrite(Buzzer, HIGH);
    digitalWrite(SOLENOID_PIN, HIGH);

     lcd.setCursor(0, 1);
      lcd.print("Gas value: High");
```

```
  }
  else{
    digitalWrite(GREEN_LED, HIGH);
    digitalWrite(RED_LED, LOW);
     digitalWrite(Buzzer, LOW);
    digitalWrite(SOLENOID_PIN,  LOW);

      lcd.setCursor(0, 1);
      lcd.print("Gas value: Nomal ");

  }
  delay(2000);
}
```

APPENDIX G – ANNEXES

The IoT Based LP gas leak detection system I am researching is part of this questionnaire. Therefore, I kindly request you to complete this questionnaire. I thank you for dedicating your time to me and we hope that you will help us to minimize the loss of life due to gas accidents in the future

Questions	Answers/Comments/Suggestion
Do you use LPG Gas? i. Yes ii. NO	
Wherever you use LP gas? i. Hotel ii. Home iii. Other places	
How many times a day do you use LP Gas? i. 1 time ii. 2 times iii. 3 times iv. More than 3	
Are you aware of the steps you can take to prevent a gas leak? i. Yes ii. No	

Are you satisfied with using a mobile app to analyze gas leak information? i. Yes ii. No	

GLOSSARY

Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them

ESP 32 module

ESP32 is the name of the chip that was developed by Espressif Systems. This provides Wi-Fi (and in some models) dual-mode Bluetooth connectivity to embedded devices**.**

Liquid Crystal Display

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation.

MQ2 Gas sensor

Gas Sensor (MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane.

Buzzer

The buzzer is a sounding device that can convert audio signals into sound signals

Blynk

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device.

Solenoid Valve

A solenoid valve is an electrically controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) in its center.

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