IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety

Falguni Sultana and Hafsa Binta Mahabub Munmun

A Thesis in the Partial Fulfillment of the Requirements

for the Award of Bachelor of Computer Science and Engineering (BCSE)

Department of Computer Science and Engineering

College of Engineering and Technology
IUBAT – International University of Business Agriculture and Technology

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Supervisor and Senior Lecturer

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Fall 2021

Letter of Transmittal

17 February 2022
The Chair
Thesis Defense Committee
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4 Embankment Drive Road, Sector 10, Uttara Model Town
Dhaka 1230, Bangladesh

Subject: The Letter of Transmittal

Dear Sir,

      With due respect, it is our great pleasure and privilege to present our thesis report entitled "IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety. This report was created to partially meet the requirements for a Bachelor's degree in Computer Science and Engineering. It was certainly a good opportunity to work on this paper to actualize our theoretical knowledge in the practical arena. Now, we are looking forward to your kind appraisal regarding this thesis report. We will remain deeply grateful to you if you kindly go through this report and evaluate our performance.

      We sincerely hope that the report will meet your expectations and help you get a complete picture of your system. Thanking you in anticipation.

Yours sincerely,

_____   _____

Falguni Sultana   Hafsa Binta Mahabub Munmun

18203008   18203075

Student's Declaration

We, Falguni Sultana Hafsa Binta Mahabub Munmun declare that the work presented in this thesis is entitled, **"IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety"** is the outcome of the gas leakage detection, carried out by us under the supervision of Shahinur Alam Shahin, Senior Lecturer, Department of Computer Science and Engineering at IUBAT. No parts of this report has been submitted anywhere for any degree, diploma or certificate.

_____   _____

Falguni Sultana   Hafsa Binta Mahabub Munmun

18203008   18203075

Supervisor's Certification

This certifies that the thesis report on "IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety" has been carried out by Falguni Sultana ID#18203008 & Hafsa Binta Mahabub Munmun ID#18203075 student of Department of Computer Science and Engineering of IUBAT-International University of Business Agriculture and Technology, as a partial fulfillment of the requirement for the degree in Bachelor of Computer Science and Engineering. The report has been prepared under my guidance and is a record of work carried out successfully. As far as we know, and according to their statement, no part of this report has been submitted for a degree, diploma, or certificate. Now they are permitted to submit the report. I wish their success in her future endeavors.

_____

Shahinur Alam Shahin

Supervisor and Senior Lecturer

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Abstract

IoT is an extended network of physical devices linked with different types of sensors and through their connection to the Internet, they can exchange data.The IOT based any system permits any objects to be controlled, monitored, detected and sensed automatically over the internet infrastructure. Nowadays we can observe that, more fire accidents occur because of gas leakage in our world due to the failure detection of leakage of flammable gases like methane, acetylene, ammonia, Hydrogen, Butane, Propylene. We all are know that more fire accidents are occurs in our world due to the failure detection of leakage of gas. We often face gas leaks and fire problems in our daily lives. Most of the incidents happen in the home. So, we have to take extra protection for this problem. Gas leakage causes many health issues. So, to prevent such disasters happen, the atmosphere of home or workplace should be regularly monitored and controlled. Therefore, it is necessary to develop a monitoring system to detect gas leaks. In order to have control over such conditions this paper proposes a system. The main purpose of this proposal system is to develop by using numbers of sensors like MQ-2. MQ-6, MQ-8,Flame sensor. This gas sensor can be sensed all type of flammable gas and flame sensor can sense the flame. And for controlling the disasters we use relay to off the power supply , on the Buzzer ,Red Led, and also on the water pump

and ventilation when any accidents occur. we have used GSM for sending SMS to owner and fire fighters, in the SMS there will be address of home owner.We have used a DC water pump as because if any fire accident happen because of gas leakage then it will supply water. The GSM module will send the notification to users. GSM is activated immediately and send the warning message and call with the registered number of us as well as Fire Brigadiers.. And Immediately, Buzzer is turned on if any gas leakage occur. By using NodeMCU V3 there has Wifi module by this we can monitor the gas level. Also by using ThingSpeak server we can see the graph and charts of gas, flame and auto action. By implementing the ways we can avoid any gas leakage incidents and also we can be alert before any incidents happen.

After testing the prototype, we have found what actually we want. This project is contributing to the life application of IoT to make families feel safer when handling gas. It will help to create a basis for further research, also help strengthen a theory or model and challenge current assumptions. It can permit the reader to evaluate them critically, whenever researchers study our paper. Our work connects the researcher to existing knowledge.

Acknowledgments

During our work on this thesis, many people supported us from technical, organizational and personal perspective. At this point, we would like to express our gratitude to them.

First and foremost, we would like to thank God for giving us the strength to finish this work. The satisfaction that accompanies the success of this thesis would not be complete without mentioning the people whose cooperation made this possible, the people who always tried and encouraged them to make every effort possible We are grateful to our honorable thesis supervisor Shahinur Alam Shahin, Senior Lecturer, Department of Computer Science and Engineering, IUBAT, for the guidance, inspiration. We also convey special thanks and gratitude to Dr. Muhammad Hasibur Rashid Chayon, Co-supervisor, Coordinator and Associate Professor, Department of Computer Science and Engineering, IUBAT for his co-supervision and help.

Table of Contents

List of Figures

List of Tables

Chapter- 01 Introduction

In today's modern life, gas is widely used, especially gas is widely used by households, restaurants and businesses. Gas plays a very important role for life. Therefore, a situation arises when using gas that is easy to leak. The Internet of Things (IoT) is an internet connection in which devices, vehicles, components, and other devices are integrated with electronic components, software, sensors, and actuators. Through a network connection, these devices can collect and transmit data. There are more and more applications of IoT in home appliance monitoring.

1.1 Background and Context

IoT basically describes a community of wearable devices integrated with sensors, software and various technologies for the purpose of connecting and replacing reality with gadgets. and different structures on the internet. The purpose of the Internet of Things is to make existence less complicated by automating every little project around us. Since IoT helps a lot in automating tasks, the benefits of IoT can also be extended to enhance current protection standards. Safety is always an essential standard, even in the design of homes, buildings, industries and cities. The accelerated attention of active gases inside ecosystems can prove to be extremely dangerous.

General Applications and Challenges of IOT:

Applications:

- Smart Homes

- Smart City

- Self-driven Cars

- IOT Retail Shops

- Farming

- Smart Grids

- Industrial Internet

Challenges:

- Security issues

- System Performance

- High sensor costs

Our Proposed system is about **"IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety".** In fact, gas leaks cause many health problems. To prevent such disasters, the atmosphere of the at home or at work should be regularly monitored and controlled. Therefore, it is necessary to develop a monitoring system to detect gas leaks.

The main purpose of this system is to develop a Notification Alert that uses IoT services and notifies the gas leakage through SMS and Call. GSM is activated immediately and send the warning message and call with the registered number of user. Also We have used a DC water pump as because if any fire accident happen,then it will supply water. And the buzzer sounds as soon as the gas leaks.

1.2 Problem Statement

Basically, we are going to proposed the system "IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety".

Actually, Kitchen is the most risky area for gas leakage. So our main concern is to develop the proposed system which will assure the safety of home.

- Kitchen(Security)
    - Gas can be leaked anytime
    - Fire accident can happen
    - No way to detect the gas leakage
- Gas leakage leads to various accidents resulting in both material loss and human injuries.

Example: In December 14,2021 , 3 contributors of a own circle of relatives, which include a infant and a women, sustained injures as a fourth ground lay down and especially collapsed with the aid of using this gas leakage. Another tale is 4 of a own circle of relatives are burnt forgas leakage hearth place in Dhaka Mugda in January 21,2022. So, for save you this type of failures happen, we proposed a device is to expand a vintage gas leakage device.

A conventional gas detection device assessments for the awareness tiers and signals human beings approximately the leakage via audio and visible alarms. The IoT primarily based totally version of the conventional gas leakage detection device does now no longer handiest signals human beings via way of means of audio alarm however additionally tries to alert the involved employees via a name and textual content message on their smartphone in

order that even supposing no person is gift with inside the location of leakage, they may be made aware about the situation.

But there are some problems in the existing system & we want to work on it:

- As existing system is an automatic gas detection and alerting system. It can not notify the emergency services like registered the number of fire Brigadiers if any accidents happen. Here, we will registered the user numbers as well as fire Brigadiers number for emergency services.

- The existing system don't have any GPS tracker that will help to detect the place where actually fire accident happened because of gas leakage.

- In some of the existing system, we can not get all types of facilities & accident prevention system. So, in our system we have combined all types of facilities in one system.

1.3 Research Questions

- Can anyone detect the place where actually gas leakage is occurred?

- Is there any notification system?

- How can we get the notification?

- If unfortunately fire accident is occurred as a result of gas leakage then how to prevent it?

- Is there any prevention system, and what is that?

- Is this system has any emergency services that will contract the fire brigadiers, if it is then how it will work?

1.4 Relevance and Importance of Research

The main purpose of this system is to develop which gives Notification Alert that uses IoT services and notifies the gas leakage through SMS and Call. Fire Brigadiers also can notified through their registered number.

- To reduce the sudden accident which occurs because of gas leakage.
- To increase a device which may be value powerful in addition to person friendly.
- To combine multiple sensors so that the gas leakage can easily detect.
- To evaluate the performance of the proposed system by utilizing prototype.

1.5 Outline of order of information in the thesis

This thesis is divided into five chapters: Chapter II describes the literature review where previous work done in the field of gas leakage detection. Chapter III illustrates the materials and methods used in the research. The prototype results, performance and discussions are demonstrated in Chapter IV. Chapter V concludes the thesis with some future directions of this research.

Chapter- 02 Literature Review

2.1 IOT BASED LPG LEAKAGE ALERTING AND ACCIDENT PREVENTION SYSTEM (2020)

In this project arduino uno is the primary operating element of the whole project. Arduino board includes each virtual and analog pins. The virtual pins are related with GSM module, Buzzer and Relay. The gas sensor senses the gas leakage it indicators the GSM module, relay and buzzer [Nguyen,2020]. GSM module and Buzzer are used to alert the person and with the aid of using the use of relay we are able to close down the strength from the mains.
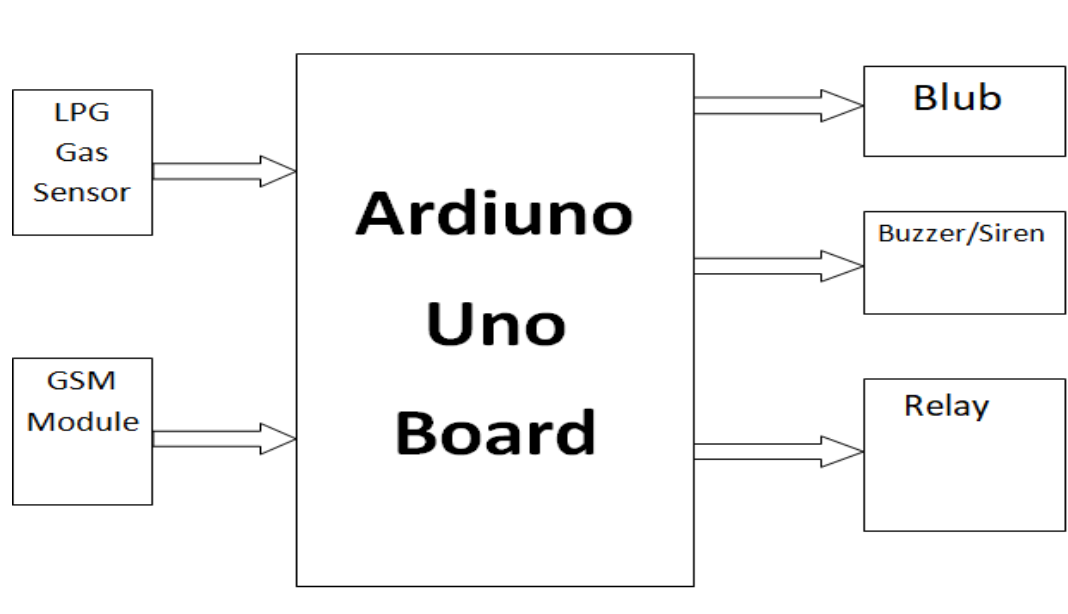
Figure 2.1: IOT Based LPG leakage alerting and accident preventing system

Figure 2.1 shows that The IOT Based LPG leakage alerting and accident preventing system. In this project arduino uno is the main working component of the entire project.

Limitations:

- Only one sensor is used to detect gas. There is no Fire sensor to detect fire if suddenly fire accident is took place.

- As well as If any fire is took place than there is no water pump to cool down the fire.

2.2 Gas Leakage with Auto Ventilation and Smart Management System Using IOT (ICAIS-2021)

In the proposed framework, gas sensor (MQ2 Sensor), fire sensors are interfaced to the Arduino microcontroller [Anika et al., 2021].
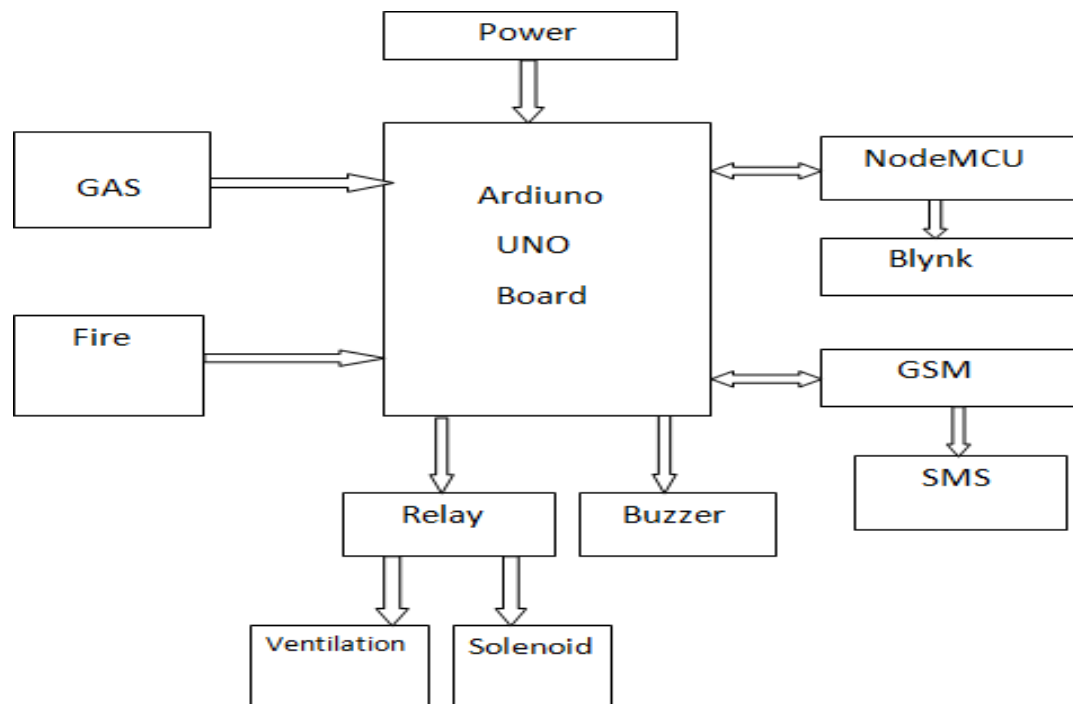

Figure 2.2: Gas Leakage with Auto Ventilation and Smart Management System Using IOT

7

Figure 2.2 shows that These sensors go about as a contribution to the framework. There action of every one of these sensors can be seen in LCD-display. GSM module utilizes AT orders for sending SMS. This item is an extraordinary development board for IoT based applications (Blynk). Auto air ventilation and water flow system is also present in the proposed system.

Limitations:

- Did not use any GPS tracking system to detect the place.
- As this is an automatic gas detection and alerting the system. It can not notify the emergency services if any accidents happen.

2.3   IoT Based System for Monitoring and Control of Gas Leaking (2020)

System Block Diagram:
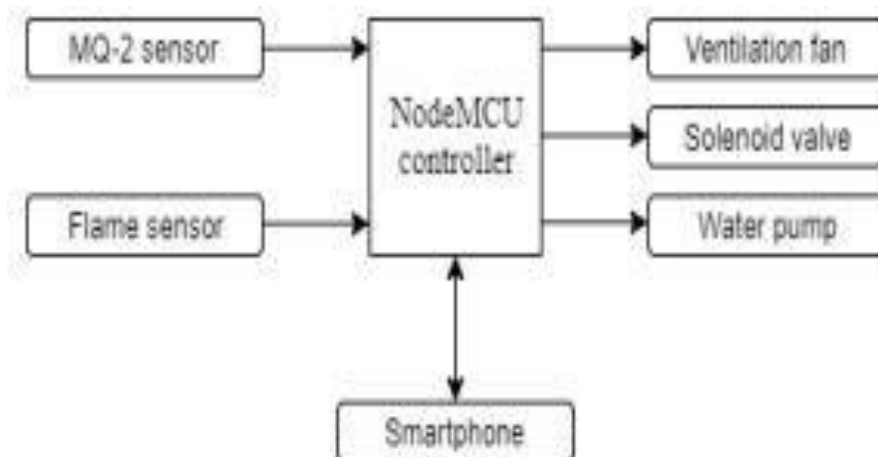
Figure 2.3: IoT Based System for Monitoring and Control of Gas Leaking

Figure 2.3 shows that The system is divided into three parts which are the sensing unit, control the unit, and output actuator [Yahaya &Mohd Zailani,2020]. For the sensing unit, two sensors are installed which are the MQ-2 sensor and the flame sensor. For the manipulate unit, the primary controller that controls the operation of the gadget is the NodeMCU even as the phone is used as a person interface. There are 3 fire stopping gadgets hooked up on this gadget that are air flow fan, solenoid valve and water pump.

Limitations:

- The system is not more stable one.
- Can not able to notify the emergency services.

2.4 Gaps in Existing Knowledge

- In these existing system, Only one sensor is used to detect gas. There is no Fire sensor to detect fire.
- As well as If any fire is occurred in that place than there is no water pump to cool down the fire.
- Did not use any GPS tracking system to detect the place.
- As this is an automatic gas detection and alerting the system. It can not notify the emergency services if any accidents happen.
- So, our system will fulfill all the gap.

Chapter- 03 Research Methodology

3.1 Research design
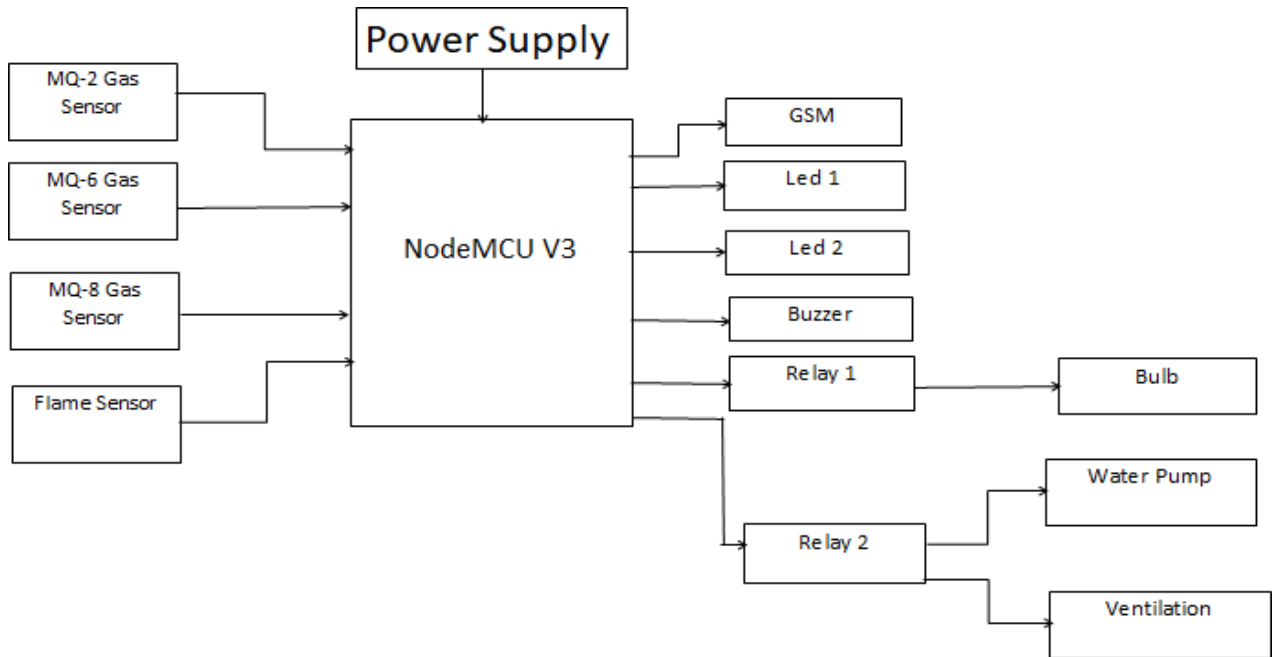
Figure 3.1 Block Diagram of the System

Figure 3.1 shows that In the proposed framework, gas sensor (MQ2 Sensor, MQ6 Sensor, MQ8 Sensor), flame sensor are interfaced to the NodeMCU V3. These sensors go about as a contribution to the framework.. For the development of this system, MQ2 Sensor, MQ6 Sensor, MQ8 Sensor, Flame sensor that is able to sense the leakage of LPG gas and fire.. Also We have used a DC water pump as because if any fire accident happen because of

gas leakage then it will supply water. The GSM module will send the notification to users.

Immediately, GSM is able to activate and send the alerting message to the users. We can turn

on the water supply of water pump by through the relay. ThingSpeak is used to display the

status about gas leakage.

Flow Chart of Proposed System:
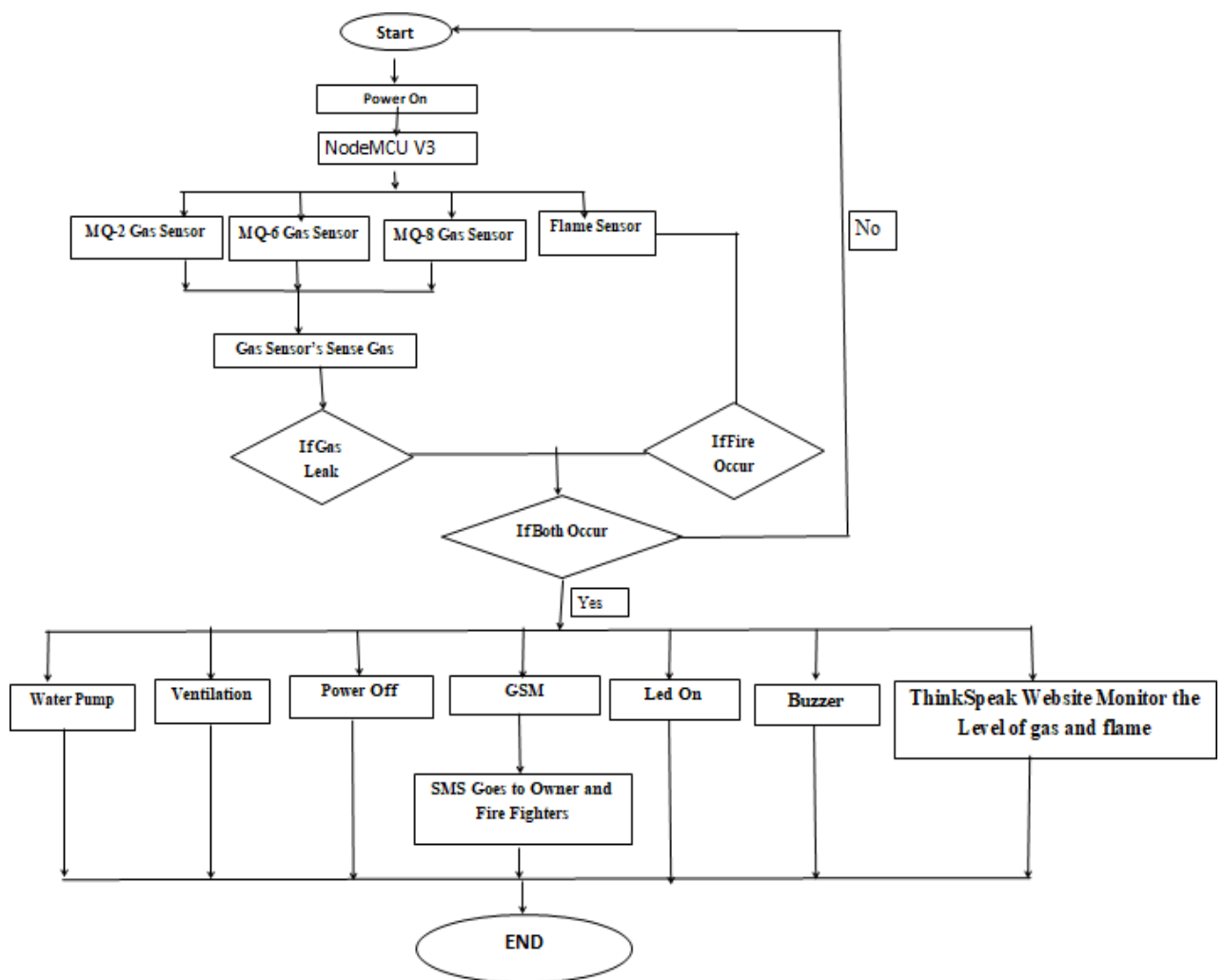
Figure 3.2 Flow Chart

11

Figure 3.2 First of all the system will start, then detect whether gas is leakage or any flame is occur or not. If occur then buzzer & LED will turn on. GSM module then send the SMS alert to the user also fire brigadiers also can informed by registered number.

3.2 Methods and Sources

- This detection system with notification alert for home safety. It is controlling, monitoring, and taking some steps for avoiding blasts or any other incidents in home.

- First of all, there need to connect the project to any power cable or any USB cable with the PC or Laptop and get the power supply from any switch for the power. By connecting the USB cable we can start this project,MQ-2 sensor, MQ-6 sensor,MQ-8 sensor, Flame sensor, NodeMCU V3 will be on.

- Then there used NodeMCU V3 by Ardiuno IDE. There will be upload the code of this project, after clicking the serial monitor , can get the value of gas, LPG and Hydrogen. Like this way can monitor the value of gas.

- After that If any fire occur then the flame sensor will be detected the fire. Then the buzzer will be on, the Led green light1 will be off and the Led red light2 will be on and the power supply will turn off and the water pump will be on for water supply and Ventilations.

- That time in the PC , it will be display that Caoution! Flammable object found.Then send SMS to the owner that fire occur and to the Fire Fighters with the address of the home Owner.

- There also can monitor the value of gas's like 338,336,339,338 like this way. But in home if there leak any kind of gas then the gas sensors will sense that if it's range is more than 400 then the notification will go to the owner and in pc it will show that gas leakage occur, the buzzer will be on and power supply will be off ,the water pump and ventilations will be turn on because the range of gas is under 400 .

- When the gas value comes under 400, then the system will be automatically will be restart ,The water pump or motor and ventilation will be off and power will be on.

- In the server of ThingSpeak, the data will be record and base on those data there will be represent the graphs for gas value and flame value and action value. After 15s the data will be upgrade.

- That's how the full process of this project will be work.

3.3 Research Tools

Following are the hardware and software requirements of our system:

Hardware Requirements:
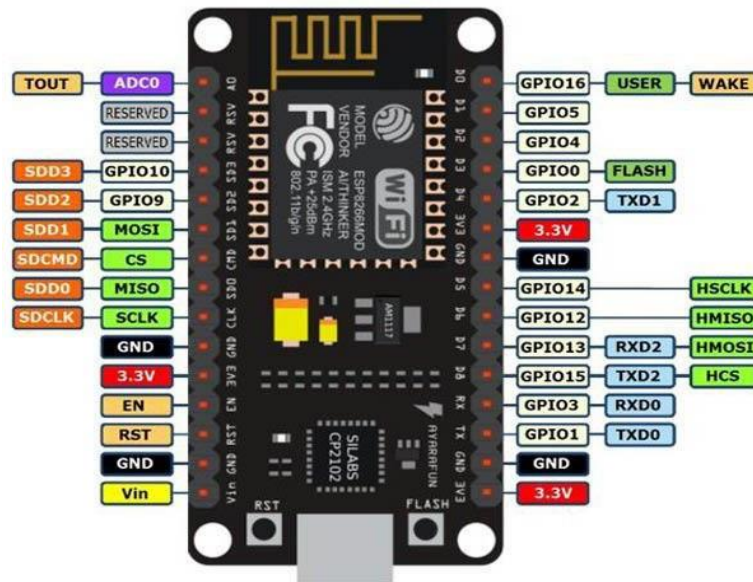
Figure 3.3 NodeMCU ESP8266 Lua

Figure 3.3 NodeMCU ESP8266 Lua is an open source firmware with WiFi module.It is used by an on module flashbased SPIFFS file system. NodeMCU ESP8266 is implemented in C.The firmware was initially developed as is a companion project which is popular ESP8266based NodeMCU development module, and the project is now community supported, and the firm 2ware can run on any ESP module.

Figure 3.4 Dual Channel 5v High Quality Relay

14

Figure 3.4 Dual Channel 5v High Quality Relay: A relay is a relatively small current operated electromagnetic switch that can turn on or off much larger currents. When an electromagnet is applied with a certain current, it creates a magnetic field around it. This is a 2 channel 5V relay interface board capable of controlling various devices. It can be controlled directly by microcontroller like (Raspberry Pi, Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).
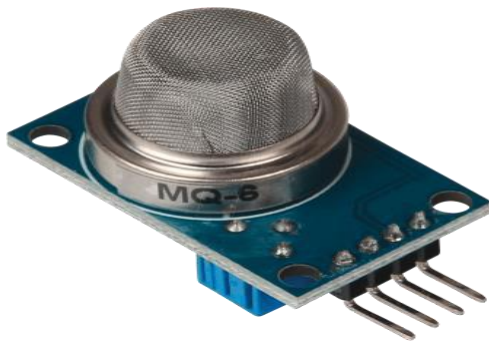
Figure 3.5 MQ6 sensor

Figure 3.5 MQ6 sensor: MQ6 (LPG gas sensor) is an easy-to-use liquefied petroleum gas (LPG) sensor. It can be used in gas leak detectors for consumer and industrial applications. This sensor is suitable for detecting LPG, isobutane, propane and LNG. MQ6 can detect gas concentration from 200 to 1000ppm. This sensor has high sensitivity and fast response time.

Figure 3.6 MQ2 Flammable gas sensor

MQ2 Flammable gas sensor Sensitive fabric of MQ-2 gas sensor is SnO2, which with decrease conductivity in the air. When the goal flammable gas exist, the sensor`s conductivity receives better side the fueloline awareness rising. Users can convert the extrade of conductivity to correspond output the sign of gas awareness via an easy circuit. MQ-2 fueloline sensor has excessive sensitivity to propane and smoke, can also come across the herbal fueloline and different flammable steam well. It is with a low price and appropriate for distinctive packages of detecting sorts of flammable gases.

**Figure 3.7 MQ8 Hydrogen gas sensor**

MQ8 Hydrogen gas sensor: MQ8 gas detectors use to decide the presence and attention of hydrogen, which includes gas chromatography, mass spectrometry, catalytic bead, and thermal conductivity.MQ-eight collection sensor makes use of a small heater

16

internal with an electrochemical sensor so that you can degree a exceptional form of gases combinations. They may be calibrated, but, so that you can do that, an recognised attention of measured fueloline or gases is needed. The MQ-eight hydrogen gas sensor is appropriate for sensing hydrogen concentrations with inside the air. The MQ-eight can discover hydrogen gas concentrations everywhere from 100-10000ppm. This sensor has an excessive sensitivity and speedy reaction time.


Figure 3.8 Fire sensor

Fire sensor: A fire sensor works by detecting smoke and/or heat. These devices respond to the presence of smoke or extremely high temperatures that are present with a fire. After the device has been activated, it will send a signal to the alarm system to perform the programmed response for that zone.
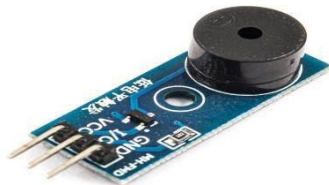
Figure 3.9 Passive Buzzer

Passive Buzzer: The passive buzzer is a bit shorter and includes exposed electronics on the bottom. It can send AC "audio signals" to it through the Arduino. It takes time for the CPU to make a sound, so other processes may slow down. You can see the exposed electronics on the bottom of the passive buzzer.
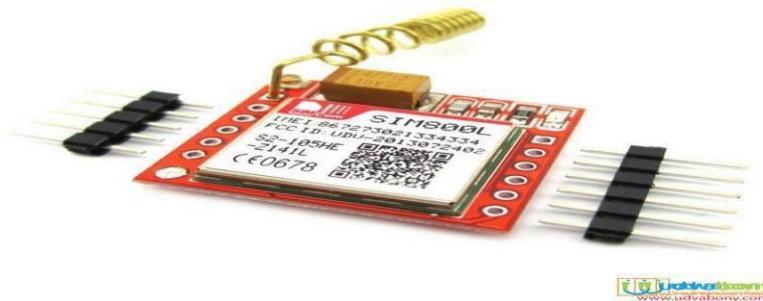

Figure 3.10 SIM800L Mini GPRS GSM Module (3.7-4.4volt)

Figure SIM800L Mini GPRS GSM Module (3.7-4.4volt): SIM800L is a cheap and portable GSM breakout board that has the features of the larger SIM900 shields. Sending and receiving text messages with your Arduino has never been easier.This module is connected to the microcontroller which makes calls and sends SMS when the sensor value exceeds the threshold limit.SIM800L GSM module is a miniature GSM modem, which can be integrated into a great number of IoT projects

Figure 3.11 5v DC Mini Water Pump Micro Submersible Motor Pump (2.5-6 volt)
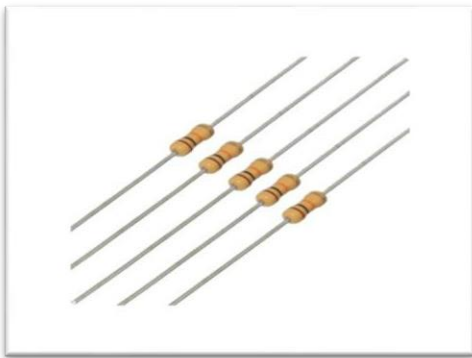
Figure 3.12 1/4w Resistors(KΩ)

A resistor can be used at any combination of voltage that how much power the resistor can convert into heat or absorb without any damage to itself. Resistors convert electrical power into heat.
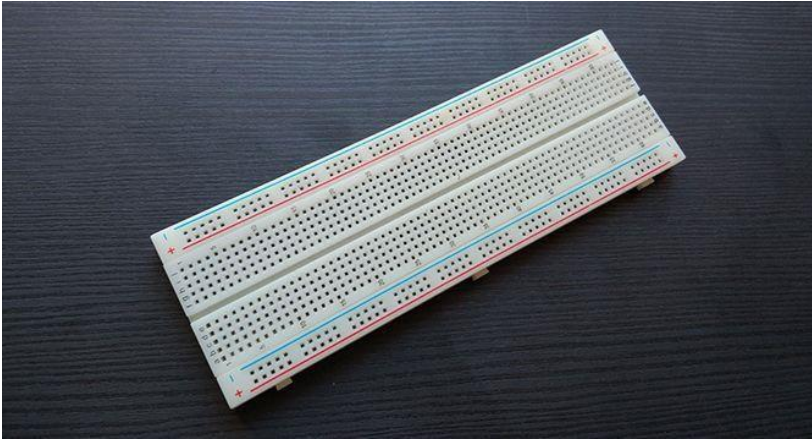
Figure 3.13 LED Lights

Figure 3.13 LED Lights: A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it.

Figure 3.14 Jumper Wire (male-male, male-female, female-female)

Figure 3.15 Breadboard

Breadboard is a rectangular plastic board with many small holes in it. These holes allow you to easily prototype electronic components (i.e. build and test an early version of) an electronic circuit, such as this one with batteries, switches, resistors and LEDs (light emitting diodes).

Software Requirements:

- o Programming Language C
- o Ardiuno 1.8.19 ID

Chapter- 04 Result and Discussion

4.1 Result

According to our system about "IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety". We are going for testing the system that we have developed, we have implemented the system based on our research method or procedure to demonstrate the performance.
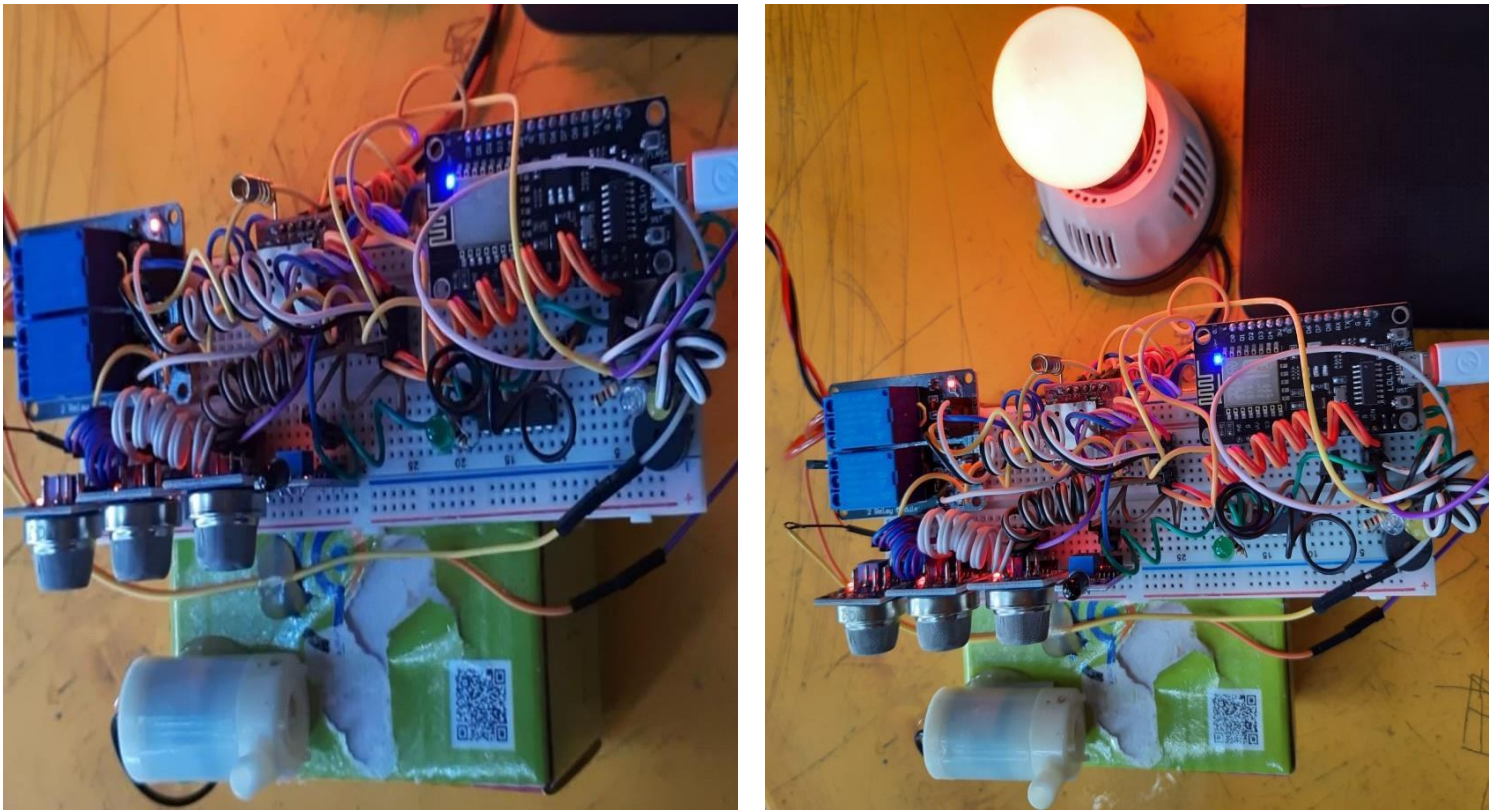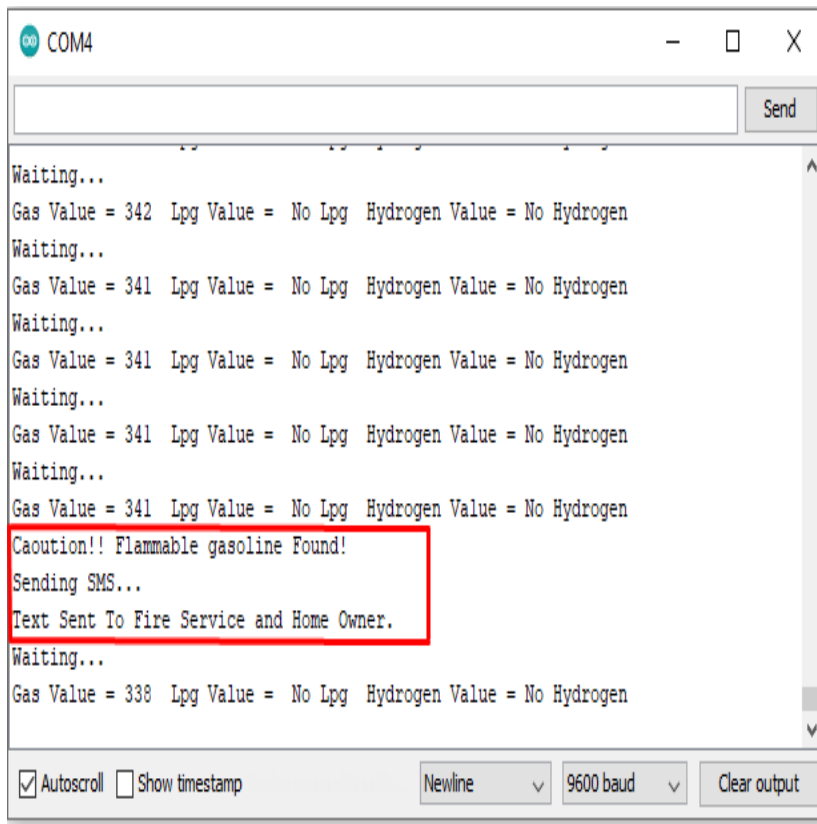

Figure 4.1 Overview of the system before & after power supply

Figure 4.1 shows a prototype that we have prepared for testing the system. It is the overviewof the system prototype. This figure shows the system before supplying the power and after supplying the power

Figure 4.2 Notification Alert on Detection of Gas Leakage and Fire

Figure 4.2 is all about the notification alert. Whenever gas or fire is detected then it gives the real time data and send the message to the house owner whose phone number is al ready registered for getting the message.
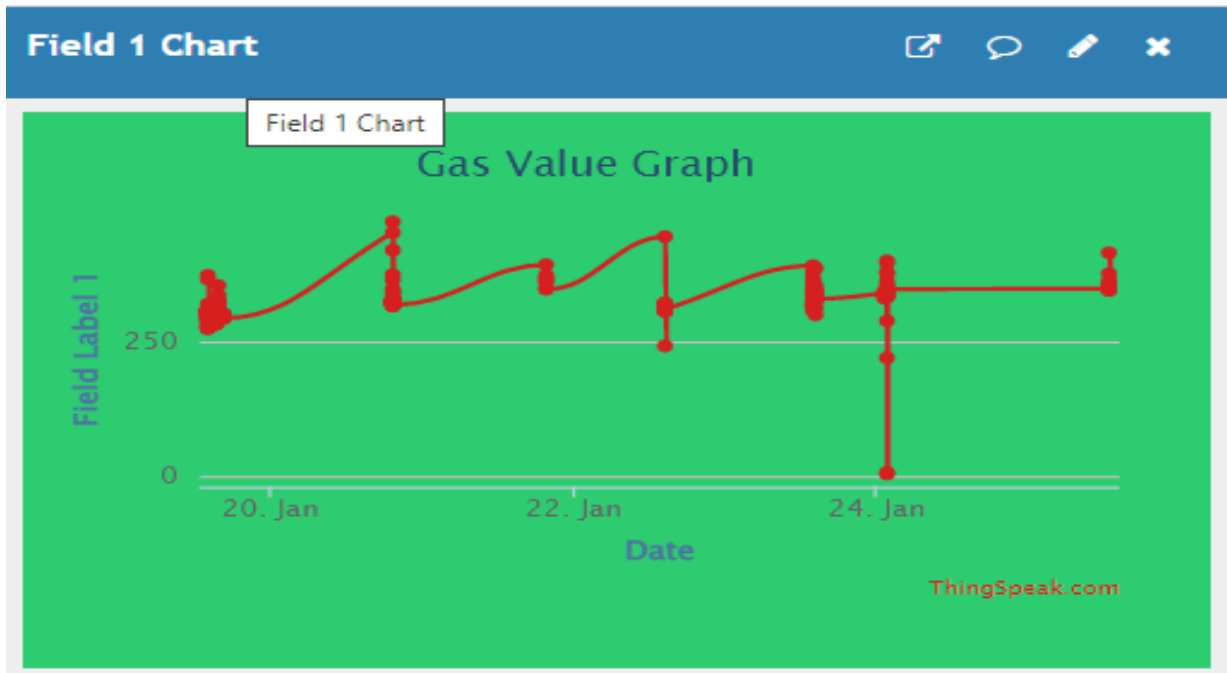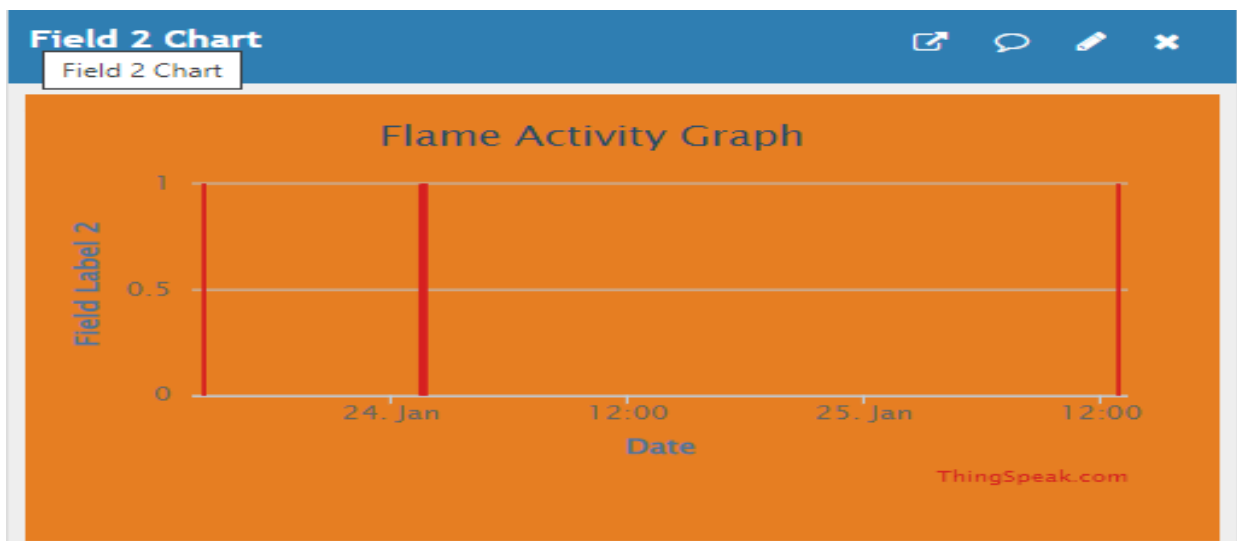
Figure 4.3 Gas Value Graph

Figure 4.4 Flame Activity Graph

24

Here figure 4.3 and 4.4 The Gas value graph and flame activity graph show the gas value level as a real time data. When gas leakage occurs then at a specific gas value level, the notification can get.

Table- 4.5 Cost of the system

Name	Quantity	Price
Nodemcu ESP8266 Lua V3	1	750
MQ2 Flammable gas sensor	1	190
MQ6 LPG gas sensor	1	150
MQ8 Hydrogen gas sensor	1	184
Flame Detection sensor	1	160
SIM822L GSM module with Antena	1	850
Passive Buzzer	1	20
Submersible Water Pump	1	170
Dual Channel 5v High Quality Relay	1	240
Male to Female Jumper Wire set	40	90
Male to Male Jumper Wire set	40	90
Female to Female Jumper Wire set	40	90
Green LED	1	10
Red LED	1	10
Resistor (1 KΩ)	1	20
		Total cost: - 3024/-

4.2 Discussion

With the help of this detection we can be more alert. The real time data will be show in the mobile app. When any gas leakage and fire detect that time the buzzer will be on, GSM will be activated and the homeowner. And also we can avoid for occurring this gas leak aging and unwanted fire disasters. This time we took more safety precision by using GPS tracking device, water pump. We can also monitor this water pump and power supply connection by using the relay. The real time data will be show in the ThingSpeak server. So that we can easily control the system wherever we are that does not matter. We have registered the number of Fire Brigades Service. So that the can easily get the information and come over the place to safe. By this way many family can stay safely in their houses.

Limitations:

- The proposed system can not cover the full building.
- Notification can't send to the owner if there is any network issue in GSM module.
- Gas value can be at least 400 otherwise, buzzer can't turn on & notification can't send, although gas is sensed.

Future Scope:

- In the future here can be use camera, additional ventilation facility, temperature sensor, automatically turn of the knob of the cylinder, voice module and so on.

Chapter- 05 Conclusion

IoT is an increasing community of bodily gadgets which are connected with extraordinary varieties of sensors and with the assist of connectivity to the net, they're capable of change data. Through IoT,the net has now prolonged its roots to nearly each viable aspect gift round us and isn't anyt any greater constrained to our non-public computer systems and cellular phones. Safety, the simple subject of any project, has now no longer been left untouched via way of means of IoT. Gas Leakages in open or closed regions can show to be dangerous.

Conventional Gas Leakage Detector Systems though, have tremendous precision, fail to well known some elements withinside the discipline of alerting the humans approximately the leakage. Therefore we've got used the IoT generation to make a Gas Leakage Detector having the MQ-6 Gas Sensor, Fire sensor this is capable of feel the leakage of LPG gas and fire. Also We have used a DC water pump as due to the fact if any fire twist of fate show up due to gas leakage then it'll deliver water. The GSM module will ship the notification to users.

Our system is about "IOT Based Flammable Gas Leakage Detection System with Notification Alert for Home Safety".

The proposed system has the facility of gas detection and fire. If the fire detected by the system then it will notify to the homeowner through SMS and also buzzer on. The system sends alert notifications to the user and the user responds accordingly with the help of

connected devices like a smartphone from any location. The IoT based toxic gas detector is cost efficient as the devices used like MQ-6 sensor are within the affordable price and are more applicable to today's fast-changing life. This integrated system has taken IoT to next the level and has helped people meet their business requirements.

The impetus for this proposal is to help the unconscious and reduce the risk of death from fire and to reduce damage to infrastructure. The proposed system has a gas detection function. Real-time data will be displayed in the mobile app. When gas leak and fire detected time the siren will be activated, GSM will be activated and owner and fire department will receive sms. The owner can turn off the power switch and turn on the water pump through the relay. In this way we can minimize this problem.

As existing system is the automatic gas detection and alerting the system. It can't notify the emergency services like registered the number of fire Brigadiers if any accidents happen. Here,we will registered the user numbers as well as fire Brigadiers number for emergency services. Or, the existing system don`t have any GPS tracker that will help to detect the place where actually fire accident happened because of gas leakage. In some of the existing system, we can't get all types of facilities & accident prevention system. So, in our proposed system we want to combine all types of facilities in one system.

The motivation of this proposal is to help people who are unconscious and to reduce the risk of fire death and reduce the damages of the infrastructure. The proposed system has the facility of gas detection.

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