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FYP Interim Report

Fire and gas leakage alarming system

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I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Abstract

In modern society, environmental and public safety is a huge concern. At home and in industrial areas, smoke, fire, gas, and temperature can cause serious problems and cause accidents. It is necessary to take the necessary precautions, including security-based initiatives, to minimize the probability of such incidents. In order to reduce the odds of such incidents, a GSM-based Fire and gas leakage alarming system can be used. This system combines an alarm system with a smart SMS alert to provide industrial and household protection. An alarm system and a smart SMS warning system are included in the system. The device uses the MQ2 sensor and flame sensor to monitor the atmosphere and alert the user if any problems occur. The machine's microcontroller is an Arduino UNO, and the smoke sensor is a MQ-2, with a flame sensor for flame detection. The device collects data from sensors and then sends it to Arduino. Furthermore, Arduino transmits data to the GSM module, which sends SMS messages to the relevant user.

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Chapter I (Introduction)

1.1. Introduction of the Topic

IOT (Internet of Things) is generally defined as any device that connects to the internet and can record specific data and send it to a central location or device for further analysis. The used sensors can record audio, video, temperature, location data, etc. Today, driverless cars and home appliances are the main applications of IOT.

The usage of sensors in buildings could be the most prominent application of IOT in the field of fire safety. The collecting of atmospheric data using sensors could be the foundation for improving human approaches to fire prevention, firefighting, and ultimately lifesaving. (Dumlao, sep 2016) .Protecting one's property and business against fire is becoming extremely important these days. Surveillance of industrial and residential areas from all aspects is an effective technique to reduce personal and property loss in the event of a fire. The detection of home fires is a major concern, and many attempts are being undertaken in most developed countries to construct automatic detection systems. The Fire Alarm System was designed to alert us in the case of a fire in order to protect ourselves, our employees, and the general public. Early detection of a developing fire emergency and notification of building residents is a vital part of fire protection. (weldesyase & Bahta G/meskel, 2010)

1.2. Current Scenario

As one of South Asia's rapidly urbanizing countries, Nepal lacks adequate plans. Cities are being built without regard to disaster protection and risk management. Among disasters that have occurred in the resident area, fires have been recognized as a dangerous catastrophe that could lead to property damage and death. A fire has been the most common, destructive and most powerful disaster in many disasters. Urban construction has increased the risk of the occurrence of major fires and other special disasters year after year. In Nepal, fire is a frequent danger, one that takes a heavy toll on life and property. When people lose their homes, their primary assets, and their valued assets, they frequently collapse into poverty. In the inner-city areas of growing cities, where houses are old, made of wooden joists, and located in close proximity, fires have a higher risk of becoming dangerous. Fire quickly jumps from house to house, spreads rapidly, and destroys entire settlements in such homes.

Various types of fires are responsible for huge losses and destruction each year. According to Ministry of home affairs data from 1971 to 2018, there were 12,694 fire occurrences in the last 50 years, killing 1,755 individuals and injuring 2,176 others, damaging 265,962 households and destroying 90,044 properties.

In the year 2018 alone 87 people were killed and 342 wounded in 2,478 accidents involving fires. In addition, 1,857 houses have been demolished and 291 damaged, resulting in a financial loss of about 3.96 billion. The estimated property losses associated with climate-induced disasters amounted to approximately NPR 6.84 billion, and about 94 per cent of these losses can be attributed to fire events. (Gautam, 2021)

The database produced by the Ministry of Home Affairs for 2017-2018 reveals that flood, fire, lightning and landslides are major disasters in terms of number of disaster records.

Damage and losses of disaster incidents										
S.No.	Incident	No. of Incidents	Dead *			Injured	Affected Family	Houses Destroyed		Estimated Losses (NPR)
			Male	Female	Total			Partial	Complete	
1	Flood	418	128	55	183	61	16196	14424	286	60,944,400
2	Landslide	483	96	65	161	182	1083	149	328	191,662,000
3	Lightning	432	87	72	160	551	618	23	14	14,687,000
4	Fire	3973	74	76	150	557	6027	549	3234	6,422,638,013
5	Cold Wave	48	26	22	48	0	48	0	0	-
6	High Altitude	45	37	4	41	6	46	0	0	-
7	Heavy Rainfall	342	8	22	30	84	538	193	252	89,415,160
8	Animal Terror	141	14	8	22	69	280	136	8	4,390,150
9	Wind storm	254	7	12	19	84	1527	763	301	51,447,998
10	Boat Capsize	10	9	7	16	9	27	0	0	-
11	Epidemic	22	11	4	15	1881	420	0	0	-
12	Snake Bite	18	7	7	14	5	18	0	0	-
13	Snow Storm	2	10	0	10	0	10	0	0	-
14	Avalanche	1	1	0	1	0	1	0	0	-
15	Hailstone	3	0	0	0	0	127	2	0	457,000
16	Other	189	54	45	99	150	289	69	10	3,181,599
		6381	**569**	**399**	**968**	**3639**	**27255**	**16308**	**4433**	**6,838,823,320**

Figure 1 Disaster incidents data from 2017-2018 (Affairs, june 2019)

Figure 2 Estimated economic loss by disaster from 2017-2018 (Affairs, june 2019)

1.3. Problem Statement

FIRE is the most common threat that all businesses face. Before the owners/trustees of these enterprises implement measures for dealing with the fire threat, no establishment is immune to fire. A fire attack is usually quiet, and only a few people are aware of the fire once it has spread across a large area. The SMS-based Fire Alarm system sends an immediate alert to one or more cellphone numbers, allowing quick action to be taken. This helps to avoid serious property damage in the event of a fire. It's possible that structural damage caused by an earthquake can be repaired. Property that has been stolen still has a chance to be recovered. Fire damage, on the other hand, is usually permanent and irreversible. Once turned to ash, historical items or materials are irreplaceable. (Rahman & Khan, 2016). Traditional fire alarm systems are excellent in preventing fires, but they lack intelligent capability that allows them to be aware of the affected area without having to be physically present in the building. During a fire, a resident's actual presence in the building is not always required. As a result, a device interference is necessary to detect and alert a potential fire outage remotely.

1.4. Project as solution

The research study will identify possible solutions to the problem identified in traditional fire alarm systems. We are designing a system that will use easily accessible and inexpensive devices to provide fire detection and alarm systems that can be easily installed indoors, use minimal energy, and require no special skills to operate. **The Fire and gas leakage alarming system** will be developed using a microcontroller and numerous sensing circuits. The proposed system will alert you about a fire outbreak even if you are not inside the house. It will use a GSM module for remote alerting about fire incidents. For detecting fire and gas, it will also use a flame sensor and MQ2 sensor, in addition to the GSM module. Additionally, MQ2 sensors will help to detect L.P.G gas leakage. A buzzer will be connected to the system to alert people via sound. Arduino will be used as a microcontroller for connecting different sensors. As a result of this fire-

alarming prototype, the fire authorities will be notified immediately following the outbreak of a fire, which will reduce the reaction time.

1.5. Aim and Objectives

1.5.1. Aim

The main aim of this project is to develop Arduino based fire and gas leakage alarming system using a microcontroller, sensing circuits (Flame sensor, MQ2 sensor), LED light, buzzers, and LCD display which will notify the users by sending alert SMS through GSM Module so that certain appropriate steps could be taken in time to mitigate the fire incident and lessen the loss.

1.5.2. Objectives

The S.M.A.R.T objectives set for this project are:

- **Specific (S):** The traditional fire alarm system prevents fire outages; however, it does not have the intelligent functionality to remotely monitor the affected area without a physical presence. Therefore, I am trying to develop an automated and IoT-based Fire alarming system that can alert about fire breakouts even if no residents are present. This project will require proper planning, research, designing, and testing to finalize the product in time.
- **Measurable (M):** Developing such an IOT-enabled device in both rural and urban locations will assist to reduce the problem of frequent fires and gas leaks. Components such as Arduino, GSM module, flame sensor, buzzer, MQ2 sensors, and software components such as C/C++, MS word, and draw.io will be required to complete the project/product.
- **Achievable (A):** To achieve the aim of the project, a milestone is created to develop the product with ease and within the desired time period implementing a proper/suitable methodology.

- **Relevant (R):** Another goal of the project is to look at the possibilities of the Internet of Things, home automation, and smart gadgets. It will assist in understanding how IOT projects and devices can be used in the real world and what benefits they can provide in everyday life**.**

- **Time-bound (T):** The project's ultimate goal is to be completed in a short amount of time. The tasks have been assigned and the time has been set aside. Every phase has been planned to fit inside the time limits. Within a year, the project (component gathering, design, testing, and documentation) must be completed. The previously mentioned WBS and Gantt chart were used to manage time and tasks.

1.6. Report Structure

1.6.1. Background

This background clarifies the project requirements, description, and intended customers, providing a greater understanding of the project. Comparing this project to other similar projects is also crucial to gaining a deeper understanding of its features and components.

1.6.2. Development

The development section provides details about the considered methodologies and the selected methodology for the project.

1.6.3. Analysis of Progress

This section explains the phases of the specified technique that have been performed to date. It provides an in-depth examination of the project's progress.

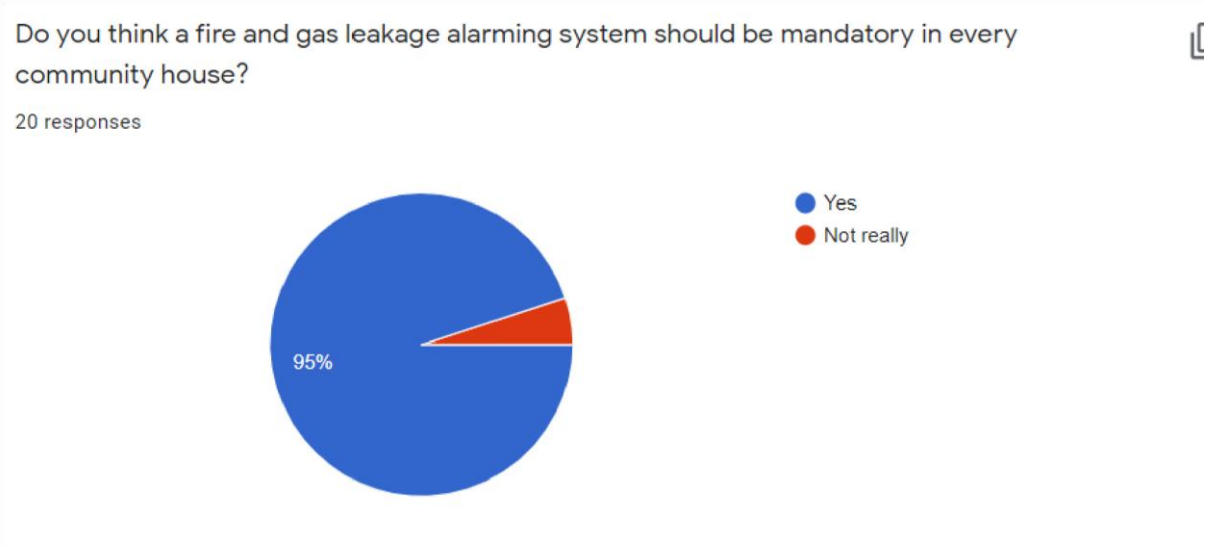
1.6.4. Future Work

The remaining development phases to be completed are explained in this section.

Chapter II (Background)

2.1. Client/survey

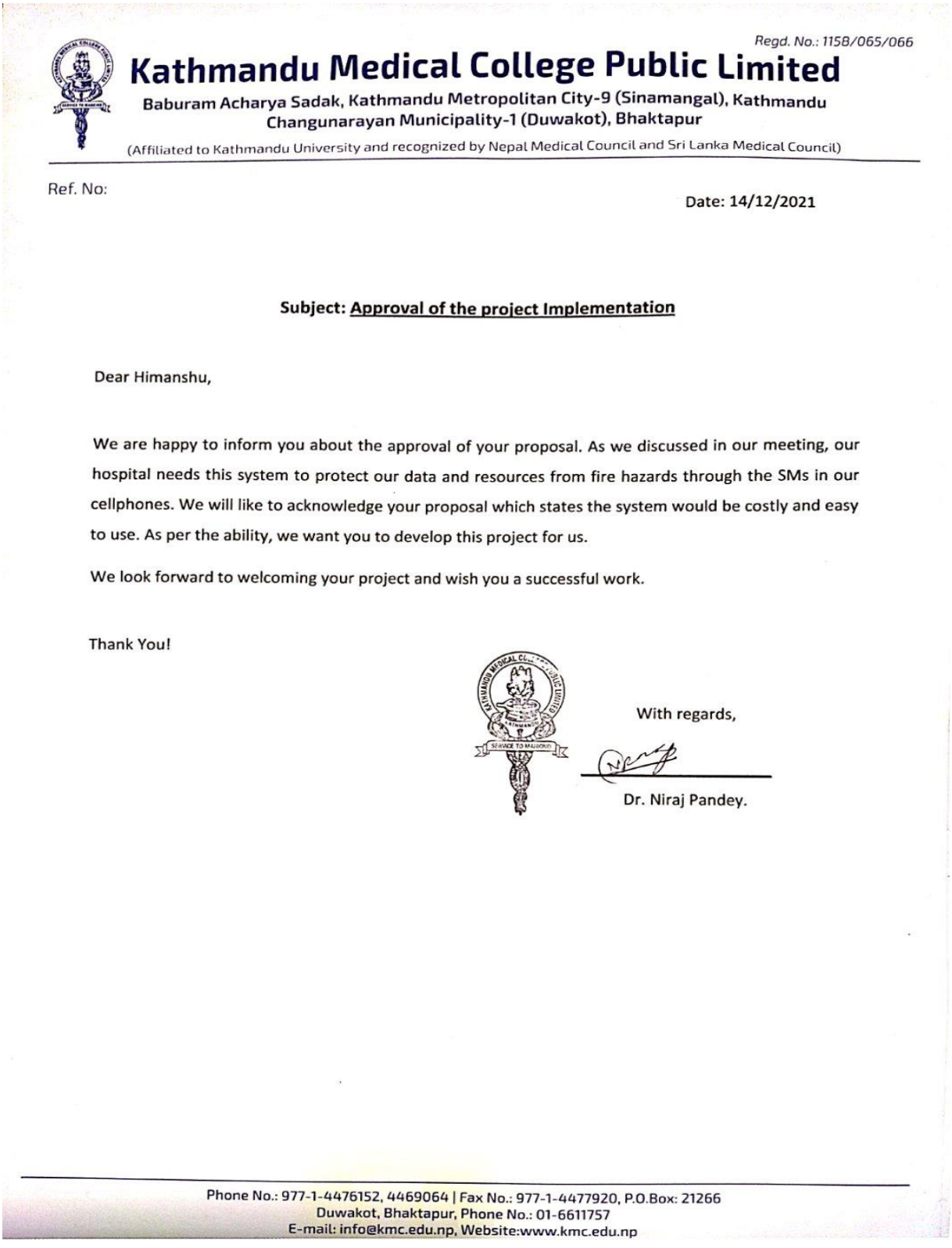
According to the pre-analysis survey conducted for this project, most organizations and individuals agreed that the fire and gas leakage alarming system is very significant.



Other findings of Survey: **Appendix 2**

2.1.0. Client approval

I have conducted an online survey form, and one of the hospital was interested and give their opinion to install this project in their data and resources office to prevent their huge data file records from the fire incidents.



Regd. No.: 1158/065/066

Kathmandu Medical College Public Limited

Baburam Acharya Sadak, Kathmandu Metropolitan City-9 (Sinamangal), Kathmandu
Changunarayan Municipality-1 (Duwakot), Bhaktapur

(Affiliated to Kathmandu University and recognized by Nepal Medical Council and Sri Lanka Medical Council)

Ref. No:

Date: 14/12/2021

Subject: Approval of the project Implementation

Dear Himanshu,

We are happy to inform you about the approval of your proposal. As we discussed in our meeting, our hospital needs this system to protect our data and resources from fire hazards through the SMs in our cellphones. We will like to acknowledge your proposal which states the system would be costly and easy to use. As per the ability, we want you to develop this project for us.

We look forward to welcoming your project and wish you a successful work.

Thank You!

With regards,

Dr. Niraj Pandey.

Phone No.: 977-1-4476152, 4469064 | Fax No.: 977-1-4477920, P.O.Box: 21266
Duwakot, Bhaktapur, Phone No.: 01-6611757
E-mail: info@kmc.edu.np, Website:www.kmc.edu.np

Figure 3 client approval letter

2.1.1. Requirements

- **Early fire detection capabilities:**
  Fire breakouts should be detected as quickly as possible by the system. Whenever a fire occurs, the flame sensor in the system should detect the flame.

  It will help to minimize the fire within time.
- **The system should be able to detect LPG gas leakage, smoke, and other harmful gas**:

  The system's MQ2 sensor should detect the concentration of LPG gas during gas leakage from gas cylinders in the home. When the value sensed by MQ2 exceeds the threshold value, the system will be notified. MQ2 should also be able to detect smoke and other dangerous gases such as methane and carbon monoxide.
- **The System should be able to alert through Buzzer:**
  The buzzer should ring as soon as the flame and MQ2 sensor detect a fire or gas leaking for a quick response time.
- **The System should be able to send alert notifications to respected personnel.**

  Even if people are not present in the residence, this proposed technology will alert them to a fire outbreak. It will employ a GSM module to send out remote fire alerts.
- **Cost-effective:**
  The system should be cost-effective because the most significant aspect that business management will consider is the cost.
- **Reliable:**
  It is necessary for the equipment to be dependable and trustworthy. The system should be simple to set up in any location, including rural and metropolitan locations, and no internet connection is necessary.

2.2. Similar Projects

2.2.1. Project 1

Design and Implementation of a Smart Fire Alarm System Based of Wi-Fi over

Long Distance (WiLD)

Author: Ahmed Radhi

The goal of the project is to create and construct a smart fire alarm system that works over long distances using WiFi (WiLD). The fire detector signals the fire's location and alerts the fire station and firefighting center. The signal is sent from the fireplace to the firefighting center, where a fire sensor is attached to a microcontroller that is linked to a local server to send the status to the firefighting center's central server. For communication, the project uses smoke sensors, LED lights, Xbee as a local server, Arduino, buzzer, and Wi-Fi. (Radhi, 2016)

2.2.2. Project 2

Development of Fire Alarm System using Raspberry Pi and Arduino Uno

Author: Rosni Abu Kassim, Md Saifudaullah Bin Bahrudin

The envisioned Fire Alarm System is a real-time monitoring system that detects smoke in the air and captures photographs of a fire using a camera installed within a room. This fire alarm system was built with the Raspberry Pi and Arduino Uno embedded platforms. The capacity to transmit an alarm remotely when a fire is detected is the system's key feature. When smoke is detected, the device displays a web page with an image of the room's condition. The device would demand user confirmation to report the incident to the firefighter via Short Message Service (SMS). The advantage of utilizing this approach is that it reduces the likelihood of false alarms. Because the camera can only take an image, it will only need a tiny amount of storage and electricity. (Md Saifudaullah Bin Bahrudin, et al., 2013)

2.2.3. Project 3

Pi Cam Based Smoke/Fire Alerting System

Author: B.R.B. Jaswanth, I. Priyanka, G. Chaitanya, J. Srinadh, T. Siva Ganesh

The project's goal is to create a Pi Cam-based smoke/fire alerting system and install it. The system would be able to detect smoke and automatically communicate the footage collected by the Pi Camera to the wireless monitoring device as soon as it detects smoke. The source of the smoke will then be visible, and the matter will be quickly resolved. A remote monitoring system may send live video to any computer with a browser that is connected to the same network as the Pi, allowing you to view it on a Web page. (Jaswanth, 2019)

2.3. Comparison Table

S.N.	Features	Project 1	Project 2	Project 3	This Project
1.	Microcontroller used	Arduino	Raspberry Pie and Arduino	Raspberry pie	Arduino
2.	Medium for communication	Wi-Fi	Short Message Service (SMS)	Web page	GSM Module
3.	Remote Data Accessibility	YES	YES	YES	YES
4.	Easy to use	YES	NO	NO	YES
5.	Provides alert	YES	YES	YES	YES
6.	Cost Effective	YES	NO	NO	YES
7.	Alert through visual display	NO	NO	YES	YES

Table 1 Comparison table

2.4. Conclusion from the similar projects

When all of the features of similar projects are considered, it is noticeable that the suggested system provides all of the fundamental functions at a very low cost. It does a good job with less effort. This project was the first to use all of the features of a buzzer, led, LCD display alert, and GSM module for remote alerting. The goal of combining all of these elements is to fulfill the needs of the client while also addressing the flaws of traditional fire alarm systems.

Chapter III (Development)

3.1. Considered Methodologies

3.1.1. The waterfall methodology

This model was created by Rolls-Royce in 1970. This is the standard model for software development. The model is an older one that is still utilized by many large organizations and government projects. A linear or classical sequence model is a term used to describe the model. Requirement analysis, design, implementation, testing, and maintenance are the next steps. The phases cannot be repeated in a systematic way every so often. The waterfall model, as represented in the diagram below, incorporates a number of non-overlapping measures. In this methodology, there is no turning back. (dubay & kumar, aug 2013)

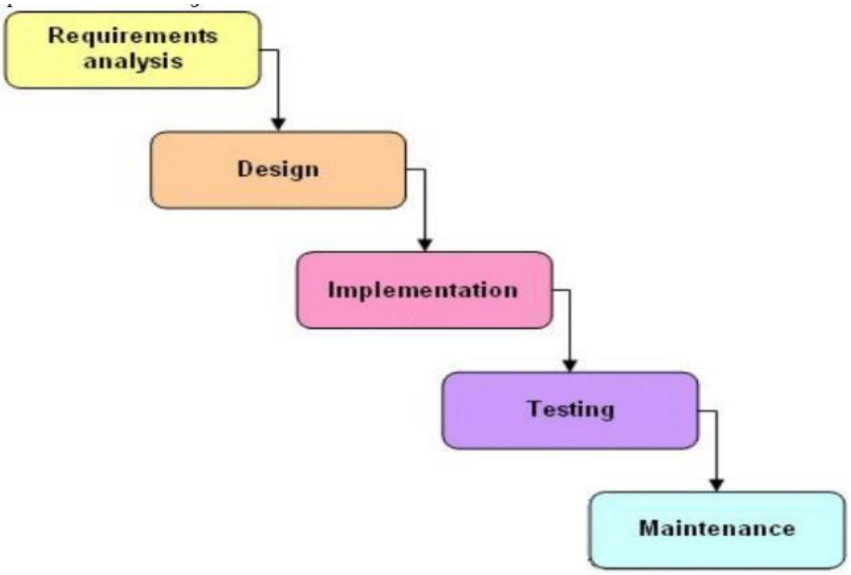


Figure 4 waterfall model (Rather & Bhatnagar, october 2015)

3.1.2. Spiral Methodology

The spiral model, introduced by Barry Boehm, was developed at the end of the 1980s and incorporates risk analysis, which was not included in previous models. Analysis, design, implementation, testing, and deployment are all operations that make up a spiral model. The spiral is applied in a clockwise direction, starting in the middle and working outward, passing through each of the locations listed above.

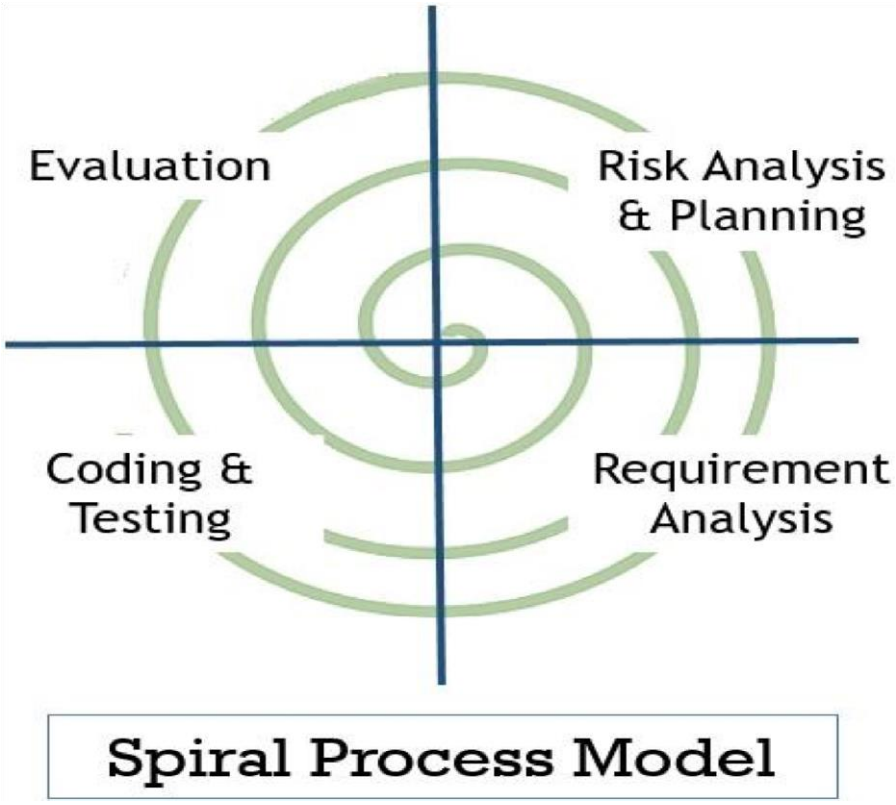


Figure 5 Spiral Model

Drawbacks of Spiral Model:

- May be costly to implement
- Requires a high level of risk analysis skills
- •Not suitable for smaller projects

3.1.3. Agile Model

Agile is a project management methodology that divides a project into multiple phases and requires ongoing communication with stakeholders at all times, as well as continuous development and iteration. Customers describe how to utilize the end product and what problem it will answer as part of the agile approach. This clarifies the client's requirements to the project team. Once the job begins, teams go through a phase of planning, implementing, and reviewing (HNEIF & HOCK OW, oct, 2009).

Figure 6 features of agile process

Weakness of agile model:

- There is no preference for thorough documentation, which may cause agile teams to believe that agile does not require documentation;
- The criteria are frequently not crystal clear at the start of projects. Teams may continue to discover that the customer's vision has shifted, in which case they will need to make multiple revisions and will find it difficult to evaluate the end outcome.

3.2. Selected Methodology

We discussed various software development approaches, including waterfall, spiral, agile, and prototyping. We shall employ the Evolutionary Prototyping Methodology for this project because of its flexibility and advantages. We can't change other software development models if a client or developer wants to change something, but we can adapt the system under the evolutionary prototyping approach based on consumer feedback.

3.2.1. Evolutionary Prototyping

Evolutionary prototyping is a process of software development in which the developer or development team builds a prototype first. After getting early feedback from customers, multiple prototypes are built, each with new features or additions, before the final product is released.

In Evolutionary system architecture is used in the context of a changing environment and dynamic system. First, a prototype with partially known requirements is built. When users interact with the prototype, they have a better understanding of the needs. Then new needs are introduced and implemented. The end result is a system that is always evolving (M.Davis, 1992).

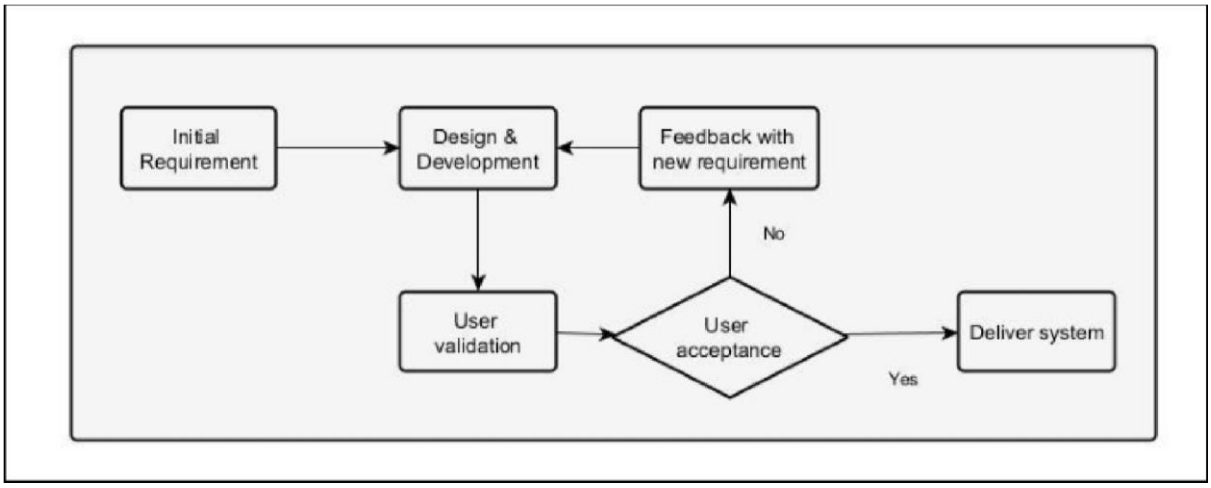


Figure 7 evolutionary prototyping Model

For this project, the Evolutionary Prototyping Model will include the following phases:

- **Identification of initial requirements**: It is the first phase and all the basic needs like hardware are gathered along with the installation of required software. Although we may not be able to know all the requirements because it is a continuous phase, we should be able to identify the basic items that are required for this project to operate.
- **Designing and development of prototype**: An overview design of the project is created in this step to get a quick idea of the project. Additionally. The Development phase is involved with the development of a prototype, which incorporates the system's basic functionality.
- **Prototype verification:** This will be accomplished through surveys and experiments with customers. Customers are the perfect individuals to ask for feedback on whether or not the system is working.

Changes for the prototypes: When a prototype is found to be adequate or unacceptable, the project team might develop several prototypes until it is improved, based on client feedback.

With this model, processes are created, and customers are continually asked to provide feedback on each of the prototypes they have created throughout the project. This is done to ensure functionality based on the specifications that consumers seek in a product or service.

Advantages of Evolutionary Prototyping methodology are:

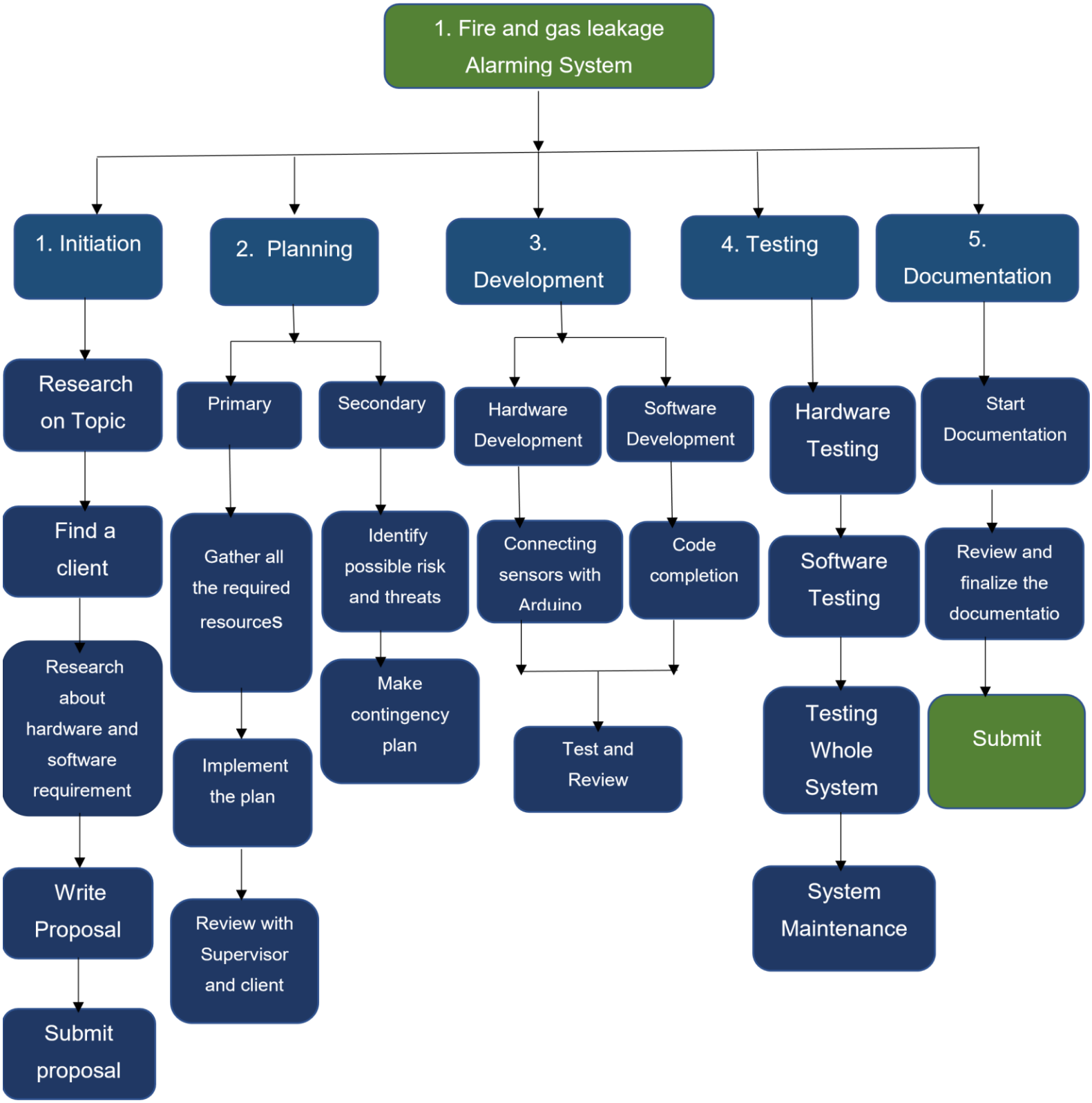
- This model is more adaptable than others.
- Errors are easily visible.
- We can easily identify missing features.
- There is opportunity for modification, which means that new requirements can be easily adjusted.
- It can be reused by the developer in the future for more complex projects.
- It ensures a higher level of client satisfaction and comfort.

Disadvantages of Evolutionary Prototyping methodology are:

- It may have poor documentation due to continuously changing customer requirements.
- There may be a massive difference in requirements.
- Sometimes, after seeing an early prototype, customers demand that the final product be delivered as quickly as possible.
- It may be more expensive due to frequent changes and maintenance.

3.3 Work Breakdown Structure

3.3. Work Breakdown Structure



3.4 Gantt chart

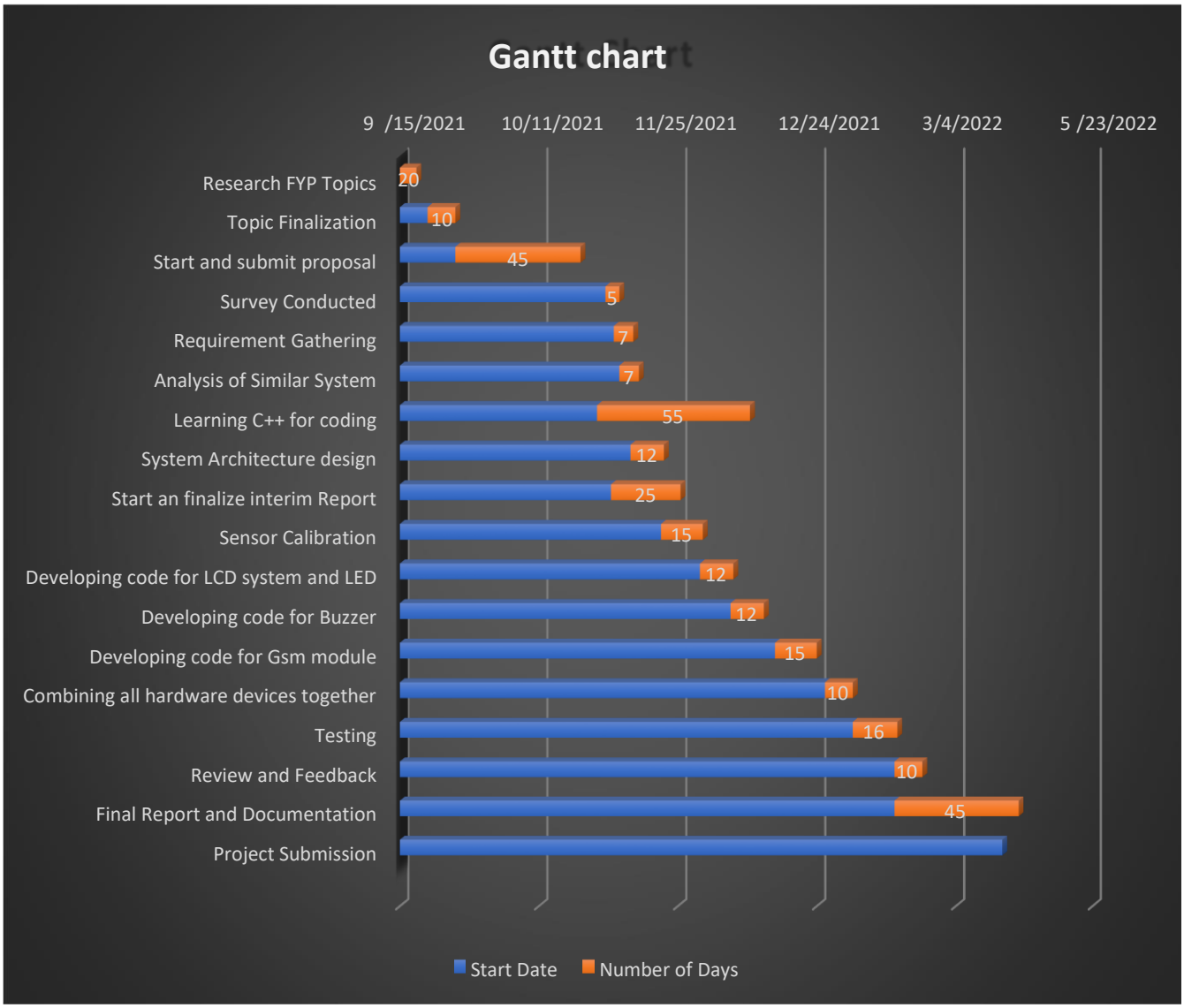


Figure 8 Gantt chart

Chapter IV (Analysis of Progress)

4.1. Progress Table

S.N.	Tasks	Status	Progress
1.	Research on FYP topic	Completed	100%
2.	Topic Finalization	Completed	100%
3.	Start and submit proposal	Completed	100%
4.	Survey Conducted	Completed	100%
5.	Requirement Gathering	Completed	100%
6.	Analysis on similar Project	Completed	100%
7.	Learning C++ for coding	Partially Completed	60%
8.	System Architecture design	Completed	100%
9.	Start and finalize Interim Report	Completed	100%
10.	Sensor Calibration	Ongoing	0%
11.	Developing code for LCD system and Led	Partially Completed	50%
12.	Developing code for Buzzer	Incomplete	0%
13.	Developing code for Gsm module	Incomplete	0%
14.	Combining all hardware devices together	Incomplete	0%
15.	Testing	Incomplete	0%
16.	Review and Feedback	Incomplete	0%
17.	Final Report and Documentation	Incomplete	0%
18.	Project Submission	Incomplete	0%

Table 2 Progress analysis table

4.2. Progress Review

4.2.1. Current scenario of progress

The method of topic selection and feasibility analysis was done in the initial stage. As the issue had been authorized by the supervisor, the most critical aspect was establishing the hardware and software requirements. This included selecting the basic hardware devices required for a basic fire alarm system. The device's prototype has been evaluated, and its cost has been determined. The hardware components required for the construction of the system were identified after a detailed review of previous projects and research. An online customer survey was undertaken to collect data based on the fire and gas leakage warning system. The survey form's screenshot may be seen in the Appendices section. According to the findings of the poll, the most serious worry for small-scale enterprises and the general public in particular was the spread of residential fires. After determining the hardware needs of the fire alarm systems through device research, it was critical to understand how the devices function and how to setup them on the Arduino board. Because the fire alarm system is made up of readily available components. The basic component needed for this fire alarm system are

The Buzzer, LED light, GSM module, smoke sensor (MQ2), Flame sensor, and LCD and Arduino are required. These devices were purchased from Himalayan Solution IOT shop that sells electronic devices for IOT ventures. I switched to the next level of development after learning the feature and its setup.

System Development was the most significant part of the project and it was divided into two sections.

- Hardware Development
- Software Development

The software development phase of the fire alarm system was done on the Arduino IDE. The IDE was easily downloaded from Arduino's official website, while hardware development task was divided into certain phases.

Hardware Development

First Phase

This diagram of the system's architecture was created in order to design the prototype. The system's main controller, Arduino, has 16 digital pins to which input and output devices can be connected. The two sensors I utilized in the experiment were the MQ-2 and the flame sensor, which detects smoke and fire. There are three major pins on these sensors (GND, VCC, A0, or D0). Through jumper wires, the MQ-2 sensor's VCC and GND pins were connected to GND and the 5-volt Arduino port. The Arduino's VCC and GND pins are expanded in the breadboard. The fire sensor's D0 pin was linked to Arduino's 11 number pin. Similarly, the MQ2 sensor's A0 pin was linked to the A2 port of Arduino. The first phase of Hardware development was completed successfully.

Second Phase

The connection between the LED light and the LCD was finished in the next phase. The I2C module on the 16/4 LCD has four pins (GND, VCC, SDA, and SCL). The GND and Voltage (VCC) pins were connected to the GND, and the breadboard was expanded with 5 Volt. The SDA and SCL pins were connected to Arduino's A4 and A5 ports. A positive LED light pin was also connected to digital pin 13 while the negative pin was grounded.

4.2.2. Progress Timeline

Because the research process took longer than predicted and other activities, such as conducting the survey, were added, the project's work could not be completed on time according to the Gantt chart presented in the proposal. Additionally, sensors required a significant amount of time to adjust, causing the planned timeline to be extended.

4.2.3. Action Plan

The Gantt chart has been revised in the interim report to be followed to complete the development and other relevant processes. To accomplish the project on time, tasks such as development, testing and documentation will be carried out concurrently to recover the missing time frame.

4.2.4. Circuit Diagram

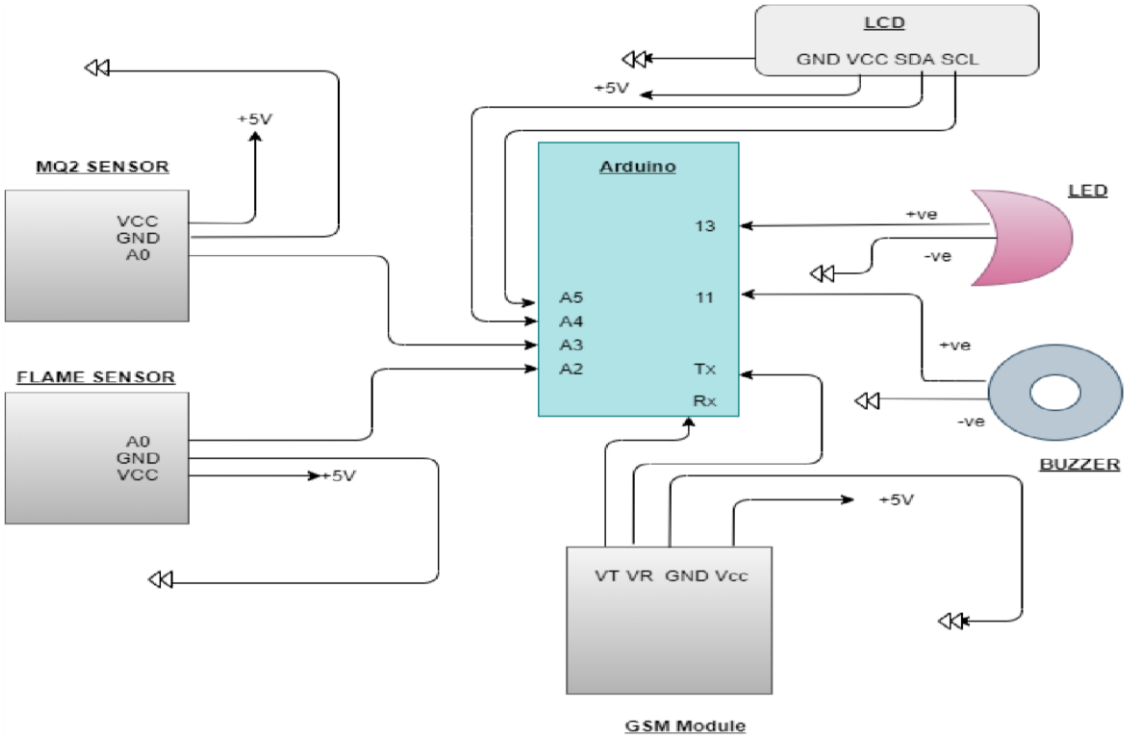


Figure 9 circuit diagram of the fire and gas leakage alarming system

Chapter V (Future Work)

5.1. Phases to complete

5.1.1. Prototype Development

I'd keep working on the prototype system's development. I would work on the second step of the evolutionary prototype process after the initial requirement collecting was accomplished. The demand for a prototype will be determined by the results of the survey. The hardware development was divided into three stages by me. First, two phases were completed, with the third phase to be completed in the coming days. The GSM and buzzer

will be connected to Arduino via the breadboard in the third phase of development. The alarm message will be sent over GSM. Software development would also be completed in the coming days. Coding will be composed for the GSM module, buzzer, and sensors.

5.1.2. Prototype refinement

A complete evaluation is carried out after the layout and improvement process, remarks is taken and modifications are made to the prototype as in step with the requirement and remarks. The levels of requirement collection, prototype layout, refinement, and updating of the standards are repeated till and except the very last product produced is satisfactory. The prototype satisfactory stage could be primarily based totally at the customer or the survey evaluation or the supervisors' remarks.

5.1.3. Testing, implementation, and documentation

When a suitable prototype is created and meets the required specifications, the product is finished. The finished product will be evaluated in order to ensure that it is accurate and efficient. The tests will be carried out in conditions where the value recorded by the MQ2 sensor and the flame sensor reaches the limit value and remains constant. Sensors, the LCD display system, the buzzer, and the LED's performance will all be evaluated. Following the successful completion of the testing, the project's final documentation will be completed.

Chapter VI (References)

HNEIF, M. & HOCK OW, S., oct, 2009. REVIEW OF AGILE METHODOLOGIES IN SOFTWARE. *International Journal of Research and Reviews in Applied Sciences,* vol.1(issue.1), p. 8.

Affairs, M. o. H., june 2019. *nepal disaster report,* s.l.: goverment of nepal.

Devices, C., 2021. *PRODUCT SPOTLIGHT:PIEZO AND MAGNETIC BUZZERS.* [Online] Available at: https://www.cuidevices.com/product-spotlight/piezo-and-magnetic-buzzers

dubay, p. & kumar, s., aug 2013. SOFTWARE DEVELOPMENT LIFE CYCLE (SDLC) ANALYTICAL COMPARISON AND SURVEY ON TRADITIONAL AND AGILE METHODOLOGY. *ABHINAV NATIONAL MONTHLY REFEREED JOURNAL OF RESEARCH IN SCIENCE & TECHNOLOGY,* volume no.2(issue no.8), p. 29.

Dumlao, M. F., sep 2016. FIRE ALARM SYSTEMS BASED ON INTERNET OF THINGS TECHNOLOGIES. *The PWU Research Journal,* Vol 1 2016 ISSN 0118-5616 (2021), p. 9.

ElProCus, 2021. *Electronic Projects for Engineering Students ....* [Online] Available at: https://www.elprocus.com/flame-sensor-working-and-its-applications/

Gautam, D. D., 2021. [Online] Available at: https://www.spotlightnepal.com/2020/05/14/growing-fire-incidents-wreaking-heavy-losses-nepal/
[Accessed 14 may 2020].

GSM, 2021. *SIM900A GSM Module.* [Online] Available at: https://components101.com/wireless/sim900a-gsm-module
[Accessed 9 oct 2018].

Jaswanth, B., 2019. Pi Cam Based Smoke/Fire Alerting System. *International Research Journal of Engineering and Technology (IRJET) ,* april.Volume: 06 (Issue: 04).

Joseph, T., 2021. *Arduino Uno Specification.* [Online] Available at: https://www.tomsonelectronics.com/news/arduino-uno-specification [Accessed 2 Aug 2018].

M.Davis, A., 1992. Operational Prototyping: A New Development Approach. *ACM Digital Library,* 1 sep.9(5).

Md Saifudaullah Bin Bahrudin, R. Abu Kassim, & N. Buniyamin, 2013. *Development of Fire alarm system using Raspberry Pi and Arduino Uno,* s.l.: s.n.

nowsms.com, 2021. *What is a GSM Modem.* [Online] Available at: https://nowsms.com/faq/what-is-a-gsm-modem

Radhi, A., 2016. *Design and Implementation of a Smart Fire Alarm System Based of Wi-Fi over Long Distance (WiLD) ,* s.l.: s.n.

Rahman, S. U. & Khan, N., 2016. *GSM based smart saftey system,* s.l.: s.n.

Rather, M. A. & Bhatnagar, v., october 2015. A COMPARATIVE STUDY OF SOFTWAREDEVELOPMENT LIFE CYCLE MODELS. *international journel of application or innovation of engineering&management (IJAIEM),* vol 4(issue 10), p. 23.

weldesyase, A. & Bahta G/meskel, 2010. *GSM Based Fire and Smoke Detection and Prevention System,* s.l.: s.n.

Chapter VII (Appendix)

7.1. Appendix 1: Hardware and Software requirements

Different hardware and software are needed for completing this project.

Hardware required

a) Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 pins (6 of which are PWM output), 6 analog inputs, a 16 Mhz crystal quartz, a USB link, a power jack, an ICSP header, and reset buttons. It also has 14 digital output / input pins. It comes with everything you need to assist the microcontroller; simply connect it or power it up with an AC-to-DC adapter or battery to begin working with a device via a USB cable (Joseph, 2021)

Figure 10 Arduino (Joseph, 2021)

It can be programmed using programming languages from Arduino and Arduino Software (IDE). In the project, Arduino acts as the brain, as it will be programmed to track and advise all sensors and analyze the details.

b) Smoke Sensor (MQ2)

The MQ2 gas sensor is an electronic sensor that detects gas concentrations in the air such as LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide. The MQ2 gas sensor is also known as a chemical sensor. It contains a sensing material whose

resistance varies as it is exposed to gas. This variation in resistance value will be used to detect gas (ElProCus, 2021).

Figure 11 MQ2 sensor (ElProCus, 2021)

c) Flame Sensor

A flame sensor is a type of detector that detects and responds to the presence of a fire or flame. Otherwise, this sensor detects a flame between 760 nm and 1100 nm from the light source. The sensor's voltage ranges from 3.3 to 5.2 DC volts. In the project, the flame sensor is used to detect a fire breakout.

Figure 12 Flame sensor

d) GSM Module

A GSM modem is a type of modem that accepts a SIM card and, like a mobile phone, operates through a mobile operator subscription. When a GSM modem is connected to a computer, the computer can communicate over the mobile network via the GSM modem. Although these GSM modems are most commonly used to connect to the mobile internet, many of them can also send and receive SMS and MMS messages (nowsms.com, 2021).

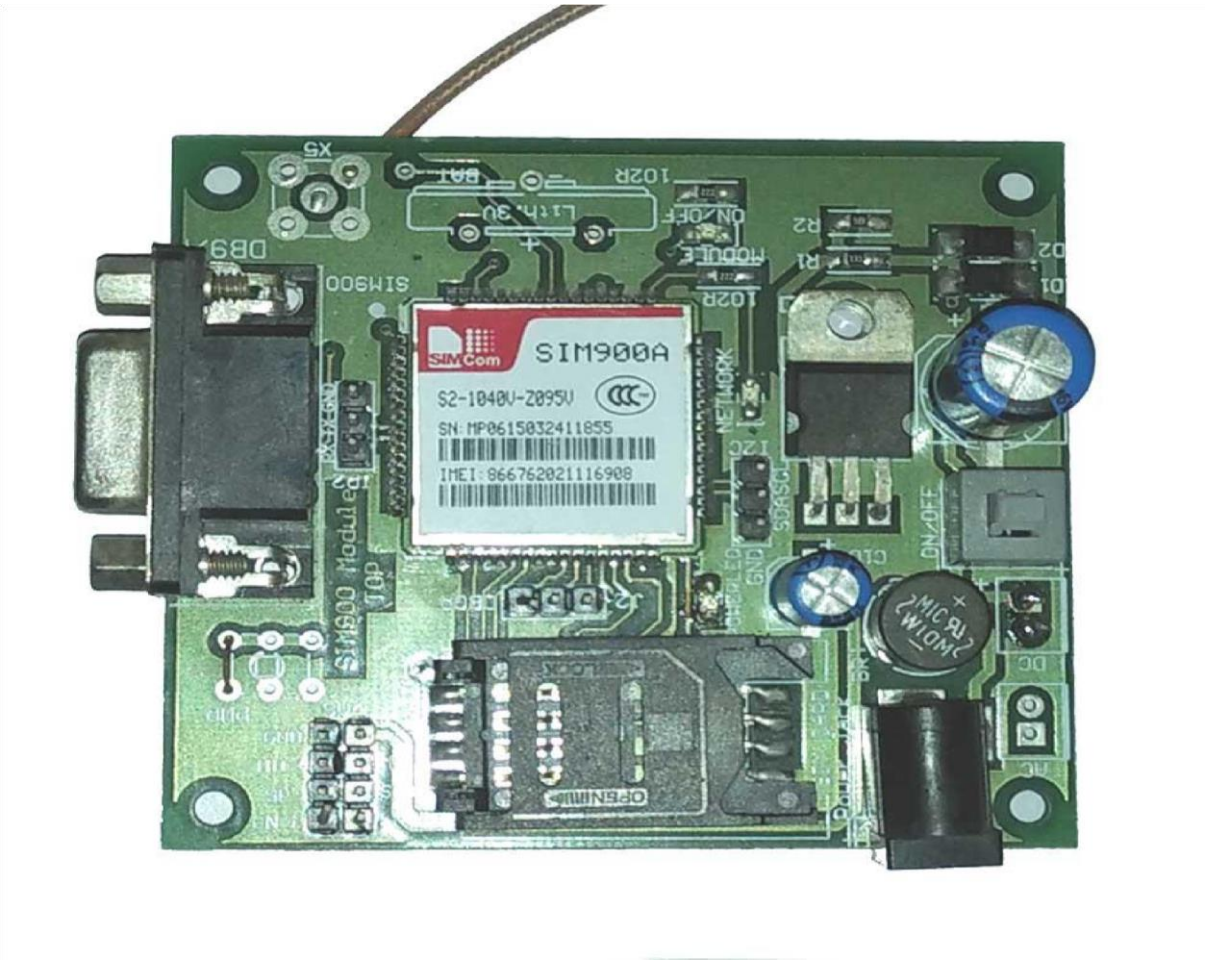


*Figure 13 GSM Module*Figure *(GSM, 2021)*

As the sensor detects the smoke and gas then it activates the pi, which warns the GSM module to send the alert message. To transmit messages, the GSM module uses SIM.

e) LCD Screen

The 14*2 LCD displays will be used in the project to display alert messages in the incident that a fire or smoke break out occurs in the room. The LCD display will be linked to the Arduino.

Figure 14 LCD display

f) Buzzer

The Buzzer is an audio signaling system that can be mechanical, electromechanical, or piezoelectric. The buzzer usually emits sound to alert people to any emergencies. A buzzer is used in this system to alert individuals if the fire and smoke sensor detects fire and gas leakage.

Figure 15 BUzzer (Devices, 2021)

g) LED Light

LEDs are inexpensive, quick, and adaptable, and they produce the best light possible. They can be used for almost any application that requires lighting. The project's lead is used to signal the detection of fire, which is linked to the breadboard. The small prototype is used in the project.

Figure 16 LED Light

h) Breadboard and Jumper wires

Jump wires are electrical wires that connect the breadboard or other test circuit components to the main processing board. The jump wires will be used to connect the sensor to the Arduino and the GSM module in this project. Breadboards are prototyping and electronics construction boards. It acts as a link between the Arduino sensor and the GSM module.

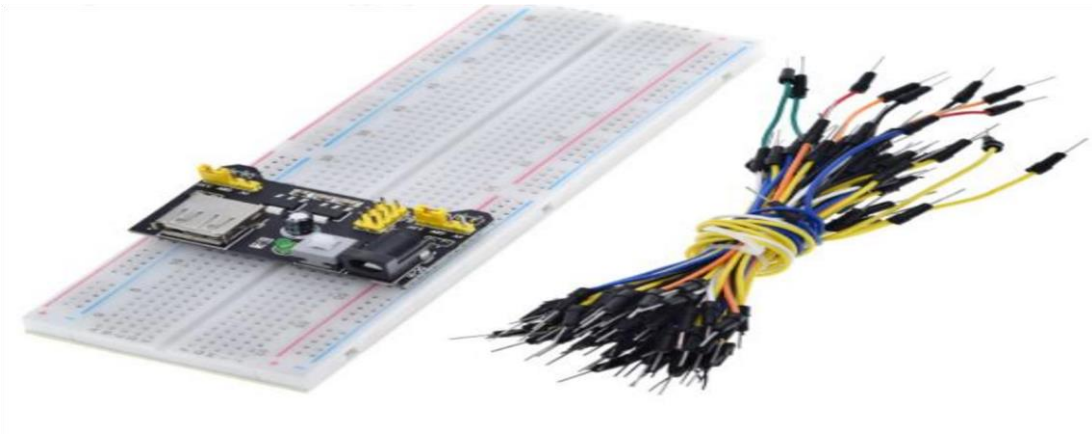


Figure 17 Breadboard

I) Personal Computer

To program the Arduino and for the documentation purpose a desktop computer or Laptop with proper network connection will be required.

Software Required

C++	C++ programming language will be needed to program the proposed system.
Documentation Software	Documentation software like; MS-word, Ms-excel, Draw.io etc. will be required for the documentation process.

7.2. Appendix 2: Survey Findings

A survey was done for a requirement review and 20 responses were collected using Google forms. The survey is shown below in the form of screenshots, pie charts or bar graphs.

GSM-based Fire and gas leakage alarming system

This survey is based on Fire and Gas leakage alarming System from my Final Year Project.

np01nt4a190131@islingtoncollege.edu.np (not shared)
Switch accounts

Fire explosion due to accidental leakage from the gas in the home.

Name

Your answer

Have you ever heard the term "IoT(Internet of the Things)"?

- ◯ Yes
- ◯ No
- ◯ Maybe

How often fire breakouts in your community?

- ◯ Frequently
- ◯ Not often

Do you want a fire alarm system that can automatically alert you and the authorities once the fire is detected?

- ◯ Yes
- ◯ Not really

Do you think a fire and gas leakage alarming system should be mandatory in every community house?

- ◯ Yes

Do you want a fire alarm system that can automatically alert you and the authorities once the fire is detected?

- ○ Yes
- ○ Not really

Do you think a fire and gas leakage alarming system should be mandatory in every community house?

- ○ Yes
- ○ Not really

What features in fire and gas leakage alarming system would fascinate you?

	pick your options
Buzzer alert	☐
Led light	☐
Alert message displayed in LCD	☐
Remote alert through SMS	☐

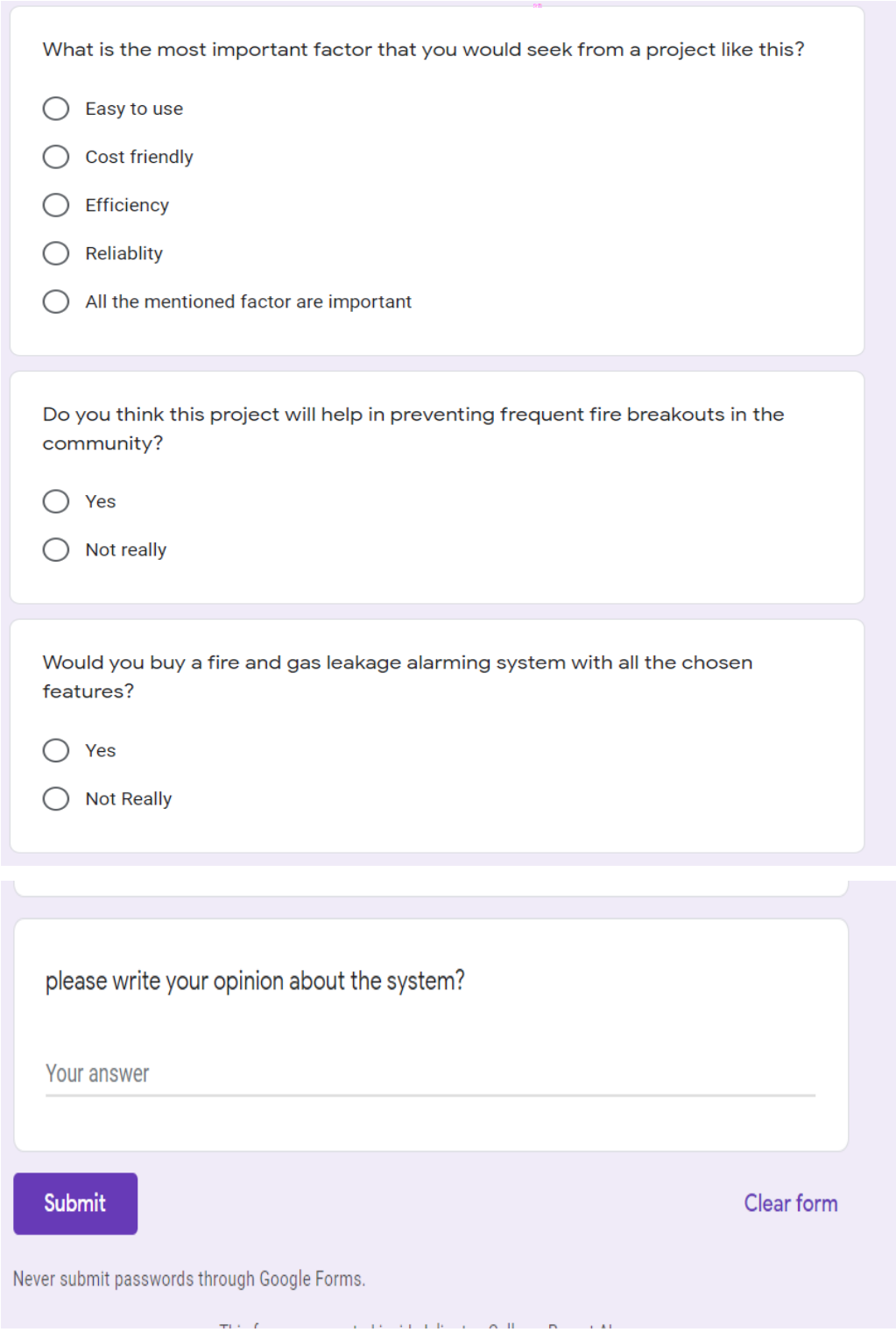


Figure 18 empty survey form for the online clients

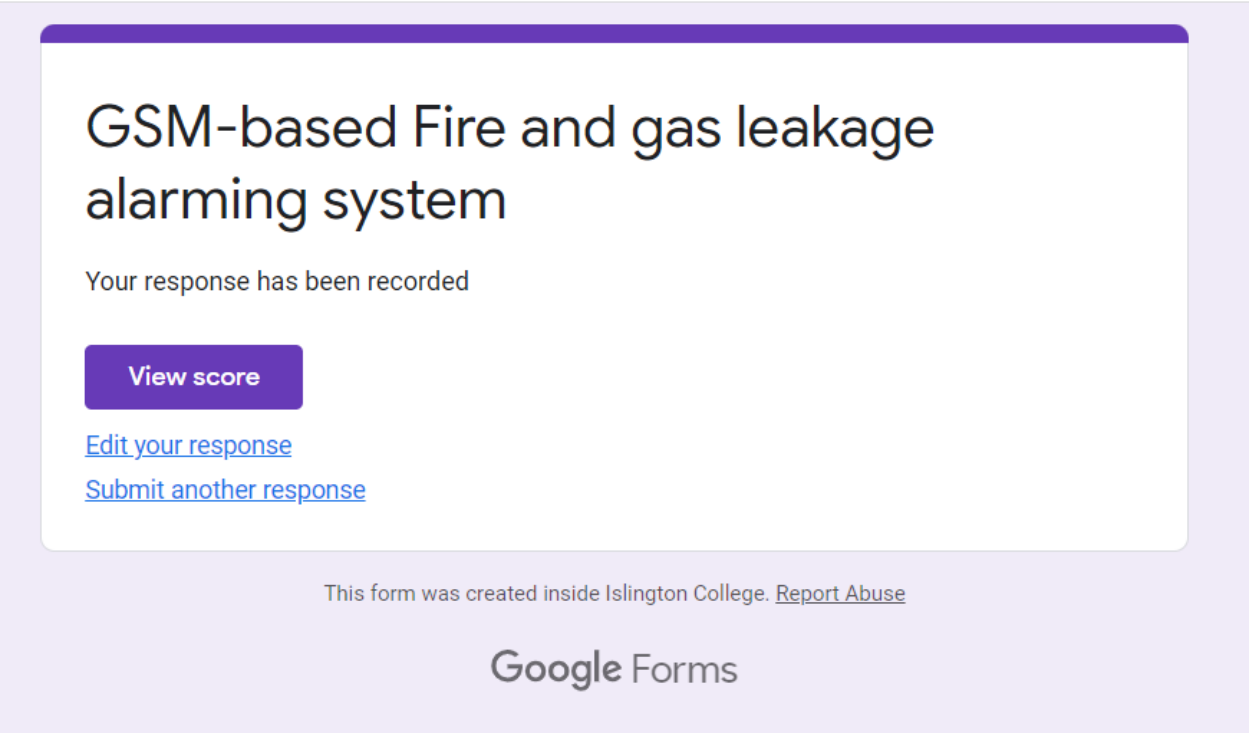


Figure 19 filled survey form of clients

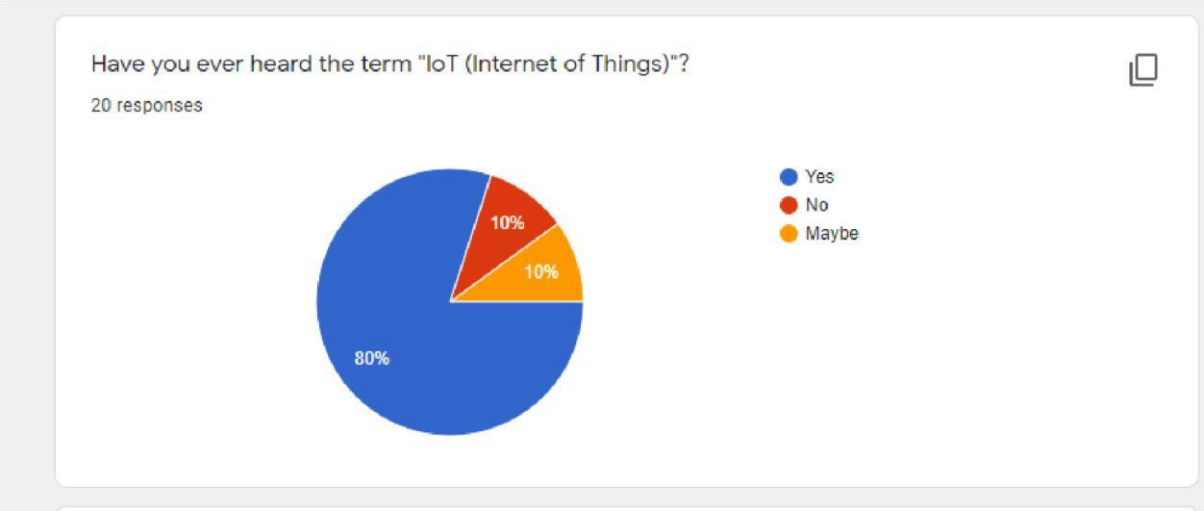


Figure 20 Survey result1

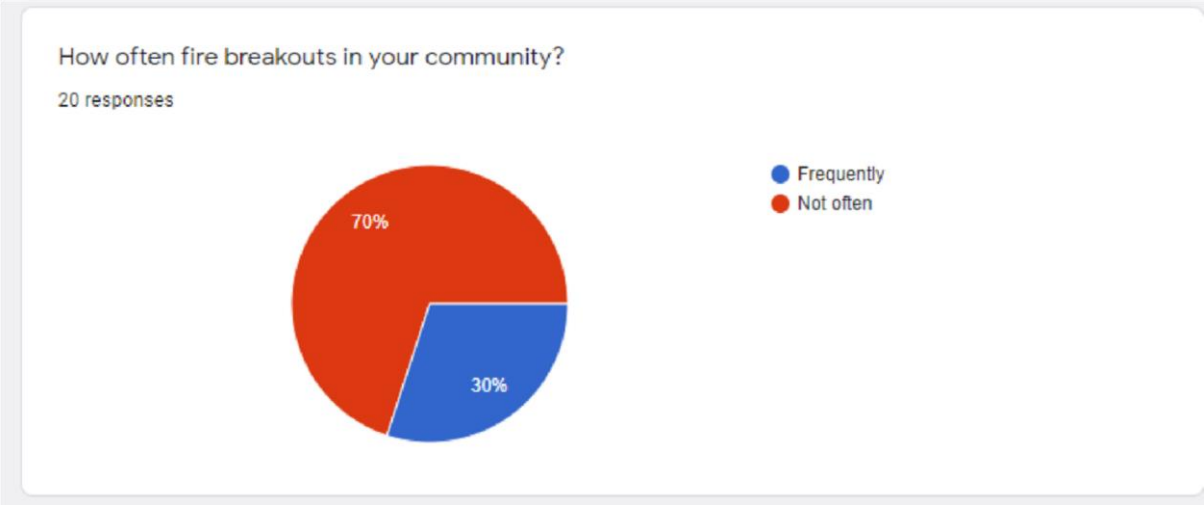


Figure 21survey result 2

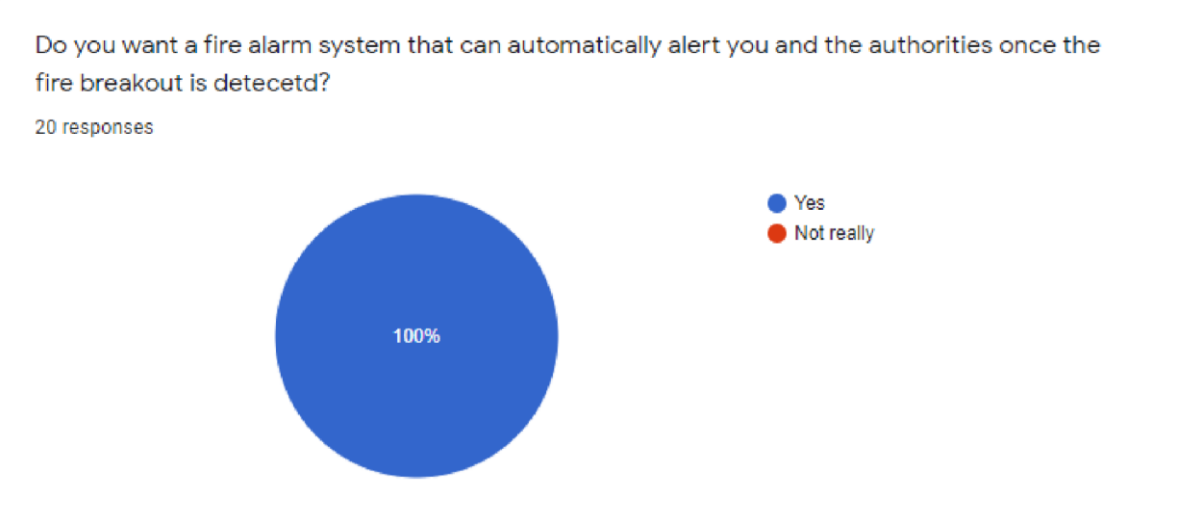


Figure 22survey result 3

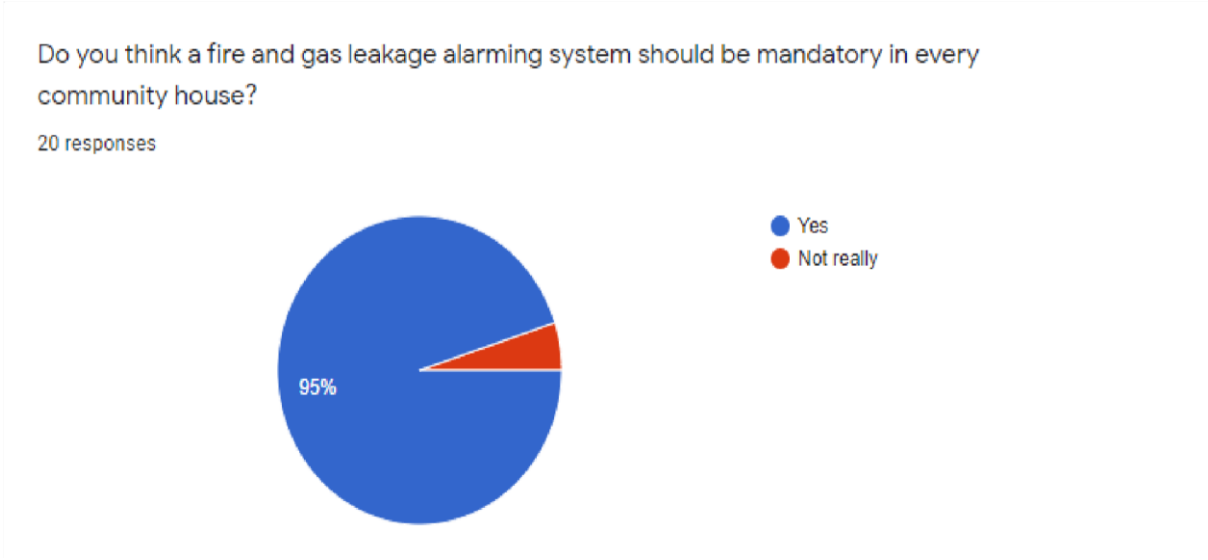


Figure 23 survey result 4

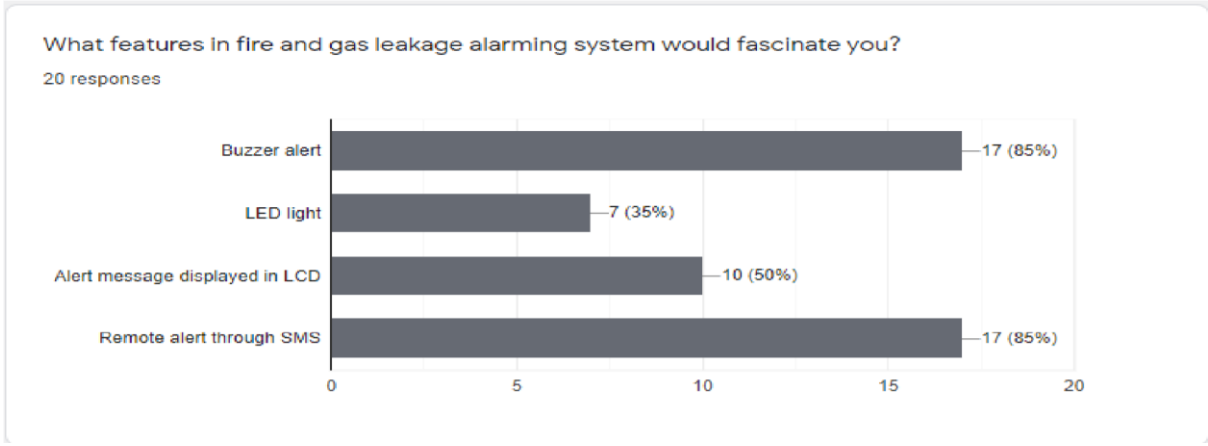


Figure 24 survey result 5

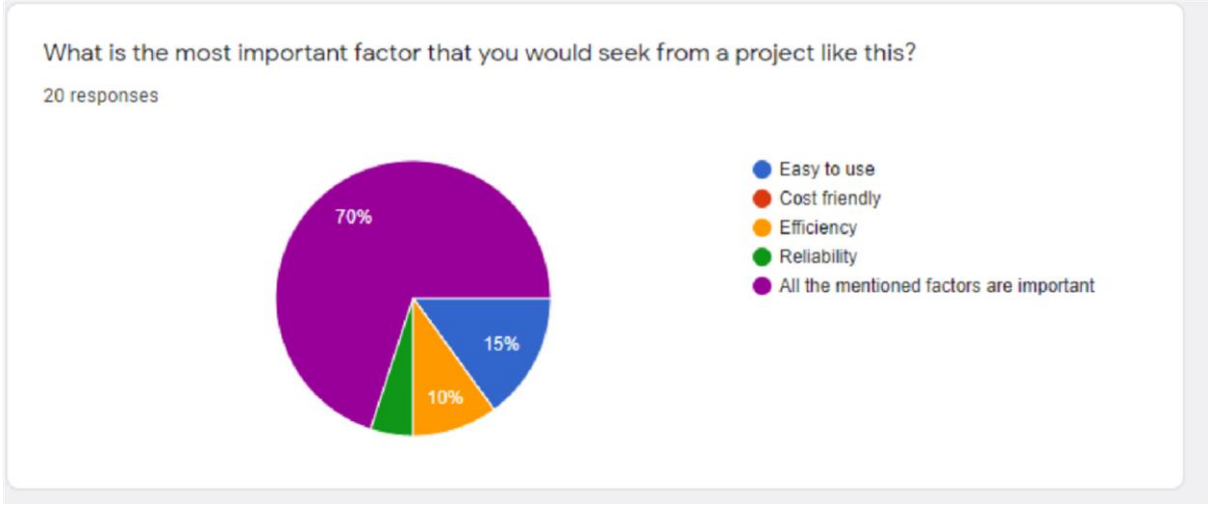


Figure 25survey result 6

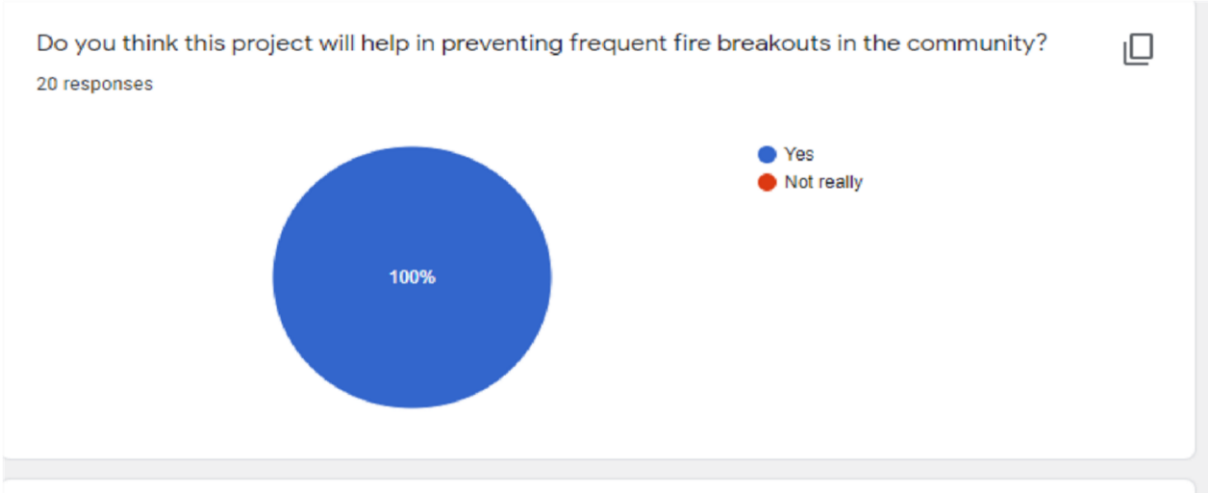


Figure 26 survey result 7

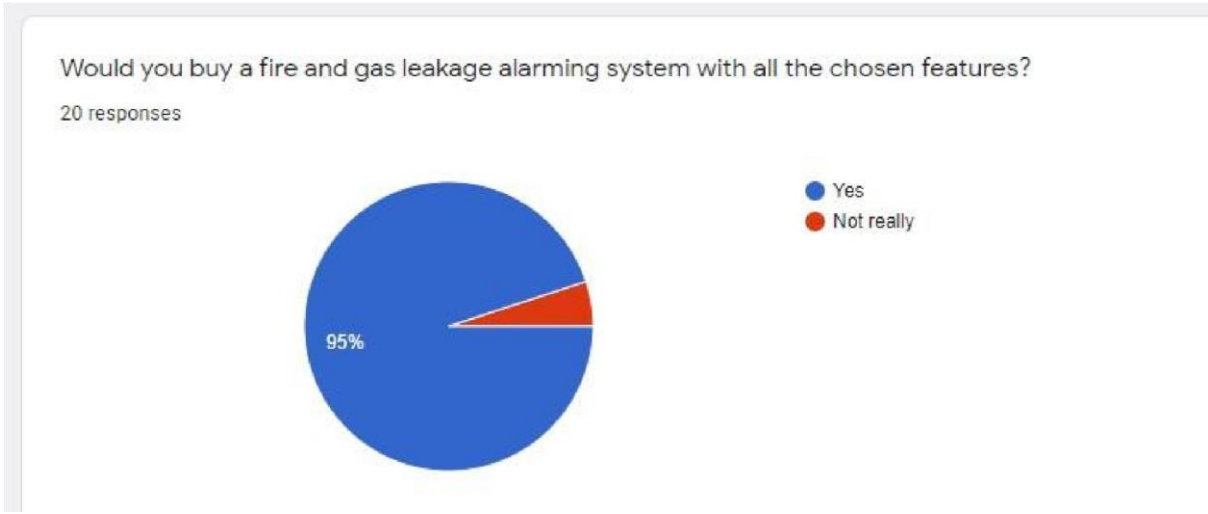


Figure 27 survey result 8

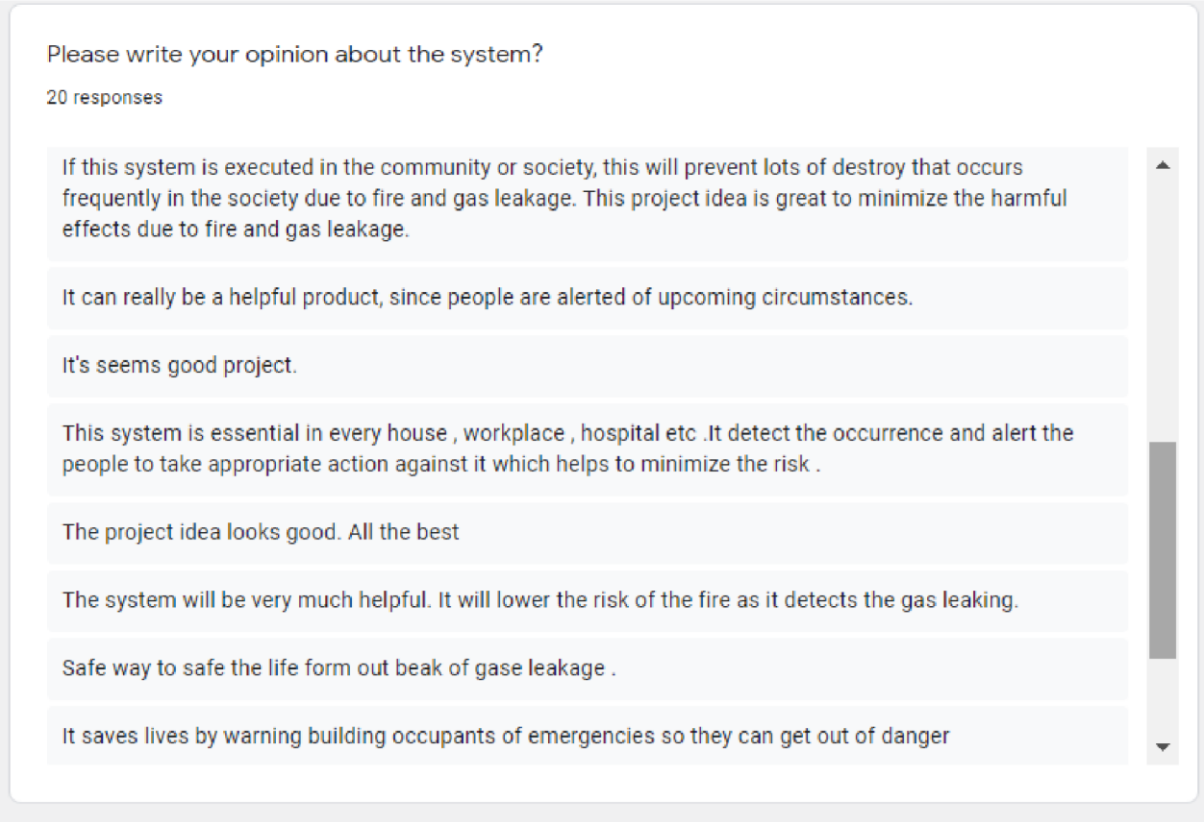


Figure 28 Survey result 9

7.3. Appendix 3: Development work

7.3.1. Connection of sensors with Arduino

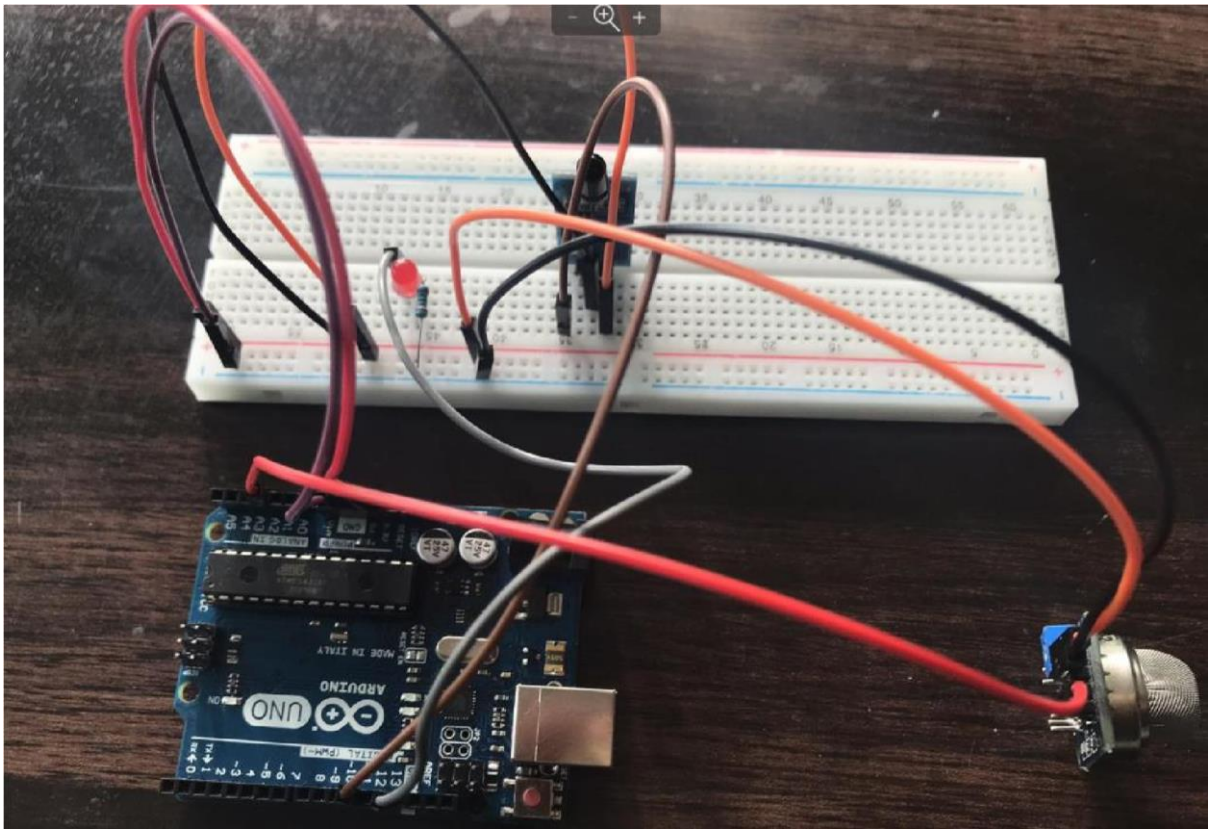


Figure 29 connection of sensors with arduino

7.3.2. Connection of LCD with Arduino

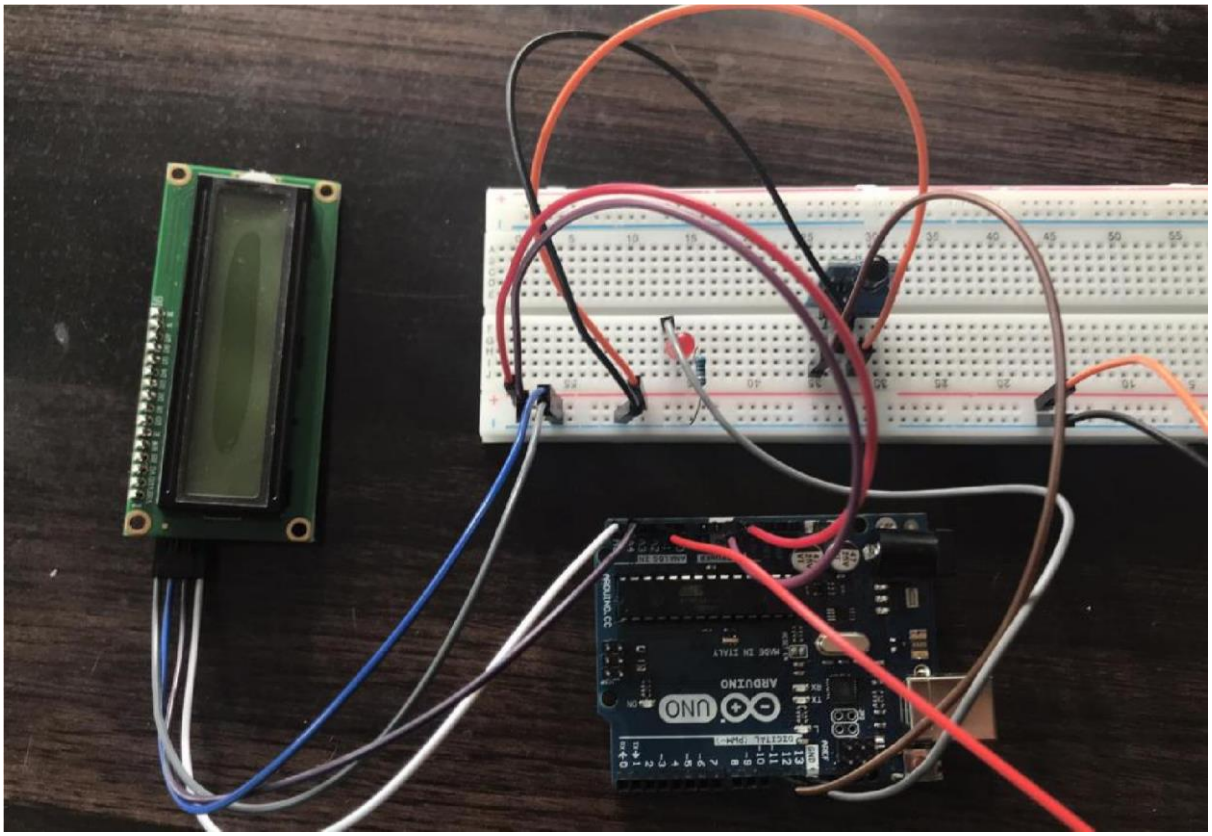


Figure 30 connection of LCD with arduino

7.3.3. Coding for sensors calibration and LCD

code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2); // set the LCD address to 0x27 for a 16 chars and 2 line display

//LiquidCrystal_I2C lcd(Declare a LiquidCrystal_I2C object with I2C address, the number of columns, the number of rows

int flamePin=11;
int gasA0 = A2;
int redled=13;
int sensorThres = 200;
int Flame, gas_value,Gas_alert_val, Gas_shut_val;
int Gas_Leak_Status;

void setup()
{
pinMode(flamePin,INPUT);
pinMode(gasA0,INPUT);
pinMode(redled,OUTPUT);
  //mySerial.begin(9600);
Serial.begin(9600);
lcd.init();
lcd.backlight();
delay(500);
}
void loop()
{
  CheckGas();
  Checkflame();

}

void CheckGas()
{
  lcd.setCursor(0,0);
  lcd.print("Gas Scan - ON");
  int analogSensor = analogRead(gasA0);
  Serial.print("Pin A0: ");
  Serial.println(analogSensor);
  if (analogSensor > sensorThres)
  {
    SetAlert(); // Function to send SMS Alerts
  }}
```

Figure 31 coding for sensors calibration and LCD