LONDON METROPOLITAN UNIVERSITY

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CS5068NI– Cloud Computing & IoT

<<LPG Gas Leak Detection System>>

Assessment Type
50% Group Coursework

2024 Spring

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Assignment Due Date: 20th January, 2025
Assignment Submission Date: 20th January, 2025
Submitted to: Mr. Sugat Man Shakya
Word Count: 4546

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Acknowledgement

Primarily, we would like to express our innermost gratitude to our module leader **Mr. Sugat Man Shakya** sir and our class tutor **Mr. Jaganath Paudyal** sir for offering this wonderful opportunity to work on IoT project and get real hands-on experience and also extend our sincere thanks to our tutor whose support and perception have been very helpful in building our project. We also extend our thanks to each group member for their hard work, cooperation and contribution in our project. Lastly, we would also like to acknowledge Islington College for providing the required resources for our project.

Thank you everyone for the sincere efforts and encouragement.

Abstract

“LPG Gas Leak Detection System” is the goal of this IoT project. The project consists of MQ-2 Gas Sensor, Arduino Uno, LCD Display, LI-ion Battery and it’s holder, Active Buzzer and Jumper Wires. This project is designed to ensure people’s safety and mitigate severe accidents caused by gas leaks and explosions. Because of poorly managed and faulty equipment, there occurs numerous inevitable incidents causing pre-mature deaths and severe health issues so we came to conclusion to build this project in order to prevent such accidents where this system works when it will detect the gas leak and triggers an alarm and will alert the users beforehand. The system aims to provide a low-cost and user-friendly solution for our users especially targeting for homes as the leakage and explosions of gas cylinders at home that have been a major incident.

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1 Introduction

The Internet of Thing (IoT) is network of physical devices that can transfer data to one another without human intervention. IoT devices are not limited to computers or machinery. This can include anything with a sensor that is assigned a unique identifier (UID). IoT based projects are created to mitigate problems and make things convenient, secure and comfortable. The primary goal of the IoT is to create self-reporting devices that can communicate with each other (and users) in real time (Schulze, 2024).

We are entrusted to build a useful IoT project hence, ‘LPG Gas Leak Detection System’ is based upon an IoT device. In this project, we propose an upgraded LPG Gas Leak Detection System using MQ-2 gas sensor which can detect not only LPG but also gases such as Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide hence, is suitable for detecting all these gases. The other required component used to build this system are Arduino Uno, Servo Motor, LCD Display, Battery and it’s holder, Active Buzzer and Jumper wires. This technology reduces potential accidents such as fires, explosions and suffocation by alerting and producing audible sounds or continuous beeping sounds when an electrical signal is applied until it returns to a normal state and is mostly designed to use for domestic purposes.

Every year, around 2.1K people die at early age because of poorly managed, electrical malfunction, negligence and faulty equipment causing gas leaks and explosions. To mitigate such premature accidents or incidents, this project is necessarily developed and is considered as crucial thing.

1.1 Current Scenario

Gas leak accidents and explosions has been a concern overtime resulting in premature death of several people. The data passed from one of the renowned hospital – Kirtipur Hospital shows that more than 100 people were admitted for treatment of gas explosion incidents, of whom 33 died in the hospital while undergoing treatment. According to police reports, in the last fiscal year five people were killed and 10 got injured in LPG Cylinder explosions.

Also, there was an incident last year of the Nepali Congress, Lawmaker Chandra Bhandari and his mother Harikala who sustained severe burns and injuries. Similarly, there are plenty of serious incidents that are still ongoing in Nepal due to careless and poorly managed equipment causing gas leaks and explosions (Kathmandu Post, 2023).

1.2 Problem Statement and Project as a Solution

There is a large number of premature deaths taking place due to the poorly managed, negligence and faulty equipment which has greatly affected the lives of people both in immediate and long-term causing significant loss of life, severe injuries, property damage and health issues. The lack of safety-standards and poorly managed or control in gas cylinders have resulted the issue especially in rural areas where such accidents are in frequent basis.

The LPG Gas Leak Detection System assists in the mitigation of premature death and accidents caused by leakage of gas and explosion. When the MQ-2 sensor detects the LPG gas or any other gas, the buzzer will create a beeping sound then the red LED will be turn on and also the LCD Display will show DANGER! And at the end, servo motor will automatically turn-off the regulator which will prevent the inevitable accident.

2 Aims and Objectives

2.1 Aim

The aim of this project is to mitigate inevitable accidents, premature death and severe burns caused by gas leak and explosions, and notify with beeping or alert sound if the sensor detects.

2.2 Objectives

The objectives of this project are: -

- To identify the gas leaks at the earliest stage.
- To automatically turn-off the regulator when the gas is detected.
- To prevent inevitable accidents due to gas leaks.
- To provide alerts and beeping sounds which will warn the user beforehand to prevent hazards.
- To provide the system in most budget-friendly cost and user friendly so that it will be easy-to-use for the users especially targeting for domestic use.

3 Background

Gas Leakage Alarm System is a device detects leakage of gas to prevent from various accidents that occur in our daily life. In this project, we used MQ-2 sensor to perceive the leakage of LPG gas using Arduino Uno board. The MQ-2 sensor detects gases like Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide. Different types of gases can be can sensed by MQ-2 sensor. Once, the gas leakage reaches the hazard level, 5V buzzer starts a nonstop beeping sound until and unless it proceeds to it's usual state. Also, proceeding with the red LCD that turns on and LCD display displays the gas level and of LPG Gas in the air and shows the sign DANGER! also ultimately, servo motor turns off the regulator.

3.1 System Overview

The components that we have used in this Gas detection project are Arduino UNO, LCD Display, MQ-2 sensor, Buzzer, Servo motor, Breadboard and Jumper wires. We have connected all the parts using jumper wires and a breadboard. Every component communicates with and receives electricity from the Arduino. Arduino is used to connect with breadboard, Buzzer, Servo motor. MQ-2 sensor and LCD Display are connected to breadboard which then connects to Arduino.

Initially, we specified the pins each Arduino component would have. Jumper wires are used to link the output pins of the MQ-2 gas sensors to the corresponding pins on the Arduino through breadboard, allowing us to obtain the necessary data. LCD display continuously gets the information about current Gas level from Arduino and displays the information. Buzzer and Servo motor receive instructions on when to turn on and off using the pins of Arduino. The breadboard is linked to Arduino's ground and 5 voltage power supply pins in accordance with arrangement, provides a complete power supply to all the components.

3.2 Design Diagram

3.2.1 Block Diagram

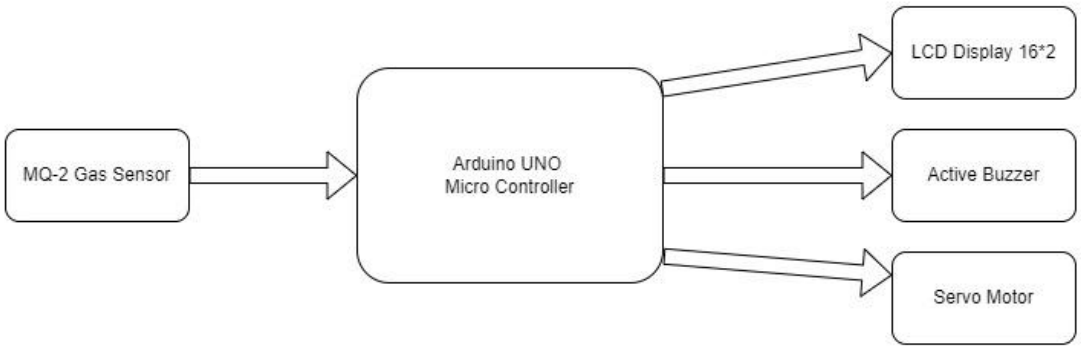

Figure 1: Block Diagram

The device's hardware architecture is shown in the picture above. Here, MQ-2 Gas Sensor detects the presence of LPG or other gases and when it detects a gas leak, it will send an analog signal to the Arduino Uno Micro Controller and the Arduino Uno Micro Controller processes the sensor data and identifies if the gas leak exceeds a set margin, then it activates the responses such as alerts or beeping sounds and servo motor will close the valve of gas regulator. The following gas concentration in real-time is shown providing the visual alert when a leak is detected in LCD Display. When a leak is detected, the buzzer alerts to provide a detectable warning to the users and the Red LED turns on.

The components shown above are the worth and best reasonable-cost, well-performing hardware products found. As this project is only a small prototype, the bigger components are not necessary to be used.

3.2.2 System Architecture

The system architecture of LPG Gas Detection System is given below: -

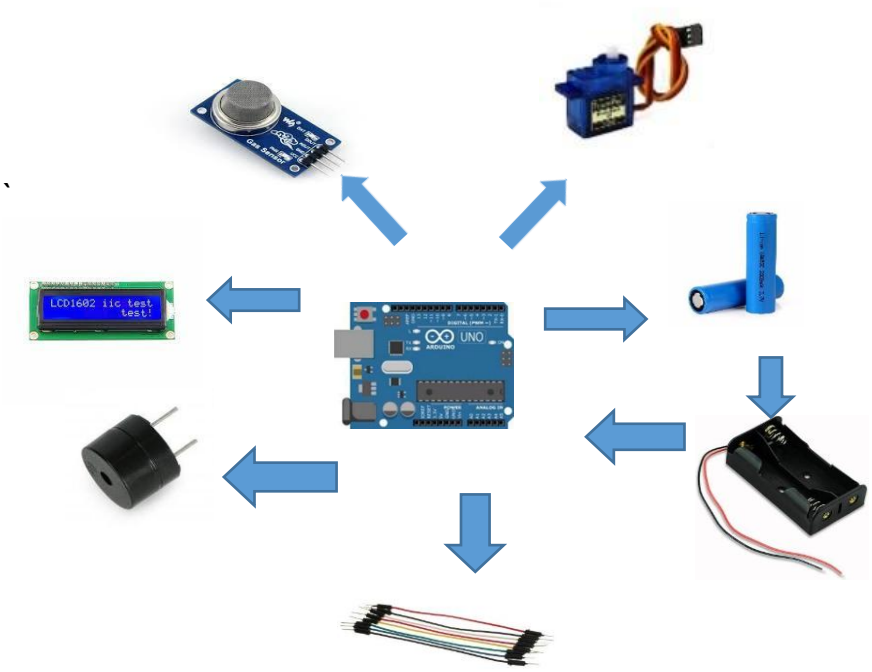

Figure 2:System Architecture

3.2.3 Flowchart

The flowchart of the LPG Gas Leak Detection System is presented below: -

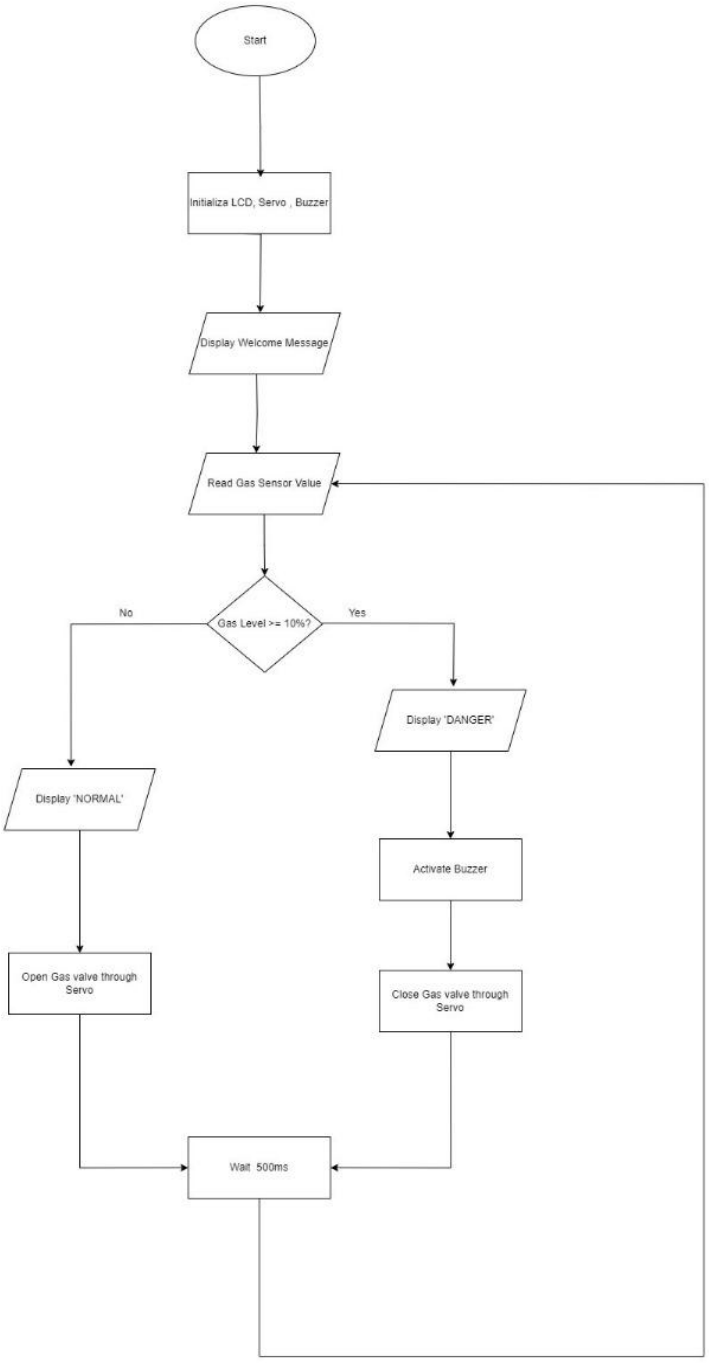

Figure 3:FlowChart

3.2.4 Circuit Diagram

The picture below is the circuit diagram of the device. Here, we can observe every link between each component that is presented in this graphic given below: -

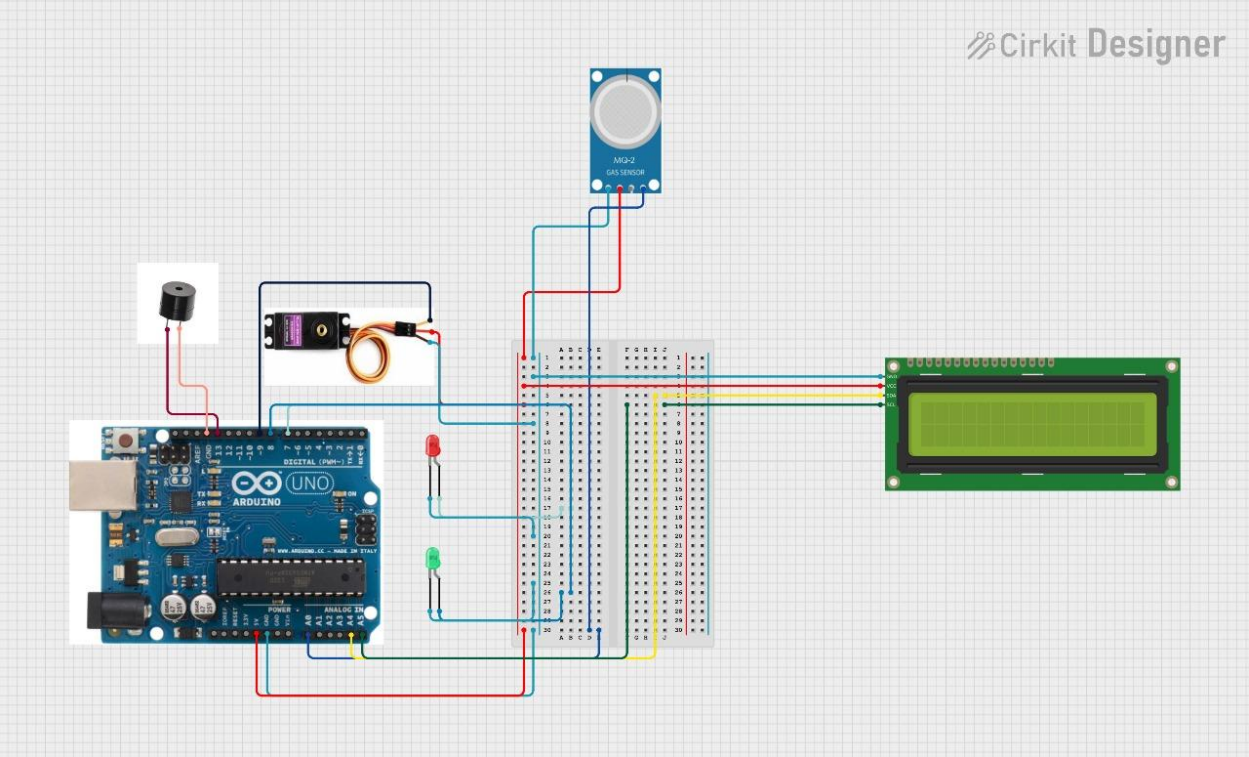

Figure 4:Circuit Diagram

3.3 Requirement Analysis

3.3.1 Hardware Components

- **Arduino Uno:** The Arduino Uno is a microcontroller which is used to process various commands and consists of analog Input/Output pins. It is integrated with Wi-Fi module. Arduino automatically draws power from peripheral power supply. It runs through simple software package programs.

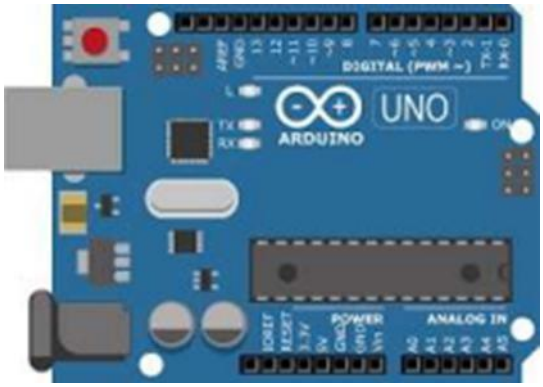

Figure 5:Arduino Uno

- **MQ-2 Gas Sensor:** MQ-2 gas sensor has ability to detect multiple gases and is widely used sensor. It sends information to analog digital converter.

Figure 6:MQ-2 Gas Sensor

- **LCD Display:** The IC2 interface (16*2) LCD display module is compact display used for communication with microcontroller.

Figure 7:LCD Module

- **Active Buzzer:** Active Buzzer operates at 5V which is used to produce noticeable sound. It is commonly used electronic component.

Figure 8:Active Buzzer

- **Battery:** Gas alarm system is run through two 18650 Li-ion Battery.

Figure 9:Battery

- **Servo Motor:** A servo motor is a compact device designed for precise control of motion and position. It operates using PWM signals and typically allows movement within a specified range, such as 0° to 180° or full rotation. Its key components include a motor, control circuitry, gears, and an output shaft. Servo motors are widely used in fields like robotics, remote-controlled vehicles, and smart systems. In this project it is used to closed the valve of Gas Regulator when the current gas level is more than 10%.

Figure 10:Servo Motor

- **Breadboard:** A breadboard is a versatile tool used to create and test electronic circuits without soldering. It features rows and columns of interconnected slots for placing components and includes power strips for connecting the power supply. Breadboards are essential for circuit experimentation and educational purposes. In this project it is mainly used to connect all the components to Arduino through it and also used to give 5V power supply from Arduino to different components.

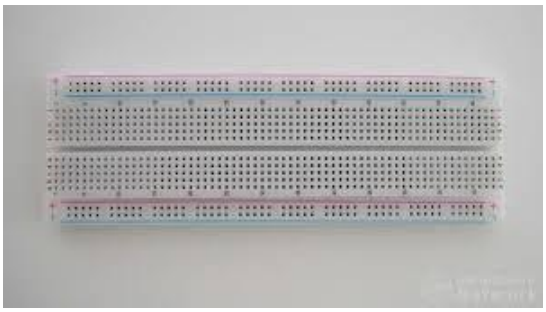

Figure 11:Breadboard

3.3.2 Software Components

- **Arduino IDE:** The Arduino Integrated Development Environment - or Arduino Software (IDE) - is 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 (docs.arduino.cc, 2024).

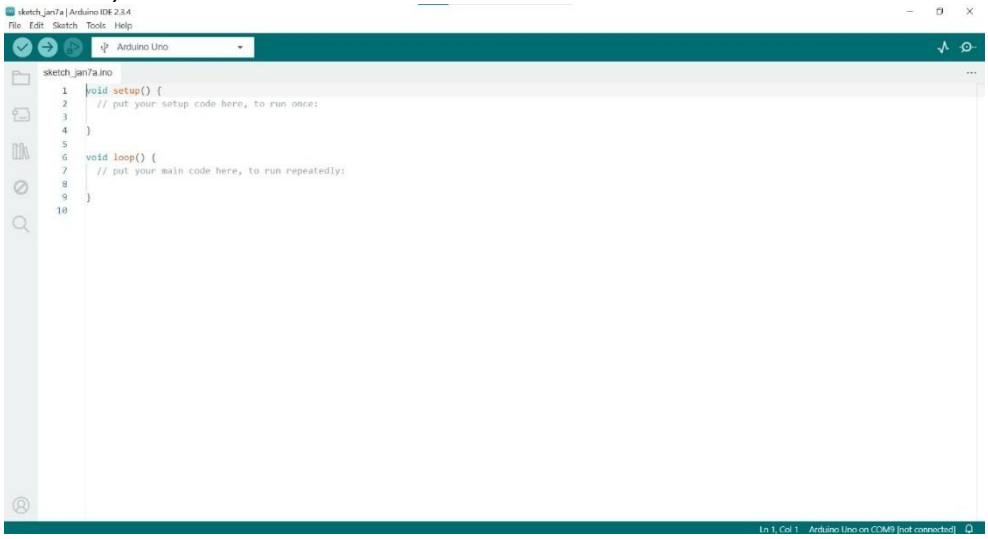

Figure 12:Arduino IDE

- **Cirkit Designer:** Cirkit Designer leverages to speed up and simplify every step of your circuit design process. From selecting components and wiring them up to writing and debugging code, the tools make designing circuits faster and more efficient (Cirkit Designer, 2025).

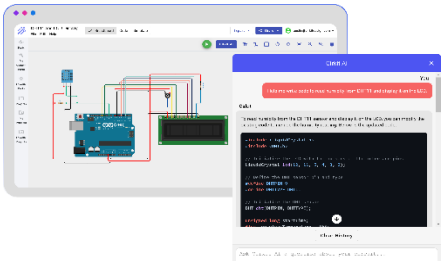

Figure 13:Cirkit Designer

- **MS-Word:** Microsoft word is a word processor software developed by Microsoft in 1983 and is the most commonly used word processor software. It is used to create professional quality documents, letters, reports, resumes, etc and also allows you to edit or modify your new or existing document (Geeksforgeeks, 2025).

Figure 14:MS-Word

- **Draw.io:** Draw.io is proprietary software for making diagrams and charts that lets you select from an automatic-layout function, or create a custom layout. It has a wide variety of shapes and hundreds of visual elements to make the diagram or chart one-of-a-kind. The drag -and-drop feature makes it simple to create a great looking diagram or chart (Computer Hope, 2025).

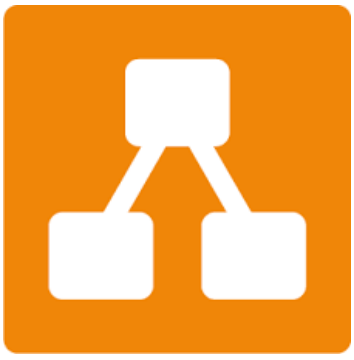

Figure 15:Draw.io

4 Development

4.1 Planning and Design

First of all, we had a meeting among us where we discussed about the project. After numerous attempts of ideas of doing something extra-ordinary which if we imply on real-world, what impacts or feedbacks could be brought on the daily lives of people. After then, we came up with the idea of explosion of gas cylinders which is the leading problem in today's world and how we can prevent it.

So, in order to mitigate the problem, we came up with the idea of building a prototype and named it after 'LPG Gas Leak Detection System'. To prevent the explosion of gas cylinders and pre-mature death, we even added buzzer which will give us an alarming sound or a beeping sound in order to alert us.

To check their compatibility, we linked a Servo motor, LCD Display and MQ-2 gas sensor to an Arduino through breadboard and to create a beeping or alarming sound and close the valve of regulator automatically, we experimented through Arduino-based arrangement connecting the buzzer to Arduino. At the end, after numerous attempts and preliminary tests we successfully attempted and started for further development of the project.

4.2 Resource Collection

The components required to build this project are: - Arduino, Servo Motor, MQ-2 Gas Sensor, Buzzer, LCD Display, Breadboard and Battery. Most of the components such as: Arduino, gas sensor, Buzzer, LCD Display, Breadboard, Servo Motor were provided from the 'Resource Department' of our college after writing a formal request application letter to our sir for those components to **Mr. Shishir Subedi** sir.

Some other components like: battery and battery holder were brought by our team member and also other useful components like: hot-glue, papers, tapes, hardboard etc. were also provided by each team member.

4.3 System Development

- **Phase-1:**

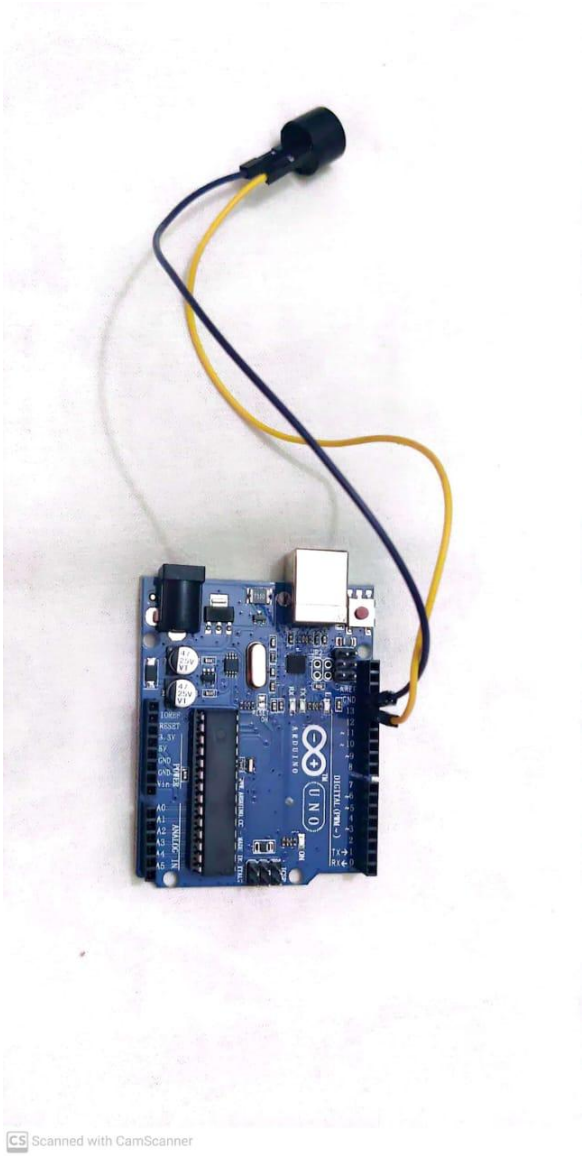

Figure 16:Development Phase-1

Firstly, we made the connection between Arduino and Buzzer.

- Connect the positive pin of the buzzer to the 13 pin on the Arduino.
- Connect the GND pin of the buzzer to the GND pin on the Arduino.

- **Phase-2:**

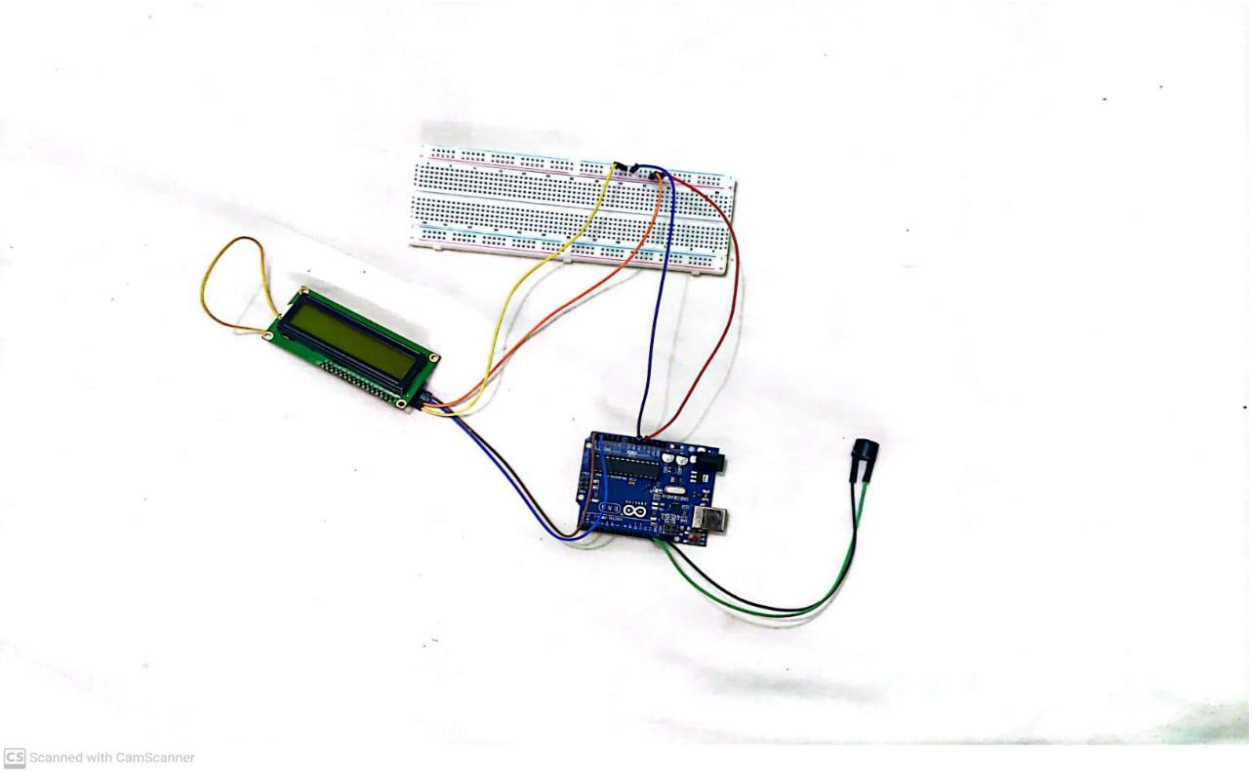

Figure 17:Development Phase-2

The I2C interface 16*2 LCD display was connected to the Arduino as shown in the figure to check if it is working and the connection was done in following manner:

- Connect the VCC pin of the LCD Display to the 5V pin on the Arduino through breadboard.
- Connect the GND pin of the LCD Display to the GND pin on the Arduino through breadboard.
- Connect the SDA pin of the LCD Display to an analog pin A4 on the Arduino.
- Connect the SCA pin of the LCD Display to an analog pin A5 on the Arduino.

- **Phase-3:**

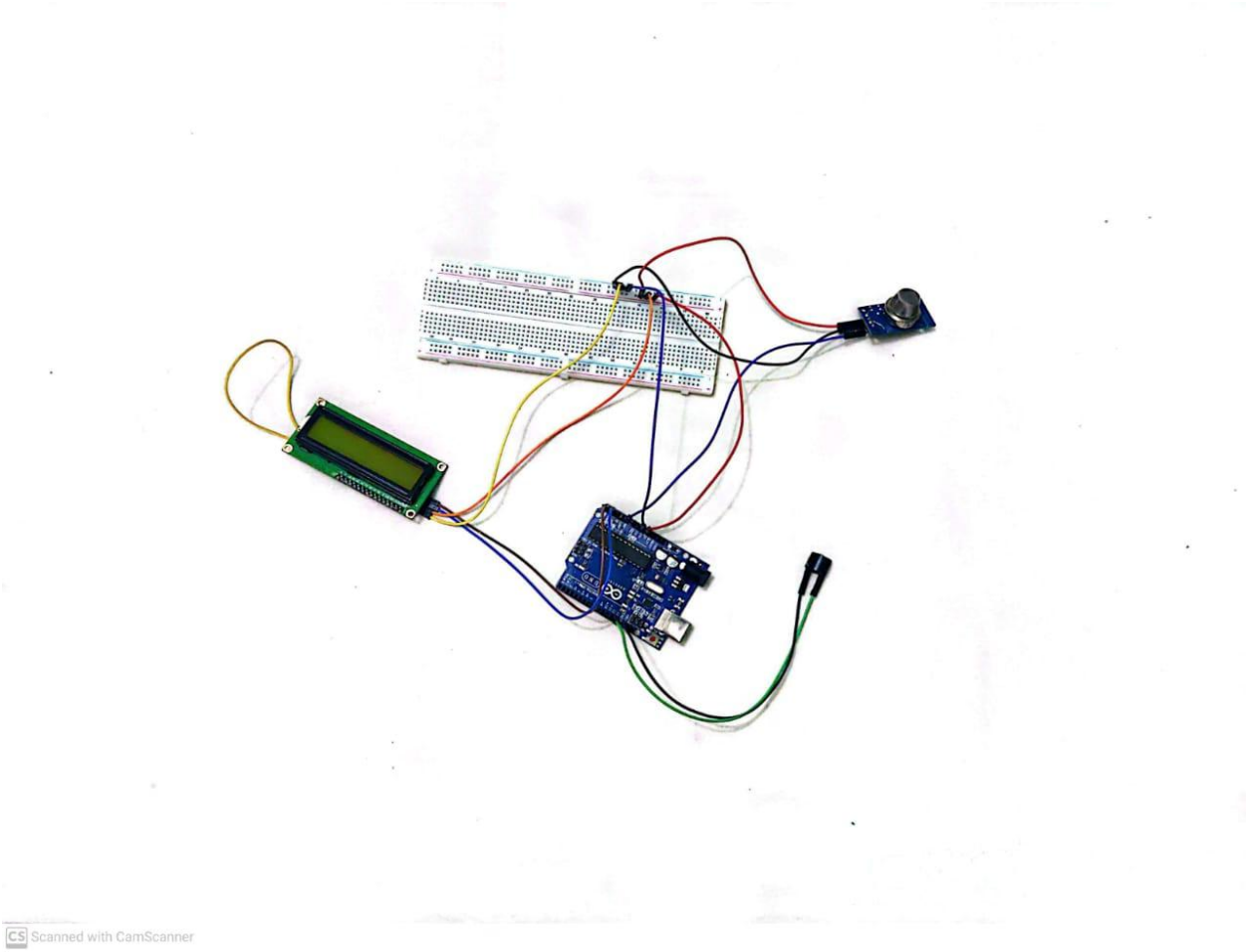

Figure 18:Development Phase-3

Then, MQ-2 sensor was connected to the Arduino as shown in the figure to check if it is working and the connection was done in the following manner.

- Connect the VCC pin of the MQ-2 sensor to the 5V pin on the Arduino through breadboard.
- Connect the GND pin of the MQ-2 sensor to the GND pin on the Arduino through breadboard.
- Connect the analog signal A0 pin of the MQ-2 sensor to an analog pin A0 on the Arduino.

- Phase-4:

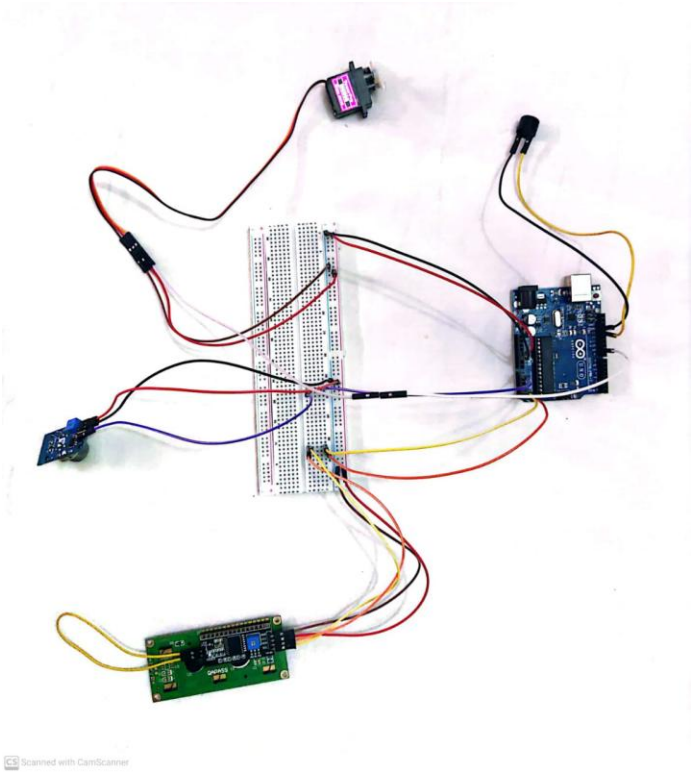

Figure 19:Development Phase-4

Then, Servo motor was connected to the Arduino as shown in the figure to check if it is working and the connection was done in the following manner.

- Connect the red wire of the Servo motor to the 5V pin on the Arduino through breadboard.
- Connect the brown wire of the Servo motor to the GND pin on the Arduino through breadboard.
- Connect the yellow wire of Servo motor to pin 9 on the Arduino.

- **Phase-5:**

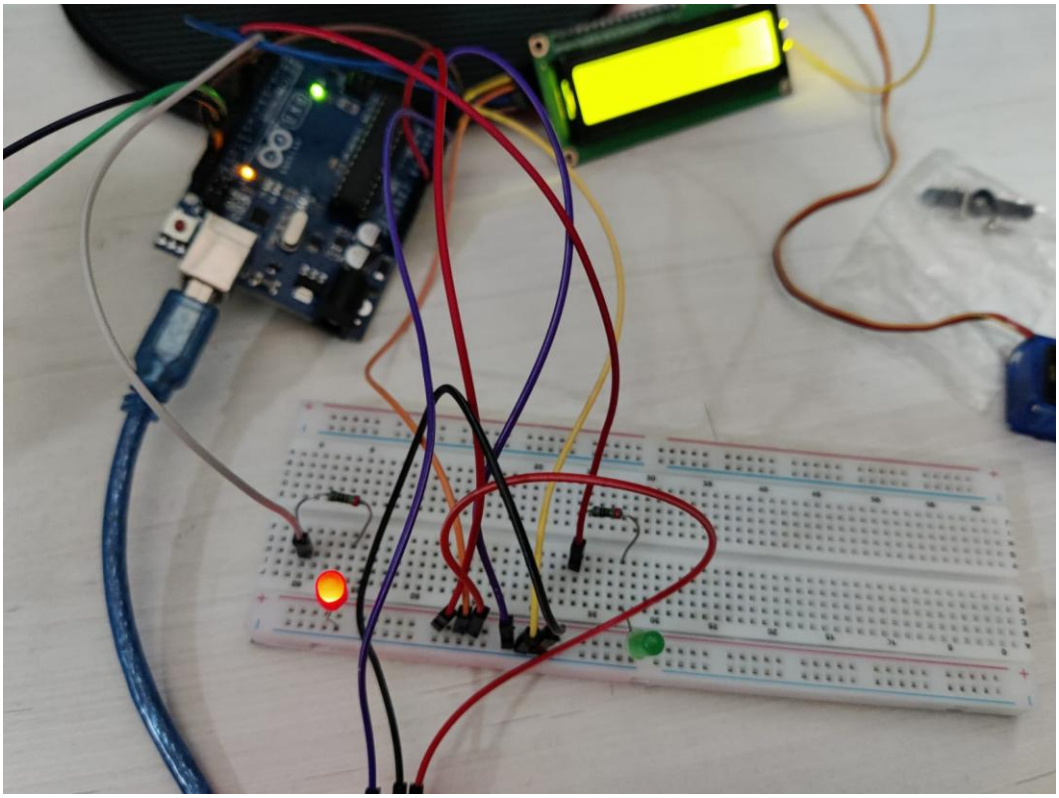

Figure 20:Development Phase-5

Then, red and green led was connected to the Arduino as shown in the figure to check if it is working and the connection was done in the following manner.

- Connect the longer leg of red led to the pin 7 on the Arduino through breadboard.
- Connect the longer leg of green led to the pin 8 on the Arduino through breadboard.
- Connect the shorter leg of red and green led to the GND pin on the Arduino through breadboard.

- **Phase-6:**

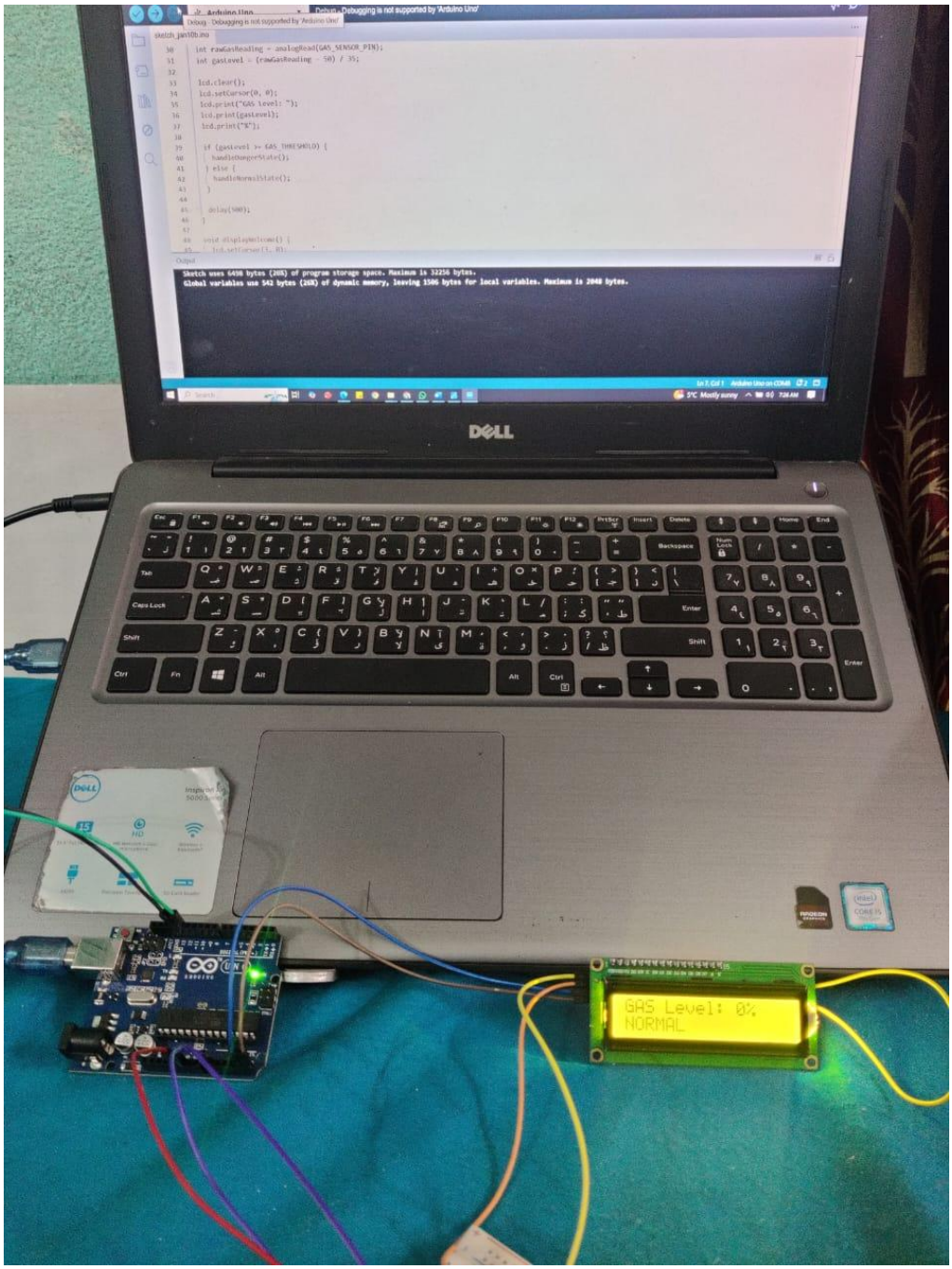

Figure 21:Development Phase-4

Now, the Arduino is connected to the laptop and the code is uploaded. At last, LCD display is working as intended.

5 Results and Findings

The project is built to be operated for it's intended goal after the full-phase development. This project that we built, we targeted mostly for domestic purpose as the gas explosions mostly happens through cylinders at home and most of the pre-mature deaths are happening due to domestic accidents ongoing at homes If there is an explosion of gas cylinders then our system will detect at it's certain level and will give an alerting sound and automatically closes the valve of the regulator and will alert the user and will prevent the inevitable accident. This is how the system will operate.

Here, the buzzer will provide an alerting or a beeping sound and the Red LED will turns on and the LCD display shows the DANGER! sign and the servo motor will turn-off the regulator automatically. After that, once the air comes into it's normal state, it will come back into it's normal state and the green LED will turn on. All the outputs of the system work in an accordance of the Arduino

6 Testing

6.1 Test 1: To compile the code and upload it.

Test	1
Objective	To compile the code and upload it.
Activity	• Connecting the Arduino with laptop • Compiling the code.
Expected Result	The code should be compiled and run successfully.
Actual Result	The code was compiled and run successfully.
Conclusion	The test was successful.

Table 1:To compile the code and upload it (Test-1)

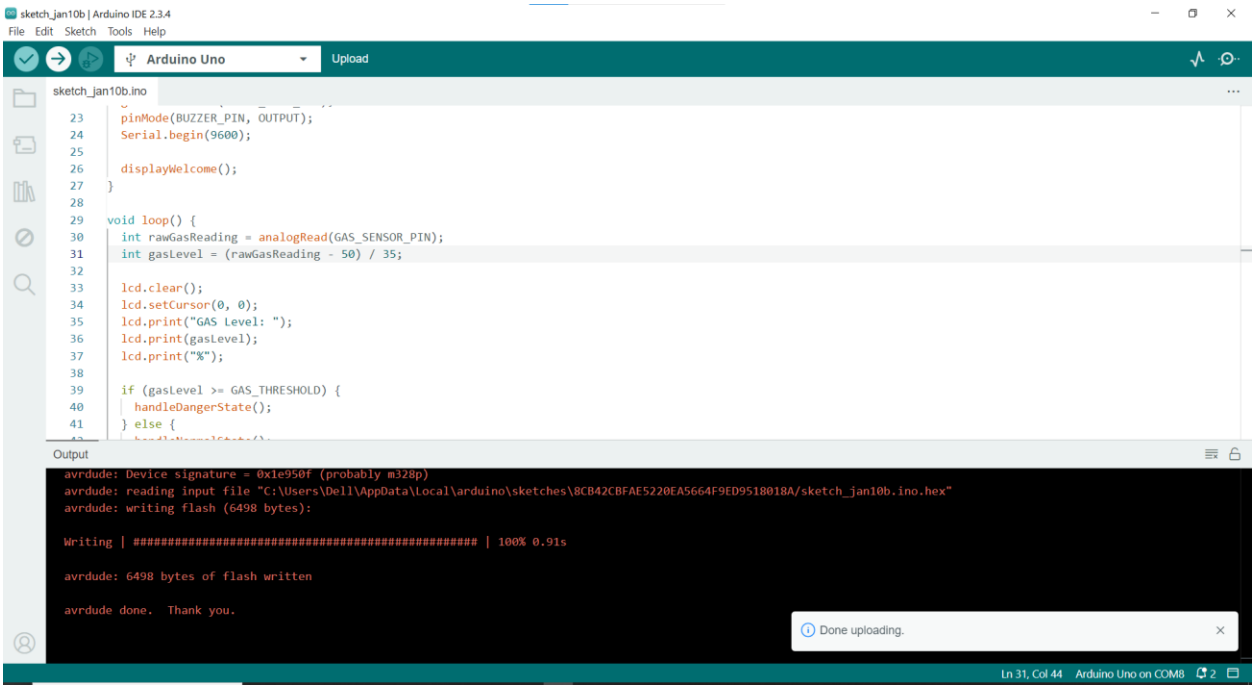

Figure 22:Successful compilation of code (Test-1)

6.2 Test 2: To check whether the LCD display show DANGER and the current gas level, when gas level exceeds the threshold which is 10%.

Test	2
Objective	To test whether the LCD display show DANGER and the current gas level, when gas level exceeds the threshold which is 10%.
Activity	• Releasing gas on MQ-2 sensor. • Capturing LCD display output.
Expected Result	LCD display should show DANGER! and current gas level.
Actual Result	LCD display showed DANGER! and current gas level.
Conclusion	The test was successful.

Table 2:To check if LCD display executes 'DANGER' (Test-2)

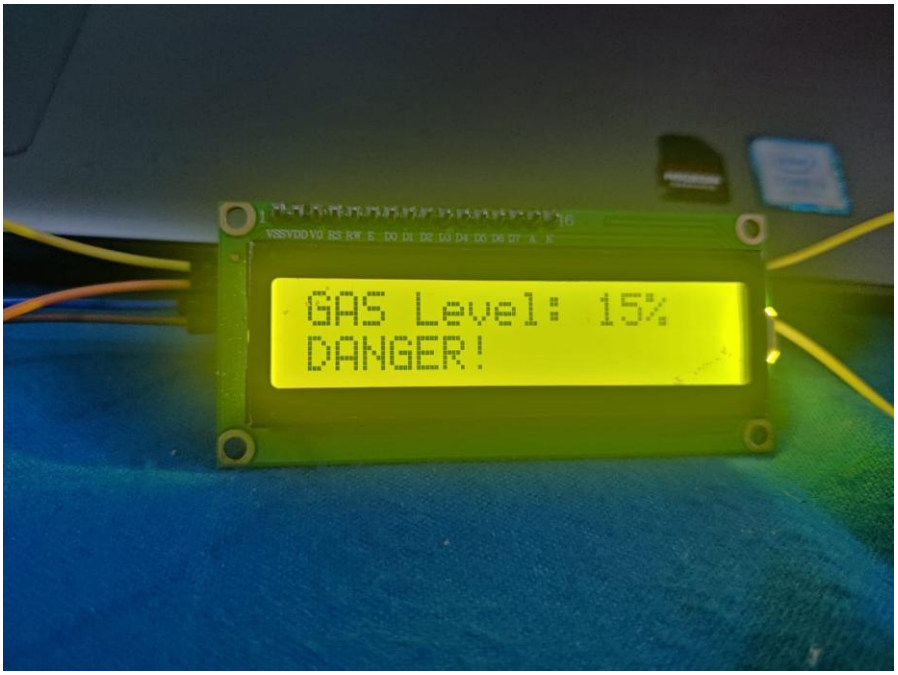

Figure 23:LCD Display shows DANGER and current gas level (Test-2)

6.3 Test 3: To check whether the Green LED turns on and Red LED turns off, when the gas level is in normal state.

Test	3
Objective	To test whether the Green LED turns on and Red LED turns off, when the gas level is in normal state.
Activity	• Powering on Arduino. • There should be not any flammable gas around.
Expected Result	Green LED should turn on and Red LED should turn off.
Actual Result	Green LED was turned on when Red LED was turned off
Conclusion	The test was successful.

Table 3:To check whether Green LED turns on and Red LED turns off at it's normal sate (Test-3)

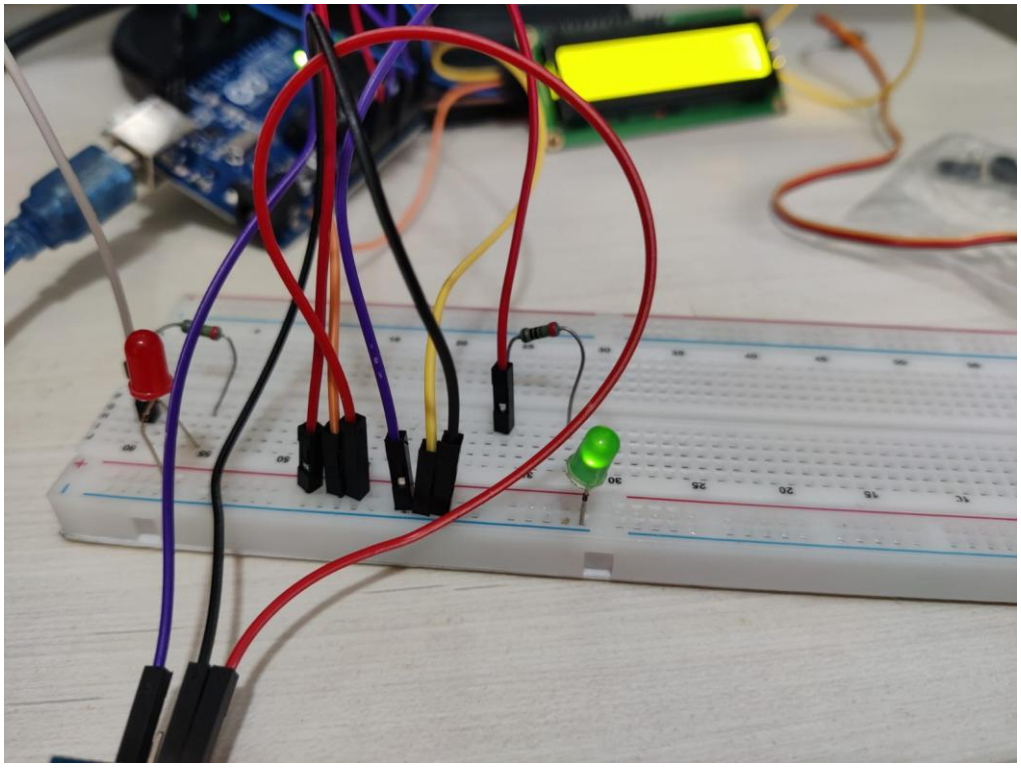

Figure 24: Green LED turns on and Red LED turns off at it's normal state.

6.4 Test 4: To check whether the Red LED turns on and Green LED turns off, when the gas level is in DANGER! state.

Test	3
Objective	To test whether the red light turn on and green light turn off when the gas level is in DANGER! state.
Activity	• Powering on Arduino. • There should be any flammable gas around. • Gas level should be above than 10%.
Expected Result	Red light should turn on and green light should turn off.
Actual Result	Red light was turned on when Green light was turned off
Conclusion	The test was successful.

Table 4:To check whether Green LED turns on and Red LED turns off at it's DANGER! sate (Test-4)

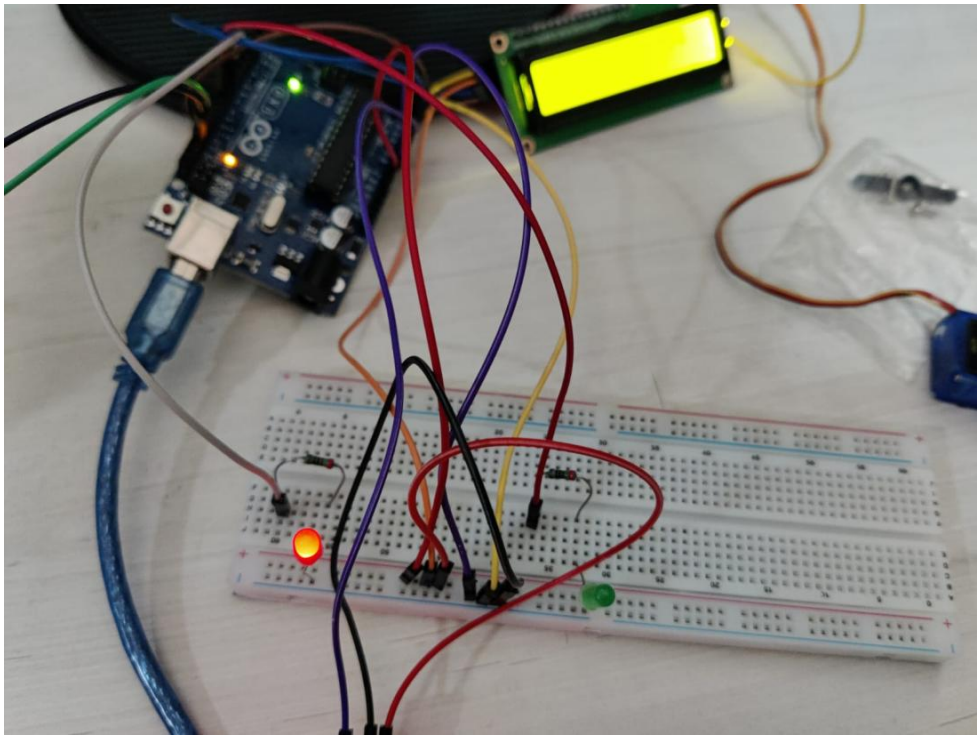

Figure 25:To check whether Green LED turns on and Red LED turns off at it's DANGER! sate (Test-4)

6.5 Test 5: To check whether the Server motor works when the gas level is in DANGER! state.

Test	5
Objective	To test whether the server motor works when the gas level is in DANGER! state.
Activity	• Powering on Arduino. • There should be any flammable gas around. • Gas level should be above than 10%.
Expected Result	Server motor should work.
Actual Result	Server motor worked as intended.
Conclusion	The test was successful.

Table 5:To check whether the Server motor works when the gas level is in DANGER! state (Test-5)

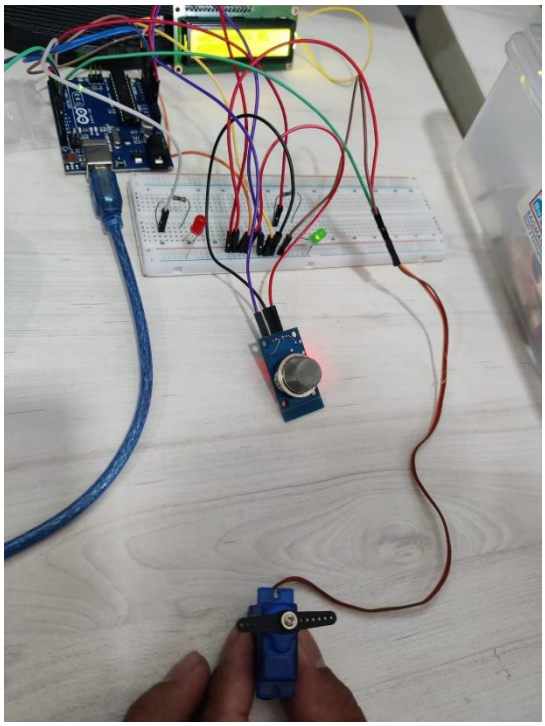

Figure 26:Servo motor at normal state (Test-5-cont.)

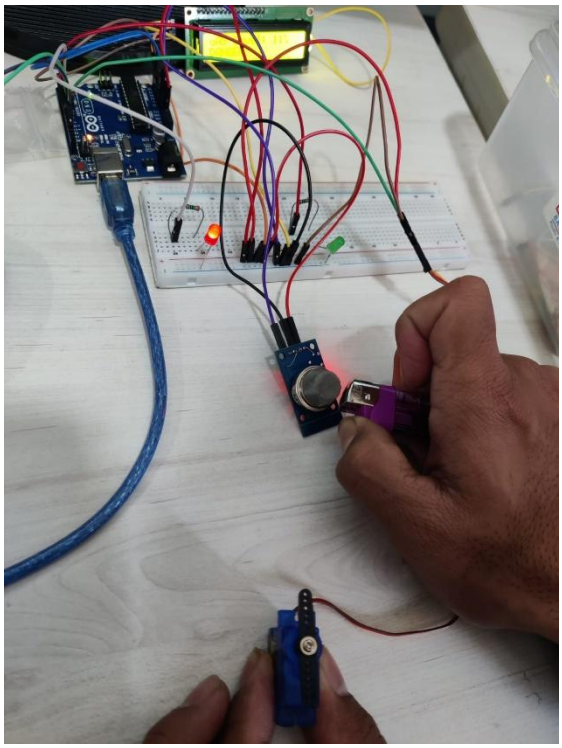

Figure 27:Servo motor at danger state (Test-5-end.)

7 Individual Contribution Plan

Our group has 5 members and each member having respective contribution doing this project as there are so many components to deal in this project.

Student Name	Role	Contribution Rate
Soumyata Shakya	**Proposal:** Introduction and Aims & Objectives **System Development Report:** Acknowledgment, Abstract and Introduction **Application Implementation:** Setting up the Arduino IDE and connecting between different components **Presentation:** Purpose and objectives of the project.	20%
Krijal Maharjan	**Proposal:** Background **System Development Report:** Results and Findings **Application Implementation:** Reviewing the code and improving it **Presentation**: System Demonstration	20%

Manish Jung Adhikari	**Proposal:** Acknowledgement and Abstract **System Development Report:** Background and Development **Application Implementation**: Did all the coding part to execute the connection between different components. **Presentation:** Working mechanism of the code	20%
Prabhat Lamichhane	**Proposal:** Individual Contribution Plan **System Development Report:** Future Works and Conclusion **Application Implementation:** Made Hardware Component and reviewing the code **Presentation:** Aim of the project	20%
Krish Bhandari	**Proposal:** Conclusion **System Development Plan:** Appendix **Application Implementation:** Made hardware component **Presentation:** Conclusion of the project	20%

Table 6:Individual Contribution Plan

8 Conclusion

In conclusion, this is our first group IoT project which resulted the ability of the students to work on coordination and cooperation with each other and also resulting on numerous different kinds of ideas and innovations. At the end, we chose to build “LPG Gas leak Detection System” as our IoT project because this project seemed to be very effective and helpful for mitigating problems and incident that has been existed in our domestic lives. The project consists of thorough research and efforts of each individual of our group. By utilizing sensor technology and automated response mechanism, the system provides timely response and alerts helping in the prevention of inevitable accidents making it an ideal project for both residential and industrial use.

We faced numerous problems and arguments but still the sincere efforts and cooperation leaded us to build this project which gave us the expertise and motivation to design a develop any other further IoT projects in near future.

9 References

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10 Appendix

10.1 Pictures of the project

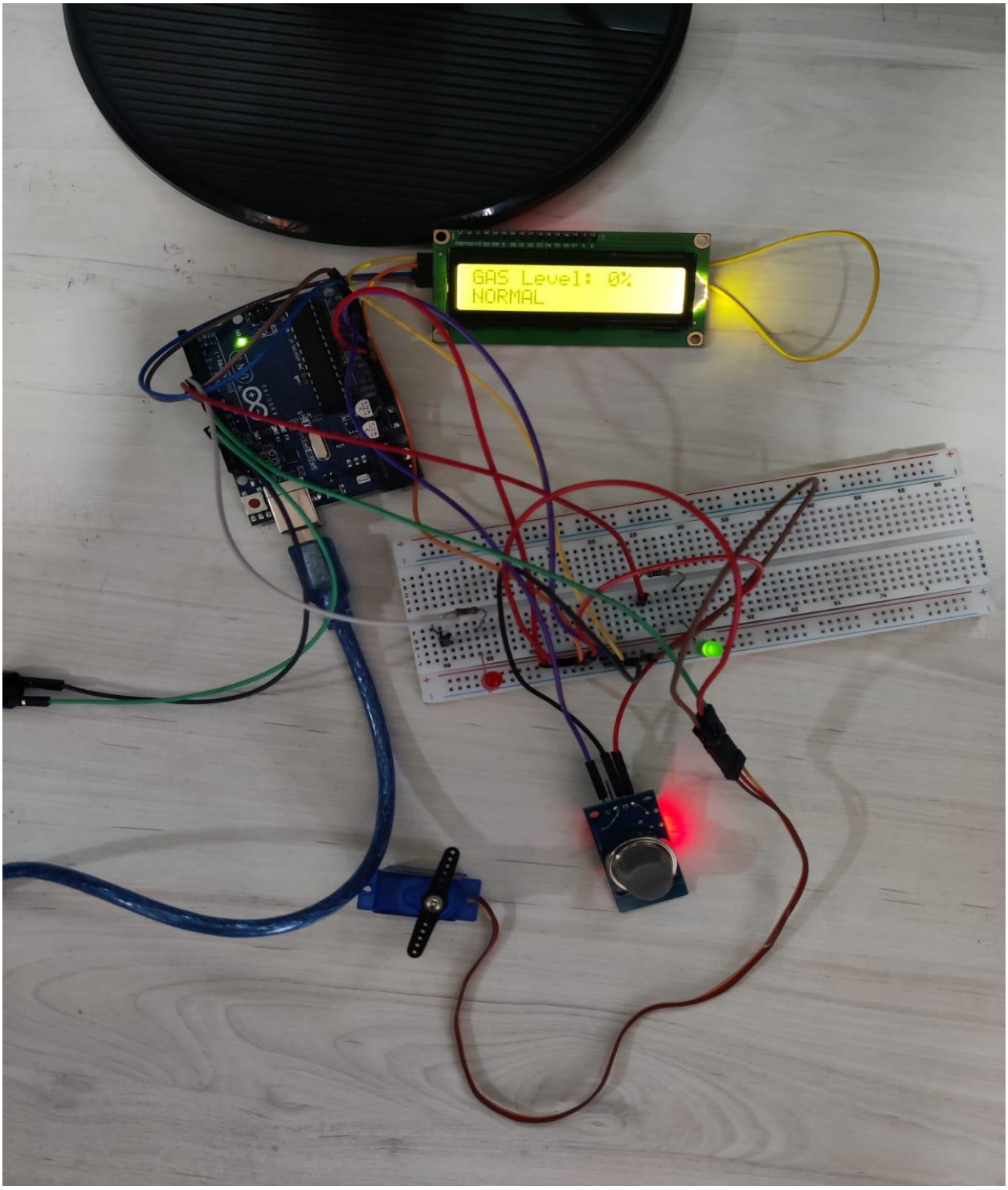

Figure 28:Final Picture of the project

10.2 Source Code

```
#include <LiquidCrystal_I2C.h>

#include <Servo.h>


// Initialize objects

LiquidCrystal_I2C lcd(0x27, 16, 2);

Servo gasValve;


// Pin definitions

const int BUZZER_PIN = 13;

const int GAS_SENSOR_PIN = A0;

const int SERVO_PIN = 9;  // PWM pin for servo

const int RED_LED_PIN = 7;

const int GREEN_LED_PIN = 8;


// Thresholds and constants

const int GAS_THRESHOLD = 10;

const int SERVO_SAFE_POS = 0;

const int SERVO_EMERGENCY_POS = 90;
```

```
void setup() {
  // Initialize LCD
  lcd.init();
  lcd.backlight();

  // Initialize servo
  gasValve.attach(SERVO_PIN);
  gasValve.write(SERVO_SAFE_POS);

  // Initialize pins
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(RED_LED_PIN, OUTPUT);
  pinMode(GREEN_LED_PIN, OUTPUT);

  Serial.begin(9600);
  displayWelcome();
}

void loop() {
  int rawGasReading = analogRead(GAS_SENSOR_PIN);
```

```
  int gasLevel = (rawGasReading - 50) / 35;


  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("GAS Level: ");
  lcd.print(gasLevel);
  lcd.print("%");


  if (gasLevel >= GAS_THRESHOLD) {
    handleDangerState();
  } else {
    handleNormalState();
  }


  delay(500);
}


void displayWelcome() {
  lcd.setCursor(3, 0);
  lcd.print("Gas Detection");
```

```
  lcd.setCursor(4, 1);
  lcd.print("System");
  delay(2000);
  lcd.clear();
}

void handleDangerState() {
  lcd.setCursor(0, 1);
  lcd.print("DANGER!");
  digitalWrite(RED_LED_PIN, HIGH);
  digitalWrite(GREEN_LED_PIN, LOW);
  tone(BUZZER_PIN, 1000);
  gasValve.write(SERVO_EMERGENCY_POS);
}

void handleNormalState() {
  lcd.setCursor(0, 1);
  lcd.print("NORMAL");
  digitalWrite(RED_LED_PIN, LOW);
  digitalWrite(GREEN_LED_PIN, HIGH);
```

```
    noTone(BUZZER_PIN);

    gasValve.write(SERVO_SAFE_POS);

  }
```