# IOT-BASED AUTOMATIC GAS LEAKAGE DETECTION AND FIRE PROTECTION SYSTEM

**BY**

**MD. Mobarak Hossain**

**ID: 172-15-9636**

**&**

**Md Faruk**

**ID: 172-15-9984**

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

Supervised By

**Mr. Gazi Zahirul Islam**

Assistant Professor

Department of CSE

Daffodil International University

Co-Supervised By

**Md. Sazzadur Ahamed**

Senior Lecturer

Department of CSE

Daffodil International University


**DAFFODIL INTERNATIONAL UNIVERSITY**

**DHAKA, BANGLADESH**

**May 2021**

# APPROVAL

This Project titled "**IoT-based Automatic Gas Leakage Detection and Fire Protection System**", submitted by **MD. Mobarak Hossain** and **Md Faruk** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on May 31 2021.

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Faculty of Science & Information Technology
Daffodil International University

**Zahid Hasan** — **Internal Examiner**
**Assistant Professor**
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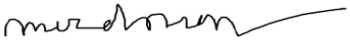
Faculty of Science & Information Technology
Daffodil International University



**Md. Riazur Rahman** — **Internal Examiner**
**Assistant Professor**
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

**Dr. Md Arshad Ali** — **External Examiner**
**Associate Professor**
Department of Computer Science and Engineering
Hajee Mohammad Danesh Science and Technology University

# DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr. Gazi Zahirul Islam, Assistant Professor,** Department of CSE at Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

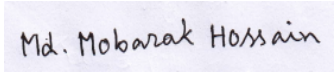
**Supervised by:**

**Mr. Gazi Zahirul Islam**
**Assistant Professor**
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

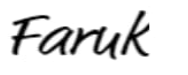
**Co-Supervised by:**

**Md. Sazzadur Ahamed**
**Senior Lecturer**
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

**Submitted by:**



**MD. Mobarak Hossain**
ID: 172-15-9636
Department of Computer Science and Engineering
Daffodil International University



**Md Faruk**
ID: 172-15-9984
Department of Computer Science and Engineering
Daffodil International University

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

# ABSTRACT

Human interference has been less as embedded fields of project have advanced, and embedded fields of project are now commonly used for safety plans. LPG gas accidents have become very common and hazardous, and they can often lead to dangers that endanger our lives, necessitating the need to protect human life. However, we can defend ourselves from the incident using modern technology. In this case, we've completed some critical system design and implementation work that will pave the way for the future of embedded systems. We are developing a framework that is focused on human-computer interactions. The next automation system will be this automatic gas leakage detection and fire protection system. This device can be mounted in hotels, kitchens, rooms, or anywhere else in the house to detect LPG gas and assist our world in developing a cost-effective gas leakage detection and explosion protection system as a replacement for manual primary LPG gas detection. We use the MQ-4 Sensor Module, which is a generic gas sensor that detects the presence of LPG. Digital and Analog outputs are available on the module. It detects LPG at concentrations ranging from 200 to 10,000 parts per million. When the MQ-4 Sensor Module detects some gas/smoke, the GSM Module sends a message to the owner's phone number. The Node MCU can also be used to power a solenoid valve and a fan. By continuing this process this device will help us from being damaged and keep us safe.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Introduction

Ours is a technologically advanced age. People are becoming increasingly reliant on embedded systems. As time passes, this reliance grows exponentially. While LPG gas has become more widely available, some leakage incidents can pose a risk to people. As a result, we wanted to create a template that would help us minimize it. In light of these conditions, we have completed some significant system design and implementation. What will the future of embedded systems look like? We'll have a framework that's built around human-computer interactions. The next automation system will be this automatic gas leakage detection and fire protection system. This device will be installed in hotels, kitchens, and rooms, and it will detect LPG gas, ensuring our safety and that of our friends and family. We built a low-cost automatic gas leak detection and fire suppression system. We call it Automatic gas leakage detection and Fire protection system.

Gas leakage and explosion is one of the deadliest accidents in the world and mostly in Bangladesh. It can be happening by gas leakage or cylinder blast. After blasting cylinder, it goes to a large fire accident where a lot of people lose their life and lot of people are injured. In last year about 350 people are died by gas explosion. So, if we can make a system that prevent gas explosion, we can save people's life. We want to make a system that is IoT based system. At first If gas leaked inside the chamber of gas cylinder Using gas detection sensor, we detect gas leakage. Then system inform the owner by sending notification and shut off gas supply. The system throws the leaked gas out of the chamber by an exhaust fan that would be a kitchen or gas cylinder chamber at hotel or another. Accidentally If there is fire system can automatically throw fire extinguisher ball to extinguish fire and send notification to owner.

## 1.2 Motivation

Every year a huge number of accidents occurring by a gas explosion and we lose a huge number of people's life, we want to prevent a gas explosion. WHO estimated that moreover 1.3 million children are getting orphans every year around the world by Gas Explosion? Fire accidents occur a lot of damage to the economy.

The main goal of this project is to create an LPG gas or smoke detector that uses a MQ-4 gas/smoke sensor and sends an SMS to the user. The gas leakage detection and message warning system will be mounted in kitchens and rooms as a permanent unit. The MQ-4 gas/smoke sensor and Arduino Uno GSM SIM800L module were used to detect gas leakage or smoke. This project is used to detect gas/smoke, and when the gas/smoke is detected, a message is sent to the owner via their phone number. Interfacing the GSM SIM800L and MQ-4 sensors with an Arduino Uno or Mega is a breeze. Finally, a sound alarm can sound if there is a gas leak, and the Node MCU will power the solenoid valve and fan.

## 1.3 Objective

The main objective of this project is:

- A system against gas explosion with automatic fire protection.
- Want to build a kitchen system in house or hotel which has no risk.
- Detect the leakage for gas and send notification to house or hotel owner with taking action by switch off the gas supply.
- Its automatically through the licked gas outside the kitchen.
- If there is a fire, our system can take action.
- It is used in house, gas cars, industries as LPG leakage detection
- This system saves the precious time of users.
- It's very easy to use.
- Cost efficient and less power consumer.
- It has a small size and is portable; it can be brought anywhere and set up in any place.

## 1.4 Expected Outcome

The following expected outcome

- It detects LPG leakage using sensor and activates an alarm with sending SMS text message to a specified mobile number.
- Shuts off gas supply using a solenoid valve when gas leakage is detected and evacuates the leaked gas using an exhaust fan.
- When gas leakage is under control, system send text message and if there is fire use automatic fire extinguisher ball supply.
- Fire extinguisher ball will stop the fire.

## 1.5 Report Layout

Mainly discussing about motivation, objectives and goal briefly is the purpose of this chapter. Besides that, message is sent to the owner by their number, sound alarm will produce alert on gas leak. The system throws the leaked gas out of the chamber by an exhaust fan. if there is fire use automatic fire extinguisher ball supply and send notification to owner that fire is under control. It has summarized the "IoT-based Automatic Gas Leakage Detection and Fire Protection System".

# CHAPTER 2

# BACKGROUND

## 2.1 Introduction

In this section, we'll go through some of the previous research that has been done on designing, building machines, and gas identification. The majority of the work in our system is done using Arduino programming.

An embedded device creates or designs a module or computer that can be programmed to perform a task. The embedded device is a software that is updated on a regular basis. One of the most visible challenges is qualification. The ability to make the embedded system visually appealing will always be a key feature. The embedded system subject is cinched by stipulation, and a wide range of opportunities for embedded system certification are open.

## 2.2 Related Work

- "AN APPRAISAL ON GAS LEAKAGE DETECTION AND CONTROLLING SYSTEM IN SMART KITCHEN USING IoT "by D. Gowdhami, P. Karthik kannan from Tamil nadu, India.

Where their system can detect gas leakage. And then open the window of kitchen automatically for passing the gas. It also sends SMS to house owner about gas leakage.

- "LPG Gas Leakage Detection & Control System" by Rajeshwari Salmani from Karanataka, India.

Where she develops a system that can detect gas leakage. After detecting it can shut off the gas supply and pass the gas from room. The system will also shut down electric supply.

## 2.3 Comparative Studies

People may use this system to install a gas leak detection and message warning system in their kitchens and rooms. If there is any kind of leakage of LPG gas then MQ-4 gas/smoke sensor will sense then LPG gas. When the gas/smoke is detected, a message is sent to the owner by their number and it will perform a sound alarm. By hearing this alarm, the people of that home can aware about the situations. Then the people can take necessary step against the situation. People also use the NodeMCU which will control Solenoid valve and fan. Also use fire extinguisher ball to stop fire.

## 2.4 Scope of the project

Saving people and the world with LPG gas has always been considered a dangerous challenge. We can use this embedded device to take some precautions to ensure that LPG does not pose a danger. Several similar agencies have already attempted to build and deploy a less complicated LPG gas and rescue scheme. Nonetheless, the product's success does not provide an acceptable level of satisfaction. This project is primarily assessed from two perspectives: “price and performance” and “weight and size.” Finally, the device should allow people to be saved while also detecting LPG gas leaks.

## 2.5 Challenges

- Gas Leakage sensor value setting related problem.
- Its susceptibility depends on Humidity and temperature.
- Throwing fire extinguisher ball into fire.

# CHAPTER 3

# REQUIREMENT ANALYSIS

## 3.1 Business Process Model

In business process management and systems engineering is the activity of representing processes of an enterprise, so that in order to analyze, develop, and automate the existing process. This is a visual representation of our project work in the form of a flowchart.

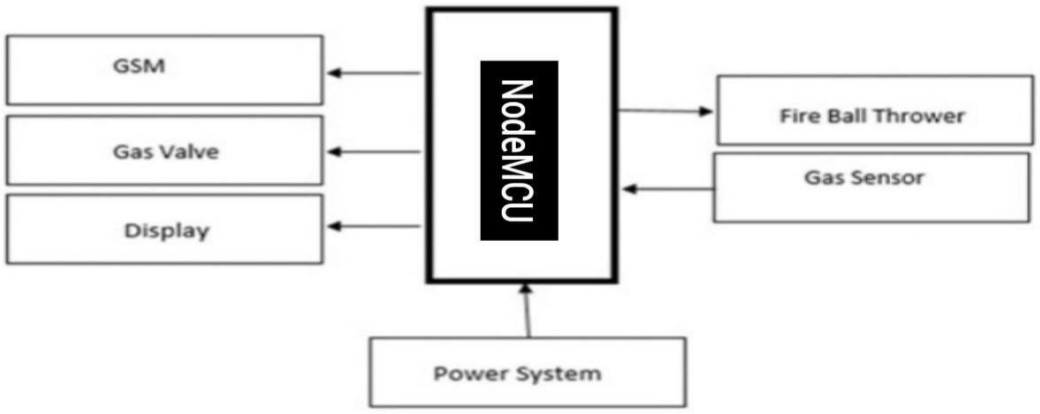


Figure 3.1: Business Process Model (BPM)

## 3.2 Requirement Collection and Analysis

Requirement Collection:

The types of equipment we use to complete our project are referred to as requirement collection. The following is a list of project devices that we will be using to complete our project.

### 3.2.1 User Requirement:

| | | | |
|---|---|---|---|
| LM2596 buck converter | 12v adapter | MQ-4 sensor Module | Buzzer |
| Breadboard | Jumper Wire | LED | NodeMCU |
| A2B Cables | Power Supply | Solenoid Valve | |
| SIM800L GSM | Flame Sensor | Cooling Fan | |
| Relay Module | Servo Motor | Arduino IDE | |
| LCD | Fire Extinguisher Ball | | |

Table 3.1 User Requirement

### 3.2.2 lm2596 buck converter


Figure 3.2 lm2596 buck converter

The LM2596 is a widely used step-down switching regulator integrated circuit. The customizable version will accept input voltage ranging from 4.5 to 40 volts and transform it to variable voltage sourcing with a continuous current of up to 3 amps. It is widely used in power modules to power/control heavy loads due to its high current capability.

### 3.2.3 LED Light

Figure 3.3 LED Light

LED is a kind of semiconductor. The LED will light up as electrons pass through the semiconductor. In comparison to incandescent and CFL lamps, LED lights are more energy efficient.

### 3.2.4 LCD Display


Figure 3.4 LED Light

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystal displays operate by obstructing light. Electrical currents force the liquid crystal molecules to align at the same time, allowing different amounts of light to pass through to the second substrate.

### 3.2.5 Breadboard

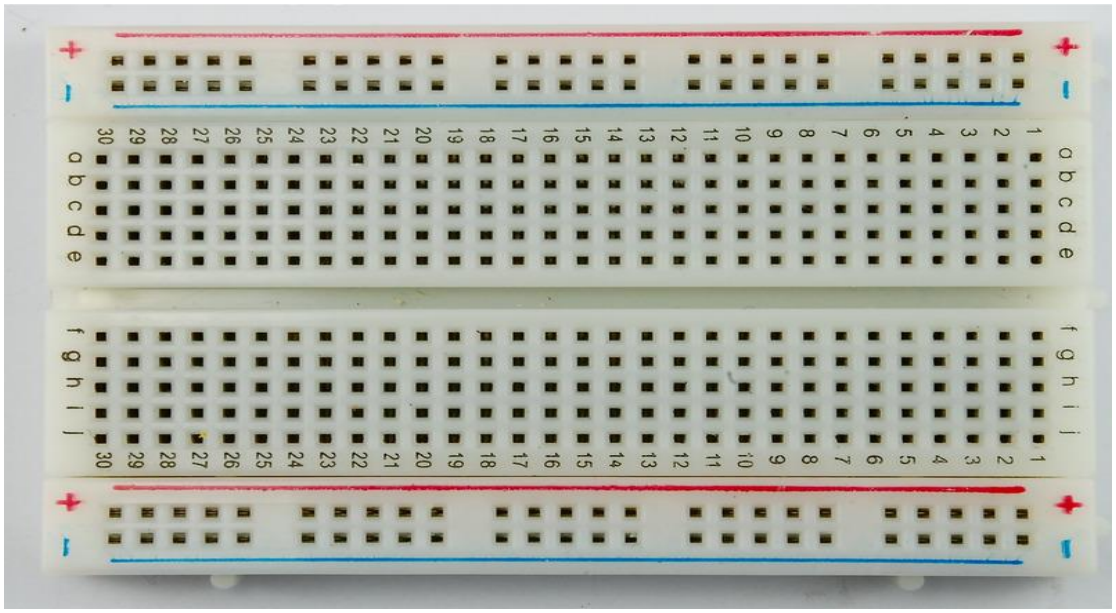

Figure 3.5 Breadboard

The breadboard's aim is to make simple electrical contacts between components such as resistors, LEDs, and capacitors so that you can test your circuit before soldering it permanently together.

### 3.2.6 Power Supply


Figure 3.6 Power Supply

A power supply is an electrical system that provides electrical power to a load. A power input link absorbs energy in the form of electric current from a source, and one or more power output connections supply current to the load on all power supplies.

### 3.2.7 MQ-4 Sensor Module


Figure 3.7 MQ-4 Sensor Module

We have done some important system design and implementation, which will be next future of embedded system. We'll be using a MQ-4 gas sensor in our system. This is a generic gas sensor for detecting the presence of LPG. Digital and Analog outputs are available on the module. It detects LPG at concentrations ranging from 200 to 10,000 parts per million. It operated on a voltage of +5 volts. This can also be used to detect other gases such as methane and alcohol.

### 3.2.8 SIM800L GSM Module


Figure 3.8 SIM800L GSM Module

We've completed some significant system design and implementation work that will pave the way for embedded systems in the future. We'll have a framework that's built around human-computer interactions. This is used to deliver SMS notifications in the event of a gas leak. Serial Communication is used in this system. AT COMMANDS - interact with the GSM Module.

### 3.2.9 Jumper ware

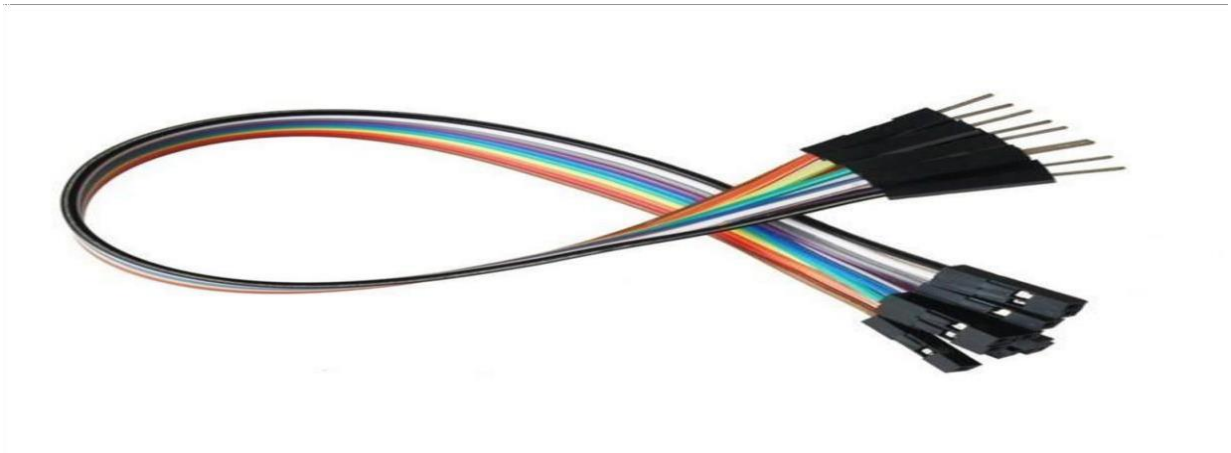

Figure 3.9 Jumper Wire

A jump wire is an electrical wire that can be connected to a set of cables. A jumper wire is a wire with a connector or pin on each end that is used to link the components of a breadboard, baseboard, or other prototype. Jumper wire would be used to link the other equipment or parts.

### 3.2.10 NodeMCU

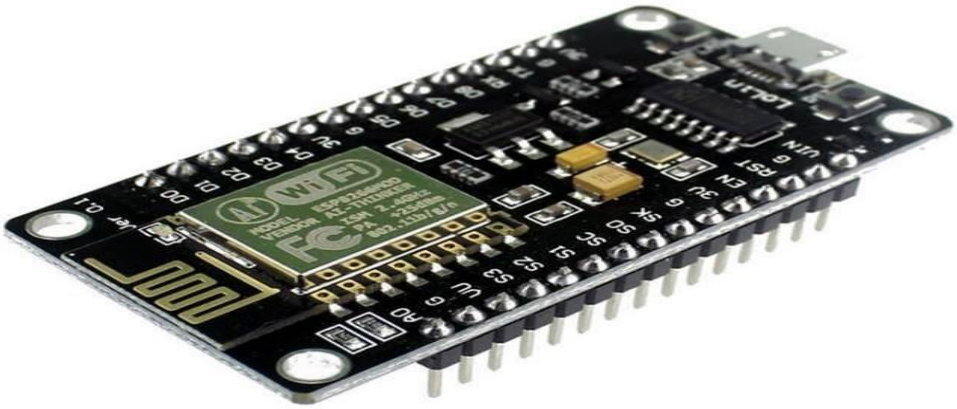

Figure 3.10 NodeMCU

NodeMCU is an open-source Internet of things (IoT) platform. This NodeMCU is being used in our gas leakage detection system project. The ESP8266 Wi-Fi chip is used to run the firmware. In our project, we use the internet to power a fan and a gas valve, as well as send an email to the user if gas is detected. So, we may assume that this is an automation mechanism in which, when gas is detected, an email is sent to the recipient, who then reviews the email. The user can then use Android apps to monitor the gas valve or switch off the gas link. This software also allows users to control the fan. We use a 2 channel 5v relay module connected to the NodeMCU to power and attach the fan and gas valve, and then we control the entire actuators with apps.

### 3.2.11 A2B Cables

Figure 3.11 A2B Cables

A2b cables link the NodeMCU to the machine port or the battery port. This is used to link hardware and software together. We can set commands through software and have them operate through hardware by using A2B cables.

### 3.2.12 Buzzer

Figure 3.12 Buzzer

Buzzer are used for alarm. It works like an alarm by making sound. It acts as a warning by emitting a sound. There are two pins on it, one positive and the other negative. The buzzer pins are used to create a sound alarm. This buzzer will be used in our project to detect gas leaks; if a leak occurs, the buzzer will sound and turn on.

### 3.2.13 Solenoid Valve

Figure 3.13 Solenoid Valve

Solenoid valve will be set up on the gas cylinder. This solenoid valve has two valves, one of which is connected to a gas cylinder and the other to a main line. We can regulate the flow of gas through this solenoid valve. If a gas leak occurs, the consumer will turn off the valve using the applications that will be installed on their device; by doing so, we will avoid a gas accident.

### 3.2.14 Cooling Fan

Figure 3.14 Cooling Fan

In most cases, a cooling fan would be used to remove the smoke or gas. If a gas leak occurs, one user will turn off the fan using the applications that have been installed. This practice will help to avoid such circumstances in the future.

### 3.2.15 Relay Module


Figure 3.15 Relay Module

In our project, we use a 2 channel 5v relay module that is connected to the NodeMCU and allows us to monitor all of the actuators via apps. The power to the actuators is controlled by switching on and off the relay module.

### 3.2.16 12v adapter

Figure 3.16 12v adapter

The 12 Volt Power Supply Adapter is a throwback to the early days of electronics when 12V was a common battery output voltage. The 12 Volt Power Adapter, also known as a "Brick", "Desk Wart" and "Floor" supply, provide a regulated 12 Volts DC output

### 3.2.17 Flame Sensor

Figure 3.17 Flame Sensor

To build a fire alarm system, connect a flame sensor to an Arduino. A photodiode detects light and an op-amp controls sensitivity in the flame sensor module. It detects fire and sends out a HIGH signal as it detects it. Arduino detects the signal and alerts the user by activating the buzzer and LED.

### 3.2.18 Servo Motor


Figure 3.18 Servo Motor

A servo motor is a miniature motor with an output shaft. By transmitting a coded signal to the servo, this shaft may be moved to various angular locations. The servo can retain the shaft's angular orientation as long as the coded signal is present on the input side.

#### 3.2.19 Fire Extinguisher Ball


Figure 3.19 Fire Extinguisher Ball

The Fire extinguishing ball automatically works to extinguish a fire when it senses flames. here is no waiting for someone to recognize the alarming order of something burning. Instead, the Fire Ball is ready to react when it senses flames.

## 3.3 Use Case Modeling and Analysis

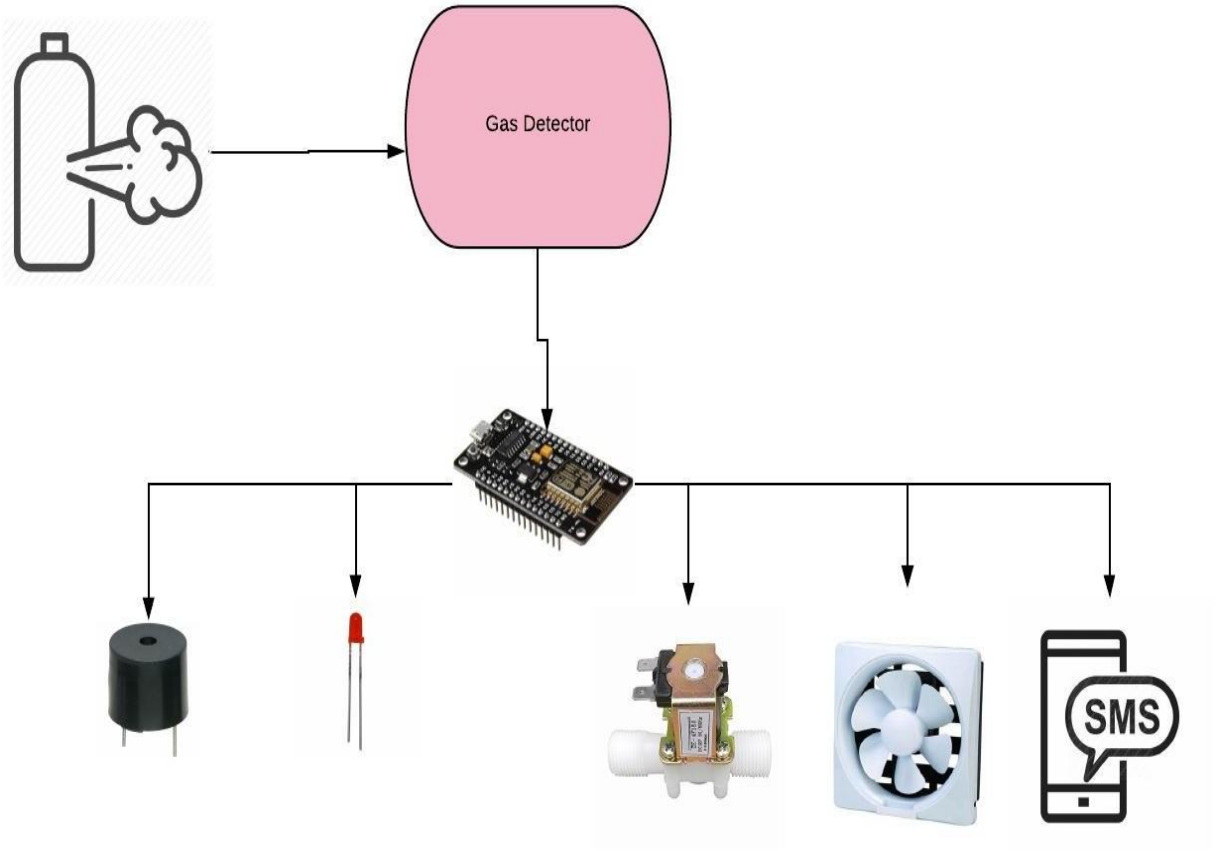


Figure 3.20 Use Case Modeling and Analysis

We've designed and implemented some critical systems. What is the future of embedded systems? The MQ-4 Sensor Module is a generic gas sensor that detects the presence of LPG. Digital and Analog outputs are available on the module. It detects LPG at concentrations ranging from 200 to 10,000 parts per million. When the MQ-4 Sensor Module detects any gas/smoke, the GSM Module sends a message to the owner via their phone number informing them of the threat.

# CHAPTER 4

# Design Specification

## 4.1 Front-end Design

We use virtual lm2596 buck converter and many other hardware devices in front-end design to help us build up the hardware design specification. Virtual Arduino Pro Mini, GSM SIM800L, 12v adapter, Jumper wires, MQ-4 Sensor Module, Buzzer, Cable, Fan & Solenoid Valve, as well as a fire detector sensor are all used in this project.

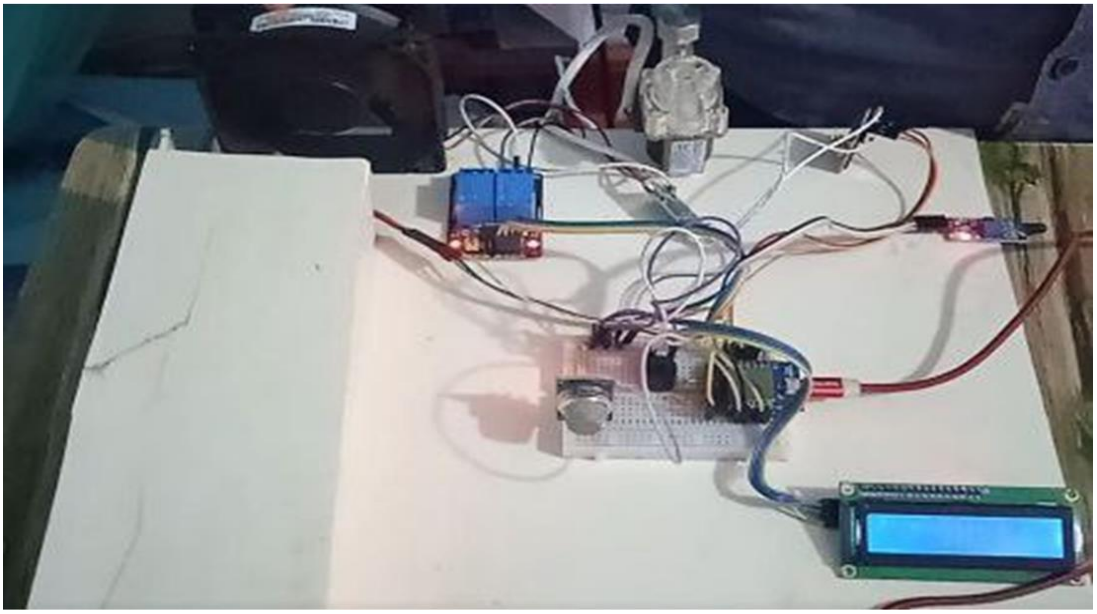

Figure 4.1 Front-end Design

## 4.2 Back-end Design

Arduino code

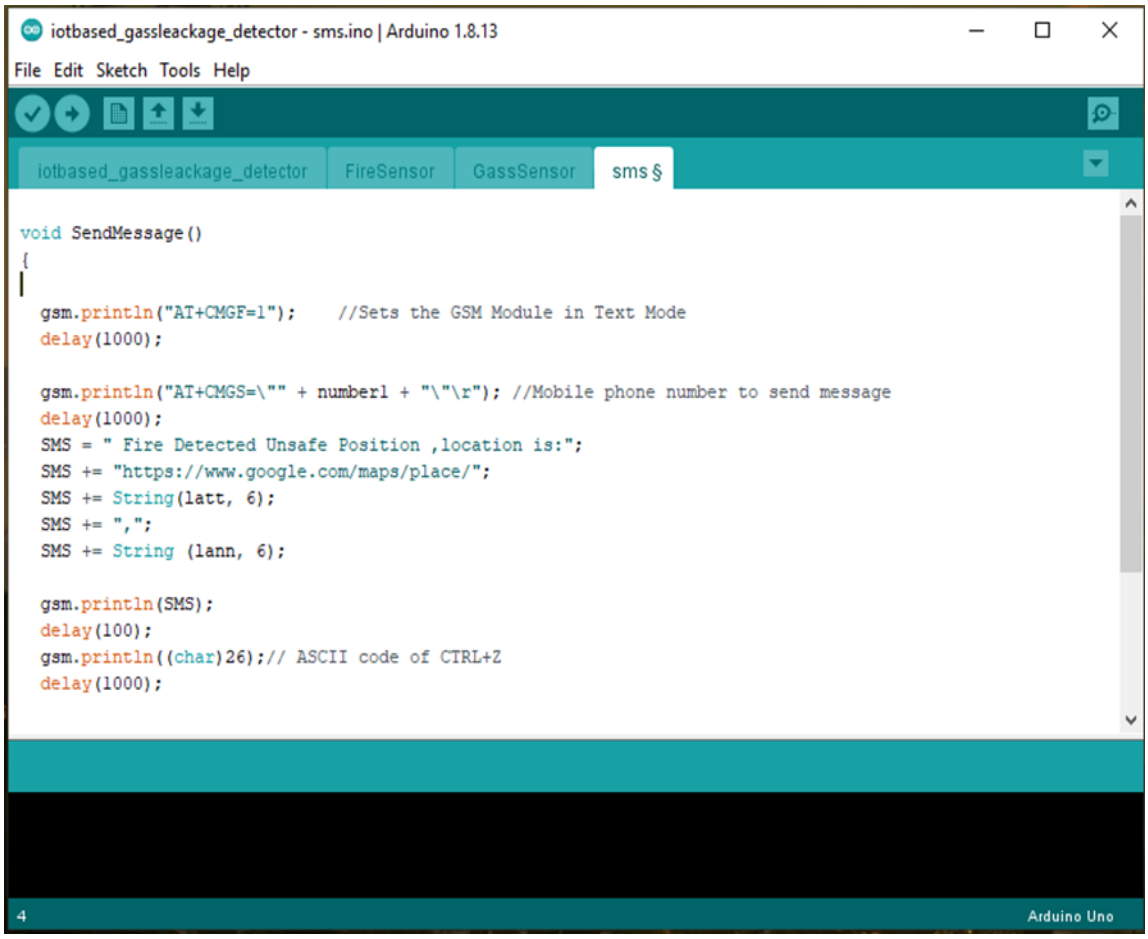


Figure 4.2: Arduino code

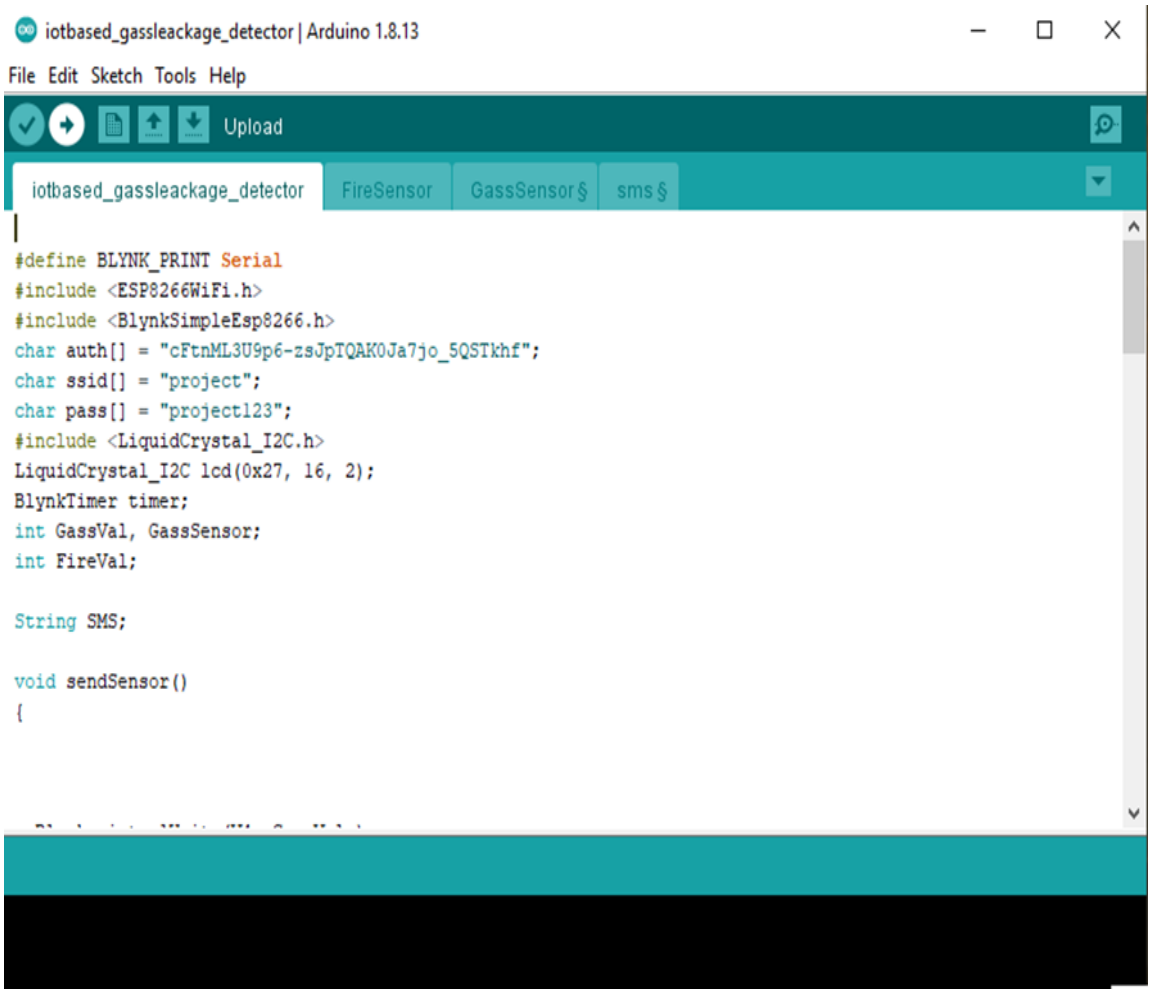


Figure 4.2: Arduino code

## 4.3 UX (User Experience)

- Firstly, it can detect leakage gas. If it found any gas, it will shut down gas line automatically and provide harsh signal.
- Secondly, if there any unfortunate situation such as fire, it will throw fire extinguisher ball toward fire to extinguish it and give different type of warning.
- Cost efficient and less power consumer.
- It likewise recognizes as gas analyzer.
- The sensor has superb conductivity joined with a spanking reaction time.

## 4.4 Implementation Requirement

| | |
|---|---|
| • LM2596 buck converter | • Jumper Wire |
| • MQ-4Gas Sensor | • Buzzer |
| • Breadboard | • Fan |
| • SIM800L GSM | • Solenoid Valve |

Table 4.4 Implementation Requirement

# CHAPTER 5

# Implementation and Testing

## 5.1 Implementation of UX

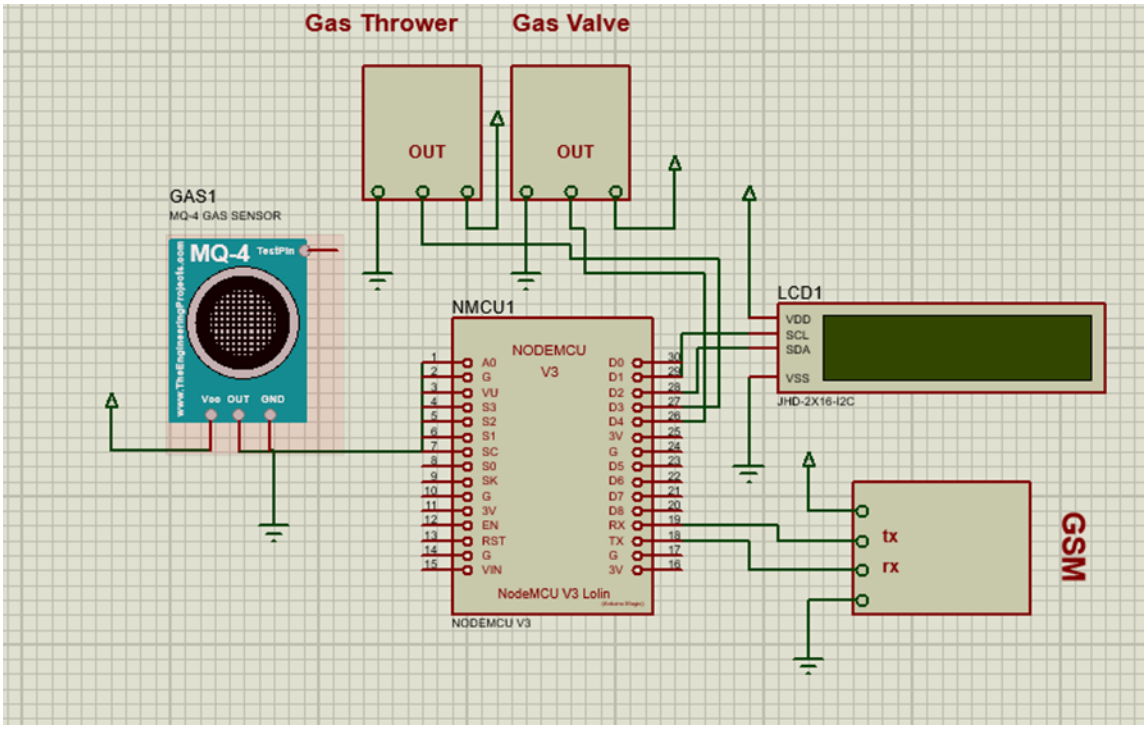


Figure 5.1: Implementation of UX

- Susceptibility is high It recognizes LPG, iso-butane, propane, and small susceptibility, as well as liquor, and is thus used as a gas analyzer.
- The sensor has incredible susceptibility joined with a spanking and speedy response time.
- Durable execution and long life.
- Basic drive circuit.

## 5.2 Testing Implementation

The following figure of 5.1 Main system design

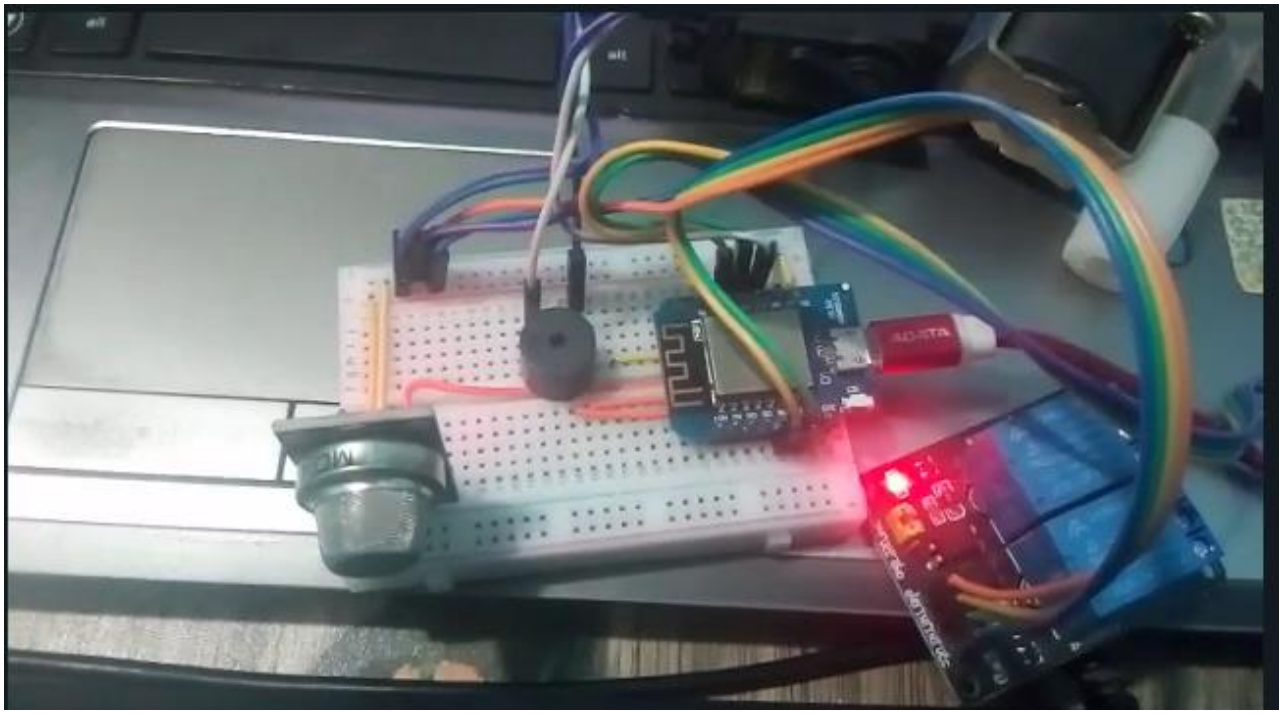

Figure 5.2: Testing Implementation

## 5.3 Test Results and Reports

- If gas intensity more than (>620), according to this condition servo motor remained constant around 15 seconds.

- If the temperature is greater than or equal to (=50°), the pump motor will start and the buzzer will sound before the temperature falls below 50°.

# CHAPTER 6

## Impact on Society, Environment and Sustainability

### 6.1 Impact on Society

The Recent trend is to bring the technology into our home and office. By making the place smart, the day-today activities are becoming more and easier. The development of home automation has become mandatory in homes as people are moving towards to the smart home concepts. This is where 'Internet of things (IoT)' comes into picture. As the regular works has become smart, the things used are still the same like Gas cylinder in homes. Gas is an essential need of every household; its leakage could lead to a disaster. Sometimes it may result on an accident. But the help of this project it could bring so much positivity in society. In Bangladesh, there has been many incidents because of cylinder blast. many people injured and killed by a cylinder explosion. The blast in a mosque in Narayanganj's Paschim Tallah is the latest example of such a tragic accident. At least 24 people have succumbed to their burn injuries and many more are dead. So, by this autocratic gas leakage detection can control the explosion rate.

### 6.2 Impact on Environment

Gas leakage is commonly observed problem which causes hazardous effects on environment and human health. Gas cylinder may leak as a gas or a liquid. If the liquid leaks it will quickly evaporate and form a relatively large cloud of gas which will drop to the ground, as it is heavier than air. Gas cylinder vapors can run for long distances along the ground and can collect in drains or basements. When the gas meets a source of ignition it can burn or explode. Burning gas releases carbon dioxide, a greenhouse gas. The reaction also produces some carbon monoxide. Greenhouse gases have far-ranging environmental and health effects. They cause climate change by trapping heat, and they also contribute to respiratory disease from smog and air pollution. Extra carbon dioxide in the atmosphere increases the greenhouse effect. More thermal energy is trapped by the atmosphere, causing the planet to become warmer than it would be naturally. This increase in the Earth's temperature is called

global warming. As we have seen environmental pollution can increase by the gas leakage and explosion, so this autocratic gas detection can be a blessing if we say. Because it saves both human lives and environment.

## 6.3 Ethical Aspects

In Bangladesh there has many incidents due to Gas cylinder leak and explosion. Many people died and injured due to several explosion. And it has bad effects of our environment too. The main concern of making this project is make human safe in home, office and other places. It can aware the people from any inappropriate situation like gas leakage through SMS over their phone or can alarm ring. So, people can handle the situation and stay safe.

## 6.4 Sustainability Plan

IoT technology helps utility companies and other energy providers expand their services by linking up with countless decentralized devices and energy sources like solar panels and microgrids to reduce strain on conventional power sources. It benefits numerous industries by improving connectivity, reducing energy waste and allowing for the collection of energy data that can then be analyzed to enhance delivery and efficiency. In a more direct way for consumers, IoT means greater control of home energy use via smartphones or tablets. The result: greater sustainability and lower energy costs. Autocratic gas leakage detection could sense the presence of desired gas from the environment and will give the SMS on owner mobile phone, it will also ring alarm on the spot and by the help of motor it will off the leakage area of the cylinder or gas line.

# CHAPTER 7

# CONCLUSION AND FUTURE SCOPE

## 7.1 Conclusion

The enhancement of the weight recognition schematic provides information on the holder's weight change, the weight scope of gas inside the barrel, and notifies the customer. A remote weight sensor inside the barrel was used to perform consistent estimation. As the edge approaches, the renewed esteem is shown, and the caution is strengthened. The gas spillage, if any, is detected by the specific sensor, which warns the user. The test result validates the model's ground-breaking and profitable movement by detecting up and down gas spillage levels, automatically shutting down the gas supply, and alerting the customer through an equipped for hearing alarm forewarning signal. In the midst of the fundamental circumstances, the Arduino-based gas spillage marker provides a higher and faster response than the manual errand. To avoid jeopardizing human lives, the device can be presented for recognizing distinct spillage gases at private, hotel, restaurants, various business items, and mechanical domains.

## 7.2 Scope for Further Developments

- Its defecting licked gas in using this system.
- Making a fireproof cover for the protection of its internal parts and improving the quality of the device's output.
- It has a small size and is portable; it can be brought anywhere and set up in any place.
- It’s also cost effective and useful for large industries which are needed very much.

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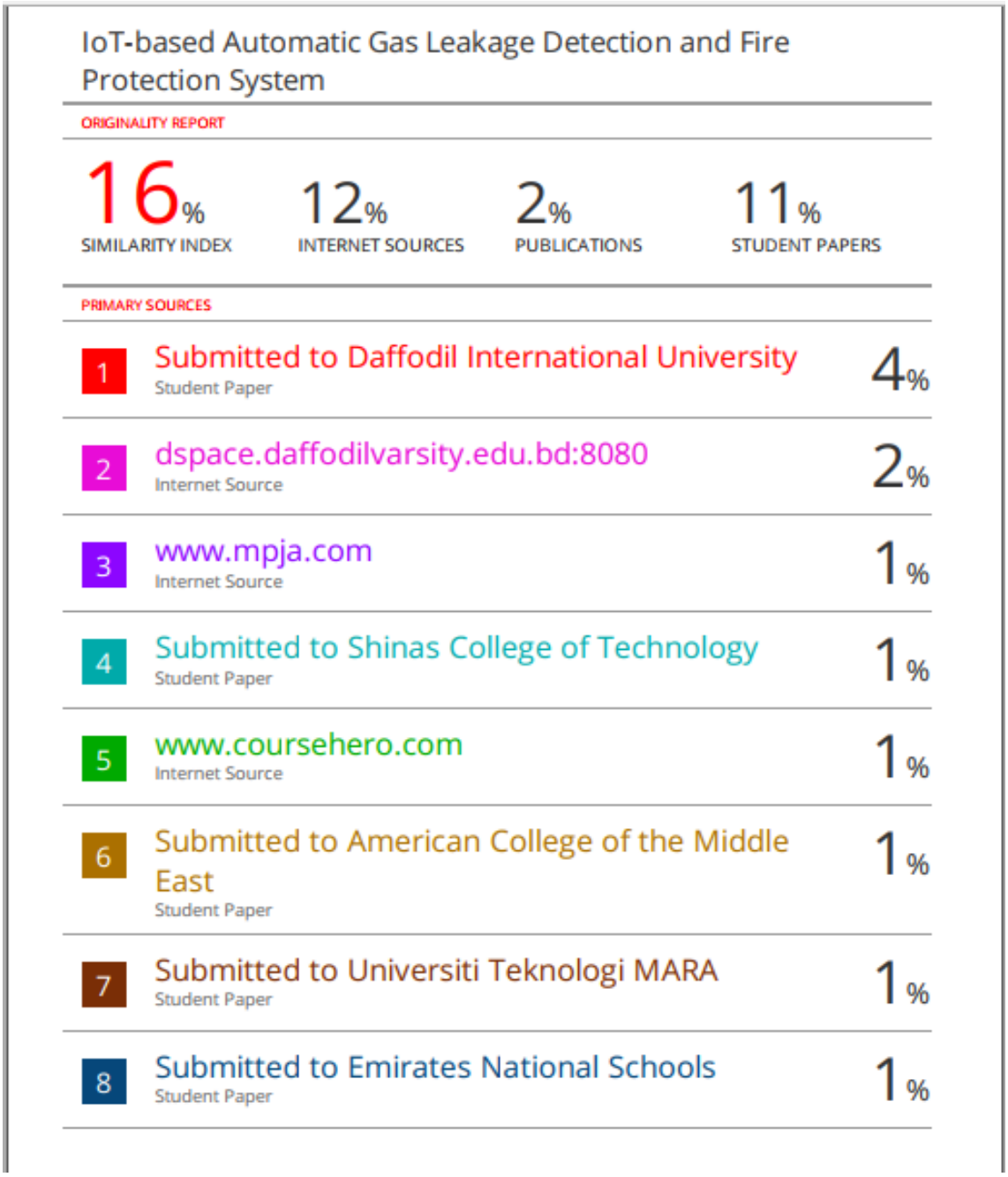

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