IoT Based Fire Detection and Alert System for High-Rise Building

Sunjida Ahmed Jarin and Musfiqua Haque

A Thesis in the Partial Fulfillment of the Requirements

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

Department of Computer Science and Engineering
College of Engineering and Technology
IUBAT – International University of Business Agriculture and Technology

Summer 2021

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The thesis has been examined and approved,

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Summer 2021

Letter of Transmittal

15 June 2022

The Chair

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Subject: Letter of Transmittal.

Dear Sir,

With due respect, it is our great pleasure and privilege to present our thesis report entitled "**IoT Based Fire Detection and Alert System for High Rise Building"**. We have prepared this report as partial fulfillment of the requirement for the degree of Bachelor of Computer Science and Engineering. It was certainly a good opportunity to work on this paper to actualize our theoretical knowledge in the practical arena. Now, we are looking forward to your kind appraisal regarding this thesis report. We will remain deeply grateful to you if you kindly go through this report and evaluate our performance.

We have great hope that the report will meet your expectation and aid you in getting a clearer idea about the system.

Thanking you in anticipation.

Yours sincerely,

_____	_____
Sunjida Ahmed Jarin	Musfiqua Haque
18203043	18203069

Student's Declaration

We, Sunjida Ahmed Jarin & Musfiqua Haque declare that the work presented in this thesis paper titled, "**IoT Based Fire Detection and Alert System for High Rise Building**" is the outcome of the fire detection, alert system carried out by us under the supervision of Dr. Abhijit Saha, Professor, Department of Computer Science and Engineering, IUBAT. No parts of this report has been submitted anywhere for any degree, diploma or certificate.

_____	_____
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Supervisor's Certification

This is to certify that the thesis report on "IoT Based Fire Detection and Alert System for High Rise Building" has been carried out by Sunjida Ahmed Jarin ID#18203043 & Musfiqua Haque ID#18203069 student of Department of Computer Science and Engineering of IUBAT-International University of Business Agriculture and Technology, as a partial fulfillment of the requirement for the degree in Bachelor of Computer Science and Engineering. The report has been prepared under my guidance and is a record of work carried out successfully. To the best of my knowledge and as per their declaration, no parts of this report has been submitted anywhere for any degree, diploma or certificate. Now they are permitted to submit the report. I wish their success in their future endeavors.

_____

Dr. Abhijit Saha

Supervisor and Professor

Department of Computer Science and Engineering

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Abstract

A survey found that 80% of the damage caused by fires could have been avoided if the fire had been detected early. Fires claim thousands of properties and lives every year. Fire is the leading cause of accidental death, taking valuable lives and property. The main property of fire is that it spreads exponentially over time, spreading in a short amount of time and destroying whatever it catches. Early detection of fires is therefore important so that many lives and property can be saved. A fire alarm system is essential to ensure the safety of human life and reduce the number of casualties as much as possible. Some homes have a conventional fire alarm system installed, these conventional fire alarm systems have some limitations, especially when it comes to being activated while the homeowners are away or asleep and cannot hear the alarm. Many authors already implemented many systems for detecting fire. Some systems for forests, some for garments, some systems for industry. In this paper it is proposed a low-cost IoT based fire detection and alert system for high-rise building. The main target of this research is to reduce false fire alarm. To implement this proposed system, it used two sensors namely DHT 11 and MQ2 for sensing humidity, temperature, gas and smoke level from the environment. Each of these sensors connected to the microcontroller (ESP 8266 nodeMCU). First of all, DHT 11 will sense the humidity and temperature level from the environment. If the level is exceeded the threshold value, then MQ2 sensor will sense the gas and smoke level from the environment. If the gas and smoke level is exceeded the threshold value then the real time data will be sent to the base station with the unit id by the Wi-Fi module. This system creates its own Wi-Fi network. An LCD display used for showing real time values whatever

values are sensed by the sensors. Once fire is detected by the sensors there is a green LED light which will turn on red after detecting fire. The guard can get information by the red LED light. The user can also get information by turning on the buzzer. A SMS will send to the fire brigade via GSM module. As the system is checking double time so there is no possibility of given false alarm. The method of reducing false alarm is checking the system double time. This system is extremely helpful for the high-rise buildings. A prototype was developed for the proposed system and it carried out the desired functionalities successfully.

Acknowledgments

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

First and foremost, I would like to thank God for giving me the strength to finish this work. The satisfaction that accompanies the successful completion of this thesis would be incomplete without the mention of people whose ceaseless cooperation made it possible, whose constant guidance and encouragement crown all efforts with success. I am grateful to my honorable thesis supervisor Dr. Abhijit Saha, Professor, Department of Computer Science and Engineering, IUBAT, for the guidance, inspiration and constructive suggestions which were helpful in the preparation of this thesis. I also convey special thanks and gratitude to Dr. Hasibur Rashid Chayon, Associate Professor, Department of Computer Science and Engineering, IUBAT for his co-supervision and advice.

Table of Contents

List of Figures

List of Tables

Chapter I. Introduction

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

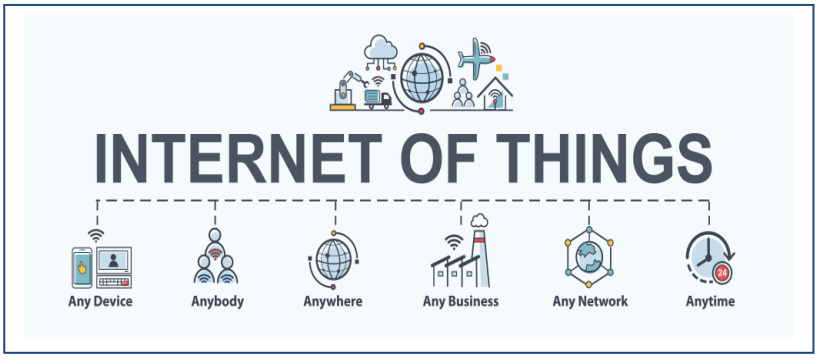

Figure1.1 Architecture of IoT

Figure1.1 shows the architecture of IoT. IoT means basically anybody can access it anytime from anywhere by using any device over internet. Devices and objects with embedded sensors are connected to an Internet of Things platform that integrates data from different devices and applies analytics to share the most valuable information with applications designed for specific needs. These powerful IoT platforms can identify exactly what information is useful and what can safely be ignored. This information can be used to identify patterns, make recommendations, and spot potential problems before they arise.

There are many applications and challenges of IoT. Some applications are given below-

- Smart Homes
- Smart City
- Farming
- Smart Fire detection and alarm system
- Healthcare

Simply, we can say that anything connected to the internet and sharing and processing information according to the response from the outside is an IoT device. And by things, the IoT means the devices that are connected to the Internet and can be something like a biometric device used for presence, a heart monitoring sensor implanted in a person, cell phones with a range of functions, alarm search engines, or a device that locates the specific metal. because all these devices collect useful data using technologies and then exchange the data between other devices.

There are some challenges of IoT. They are given bellow-

- **Insufficient testing and updating:** With the increase in the number of IoT (internet of things) devices, IoT manufacturers are more eager to produce and deliver their device as fast as they can without giving security too much of although. Most of these devices and IoT products do not get enough testing and updates and are prone to hackers and other security issues.
- **Battery life is a limitation:** Issues in packaging and integration of small-sized chip with low weight and less power consumption. If you've been following the mobile space, you've likely see how every year it looks like there's no restriction in terms of display screen size. Take the upward thrust of 'phablets', for instance, which can be

telephones nearly as huge as tablets. Although helpful, the bigger monitors aren't always only for convenience, rather, instead, display screen sizes are growing to accommodate larger batteries. Computers have getting slimmer, but battery energy stays the same.

- **Increased cost and time to market:** Embedded systems are lightly constrained by cost. The need originates to drive better approaches when designing the IoT devices in order to handle the cost modelling or cost optimally with digital electronic components. Designers also need to solve the design time problem and bring the embedded device at the right time to the market.
- **Security of the system:** Systems have to be designed and implemented to be robust and reliable and have to be secure with cryptographic algorithms and security procedures. It involves different approaches to secure all the components of embedded systems from prototype to deployment.
- **Connectivity:** It is the foremost concern while connecting devices, applications and cloud platforms. Connected devices that provide useful front and information are extremely valuable. But poor connectivity becomes a challenge where IoT sensors are required to monitor process data and supply information.
- **Data collection and processing:** In IoT development, data plays an important role. What is more critical here is the processing or usefulness of stored data. Along with security and privacy, development teams need to ensure that they plan well for the way data is collected, stored or processed within an environment.

1.1 Background and Context

In recent years, fire accident is a massive problem. It may occur for diverse occasion but specially occur due to human carelessness or environmental changes. The results of uncontrolled fire may bring in death of human lives and animals. It also an extensive threat for our ecosystem. Fire broke out in the engine room of a launch on the Sugandha River near Jhalakathi, 35 people were killed. Fire incident occurred at Bangladesh juice factory

(Shezan), on 9 July 2021. At least 52 people were died and another 20 were injured. To monitor our commercial or residential areas and to secure our property and lives against fire, we used many effective methods. To secure our lives and properties preventing of fire is a global concern. Fire accident can take place in both indoor and outdoor environment. A large number of fire accidents can ensue only for short circuit. In case of indoor fire accidents, the biggest cause is the improper use of electricity. Most of the fire accidents are related with human error. Due to gas leakages, unattached equipment, poor handling of sensitive materials and human carelessness fire accident can take place inside the buildings. Outdoor fire accidents are related with forests, agricultural operations or natural factors. Between these two outdoor fire accidents are more adventurous than indoor fire accidents. A large number of people die due to lack of oxygen or toxic gases. Automatic fire detection system can save a maximum number of human lives, animals and properties. Owners will be aware before the accident by getting some notification whether the environment is not immune. In traditional fire detection system, it is not feasible to know about the environment before arriving fire. For getting continuous information about home environment automatic fire detection is applicable for any scenario. Catastrophic intimate injury and demolishing damage is the outcome of fire accident. Only for fire accident billions of rupees in property are damaged. Fire also relief carbon dioxide and the effect is adventurous for our environment, major issue for global warming. The land in the area of the wildlife has been entirely ruined, animal vanquish their existence, vegetation is damaged, global warming and ozone layer depletion all this are the effects of fire accident. A large number of fire accidents can be attributed only for human carelessness and at the end up they are spending a lot of money on fire damage restoration. Millions of rupees are

exhausted for repairing these damages. Fire accident also may affect in our eyes and respiratory system which is more serious disorder. The effect of smoke is injurious for children, pregnant woman, a person with heart or lung diseases and also a person with diabetes.

Damage of fire rely on the fires intensity and the rate of spread. Fire accidents are responsible for air pollutants and have impacts on human health. It emits carbon monoxide, nitrogen dioxide, polycyclic aromatic hydrocarbons, volatile organic components (VOCs), particulate matter and ozone. These particulate matters length is less than 2.5 micron (PM2.5). These microscopic particles are smaller than the width of a human hair. It is only 50 to 70 microns. They can cause a limit of health problem. These small particles can grave into the lungs and cause biological damage without trouble. It also can affect the cardiovascular system. As fire is hazardous for our lives and property so we all are concern about those tools which can detect fire at the early stage. Providing early warning notification is the main worry in case of an effective fire detection system. To decrease the number of damages, causing injurious of lives we have to minimize the intensity of the fire and the spread of the fire. According to the National Fire Protection Association (NFPA) every year, almost 2,500 civilian fire deaths and 12,300 civilian fire injuries.

1.2 Problem Statement

This thesis is targeting the high rise building that is much propagated by fire accidents. In fire breakout the floor is filled with full of smoke and using elevator is a worst idea at that time. To rescue people from high rise building is quite difficult. If we think about the structural way high rise buildings are amenable. Fire is spreading rapidly because of its

elevator shapes, and stairwells. Nowadays most of the buildings are developed by maintaining the rules and safety system are available according to the government. But in case of fire breakout many toxic gases, carbon monoxide, nitrogen dioxide, polycyclic aromatic hydrocarbons, volatile organic components (VOCs) are produced. People those who live in the top of the building just cannot see anything and smoke attack themselves in a way that they cannot breathe. So, to rescue people from upper-level floor is not so easy. In small building people can save their life to jump from the top or by doing alternative way and it is easy for the firefighters to rescue people and control the spread of the fire. But in case of high rise building which is 10 storied and above that time it is not possible to jump from that top level and that time damage and the death is increasing. There are many other detection systems that can identify the fire sprinkle or if there is something wrong. But sometimes it provides people the wrong information and the people may fall in trouble. Using this technique alone will not be sufficient to eliminate all of the damages described above. So, this is the current problem that has been identified in high rise building. This thesis is really progressing in terms of how we can be composed this challenge.

1.3 Importance of the proposed research

Lives and property both are the valuable things for a person. A fire's heat will quickly melt the lead fastenings, causing the light fixture to fall. These collapse hazards exist in the halls of concrete structures such as public schools, hospitals, and high-rise office buildings. For high-rise buildings, without using any fire detection it is not possible for a human being to find out from where and when fire can occur. From smoke, heat, increasing temperature

fire accident can be occurred. It has the ability to damage the property, people can be injured badly also they lost their lives within a second. False alarms are another obstacle that provides wrong information to the user. False alarms are inconvenient for building occupants, interrupt company operation, and for essential community tasks, such as-life threatening incidents. To save the lives and reduce the damages we need a significant system that assists us to control the fire efficiently. For high-rise buildings if owner is sleeping or busy working, it is not possible to check again and again weather the fire is occur or not. From the fire smoke environment is polluted also. Toxic gas, carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen all this assorted with the air, as a consequence air pollution and global warming is expanding. In case of fire accident, it will take long time to recover the damages. So, the lesser the property damages the shorter time to need for recovery. According to the NFPA, the United States Fire Department responded to 2,238,000 false alarms in 2012. So, we proposed a system that capable to reduce the false alarm, reduce the percentage of damages and save lives and mostly used for high-rise buildings to give extra security.

1.4 Research Questions

- Are multiple sensors able to reduce the false alarms?
- How can we get a good result by using several sensors?
- Is the system design appropriate for high-rise buildings?
- Is the system able to detect fire at the early stage?
- Will the GSM module able to give the notification message to the user on time?

1.5 Research Objectives:

- To propose a low-cost fire detection and alert system.
    - Detecting the fire.
        - To detect humidity and temperature level by using DHT11 sensor.
        - To sense different gases and smoke by MQ2 sensor.
    - Alarm for the fire detection.
        - To detect fire by the using of different sensor.
        - To pass the unit id to the monitoring unit by the using of wi-fi module.
        - To give the alarm by the buzzer.
    - Monitoring the fire detection.
        - To keep the records of the level of humidity, temperature, smoke, different gases and particular matter.
        - To send the SMS, GSM module is utilized.
- To demonstrate the performance of proposed system by utilizing a prototype.

1.6 Outline of order of information in the thesis.

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

Chapter II. Literature Review

Three research papers have been considered here as a reference. They are the IoT Based Fire Alarm System (Mahgoub, A., Tarrad, N,. Elsherif, R., Ismail, L., 2019), IoT Based Forest Fire Detection System (Trinath, B. M., 2018), Fire Detection, Monitoring and Alerting System Based on IoT (Shreya, G., Abhishek, J., Krutika, L., 2018).

2.1 Key concepts, Theories and Studies

In "IoT Based Fire Alarm System" the authors proposed a fire alarm system which are essential to alert people before a fire engulfs their homes.

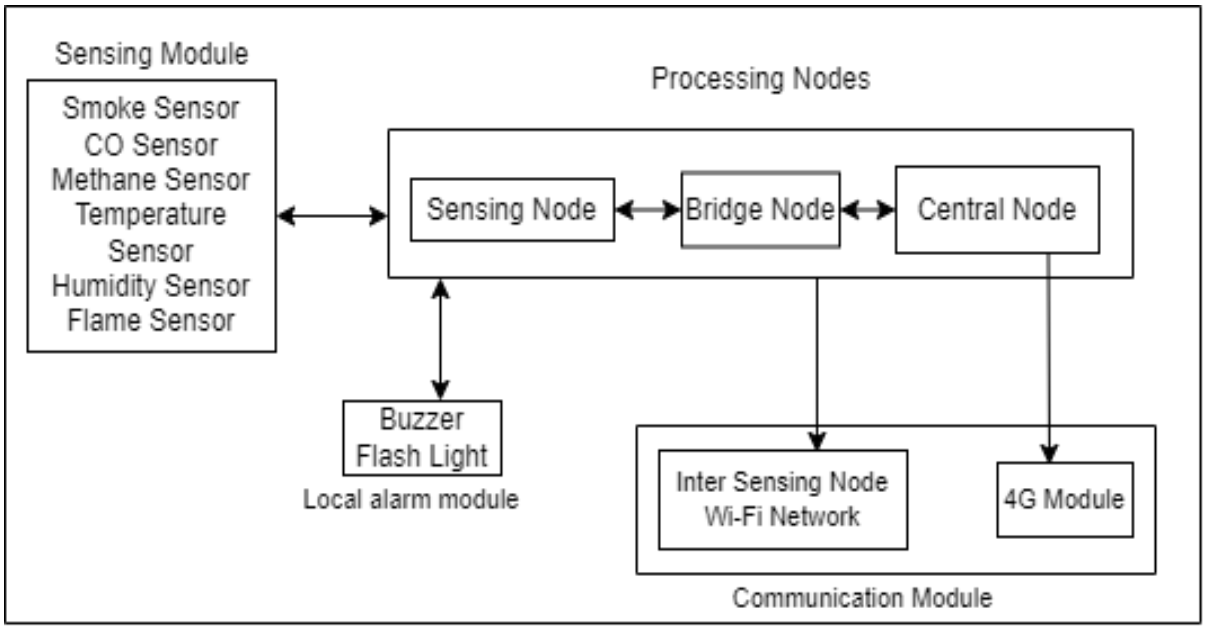

Figure 2.1: System's Block Diagram

Figure 2.1 shows the system's block diagram. The system consists of three main nodes: sensing node, bridge node and central node. Communication between the nodes is via the nodes' Wi-Fi interface. Communication with the user is via the 4G module. A local alarm module is used to alert system locally. There are two main functions in this system. The first one is for detecting fire. The detection nodes detect the environment and send the value of the sensors to the microcontroller to which they are connected. The microcontroller analyzes the parameters and compares them to a predefined threshold. If the threshold is exceeded, a local alarm is raised and a notification is sent to the brigade node, which notifies the central node. A fire alarm sent to the central node causes it to notify the fire brigade and the user via the GSM mobile network. In addition, the sensor values are periodically sent to the central node via the bridge node. If the bridge is unreachable, the sensor node forwards the packet to the next node, the packet keeps waiting for the node until it reaches the bridge node.

The second function of the system is to allow the user to request measurements from sensors in real time. The user sends a request via SMS. The central node receives the user's request via the GSM network and retrieves the value of the last sensors. The value is sent to the user. The central node has an additional function as it is configured to monitor the detection nodes and inform the user in case of failure. If a node does not reply to the central node, an SMS will be sent to the user to notify him.

Limitations:

The false fire alarm can be there, because no method has been used to verify the fire occur once. A mobile application needs to be developed, which will be able to easily access the system.

In “Fire Detection, Monitoring and Alerting System Based on IoT” the authors proposed a low-cost fire detection, monitoring and alerting system for industrial and home applications which is based on IoT.

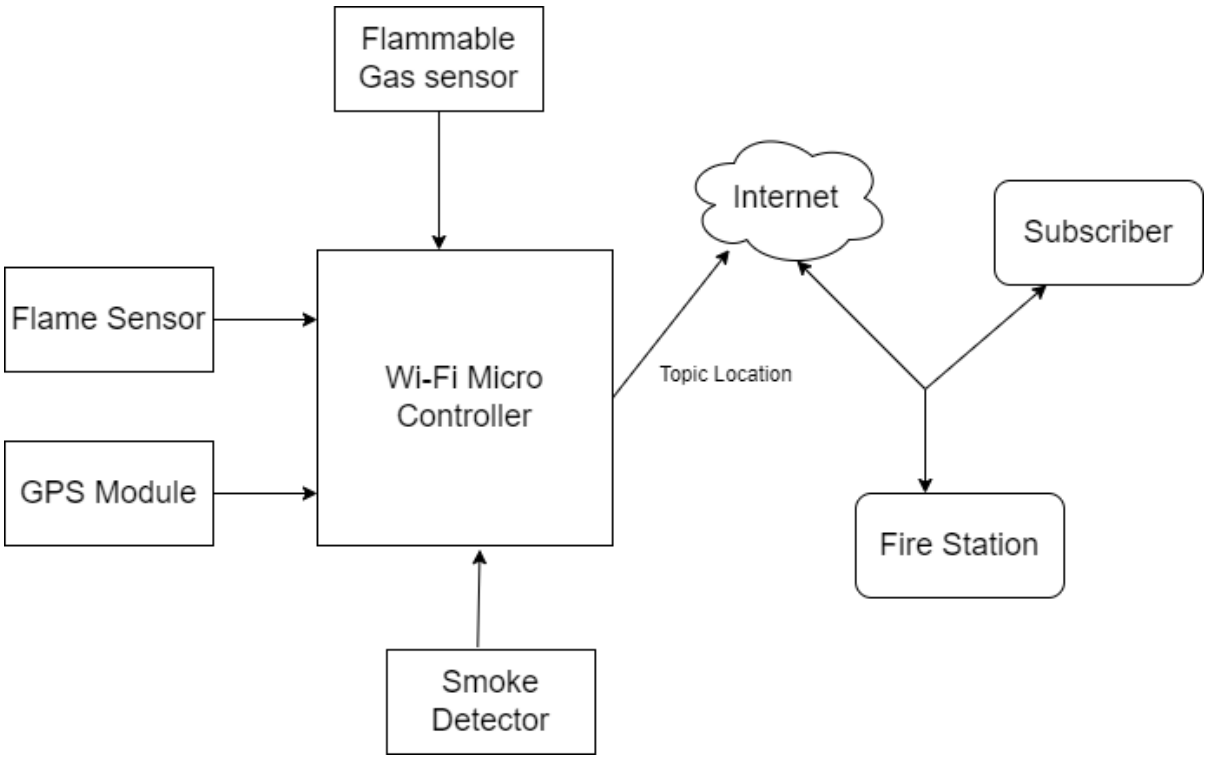

Figure 2.2: System’s Block Diagram

Figure 2.2 illustrate the block diagram of this project. To implement this proposed system a low-cost Wi-Fi module, gas detection sensor, Flame detection sensor, buzzer to alert and temperature sensors are used. The sensors detect and alerts the local emergency with the data collected by the system, and alerts organizations like fire departments, police stations and hospitals by sending the exact location to both user and operator through module which all are well connected with. In this frame they have inserted the LM35 and MQ6 sensors on the Arduino board. The temperature sensor is LM35. The LM35 sensor provides accurate readings

at room temperature. The smoke sensor used is MQ6, which detects smoke. It's a non-exclusive gas sensor. It detects LPG, isobutane, propane, hydrogen, smoke methane. The performance of the sensor depends on the performance of the gas. A small control unit acts as the central drive unit, which uses the properties evaluated by these sensors as a contribution for further processing. Each frame is fused with a bell. The whole frame is linked to a Wi-Fi module to have the possibility to exchange information from the sensors in different frames. Each frame has a unique identification number. The sensors on the frame receive information and continues to send it continuously through this site with the help of the Wi-Fi module. Reliable specialists will be sure to keep up to date with status in any area. Every time the value detected by the sensors changes significantly, an alarm is sent via both to the local fire department group and to the number indicated next to the frame. If the temperature or gas level rises outrageously, the sensors will activate the and an alarm will quickly be sent to the site as an alert to be received by the local fire department. The local fire department is then expected to send help as soon as possible as area will be registered with them. At that time, the local fire department focus group will send an immediate alert to the fire station closest to the scene of the accident. Just prior to an alarm, is also dispatched to the nearest medical clinic to send emergency assistance to in the event of an incident.

Limitations:

Their system has possibility of given false alarm as they don’t use any method for reducing false fire alarm.. In this system has no LED light for giving the fire alert notification.

In “IoT Based Forest Fire Detection” the authors proposed a system to detect the forest fire as early as possible by measuring the level of temperature and CO2 level.

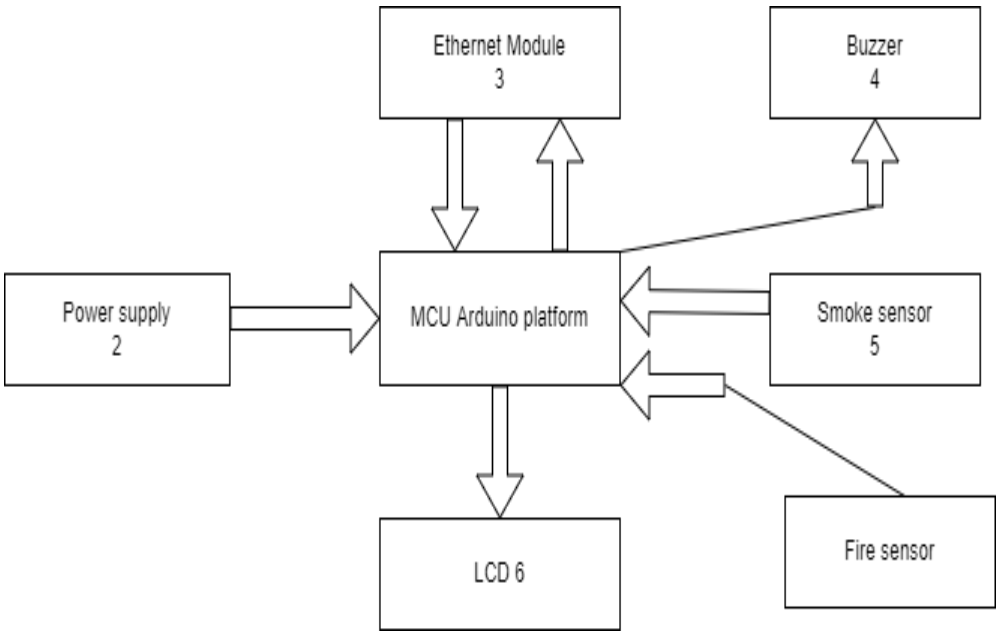

Figure 2.3: System’s Block Diagram

Figure 2.3 shows the block diagram of the system. They have used two sensors: smoke sensor and fire sensor for sensing the environmental value. These sensors will send the data to the microcontroller. Buzzer used for giving the notification of fire alert to the user. If any of sensor reading exceeds the threshold value the buzzer will be activated and give the fire alarm. At a time, a message will be sent to the forest department. Fire victim space will be notified by the satellite image tool. Then the forest department authority will take the action against fire.

The entire outlining of this IoT empowered woodland fire location and observing framework has been for the most part classified into 4 sections: -

• Interfacing and programming of LCD with Arduino.

• Interfacing and programming of Collector and transmitter with Arduino.

• Interfacing of Ethernet Shield with Arduino and making Taste condition by programming.

• Interfacing of sensors with transmitter.

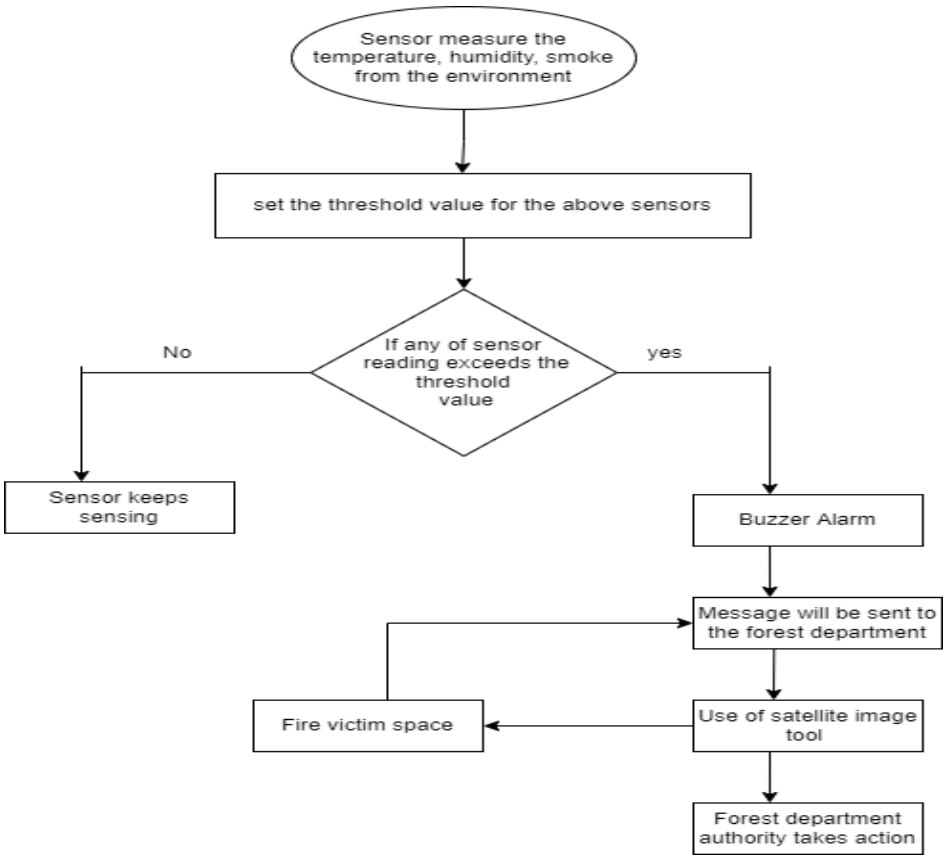

Figure 2.4: Flow Chart of the system

Limitations:

There has no LED light for giving the fire alert notification. As it is forest fire detection system, but there is no GPS tracking system has been used to detect the place where fire has occurred.

2.2 Gaps in Existing Knowledge

In other research paper they do not check the system two times. So, it has possibility to give the false alarm. Even some researchers use only GSM, they do not use any alarm system. But our target is to reduce false alarm. We are also introducing the alert system that can help the users to notify. Our main goal is to reduce false alarm and give alert to the flat or building owner.

Chapter III. Research Methodology

We use different sensor for detecting, and monitoring the fire detection in high-rise building and this sensor will help us to minimize the rate of false alarm. We used Wi-Fi technology; a Wi-Fi router will be working for collecting the environmental data which is came from sensor. GSM module will be used here for giving the alert notification to the user on time.

3.1 Research Design

We proposed a system for detecting and monitoring the fire accident and minimize the rate of damages and lives. We focus on high-rise building which is very hazardous as they use manual fire detection system. Giving false alarm is another trouble that people become terrified without any impetus. As it is design for high-rise building so a unique number is allocated for every floor. After initializing the node MCU the environmental temperature and humidity is checked. We are using low cost of DHT11 sensor that takes the parameter of humidity and temperature. This time the system compares the pair value with the given threshold value. We have used MQ2 sensor for second time checking to reduce the rate of false alarm. MQ2-sensor detect the presence of smoke, heat, or carbon monoxide. It can happen that the alarm which is coming is not actual fire alarm or one of many false alarm conditions. So before deciding that the alarm is an actual alarm the MQ2 sensor compare the input and give the right decision. For accumulating and proceed the data we use router technology. As the constitution is for high-rise building so assorted data is gathering through the router. As an end user we use the owner cell number or fire brigade number that’s why the SMS will send to the owner cell number or to the fire brigade after detecting fire. The fire accident is monitored by the monitoring unit. We are preparing and designing a prototype which will be utilized to regulate the performance.

3.2 Research Methods

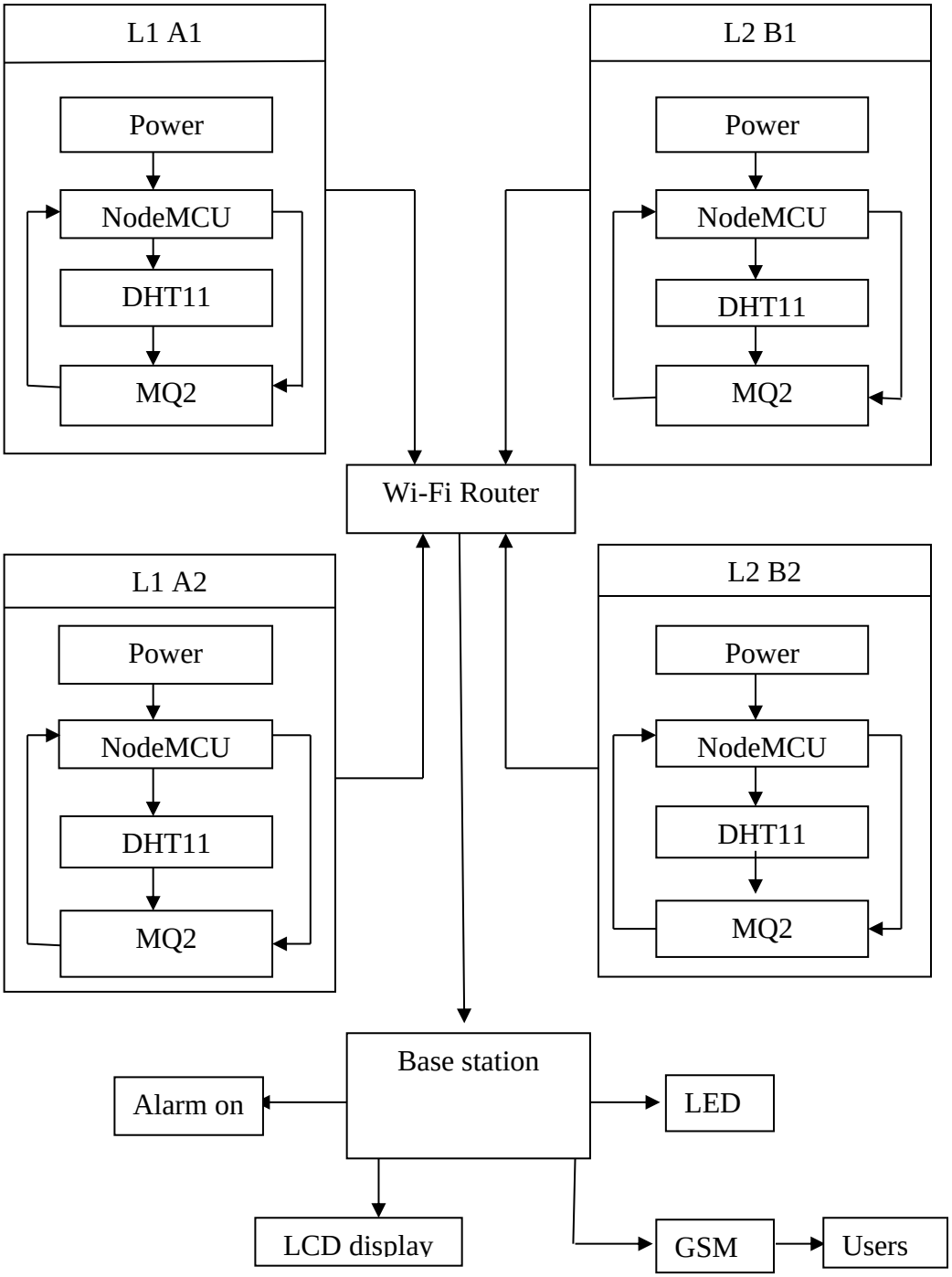

Figure 3.1 Block Diagram of Proposed System

Figure 3.1 depicts the proposed model's block diagram. Here we showed that how our system is work for two storied building. For a high-rise building each building has separate unique id like level-1 A-1 (L1 A1) level-1 A-2 (L1 A2). Our system is implemented for every floor. First the DHT11 sensor is connected with the node MCU for sensing the environmental temperature and humidity. A threshold value is given for understanding the level of temperature and humidity value. For any reason if the temperature and humidity level is more than the threshold value that time MQ2 sensor start to working. It also connects with node MCU and when both humidity level and temperature level is more than threshold value that time MQ2 take the gas and smoke level value. For gas and smoke a threshold value has also given. After crossing this threshold value, the entire system understands that there has occurred fire accident. For collecting the information, we use router protocol. Figure 3.2 we design for two storied building where each floor has 2 units. For that design we use one router to collect the information. All the information that means temperature humidity and gas value are displayed in LCD display which is situated in monitoring section. The unique id has also displayed that is given for individual flat. When the information come to the monitoring center that time GSM module is working. The house owner phone number or fire bridged phone number has inserted into the GSM module. So, a message has sent to those number and necessary steps will take for reduce the damage. Also, at the same time a buzzer is on to alert the other people about the fire accident. Here our main purpose is to checking the fire’s related information two times for minimizing the false alarm.

Flow chart of Proposed Model:

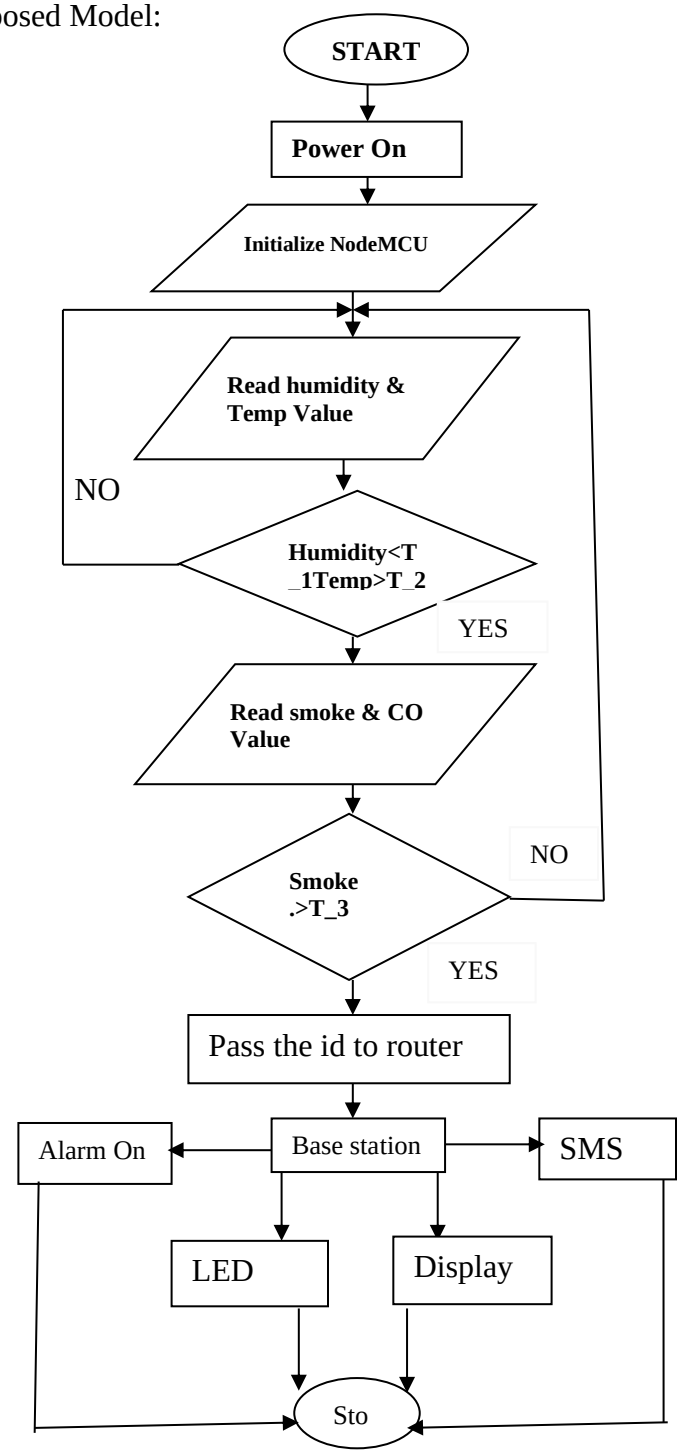

Figure 3.2 Flow Chart of Proposed System

Figure 3.2 depicts how the proposed system will function. The entire system is powered by an electricity charge. First, we must connect the node MCU to the sensors. We use a DHT11

sensor to detect temperature and humidity. All sensor values are read by the node MCU, and the data is converted from analog to digital. We take the temperature threshold T_1 value degree 50 C – degrees 60 C and humidity threshold T_1 value 30% - 50%. At the same time the sensor takes the temperature level and air humidity level. If the both level is more than the threshold value level then MQ2 sensor will work. MQ2 sensor senses the smoke and as a gas it measures the carbon monoxide level. A threshold value has given for smoke and gas. If the sensed value is more than the threshold value that time the data will send to the base unit by Wi-Fi. Each floor has assigned with a unique id. So, the data will pass with that unique id for understanding the location where the fire actually will occur. Monitoring unit will decide that fire has occurred and from there SMS will send to the owner cell number and also fire brigade. A buzzer also will give an alarm that fire has occurred.

3.3 Research Tools

Our proposed system needs software and hardware requirement. We are using two sensors for measuring temperature, humidity, smoke and carbon monoxide. We have taken temperature and humidity levels with the DTH11, a MQ2 sensor to detect smoke, and carbon monoxide gas, node MCU for giving connection. Wi-Fi Module used for passing the data to the base station. GSM module we used for sending message to the user and fire brigade. Buzzer used for giving the alert notification to user on time.

DHT 11:

The DHT11 is a simple and very low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and thermistor to measure the ambient air and output a digital signal to the data pins (no analog input pins required). It's fairly easy to use, but it requires careful timing to collect the data. A temperature and humidity sensor complex with calibrated digital signal output is included in the DHT11 temperature and humidity sensor. Adopting original digital signal detection technology and temperature / humidity detection technology, it guarantees high reliability and excellent long-term stability. The sensor incorporates a resistance humidity detection component and an NTC temperature detection component to interface with a powerful 8-bit microcontroller that offers superior quality, fast response, and interference protection.

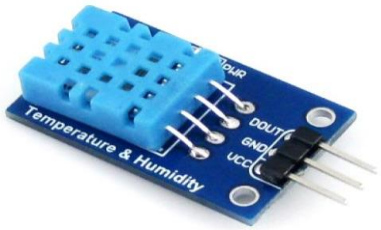

Figure 3.3 (a) DHT 11

LCD:

Liquid Crystal Display (LCD) is a kind of level board show which involves fluid gems in its essential type of activity. LEDs have an enormous and shifting arrangement of purpose cases for purchasers and organizations, as they can be ordinarily found in cell phones, TVs, PC screens and instrument boards. Liquid Crystal Display (LCD) or other electronically balanced

optical gadget that utilizes the light-adjusting properties of fluid gems joined with polarizers. Fluid precious stones don't radiate light straightforwardly, rather utilizing a backdrop illumination or reflector to create pictures in variety or monochrome. LCDs are accessible to show inconsistent pictures (as in a broadly useful PC show) or fixed pictures with uninformed substance, which can be shown or stowed away. For example: preset words, digits, and seven-portion shows, as in a computerized clock, are altogether genuine instances of gadgets with these presentations. They utilize a similar essential innovation; then again, actually erratic pictures are produced using a grid of little pixels, while different showcases have bigger components. LCDs can either be regularly on (positive) or off (negative), contingent upon the polarizer plan.

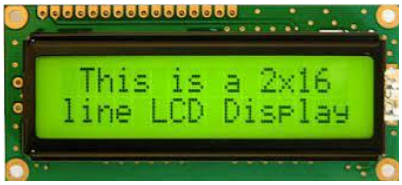

Figure 3.3(b) LCD

MQ 2:

Delicate material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. Whenever the objective combustible gas exists, the sensor's conductivity gets higher alongside the gas fixation rising. Clients can change the difference in conductivity over to relate yield sign of gas focus through a straightforward circuit. MQ-2 gas sensor has high aversion to propane and smoke, additionally can recognize the gaseous petrol and other combustible steam well. It is with minimal expense and appropriate for various uses of identifying sorts of

combustible gases. It is broadly utilized in homegrown gas spillage caution, modern combustible gas alert and versatile gas identifier.

Figure 3.3(c) MQ 2

Node MCU:

MCU represents Micro Controller Unit - which truly implies it is a PC on a solitary chip. A microcontroller contains at least one CPUs (processor centers) alongside memory and programmable info/yield peripherals. They are utilized to mechanize car motor control, implantable clinical gadgets, controllers, office machines, apparatuses, power devices, toys and so on. Node MCU is an open-source firmware and improvement unit that helps you to model or fabricate IoT items. It remembers firmware that runs for the ESP8266 Wi-Fi SoC from Expressive Systems, and equipment which depends on the ESP-12 module. The firmware utilizes the Lua prearranging language.

Figure 3.3(d) Node MCU

GSM Module:

Figure 3.3 (e) shows the GSM module. The SIM800L is a cheap and portable GSM breakout board with all the capabilities of the larger SIM900 shields. It supports networks: China Mobile, China Unicom and global quad-band network. Its power module automatically boots, homing network. It has onboard signal lights all the way. It flashes slowly when there is a signal, it flashes quickly when there is no signal.

Figure: 3.3 (e) GSM Module

Connecting Wire:

Interfacing or connecting wires permits an electrical flow to go starting with one point on a circuit then onto the next in light of the fact that power needs a medium through which it can move. Most wires in PCs and electronic parts are made of copper or aluminum. Copper is modest and electrically conductive. Silver has higher conductivity yet is undeniably more costly. In a fundamental circuit, the wire comes from one terminal of a power source, like a battery. It then, at that point, associates with a switch that decides if the circuit is open or shut. The wire then, at that point, interfaces with the gadget that is drawing power, permitting it to

draw power and play out its undertaking. At long last, the wire interfaces the heap back to the contrary terminal of the power source.

Figure 3.3(f) Connecting wire

LED:

Figure 3.3 (g) shows a light-emitting diode (LED) which is a semiconductor light source that emits light when current flows through it.

Figure: 3.3 (g) LED

Breadboard:

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

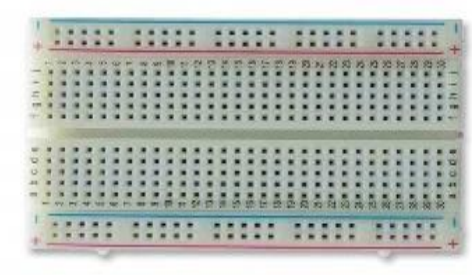

Figure: 3.3 (h) Breadboard

Buzzer:

Buzzer is a kind of voice device that converts audio model into sound signal. It is mainly used to prompt or alarm.

Figure: 3.3 (i) Buzzer

Then we are using Arduino IDE 1.8.15 and Embedded C Language for software designing. Arduino IDE is a free integrated development environment that program in the Arduino board. The boards are considered microcontrollers units instead of computers and also called MCU systems. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. The open-source Arduino software (IDE) makes it easy to write code and upload to the board. This software can be used with any Arduino board. The microcontroller itself (just the chip) can be programmed

using embedded C inside the Arduino IDE. The written program must then be compiled, assembled, linked, and then physically written (flashed) out onto the microcontroller's program memory.

3.4 Practical Considerations

The system that we are working on, during designing a prototype we have to make Arduino size as small as possible. As we are applying threshold value to measure the different values, sometimes it often lacks the sensitivity and specificity needed for accurate classification. We are using double checking system in one prototype, so some complexity is there as well.

Chapter IV. Result and Discussion

For detecting and monitoring the fire we used different sensor, different devices which will help to reduce the fire accident from the high-rise building and GSM module which will be used to give the alert message to the fire brigade on time. LED light will be used to give the alert message to the security guard of the building. For testing the system that we have assumed, we have designed a prototype based on our research method or procedure to demonstrate the performance.

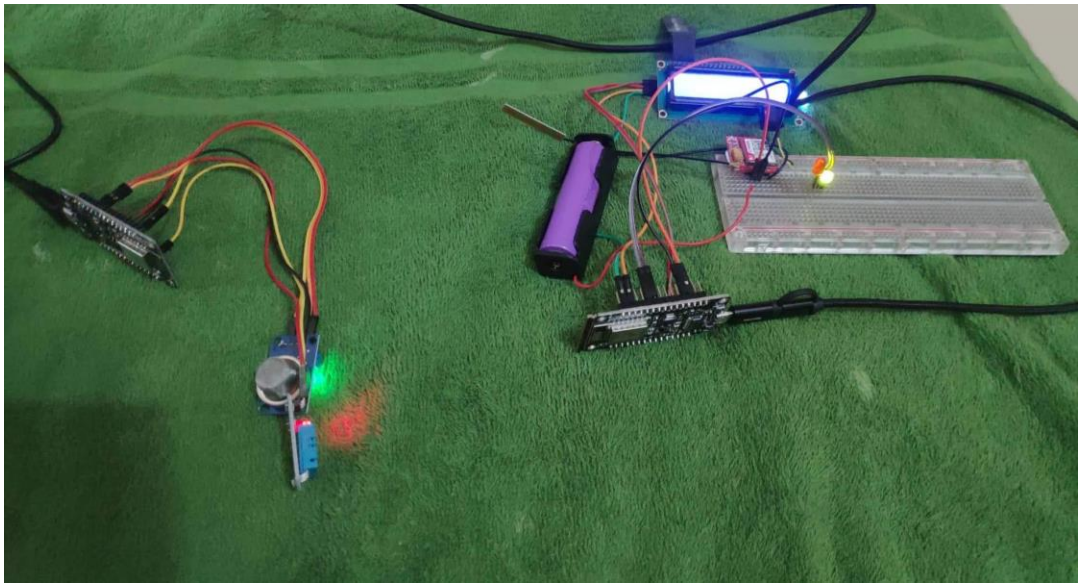

Figure 4.1: Overview of the fire detection system

Figure 4.1 shows a prototype that we have prepared for testing the system. It is the overview of the fire detection system.

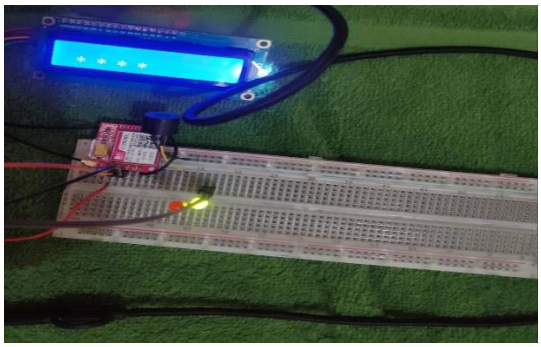

Figure 4.2: Initial Display screen

Figure 4.2 shows the initial display screen after connecting all those things.

Table 4.1: Detecting Range of parameter

Parameter	Range
Temperature	45 degrees Celsius
Humidity	25 degrees Celsius
Gas	150 ppm

Table 4.1 shows the detecting range of different parameters. Here, we are measuring the level of environmental value that means we are considering the threshold value.

Figure 4.3: Graph of MQ2 Gas Sensor

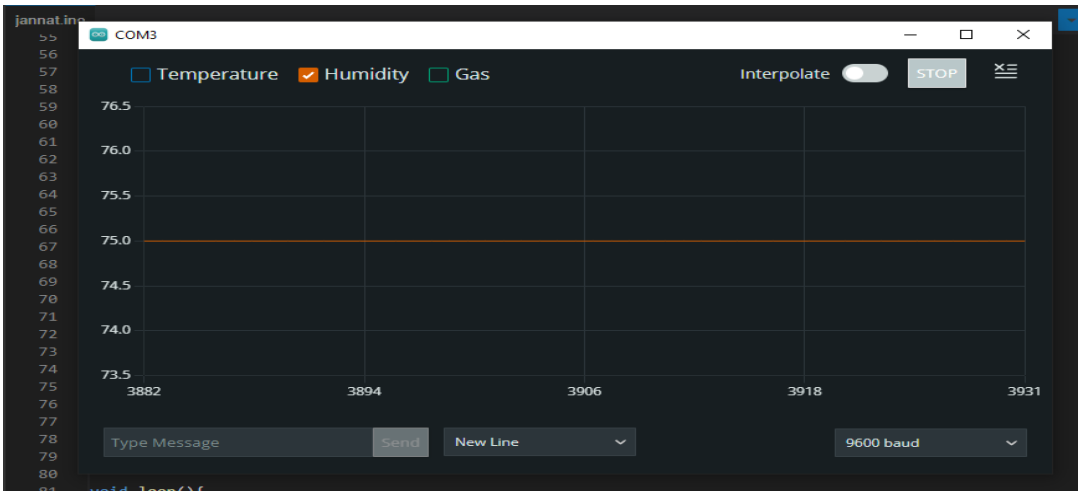

Figure 4.4: Graph of DHT 11 Humidity sensor

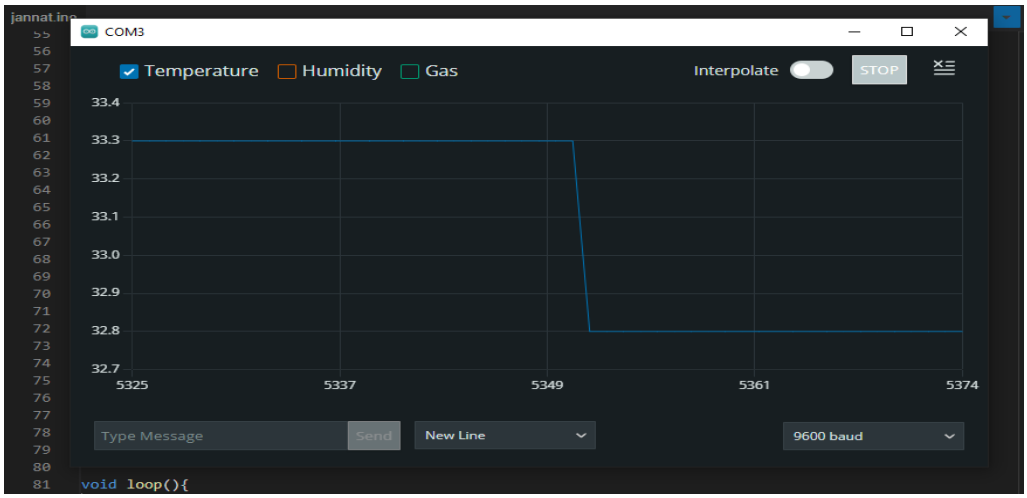

Figure: 4.5: Graph of DHT11 Temperature sensor

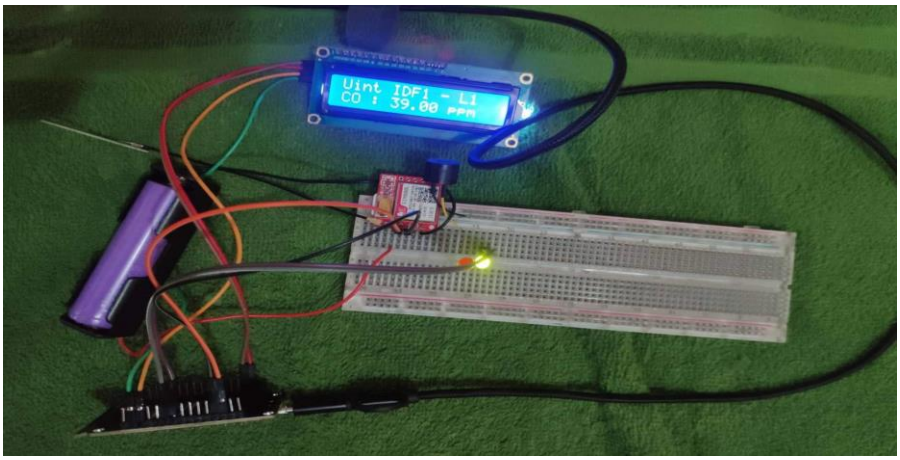

Figure 4.6: Showing Value with unit ID

After testing the prototype for detection system, gas is detected by MQ2 sensor, humidity and temperature level is detected by DHT11 sensor. After detecting the different environmental value, if the level is in the threshold value, then sensor will again detect the environmental value. If the value of humidity and temperature sensor is in threshold value, then the gas sensor will not be activated. The gas sensor will be activated when the humidity and temperature value is more than threshold value. If all the sensing value is more than threshold value then access point will pass the value with its unit id. If it is not then again DHT11 sensor will detect temperature and humidity from first. For real time monitoring system, we are using an application where we are set the value to evaluate the performance of the prototype. Whatever the values are shown on the LCD display, the same values are showing into the app. If the values are exceeded, then it will send to the receiver point. Then from the receiver point it will give the notification to the user by a red LED light and alarm will turn on and a SMS will send to the fire brigade as well.

Chapter V. Conclusion

Various studies have previously been conducted on this subject, but we are working to improve the results and make them more efficient or effective by incorporating new methodologies and experimenting with various IoT technologies. We performed fire detection in this project, and after detecting fire, a buzzer will sound, a green led light will become red, and an SMS will be sent to the fire department for fire control. The fire detection and alarm system we chose is mostly based on the Internet of Things. The Internet of Things (IoT) is defined as a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people with unique identifiers and the ability to send data over a network without requiring human-to-human or human-to-computer interaction. IoT is likewise limited in terms of resources. To overcome the constraints, it faces a number of significant problems. Application needs and interaction with the environment, physical resource restrictions, self-management, and so on. Because IOTs are triggered by external events, their activity graph might change dramatically over time. While activity is often minimal, when an environmental change happens, activities occur in bursts, which can cause traffic congestion. As a result, we've decided to focus our study on IoT-based fire detection. Fire detection and protection are major problems in high-rise buildings that we are targeting for our thesis. protection is a key issue. A propane tank, a defective product, a vehicle crash, or inadequate workplace safety can all contribute to a fire accident. Fires in high-rise buildings can happen for a variety of causes. Cooking equipment, heating equipment, electrical and lighting equipment, smoking materials, and intentional fires are some of the most typical causes. These factors contribute to the

occurrence of fire accidents in high-rise buildings. We discovered that certain systems employ image processing and employ many sensors at the same time. We've also discovered that they use ionization, photoelectric, and heat detectors, among other things. We aim to put in place a system that is more accurate and reduces the number of false fire alarms. That is why we designed this technology in such a way that it can double-check the environmental value. There is a low chance of giving a false alarm if the value is verified again. To solve the fire detection problem, various writers have offered various systems, procedures, or methodologies. Based on IoT, one of the researchers presented an early fire detection system for home monitoring. Their system is focused on environmental monitoring and early intervention to avoid any casualties. The end device, gateway, action point, server, and user are the five major points in their system. The authors proposed a fire detection system based on light detection and analysis in another system. The proposed solution for these systems is a real-time processing method based on color circumstances and fire growth verification. The frame discrepancies are used to monitor the spread of the fire. Another intriguing contribution is the authors' proposal for a review of the Internet of Things-based wildfire detection system. In comparison to satellite-based systems, IOT can identify and monitor wildfires in real-time and quickly. Although satellite-based detection is the most prevalent approach for detecting fire, its efficiency is limited by its long scan time and low resolution. Sensor nodes collect data on temperature, humidity, smoke, and other characteristics and send it to the appropriate cluster head, which then sends the data to the manager node, resulting in the creation of a network. The sensors collect data from the environment based on the parameters we wish to measure, and this data is passed on to further sensors until it reaches the gateway. We discovered that there is no alarm system or SMS system in some of the papers. Some systems have been designed in such a way

that they may generate false alarms. Our main goal is to limit the number of false alarms. "IoT Based Fire Detection and Alarm System for High-Rise Building" is the name of our system. As a result, we've set up the system in such a way that it will help eliminate false warnings. The proposed system is capable of detecting all felt values from the surrounding environment, such as temperature, humidity, gas, and smoke. In the LCD display, we can observe the sensor value. If the sensed value exceeds the threshold, the value is transmitted to the reception point through the Wi-Fi module. The sensed value will be supplied together with the unit id so that security may determine which unit has experienced aberrant behavior. The access point must have a Wi-Fi module to send the sensing value to the receiving point. The gas sensor will be triggered and begin to detect gas and smoke if the humidity and temperature values are higher than the threshold value. Otherwise, the gas sensor will be in a dormant state. On the reception point, there will always be a green LED light that will change red after the fire and a buzzer will sound. After detecting a fire, the system sends alert notifications to the security guard and the fire department. The SMS is delivered to the fire department via the GSM module. We are creating a prototype to regulate the performance after designing our recommended model. When we tested our prototype for the detection system, we used the DHT11 sensor to detect temperature and humidity, and the MQ2 sensor to detect gas and smoke. On the LCD panel, the value has been displayed. When we discover that the temperature, humidity, gas, and smoke values are higher than the threshold value, the Wi-Fi module sends the values to the receiving point. A buzzer then sounded, and the green LED light turned red. Through the GSM module, an SMS was sent to the fire department. Users will be able to display real-time data on the webpage as well. In several countries, fires in high-rise buildings are a major problem. During the prototype's installation, we encountered some issues. We were concerned about the

accuracy of the system because it would give more accurate results and reduce false alarms. Finally, by checking the value for a second time, we were able to obtain an accurate result. This proposal is inspired by the wish to support people who are unconscious, as well as to decrease the risk of fire death and infrastructure damage. When the researchers observe our paper, the reader will be capable to create a critical assessment of them.

References

S. K. Bhoi *et al.*, "FireDS-IoT: A Fire Detection System for Smart Home Based on IoT Data Analytics," *2018 International Conference on Information Technology (ICIT)*, 2018, pp. 161-165, doi: 10.1109/ICIT.2018.00042.

K. Jayaram, K. Janani, R. Jeyaguru, R. Kumaresh and N. Muralidharan, "Forest Fire Alerting System With GPS Co-ordinates Using IoT," 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), 2019, pp. 488-491, doi: 10.1109/ICACCS.2019.8728383.

S. D. V, S. Y. R, T. Sneka, S. Shobika and S. R. S, "IoT Based Intelligent Fire Fighting Machine Using Arduino," 2021 5th International Conference on Electronics, Communication and Aerospace Technology (ICECA), 2021, pp. 445-451, doi: 10.1109/ICECA52323.2021.9676011.

M. Ralevski and B. R. Stojkoska, "IoT based system for detection of gas leakage and house fire in smart kitchen environments," 2019 27th Telecommunications Forum (TELFOR), 2019, pp. 1-4, doi: 10.1109/TELFOR48224.2019.8971021.

K. R. Ahmed and M. Alomgir Hossain, "An automated IOT Based Fire Detection & Safety Control for Garments industry in Bangladesh: A-Study," 2021 International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI), 2021, pp. 1-5, doi: 10.1109/ACMI53878.2021.9528094.

G. B. Neumann, V. P. d. Almeida and M. Endler, "Smart Forests: fire detection service," 2018 IEEE Symposium on Computers and Communications (ISCC), 2018, pp. 01276-01279, doi: 10.1109/ISCC.2018.8538719.

K. R. Ahmed and M. Alomgir Hossain, "An automated IOT Based Fire Detection & Safety Control for Garments industry in Bangladesh: A-Study," 2021 International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI), 2021, pp. 1-5, doi: 10.1109/ACMI53878.2021.9528094.

A. Divya, T. Kavithanjali and P. Dharshini, "IoT Enabled Forest Fire Detection and Early Warning System," 2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN), 2019, pp. 1-5, doi: 10.1109/ICSCAN.2019.8878808.

S. Z. Yahaya, M. N. Mohd Zailani, Z. H. Che Soh and K. A. Ahmad, "IoT Based System for Monitoring and Control of Gas Leaking," 2020 1st International Conference on Information Technology, Advanced Mechanical and Electrical Engineering (ICITAMEE), 2020, pp. 122-127, doi: 10.1109/ICITAMEE50454.2020.9398384.

M. E. Hassin, A. Al Neon, S. Sabila and R. M. Rahman, "Smart Fire Detection and Security System," 2021 IEEE 12th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), 2021, pp. 0460-0465, doi: 10.1109/UEMCON53757.2021.9666623.