اقليم كوردستان – العراق جامعة
جيهان - اربيل
كلية الهندسة
قسم هندسة الاتصالات و الحاسبات

هەرێمی کوردستان – عێراق
زانکۆی جیهان – هەولێر
کۆلێژی ئەندازیاری
بەشی ئەندازیاری گەیاندن و کۆمبیوتەر

Kurdistan Region – Iraq

Cihan University - Erbil

College of Engineering

Communication & Computer Engineering Department

Design and Implementation of a Forest Monitoring System using Arduino, GPS, and GSM

A graduation project
submitted to the department of communication and computer engineering
in partial fulfillment of requirements of bachelor's
degree for computer and communication engineering

By

Mohammed Sanaan Qasim

Ibrahem Mudhafar Othman

Maryah Akram Mahmood

Supervised By

Asst. Lec. Firas M. Zeki

2024 – 2025

Certification

I certify that this project was prepared under my supervision Asst. Lec. Firas M. Zeki at the department of Communication and Computer Engineering, Cihan University- Erbil of as partial requirement for the degree of:

Bachelor of Science

In

Communication and Computer Engineering

Supervised By

Asst. Lec. Firas M. Zeki

In view of the available recommendation, I forward this project for debate by the examining committee.

Asst. Lec. Firas M. Zeki
Cihan University-Erbil
College of Engineering
May 2025

We, the examining committee, certify that I have read this project and have examined the students in its contents and that in our opinion it is adequate as a partial requirement for the degree of:

Bachelor of Science

In

Communication and Computer Engineering

Lecturer	Lecturer	Lecturer
Asst. Lec. Adil Al-Dalowi	Lecturer. Yazen Saifuldeen	Asst. Lec. Firas M. Zeki
Cihan University	Cihan University	Cihan University
College of Engineering	College of Engineering	College of Engineering
Department of Communication and Computer Engineering	Department of Communication and Computer Engineering	Department of Communication and Computer Engineering
(Member)	(Head of Committee)	(Supervisor)

Approved for the department committee of under-graduation studies

Prof. Dr. Nassir Hussien Salman

Cihan University

College of Engineering

Department of Communication and

Computer Engineering

(Head of Department)

Acknowledgement

We would like to show our thanks and gratitude to our family, friends and to the lecturers who have provided us with invaluable advice and helped us through with the project especially our supervisor Asst. Lec. Firas M. Zeki and Prof. Dr. Nassir Hussien Salman (Head of the department of Communication and Computer Engineering) for their continuous support. Without their support this project wouldn't be complete. Last but not least we would like to thank everyone who helped motivate us to finish this project successfully.

Abstract

The forest plays a very important role in any country and mankind as a whole. They contribute to the environmental, economic, and social well-being of the country. The forests are very crucial for the survival of the wildlife and also play an important role in the food chain to maintain the ecological balance. All of us depend on the forest for our survival which includes activities from the air breath to the wood used. Forest not only provides habitat for the animal's livelihood for humans but they also help in the watershed protection, soil erosion prevention and mitigation of climate change. Forest fire detection system is used to detect forest fire and to send the required amount of help to stop fire.

Table of Contents

Chapter One 1

1.1 Introduction 2

1.2 Aim 2

1.3 Problem Statement 3

1.4 Proposed Methodology 3

Chapter Two 4

2.1 History of GPS 5

2.1.1 GPS features 5

2.1.2 GPS in Today's World 5

2.2 History of GSM 7

2.2.1 Structure of GSM networks 8

2.2.2 GSM features 9

2.2.3 Is GSM still useful? 10

2.3 GPS & GSM 10

2.4 Arduino 10

2.4.1 Arduino Hardware 11

2.4.2 Arduino Features 12

2.5 Introduction to the climate change in Iraq and Kurdistan Region 12

2.5.1 Fire Alerts in Iraqi and Kurdistan Region Provinces 13

2.5.2 Causes of Forest Fire 14

2.5.3 Effects of Forest Fire 14

2.6 Literature Review 15

Chapter Three 16

3.1 Project Requirements 17

3.2 Block diagram of Real-Time System of Forest Fire Monitoring 22

3.2.1 Block diagram of Real-Time System of Forest Fire Monitoring 23

3.2.2 Flowchart of Real-Time System of Forest Fire Monitoring Using GPS & GSM Technology 24

Chapter Four 25

4.1 Project Implementation and Design 26

4.2 Project Result..... 27

Chapter Five..... 28

5.1 Discussion..... 29

5.2 Future Work..... 30

5.3 Conclusion..... 30

Reference..... 31

Table of Figures

Figure 1 – NEO-6M GPS Module.....6
Figure 2 – Example of Automotive navigation..... 6
Figure 3 – Example of Weather and science applications.....7
Figure 4 – GSM800L Module.....8
Figure 5 – Arduino MEGA 2560..... 11
Figure 6 – Arduino MEGA 2560.....17
Figure 7 – GSM800L Module.....17
Figure 8 – NEO-6M GPS Module.....18
Figure 9 – MQ2 Smoke Detector..... 18
Figure 10 – IR Flame Sensor.....19
Figure 11 – LM35 Temperature Sensor.....19
Figure 12 – Breadboard.....20
Figure 13 – 9V Battery.....20
Figure 14 – Jumper Wires.....21
Figure 15 – 9V to Barrel Jack Adapter..... 21
Figure 16 – Overall connection of Real-Time System of Forest Fire Monitoring..... 22
Figure 17 – Block diagram of Real-Time System of Forest Fire Monitoring..... 23
Figure 18 - Flowchart of Real-Time System of Forest Fire Monitoring.....24
Figure 19 – Project Design..... 26
Figure 20 – SMS Result..... 27
Figure 21 – Project Result on map..... 27

Chapter One
“Introduction”

Chapter One – Introduction

1.1 Introduction

In the current climate, wildlife and wildlife authorities face the challenge of animal migration from woods to residential areas. Natural disasters caused by nature, such as wind, lightning, dry undergrowth and human negligence, will ruin acres of land and consume everything in their path, causing tremendous destruction to both natural and human capitals. Our planet Earth has its carbon-rich nature cover, seasonally dry temperatures, atmospheric oxygen, and extensive lightning and volcano ignitions, let's also not forget that Earth is a naturally flammable planet. The forest is a haven for wildlife, and a source of oxygen. Because they are surrounded by oxygen, the combustion reaction occurs quickly. The volume and condition of material available to burn (leaf litter, bark, leaves, and branches) can have a significant impact on the severity of a forest fire. When a forest fire breaks out, the spread of wildfires is determined by the amount of flammable material available, its vertical distribution, moisture content, and weather conditions. The world is nowadays under fire, and the heated environment is becoming unsuitable for both animals and humans. As carbon dioxide levels rise, so does global warming, and trees are the primary component in lowering carbon dioxide levels. So, if forest fires are not addressed, we are going to face the most difficult situation. The suggested system will build a monitoring system capable of detecting the fire as soon as possible before it spreads over a large area and preventing poaching.[1][2][9]

1.2 Aim

A large area of land that is heavily vegetated with trees and other plants is referred to as a "forest." Forest ecosystems are important for a variety of reasons. It is crucial to have a real-time system forest fire monitoring using GPS and GSM technology that safeguards forests, communities, and homes against wildfire dangers. Wildfire smoke and air pollution can pose a serious health risk, and the flames can destroy or damage homes and businesses. The aim of this system is to help in protecting life, property, and any recognized resources in need of safeguarding.[2]

1.3 Problem Statement

There are various potential risks that can affect the stability of the forests. Fires are among the most catastrophic natural disasters that have impacted the area, they have become more frequent, causing mass destruction, property damage, and even death when compared to other hazards. The real-time system for forest fire monitoring using GPS and GSM technology can be used to prevent these catastrophic disasters from happening by helping the emergency services with early detection of the forest wildfire before it spreads out.[2]

1.4 Proposed Methodology

A real-time system for forest fire monitoring using GPS and GSM technology that detects and tracks the fire location. The GSM modem and GPS receiver utilizes Arduino, for sending and receiving information a GSM mobile phone can be used, that is how the GPS system will send the location that corresponds to the location of the fire on the GSM modem, for example, if a fire is detected an SMS will be sent to the emergency services. A GSM module will be installed in the system and it will also have a SIM card, the SMS will be received and sent to the Arduino through the GSM modem in the system. When the SMS is received the Arduino will be responsible for checking the request and the authentication. If everything is correct and it matches, then the request will be performed and an SMS containing the location of the wildfire will be sent to the emergency services along with a link of the area on the map that contains the position of the burning area.[5]

Chapter Two
“Background Theory”

Chapter Two – Background Theory

2.1 History of GPS

In the US, GPS initially appeared in the 1960s as a satellite navigation system for tracking submarines and military missile vehicles. The successful satellites were able to identify submarines in a matter of minutes. In order to enable advanced navigation systems, the Department of Defense agreed to deploy 24 additional satellites in 1978 in an effort to advance the technology. Selective Availability allowed the military to be the only users of GPS for almost 20 years. Selective availability refers to the US's capacity to limit access to some GPS systems based on worries about national security. On the other hand, the US government chose in May 2000 to follow President Bill Clinton's directive and stop offering GPS to private and business customers globally. With China's own GPS satellite system, BeiDou, launched in May 2020, GPS can be used for tracking and data reporting as the public sees appropriate. However, it is still fully controlled by the US government and functions as a national navigation system. The design is quite the same as the recently launched Russian satellite. The system started to compete with the December 2019 launch of GLONASS.[3]

2.1.1 GPS features

a. Standalone GPS receiver
b. Anti-jamming technology
c. UART (Universal Asynchronous Receiver/Transmitter) Interface at the output pins
d. Default baud rate: 9600bps
e. EEPROM with battery backup
f. Sensitivity: -160dBm
g. Supply voltage: 2.7V - 3.6V
h. Maximum DC current at any output: 10mA
i. Operation limits: Gravity -4g, Altitude -50000m, Velocity -500m/s
j. Operating temperature range: -40ºC to 85°C

2.1.2 GPS in Today's World

In the present day, GPS is used for a variety of purposes regarding real-time forest fire monitoring for the purpose of acquiring accurate and reliable source of location and time information of the area affected by the wildfire, also GPS is used in. [13] :

- Automotive navigation
- Weather and science applications

Figure 1 – NEO-6M GPS Module

Automotive navigation

An automotive navigation device shows the vehicle's location on the map and its route to a specific location. At a certain intersection, the vehicle's navigation system directs the driver to turn left or right. The precise location and direction of the vehicle are determined by the navigation system through the use of GPS signals. An example of automotive navigation is MAPS.ME.

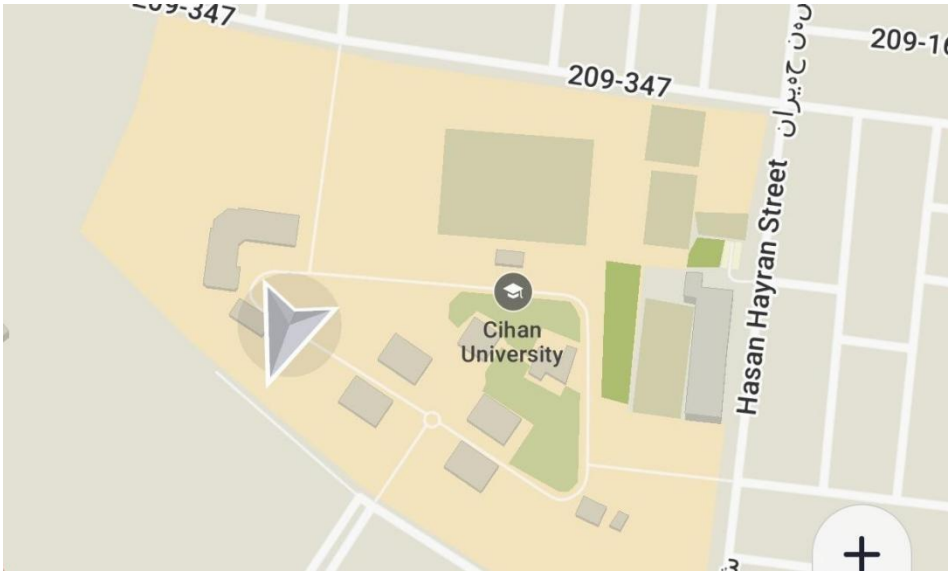


Figure 2 – Example of Automotive navigation [14]

Weather and science applications

A weather app is a mobile or web application that provides forecasts of weather conditions. Weather apps tell you the current temperature, the high and low temperatures for the day, the chance of precipitation, and other relevant information. Weather apps also update their forecasts regularly, so you can stay informed of any changes.

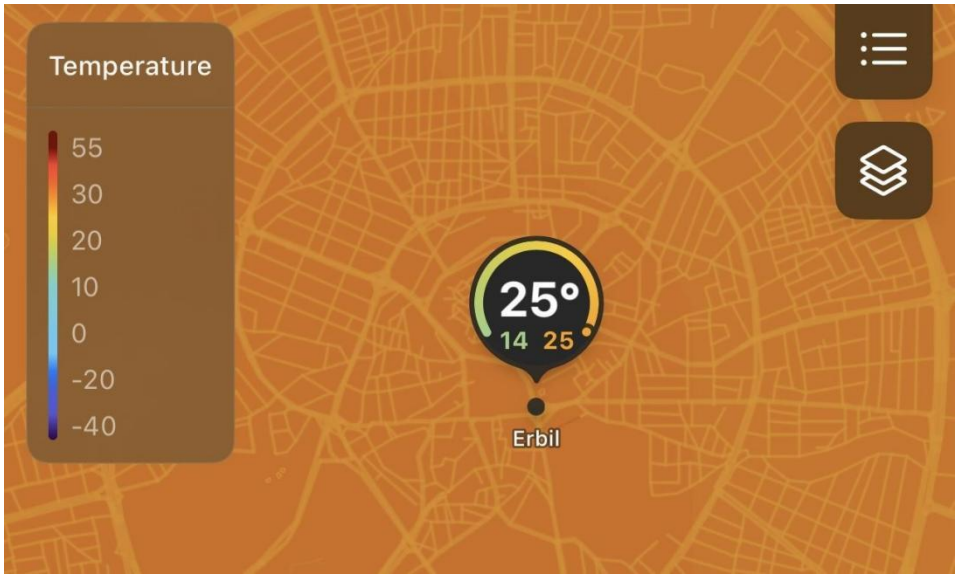


Figure 3 – Example of Weather and science applications [15]

2.2 History of GSM

GSM stands for Global System for Mobile Communications. It is a standard that describes the functionality of second generation (2G) cellular networks. GSM marked the switch from analog to digital telecommunications and was a major advancement over the first generation of cellular networks. With the introduction of the Global System for Mobile Communications in Europe in 1991, faster and more secure wireless connections were made possible by these 2G networks. Voice communications were first converted from analog signals into digital signals before being sent across the network. For many years, GSM was the most extensively utilized mobile communications standard in the world. However, 2G networks are becoming slower than other cellular networks, and they are being turned off in a number of nations.

Additionally, the Internet of Things (IoT) was not considered when designing GSM standards; instead, cell phones were. In addition to phones, billions of other devices such as industrial machinery, parking meters, automobile infotainment systems, and security systems also rely on cellular networks. Specialized networks have therefore developed to support the current state of cellular communication. Every component in the network is made up of multiple parts. These elements come together to form a single, whole cellular network. Each cellular operator has all of these components in their own infrastructure.[4]

Figure 4 – GSM800L Module

2.2.1 Structure of GSM networks

GSM standards divide networks into four distinct parts. [4]:

1. Mobile Station
2. Base Station Subsystem (BSS)
3. Network and Switching Subsystem (NSS)
4. Operations Sort System (OSS)

Mobile Station

In general, the Mobile Station serves as the user's network access point. It's a device that has a Subscriber Identity Module (SIM), like an alarm system. The device can connect to the closest Base Station Subsystem since the SIM links it to a specific subscriber.

Base Station Subsystem (BSS)

Base Transceiver Stations and a Base Station Controller are part of the BSS. The Base Station Controller enables the Base Transceiver Stations to relay signals via the network, using the Network and Switching Subsystem. The Base Transceiver Stations are equipped with components such as receivers and antennas, which enable connected devices to send and receive signals.

Network and Switching Subsystem (NSS)

A 2G core network's primary components are collectively referred to as the Network and Switching Subsystem. When it came to the Home Location Register (HLR), Authentication Center (AuC), Message Service Center (MSC), and Visitor Location Register (VLR), the NSS first assisted in facilitating connection-oriented phone calls.

The NSS started to participate in data connections once the GPRS core network and its support nodes (GGSN and SGSN) were introduced.

Operations Support System (OSS)

The Operations Support System is a collection of processes, data, applications, and tech that allows providers to manage their network. Carriers can use their OSS to:

1. Configure network elements
2. Manage and configure the services they offer
3. Handling system errors and managing the system's state
4. Monitor performance based on quality of service and quality of experience KPIs

More advanced cellular networks have similar structures, but with additional components to improve the networks' security and capabilities.

2.2.2 GSM features

a. Single supply voltage: 3.4V – 4.7V
b. Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
c. Operating Temperature: -40ºC to +85ºC
d. Supports SMS
e. Features Real Time Clock
f. connect onto any global GSM network with any SIM
g. Supports micro-SIM card
h. Communication by using AT commands

2.2.3 Is GSM still useful?

Yes, GSM is still being used to address the location of the wildfire an SMS will be sent by the GSM by the help of GPS to attain the exact location of the wildfire through coordinates that will be sent over by GSM to the nearest emergency service. This method has been used to get in touch with the emergency services as soon as possible to prevent spreading out of the fire throughout the forest.

In the 30 years since GSM networks were created, there have been three generations of mobile networks with much higher data transfer speeds, more secure connections, and advanced networking features.

Over the years, telecommunications organizations have been implementing upgrades to expand the reach of GSM-based networks, but 2G is coming to an end in several countries. This does not have much of an impact on consumers, as mobile phones usually support multiple technologies. However, GSM is one of the most popular connectivity options for cellular IoT. Modern IoT manufacturers should consider whether 2G connectivity is still a viable option for their applications in the regions they plan to deploy.[5]

2.3 GPS & GSM

When a fire breaks in a green area, the sensor inside the system will directly detect through the readings that there is a fire and it will activate the system which will send a signal to the Arduino requesting the location of the fire and the GPS system will locate the location of the fire and when it's located it will send a signal back to the Arduino which will then send a signal to the GSM to alert the nearest emergency service via an SMS which will have the location provided by the GPS included.[16]

2.4 Arduino

Arduino is a microcontroller-based platform that consists of open-source hardware, software, and programming tools. The concept of the Arduino ecosystem revolves around simplicity, making microcontrollers more accessible to the general public and great educational aids. Arduino was created in 2003 by David Cuartillas, Gianluca Martino, Tom Igoe, David Mellis, and Massimo Banzi. at the Interaction Design Institute Ivrea in Italy.[6] [7]

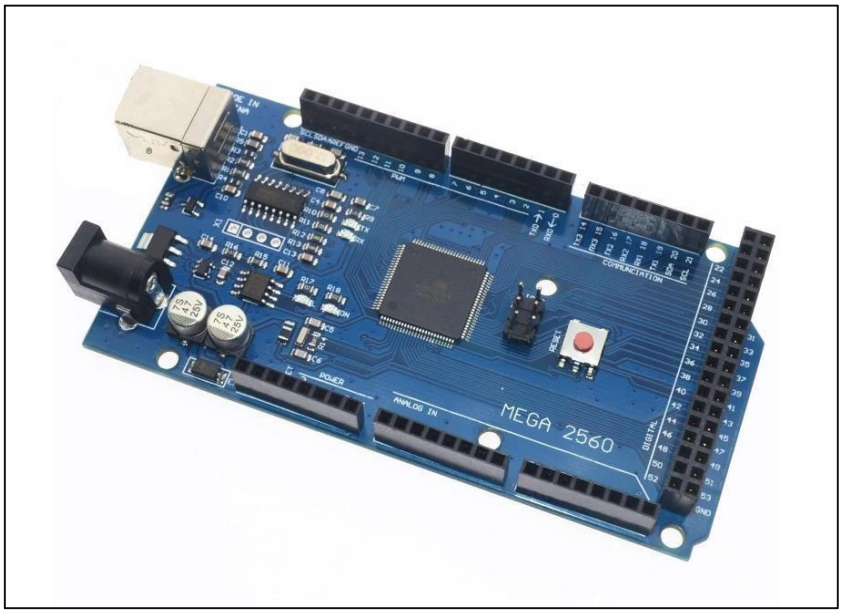


Figure 5 – Arduino MEGA 2560

2.4.1 Arduino Hardware

Arduinos contain a number of different parts and interfaces together on a single circuit board. The design has changed through the years, and some variations include other parts as well. But on a basic board, you're likely to find the following pieces:

1. A number of pins that can be used to link the Arduino to different parts that you may wish to use. There are two types of these pins:

    a. Digital pins, which have the ability to read and write a single, on/off state. There are 14 digital I/O pins on most Arduinos.
    b. For finer-grained control, analog pins are helpful since they can read a range of values. There are 6 analog pins on most Arduino boards.

2. A power connector, which powers the device and, if the connected components' power requirements are manageable, supplies a low voltage that can power them, such as LEDs and different sensors. A little battery or an AC adaptor can be connected to the power connector.
3. A microcontroller, the primary chip, which allows you to program the Arduino in order for it to be able to execute commands and make decisions based on various input
4. A serial connector, is a connector that allows you to communicate to the board from your computer through a USB port, as well as load new programs onto the device. Often times Arduinos can also be powered through the USB port, removing the need for a separate power connection.
5. A variety of other small components, like an oscillator and/or a voltage regulator, which provide important capabilities to the board.[8]

2.4.2 Arduino Features

Arduino is an open-source platform that is used for building electronic devices and systems. Here are some key features of Arduino:

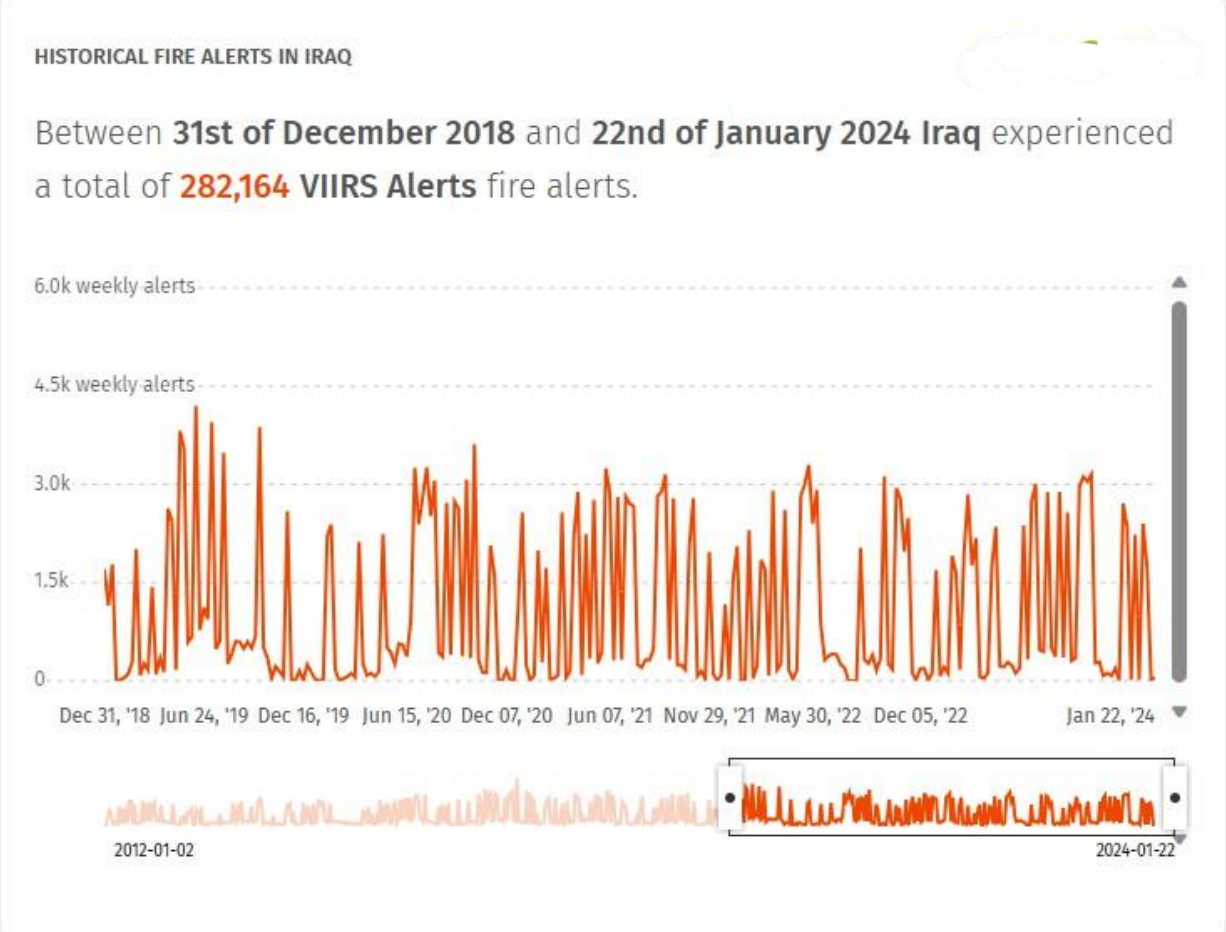
a. Open-source: The Arduino platform is open-source, which means that the hardware and software designs are freely available and can be modified and shared by users. This makes it easy for users to customize and extend the platform to meet their needs.
b. Easy to use: The Arduino platform is designed to be easy to use, even for those who are new to electronics and programming. It includes a user-friendly Integrated Development Environment (IDE) that makes it easy to write and upload code to the board.
c. Wide range of libraries and examples: The Arduino platform includes a wide range of libraries and examples that make it easy to get started with common tasks, such as reading sensors, controlling motors, and communicating over Wi-Fi or Bluetooth.
d. Community support: The Arduino platform has a large and active community of users who share knowledge, code, and ideas. This makes it easy for users to get help and support when working on their projects.
e. Versatility: Arduino is widely used in a variety of applications, from home automation to robotics to artistic installations. Its simplicity and versatility make it a popular choice for a wide range of users.[12]

2.5 Introduction to the climate change in Iraq and Kurdistan Region

In Iraq and the Kurdistan Region, the loss of vegetation and trees is so extensive that every year approximately 100 square kilometers of land turn into deserts, accounting for 40% of the total land area. Along with its long-term effects, this desertification will lead to Iraq's agricultural land to drop from 12.2% to 8.3%, increase water evaporation, and deplete wells, rivers, and waterways. It will also destroy nature and cause fires. Global Forest Watch (GFW) estimates that between 2000 and 2022, Iraq would lose 137 hectares of forested area, of which 22 hectares will be lost to fire alone and the remaining 115 hectares will be lost to various causes. The year that saw the greatest loss of greenery and trees was 2003, when a fire destroyed 7 hectares of forested area.
Meanwhile, a scientific research study carried out in 2000 estimated that 9,800 square kilometers of Iraqi land were decertified: nevertheless, after 14 years, that area has increased to more than 14,400 square kilometers due to deforestation, forest drying, fires, and rising temperatures during the previous ten years. The temperature has risen and moved into a new stage. Iraqi cities currently record the highest temperatures in the world due to the loss of greenery which is closely correlated with high temperatures. There are other things like campfires, cigarettes, man-made fires, and gunshots that may end up resulting in a large-scale fire in any natural area.

2.5.1 Fire Alerts in Iraqi and Kurdistan Region Provinces

According to the Visible Infrared Imaging Radiometer Suite (VIIRS) data, the fire season starts in late February and lasts for 40 weeks. Between August 8, 2022 and August 7, 2023, 18,442 fires were recorded in all Iraqi provinces, an increase compared to previous years. Between 2001 and 2022, about 22 hectares of wooded land will be burned and another 115 hectares will be destroyed for other reasons in Iraq. The highest fire destruction was in 2003, when 7 hectares were destroyed. In summer of 2023, especially from late June to the first week of August, the number of fires in Iraq has doubled, so that in 2012 to 2022 did not reach more than 5,000 weekly fires, but in 2023 it has exceeded more than 25,000 fires in Iraq.[17]



Graph 1: Historical fire incidents by week from 2019 to 2024 in Iraq [19]

2.5.2 Causes of Forest Fire

According to the National Fire Protection Association, these are the main causes of forest fires:

a. Human activities – Fires are often caused by open burning, improperly discarded cigarettes, improper functioning of power lines, fireworks and camping fires on windy or dry days.
b. Lightning (they are one of many causes of wildland fires).
c. High wind is not a direct cause of fires, but it contributes to their spreading.

2.5.3 Effects of Forest Fire

The consequences of forest fires are devastating with their increased frequency. When they rarely occur, the forest has its way to rebuild itself. But when its natural cycle is disturbed due to the increased frequency of fires caused by people, the entire ecosystem is affected.

a. People's health is impacted since smoke and dust can lead to respiratory issues. Furthermore, fatalities are not unusual. While attempting to contain flames, lifesavers and firemen risk their lives.
b. To contain wildfires, fire departments are compelled to utilize dangerous chemicals. These flame retardants are absorbed into the soil, where their traces remain for many years. They alter the makeup of next vegetation and degrade its fertility. These substances consequently have a negative influence on biodiversity.
c. Ash is what remains behind after forest fires. They destabilize the soil's nutritional balance and cause erosion. Therefore, there's a higher chance of flooding and landslides.
d. The atmospheric concentration of carbon dioxide rises as a result of wildfires. This promotes climate change and amplifies the greenhouse impact.
e. During forest fires, smaller creatures like snakes, rabbits, insects, squirrels, and birds are particularly vulnerable to dying. Certain species may go extinct from that forest if the fire isn't contained for an extended period of time. Not every animal has the ability to leave when it senses an approaching fire. Some are killed and left behind. Since the plants that once supported their existence have vanished, those that relocate are unable to return to their previous habitats.
f. One direct result of forest fires is degradation. Many thousands of acres of plants can be destroyed by a fire. This adds to the urban area's growing air pollution problem.[18]

2.6 Literature Review

A. Aryanti, I. Mekongga, R. S. Dewi, has proposed a paper whose goal is to develop a GPS-based fire detection system and SMS Gateway. The benefits of this detection system include the ability to detect early fire occurrences based on temperature circumstances by adjusting the nature of the fire and detecting any spike in temperature produced by the presence of the fire. This detecting device must also be capable of reading smoke from a fire. Sensors capable of measuring temperature and smoke were required to construct the system. The system's brain control system is the Arduino Uno microcontroller. When the temperature exceeds 35 degrees Celsius, the system will activate the DHT 11 and MQ 2 sensors, which detect smoke greater than 50 parts per million from a fire. The system will activate Buzzer as a warning sound ahead of the next alert. The Global Positioning System (GPS) will give the user with information in the form of coordinates for the position of the point of fire via GSM SIM900 Module Short Message Service (SMS).[10]

Yunus Emre Aslan, Ibrahim Korpeoglu, Ozgir Ulusoy, states that forest fires are becoming one of the most significant sources of environmental harm, according to the study. Current forest fire surveillance systems are unable to provide continuous real-time tracking of every point in a region as well as early warning of fire dangers.
Wireless sensor networks, on the other hand, will continuously collect sensory data values like as temperature and humidity from two sites in a region, day and night, and supply the fire-fighting center with fresh and exact data. They considered a comprehensive method for identifying and tracking forest fires using wireless sensor networks in the suggested system. Our design includes the wireless sensor network architecture, sensor distribution strategy, clustering, and communication protocols. The purpose of the framework is to detect a fire hazard as soon as possible while taking into account the energy demands of sensor nodes and outside factors that may affect the network's required operation level.[11]

Sheetal Prusty, Suman Sekhar Sahoo, stated in this paper that nowadays, one of the most pressing issues is the destruction of natural vegetation, of which deforestation is one. The harm caused by forest fires is greater than the damage caused by humans for their own objectives. When someone notices a fire, it is usually too late because the fire has already spread. Taking measures at that point is pointless. That is why taking preventive measures is preferable. Because technology has brought us to a new era, by using it, we can maintain the plants and wildlife and so allow the entire ecosystem to live safely. As we all know, a rise in carbon dioxide levels causes global warming. and trees are the primary component in lowering carbon dioxide levels. So, if forest fires are not addressed, we will confront the most difficult situation. To address this pressing issue, we created a system based on GSM (Global System for Mobile Communication) and GPS (Global Positioning System) technology. This system has intriguing qualities that make it helpful for forest fire detection and prevention.[9]

Chapter Three
“Requirements and Connections”

Chapter Three – Requirements and Connections

3.1 Project Requirements

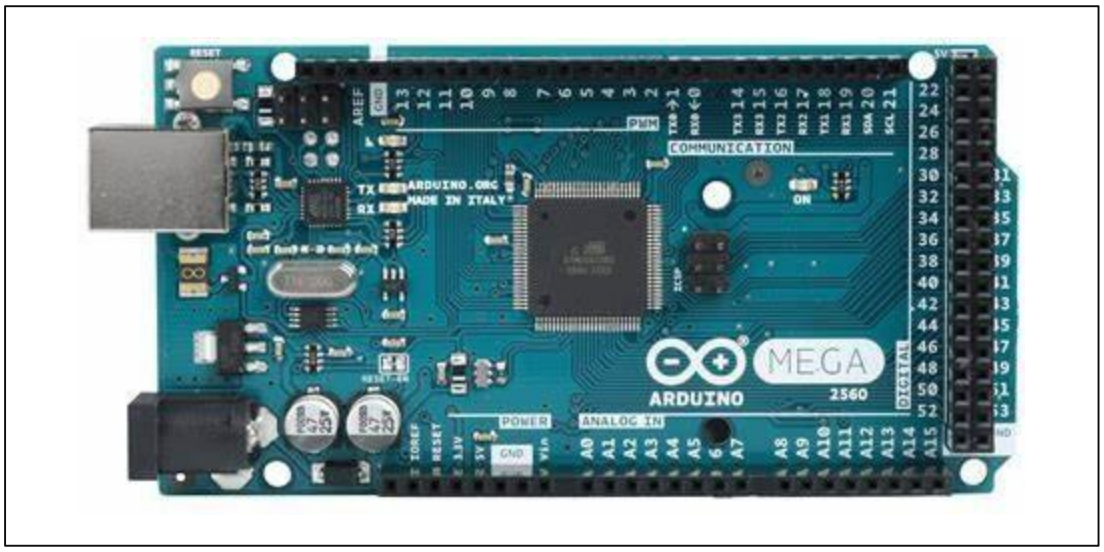


Figure 6 – Arduino MEGA 2560

The Arduino MEGA 2560 is used to run all the system. It's designed to have multiple I/O lines, more sketch memory and more RAM.

Figure 7 – GSM800L Module

The GSM800L is a GSM module that gives any microcontroller GSM functionality, meaning it can connect to the mobile network to receive calls and send and receive text messages. Another advantage is that the board makes use of existing mobile frequencies, which means it can be used anywhere in the world.

Figure 8 – NEO-6M GPS Module

GPS can be used to determine geographical position, time, and speed.

Figure 9 – MQ2 Smoke Detector

It is a versatile sensor that can detect LPG, smoke, alcohol, propane, hydrogen, methane, and carbon monoxide concentrations in the air.

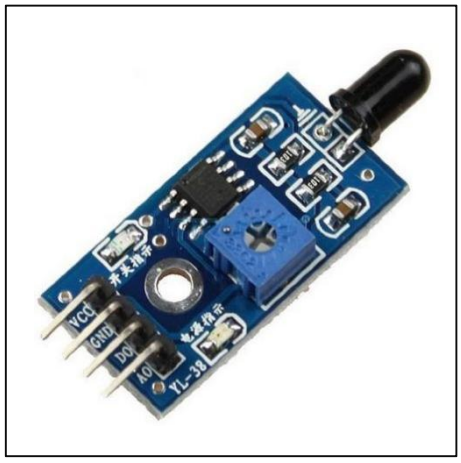


Figure 10 – IR Flame Sensor

IR Flame Sensor is a sensor which is most sensitive to a normal light is known as a flame sensor. That's why this sensor module is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source.

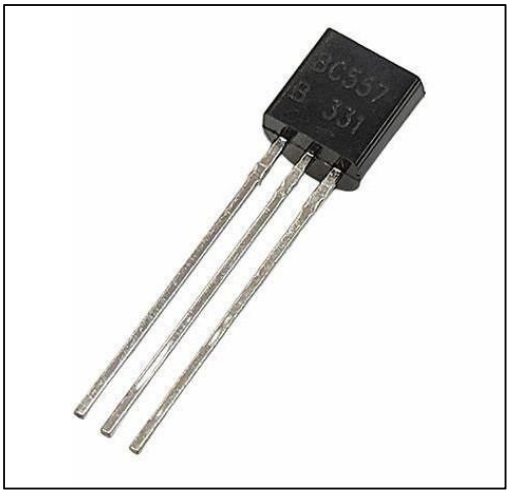


Figure 11 – LM35 Temperature Sensor

LM35 is a type of commonly used temperature sensor, that can be used to measure temperature with an electrical output compared to the temperature in (°C).

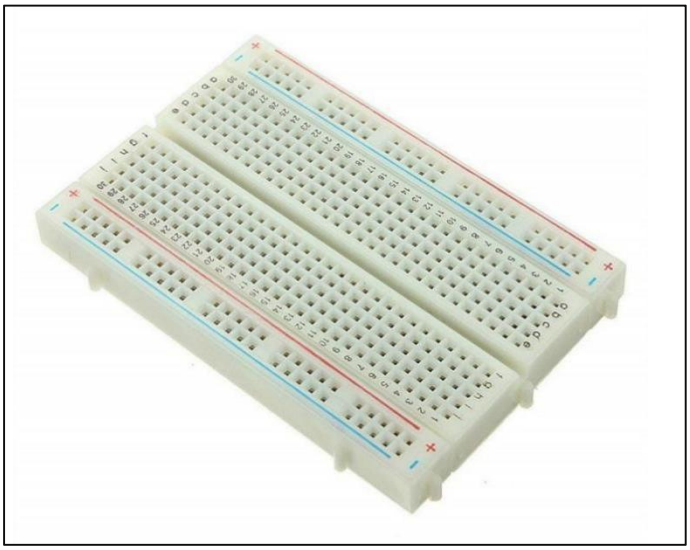


Figure 12 – Breadboard

A breadboard is a board for phototyping or building circuits without soldering.

Figure 13 – 9V Battery

This battery provides power to the Arduino and allows it to run without being connected to a power source.

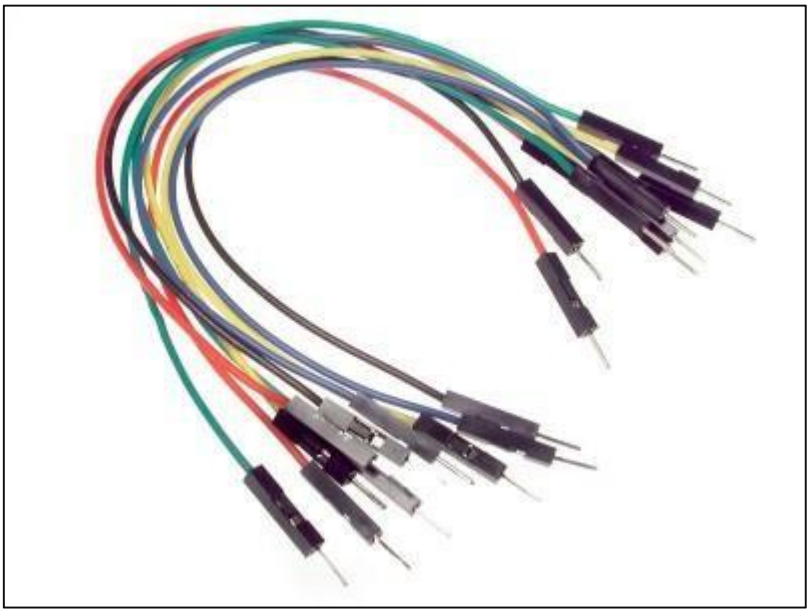


Figure 14 – Jumper Wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering.

Figure 15 – 9V to Barrel Jack Adapter

A 9V to Barrel Jack Adapter is an adapter which transfers the 9 volts from a battery to a DC power plug- which then can be plugged in and power a DC power barrel jack with 9 volts.

3.2 Block diagram of Real-Time System of Forest Fire Monitoring

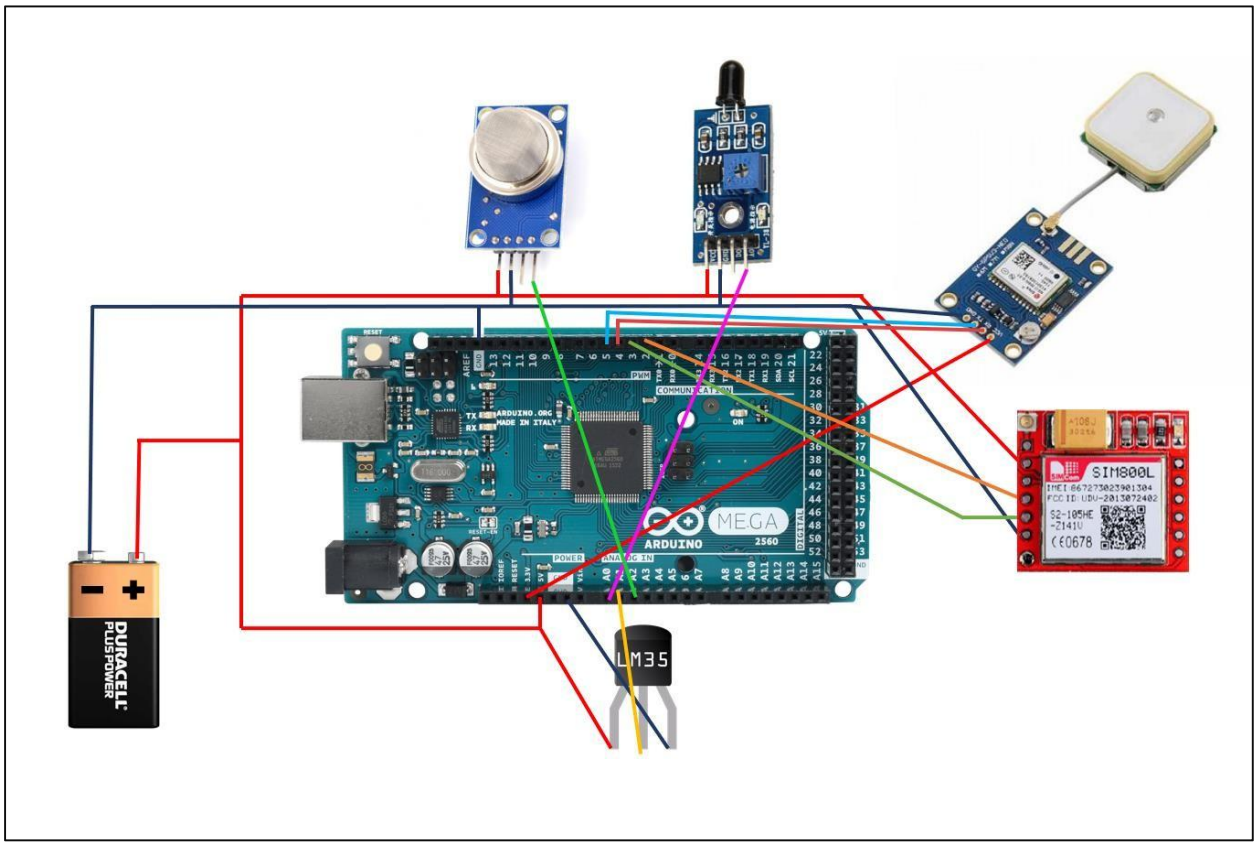


Figure 16 – Overall connection of Real-Time System of Forest Fire Monitoring

3.2.1 Block diagram of Real-Time System of Forest Fire Monitoring

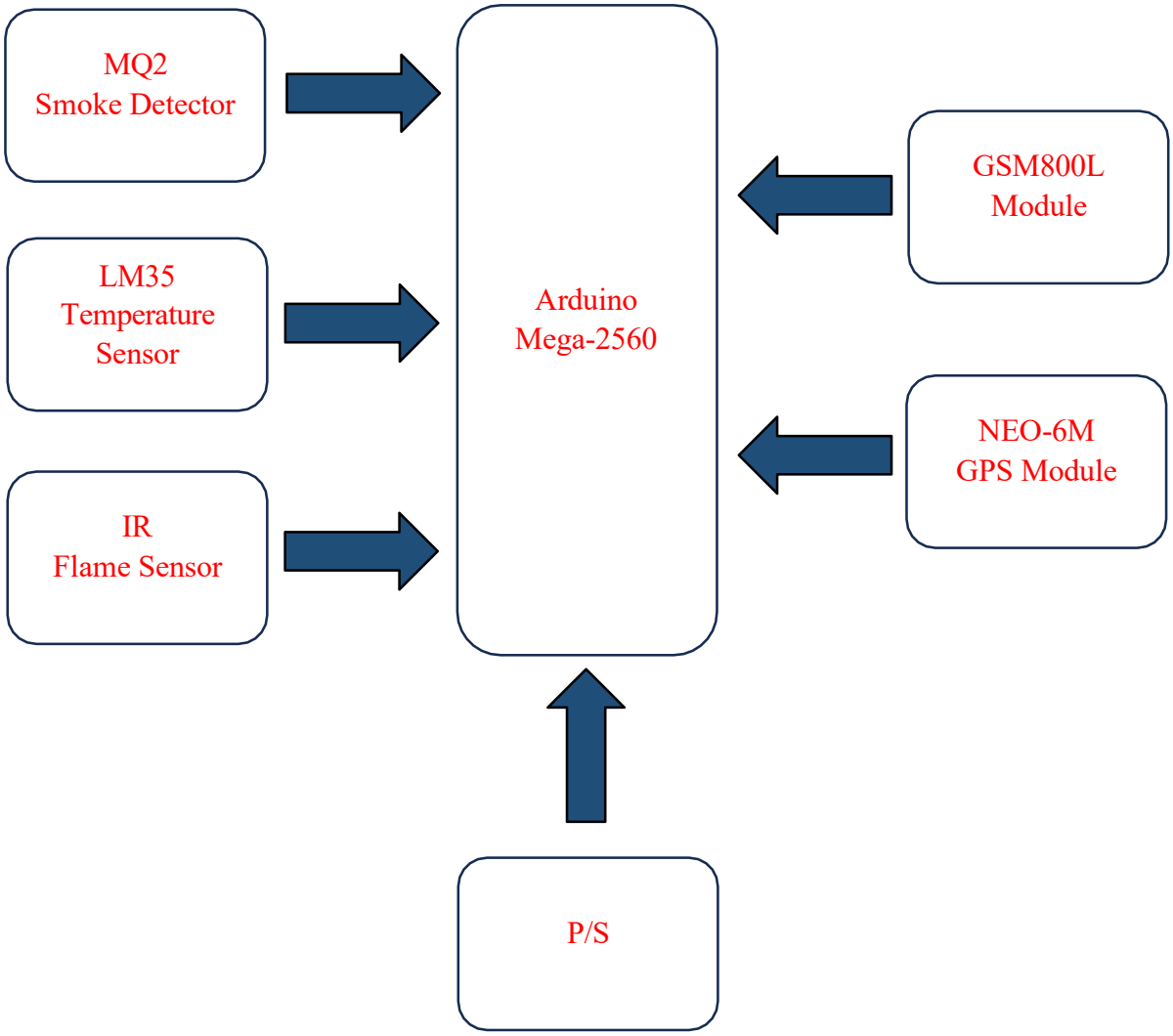


Figure 17 – Block diagram of Real-Time System of Forest Fire Monitoring

3.2.2 Flowchart of Real-Time System of Forest Fire Monitoring Using GPS & GSM Technology

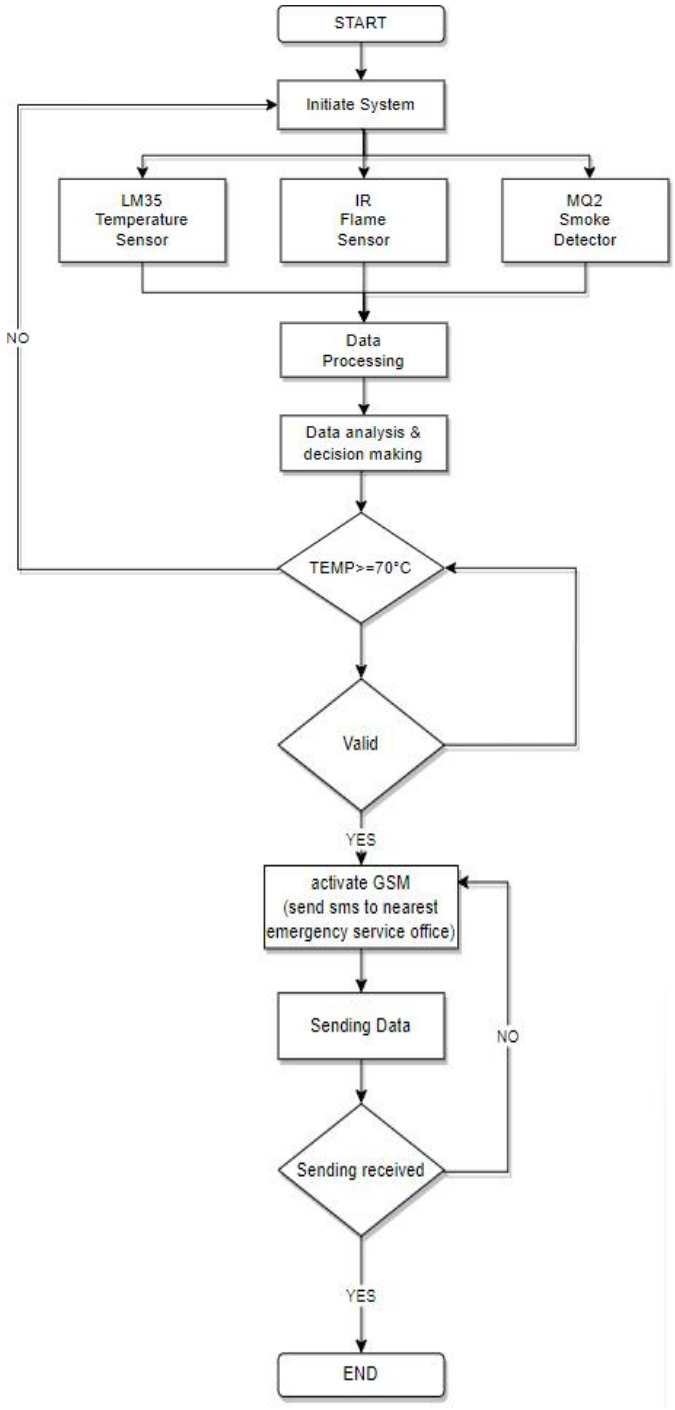


Figure 18 - Flowchart of Real-Time System of Forest Fire Monitoring

Chapter Four
“Implementation and Results”

Chapter Four – Implementation and Results

4.1 Project Implementation and Design

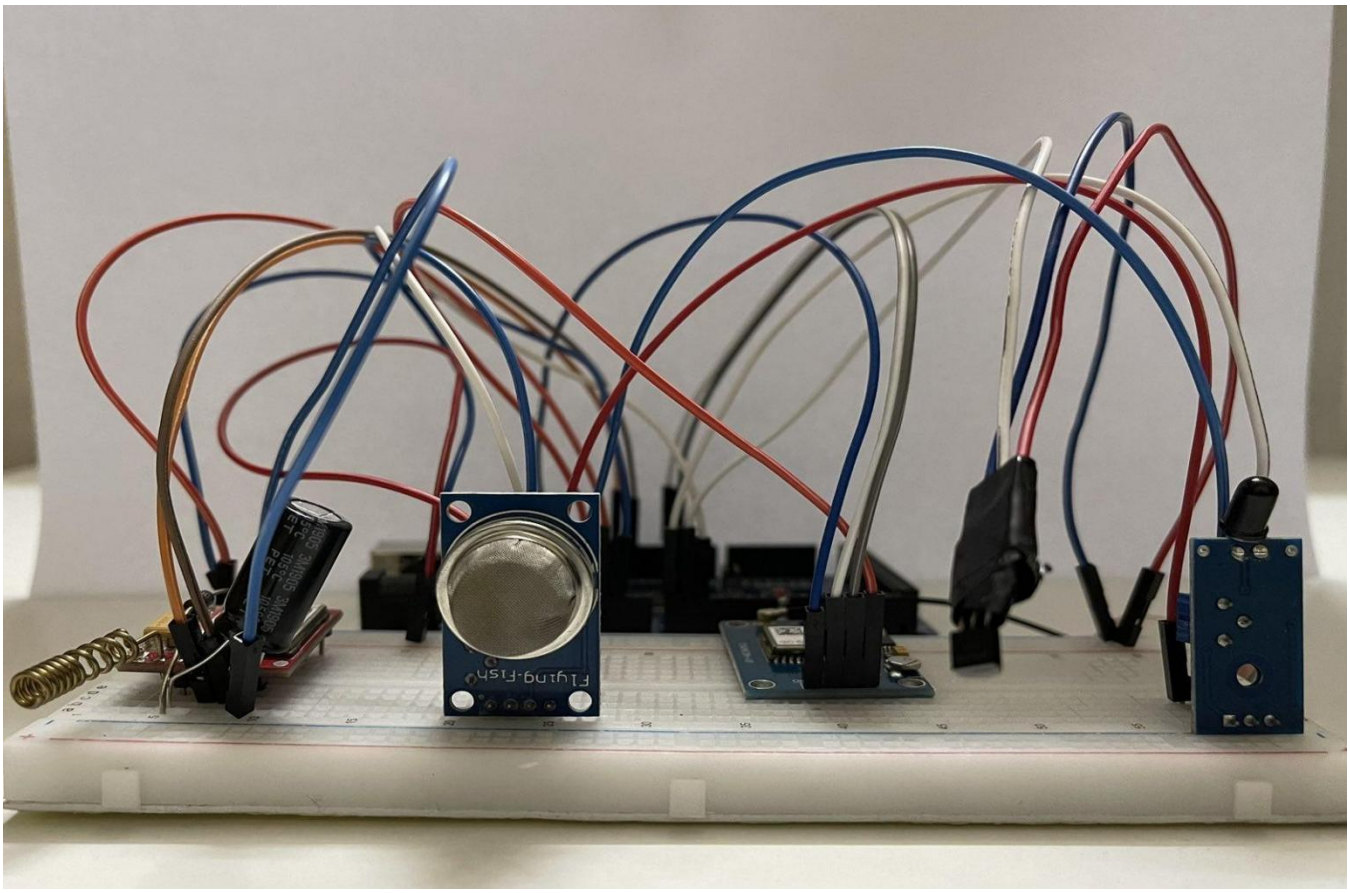


Figure 19 – Project Design

4.2 Project Result

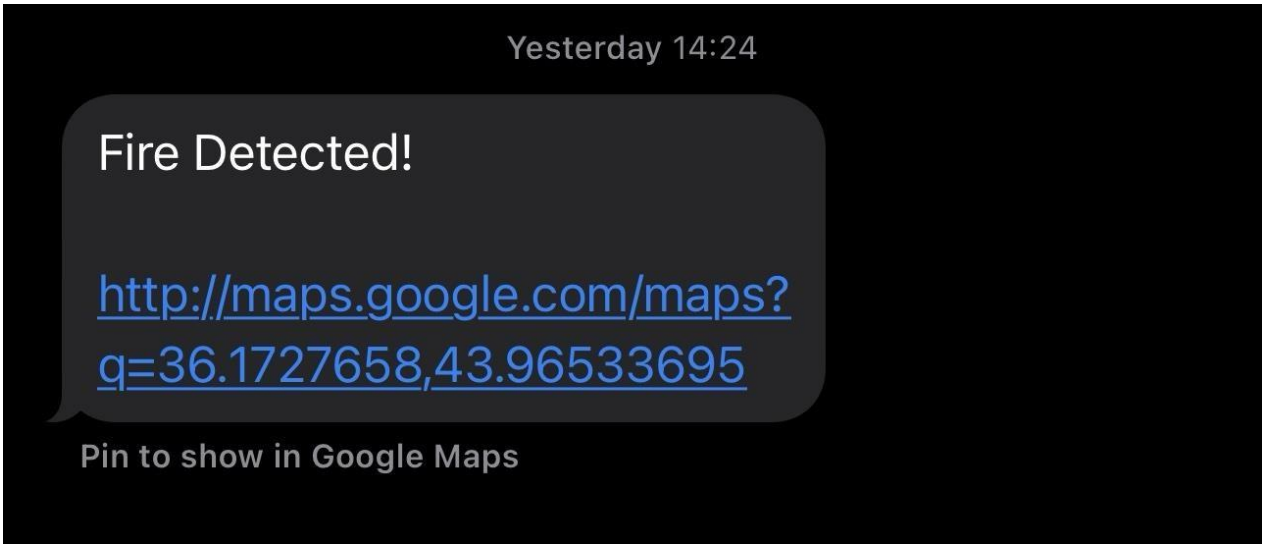


Figure 20 – SMS Result

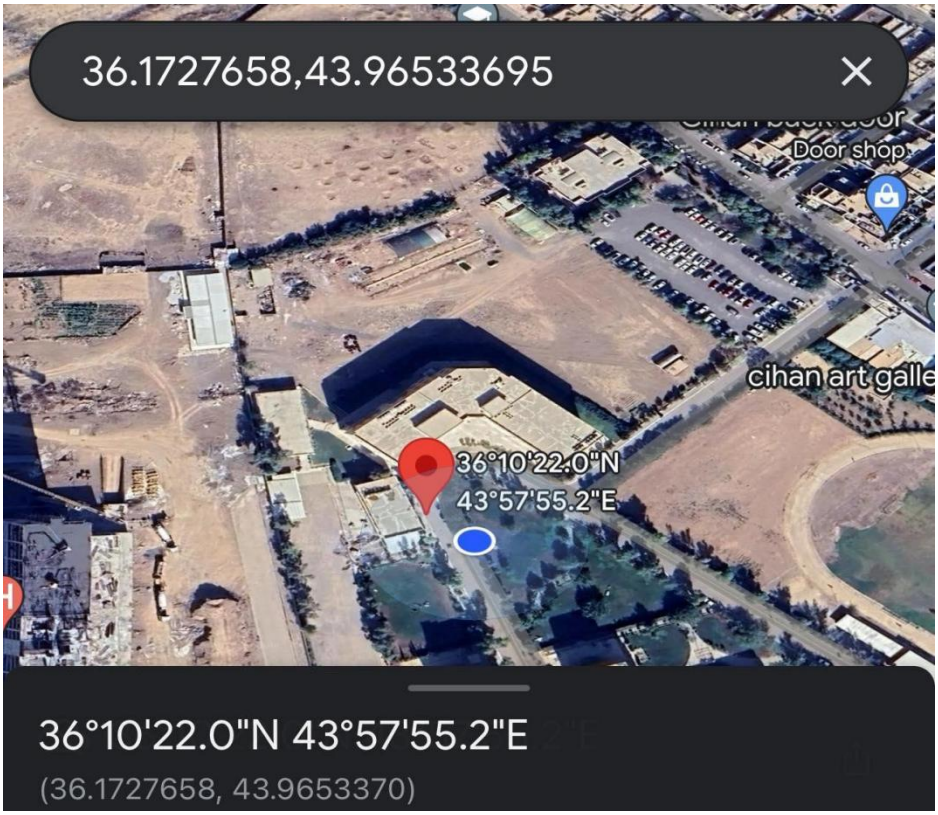


Figure 21 – Project Result on map

Chapter Five
“Conclusion and Discussion”

Chapter Five – Conclusion and Discussion

5.1 Discussion

In this research our main goal is to alert the nearest emergency service about the fire breakouts to prevent devastating losses in our green areas, by using Real-Time System of Forest Fire Monitoring using GSM and GPS technology which is used to sense the fire, high temperature and smoke then it will activate the system which then provides the exact location of where the fire is detected and will send it immediately to the nearest emergency service this can prevent fire from distributing further more.

While making this system we have faced many issues that we were able to overcome one of the main issues was the Arduino UNO which wasn't able to handle the amount of storage that was required by the system so we had to replace it with Arduino Mega which provides more storage for the system to operate without any issues. Later on, we have faced another problem which was with the GSM900A that didn't function in Kurdistan Region due to differences in frequency range and it is only used in India, so we had to replace it with GSM800L which works in Kurdistan Region, but after replacing the GSM it didn't work due to the power provided by the Arduino Mega, whenever connecting it to the system it would cause the system to shut down in order to prevent this issue we have used a diode to decrease the power going to the module so that the GSM can function perfectly. The last problem that we have faced while testing the system was with the NEO-6M GPS Module which doesn't function in a closed space and in order to get a signal on it the GPS must be in an open area.

5.2 Future Work

This project was created to be used in small sized green area due to low range of sensing, the future aspect of it is that it can be used in larger green area by adding an IR transmitter/receiver which has the ability to increase its sensing range so it can cover more area or implementing image processing technique that can help in further detection of the fire due to its video image and 360° area coverage which will definitely be a great replacement to the current sensors. A more accurate program can be added to detect early fires before they occur by alerting the emergency services with the rising temperatures which could decrease the time needed to take action against fire.

5.3 Conclusion

This project focuses on helping the emergency services to fight against the forest fires caused by natural causes or man-made, and how we can face these problems by using advanced yet simple and easy technologies to implement that is used in fire alerting, since green land are very crucial for the survival of the wildlife and also play an important role in the food chain to maintain the ecological balance. All of us depend on the green areas for our survival which includes activities from the air breath to the wood used. Green lands do not only provide habitats for the animal's livelihood for humans but they also help in the watershed protection, soil erosion prevention and mitigation of climate change.

Reference

1. https://eos.com/industries/forestry/wildfires/
2. Santhiya Ma,1, Siva Rathnam Mb, Radha Krishnan Tb, and Nishanth Sb, (2020), “Smart Forest Fire Identification and Notification System Using Iot Based Wireless Sensor Networks”.
3. GPS (nationalgeographic.org)
4. What Is GSM? | IoT Glossary (emnify.com)
5. GSM Technology: Architecture, Security and Future Challenges (researchgate.net)
6. https://control.com/technical-articles/introduction-to-arduino-history-hardware-and-software/
7. What is an Arduino? | Opensource.com
8. Introduction to Arduino: History, Hardware, and Software - Technical Articles (control.com)
9. Sheetal Prusty, Suman Shekar Sahoo, (2017), “Detection of Forest Fire by Using GSM and GPS Technology”.
10. A. Aryanti, I. Mekongga, R. S. Dewi, (2021), “GPS-based fire detection system (Global Positioning System) and SMS Gateaway”.
11. Yunus Emre Aslan, Ibrahim Korpeoglu, Ozgir Ulusoy, states, (2012),” A framework for use of wireless sensor networks in forest fire detection and monitoring”.
12. A. Hasan Abdulrahman, D. Hameed Farth, (2023), “Design and implementation of vehicle tracking system by GPS and Google map”.
13. What Is GPS? Global Positioning Systems Explained (matrackinc.com)
14. MAPS.ME.
15. Weather.
16. Gowshika. B, Madhu Mitha. G, Jayashree. S, S. Mutharasu, (2019), “Vehicle Accident Detection System by Using GSM and GPS”.
17. Mahmood Baban, (2023), “Climate Change in the Kurdistan Region and Iraq; Deforestation, Fires and Burning of Trees”.
18. Varoujan K. Sissakian, Nasrat Adamo, Nadhir Al-Ansari, (2023), “The Severe Consequences of Climate Change in Iraq: A Case Study”.
19. Iraq Deforestation Rates & Statistics | GFW (globalforestwatch.org)