IoT Based Fire with Smoke Detection & Alarm System

This paper has been submitted to the department of Electrical and Electronic Engineering of Uttara University in partial fulfillment of the requirement for the Degree of Bachelor of Science in Electrical and Electronic Engineering.

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Declaration

We hereby do solemnly declare that the work presented in this project has been carried out by us and has not been previously submitted to any other university for an academic degree.
This project being submitted as a particular fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering commenced from Fall- 2024 of Uttara University is the result of our own project work. We hereby declare that no part of this project consists of materials copied or plagiarized from other published or unpublished source have either been put under quotation or duly acknowledged with full reference in appropriate places.

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Acknowledgement

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We would like to give thanks to all the teachers of the Department of Electrical and Electronic Engineering for their constructive criticism and valuable advice and cordial co-operation during the study at the University. Specially thank my family members who gave us huge support and inspiration during our whole B.Sc. Course in EEE.

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Abstract

In industry's mishap is a spontaneous and uncontrolled occasion wherein an activity or response of an item, a substance, an individual, or a radiation brings about close to home damage. There are a few mishaps occur because of fire and smoke. Fire identifiers are utilized to recognize the fire or smoke at a beginning time and can help in sparing lives. Right now, IOT based alarm has been planned utilizing temperature and smoke sensor. It would not just flag the nearness of fire in a specific reason yet will likewise send related data to portable through IOT. By utilizing the temperature sensor, smoke sensor and there is a simple to advanced convertor, which changes over the simple signs got at the sensor end to computerized and afterward transmits them to a smaller scale controller and to the Arduino. The small-scale controller is modified to turn on the ringer, when the temperature and the smoke arrive at an edge esteem. Simultaneously, ESP-32 sends the information to the Wi-Fi module ESP8266. ESP8266 will then the accompanying information to the IOT site, where, approved individuals can take fitting measure so as to check the fire. The gadget id is the one-of-a-kind id given to a gadget, which would enable the work force to get data identified with the area, where the fire is detected. This paper can urge numerous new specialists to do investigate in the forthcoming space of IOT.

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List of Abbreviations

01	PWM	Pulse Width Modulation
02	IoT	Internet of Things
03	IPS	Instant Power Supply Unit
04	LCD	Liquid Crystal Display

Chapter 1
Introduction

1.1 Introduction

By combining IoT devices, such as fire alarm systems sensors, and other supplementary equipment, the research paper offers the **" IoT Based Fire with Smoke Detection & Alarm System"** in smart buildings. The research article proposes the **" IoT Based Fire with Smoke Detection & Alarm System"** in smart buildings by merging IOT devices such as fire alarm systems sensors, and other auxiliary equipment. That notification includes the time and location of fire occurs. Comparing two existing smart IoT-based fire warning systems from around the world. The Internet of Things is designed to provide organisations and individuals more visibility, and it now has the ability to govern 99 percent of available surroundings and objects that aren't connected to the Internet. Thus, IOT will be able to accomplish more meaningful work at a higher level by creating opportunities for individuals and businesses so that they can engage more with the outside world more than ever. Old fire alarm systems include many different types of devices that play a particular role in the workings of the system, detecting a person and detecting and wearing out a person through visual and auditory devices in the event emergency. These types of alarms can be actuated by manual focus or manual fire alarms, such as suction stations, and can be activated automatically on smoke and heat detectors. The alarm can come with an electric chime. A horn or wall speaker can be a bright tone for a speaker that sounds an alarm; for example, you can add an audio evacuation message to warn you about using the elevator and other warning messages to users.

1.2 Problem Statement

Fire outbreaks are a significant threat to life, property, and the environment, often resulting in catastrophic consequences. Traditional fire detection systems are often limited in their ability to provide real-time alerts, remote monitoring, and seamless integration with other safety measures. These systems also require constant human supervision and may fail to alert occupants or authorities promptly in case of a fire and smoke, leading to delayed response times and increased damage.

The need exists for an efficient, cost-effective, and automated solution that can detect fire hazards early, send instant alerts to concerned parties, and trigger necessary safety protocols, even when no one is on-site. By leveraging IoT (Internet of Things) technology, such a system should offer real-time monitoring, remote access, and integration with smart devices to enhance fire detection and response capabilities.

1.3 Objective of the Project

The objective of the IoT-Based Fire Detection & Alarm System project is to design and develop a smart system capable of:

- Early Fire & smoke Detection: Detect fire and smoke hazards in their initial stages using sensors that monitor key parameters such as temperature, smoke, and flame.
- Real-Time Monitoring: Continuously monitor environmental conditions and provide real-time data to users through an IoT-enabled platform.
- Instant Alerts: Automatically notify users, authorities, or emergency responders via alerts through smartphones, emails, or messaging services when a potential fire is detected.
- Remote Accessibility: Enable users to access and control the system remotely through an IoT application, allowing them to verify alerts and take necessary actions.
- Integration with Safety Mechanisms: Activate safety measures, such as sprinklers or emergency shutdowns, to mitigate fire-related damages.
- User-Friendly Interface: Provide an intuitive and user-friendly interface for ease of operation, configuration, and maintenance.
- Cost-Effectiveness and Scalability: Develop a system that is affordable, reliable, and scalable for deployment in homes, offices, industries, and public spaces.
- Energy Efficiency: Ensure that the system is energy-efficient and sustainable for long-term use.

1.4 Background of the Project

Fire and smoke Detection Systems are now widely used in various safety and security applications. The major amount of fire starts due to the electric short circuit. It leads to damage to property and also loss of life. To avoid that or to minimize the damage caused by fire outbreaks due to electric short circuits an IoT technology is used to control such a kind of risk. Traditional fire & smoke detection systems are not that effective and quick to alert the owner about fire, in case no one is present on the location. To overcome this problem in this paper we present the design and development of IoT based Fire Detection System. A system that for fire detection, sending alert the fire to the user along with onsite alarm(buzzer), floor number on blynk cloud every 3 seconds, and it also moves manually with the help of Android Application. We will be able to get updates on each floor from the display, as well as monitor it via the internet. As soon as a fire is detected, the alarm will sound, the specific floor number will be known from the display, and monitoring and notifications will be available via the internet.

1.5 IoT System

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The definition of the Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems.

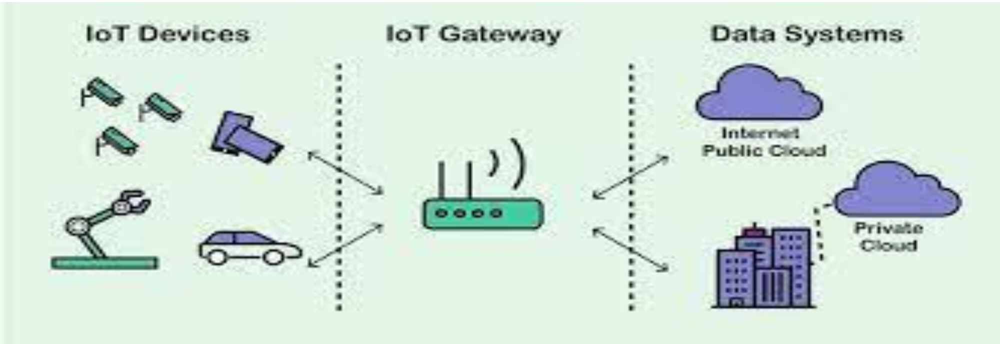

Fig-1.1: IoT System

Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of Things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the **" IoT Based Fire with Smoke Detection & Alarm System",** covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as

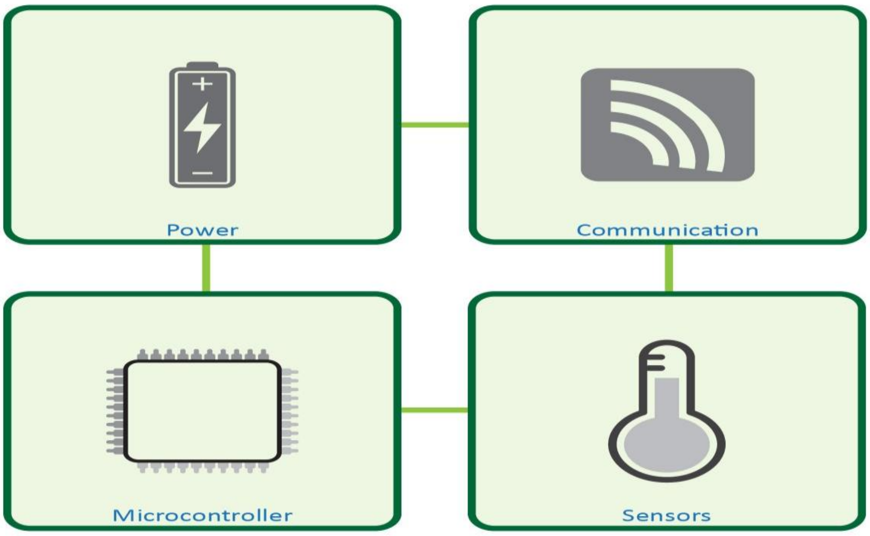

Fig-1.2: Block Diagram of IoT

Smart phones and smart speakers. There are a number of serious concerns about dangers in the growth of IoT, especially in the areas of privacy and security; and consequently industry and governmental moves to begin to address these.

1.6 Methodology

The methodology for developing an IoT Based Fire with Smoke Detection & Alarm System System involves a systematic approach comprising the following key steps:

1. Requirement Analysis.
2. System Design.
3. Prototyping and Development.
4. Integration with Cloud Services.
5. Testing and Validation.
6. Implementation.
7. Optimization and Scalability.
8. Documentation and User Training.

This methodology ensures a structured approach to designing, developing, and implementing the IoT Based Fire with Smoke Detection & Alarm System, meeting the objectives of reliability, cost-effectiveness, and user-friendliness.

1.7 Motivation for Project

The motivation for developing an IoT-Based Fire Detection & Alarm System stems from the following factors:

1. Need for Enhanced Fire Safety

Fire hazards pose a significant risk to life, property, and the environment. Traditional fire detection systems often lack advanced capabilities such as real-time alerts, remote monitoring, or early detection. The need to enhance fire safety measures with smarter and faster solutions drives this project.

2. Advancements in IoT Technology

The rapid growth of IoT technology has opened new possibilities for improving safety systems. With IoT-enabled devices, it is now possible to monitor environmental conditions in real-time, detect potential fire hazards early, and take timely actions remotely. This advancement motivates the integration of IoT into fire detection systems.

3. Mitigating Human and Economic Losses

Fires result in significant losses, including casualties, property destruction, and economic damage. An efficient fire detection and alarm system can minimize these losses by providing early warnings and reducing response times. This project aims to contribute to reducing such impacts.

4. Demand for Smart and Automated Systems

As the world moves towards smart cities and homes, there is a growing demand for automated safety systems. A smart fire detection system aligns with this trend, offering automation, remote accessibility, and seamless integration with other IoT-enabled devices.

5. Inadequacy of Existing Solutions

Existing fire detection systems are often standalone, requiring constant human presence and manual operation. By creating an IoT-based system, this project seeks to overcome these limitations by providing a comprehensive, automated, and remotely accessible solution.

6. Promoting Awareness and Accessibility

Fire safety is crucial, but advanced systems are often costly and complex. This project is motivated by the desire to create a cost-effective and user-friendly solution that is accessible to a broader audience, including homes, small businesses, and public facilities.

7. Contributing to Sustainable Development

Developing a reliable and energy-efficient fire detection system aligns with global goals for sustainable development, ensuring safer environments and protecting resources while conserving energy.

The combination of technological possibilities, societal need, and the desire to make a positive impact motivates this project, aiming to provide an innovative and effective solution to the critical issue of fire safety.

1.8 Project Management

Effective project management ensures the successful design, development, and deployment of the IoT-Based Fire Detection & Alarm System. The following phases outline the management strategy:

1. Project Planning

Define Objectives: Establish clear goals for the system, such as real-time monitoring, instant alerts, and cost-effective implementation.

Scope Identification: Determine the boundaries of the project, including key functionalities (e.g., fire detection, remote notifications) and target environments (homes, offices, or industries).

Resource Allocation: Identify hardware (sensors, microcontrollers, communication modules) and software requirements (IoT platform, mobile apps).

Budget Planning: Allocate funds for equipment, software tools, testing, and implementation.

Timeline Creation: Develop a detailed schedule with milestones for each phase, from planning to deployment.

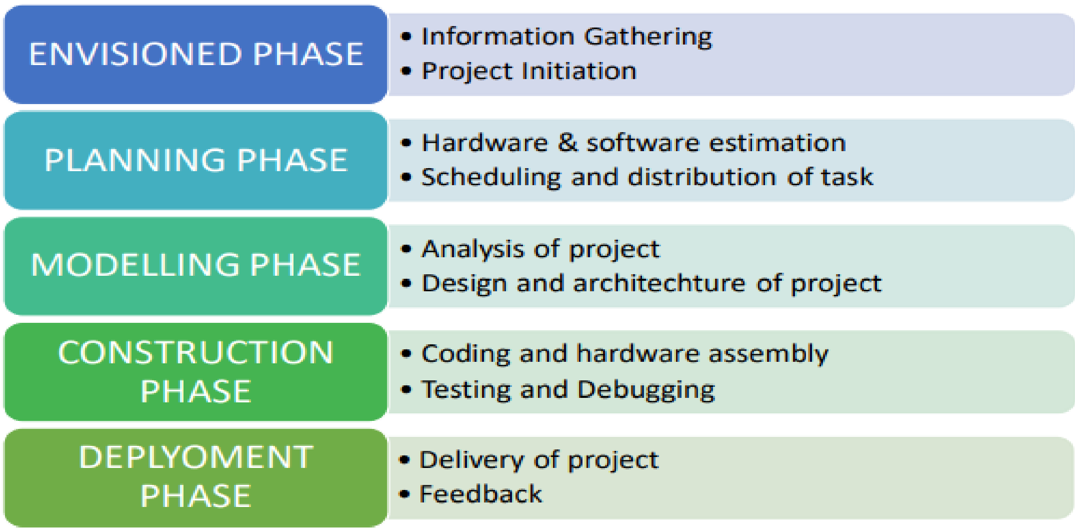

Fig-1.3: Project Management

2. Team Formation and Roles

Project Manager: Oversee the project, manage timelines, and ensure deliverables.

Hardware Engineers: Design and assemble the physical system, including sensors and communication modules.

Software Developers: Develop firmware, IoT integrations, and mobile/web applications.

IoT Specialists: Implement cloud services and ensure smooth data transmission.

Testing Team: Validate system performance under different scenarios.

End-User Support: Provide training and documentation for users.

3. Development Phases

a. Requirement Analysis and Feasibility Study

Conduct a detailed analysis of system requirements.

Evaluate technical and financial feasibility.

Identify risks and develop mitigation strategies.

b. Design and Prototyping

Create system architecture diagrams.

Develop a prototype to test core functionalities, including fire detection and notifications.

c. Implementation

Assemble hardware components and integrate them with the IoT platform.

Develop software for data processing, storage, and alerts.

Build a user-friendly interface for remote access.

d. Testing and Quality Assurance

Perform unit testing for individual components.

Conduct integration testing to ensure all components work seamlessly.

Simulate real-world fire scenarios to validate system performance.

4. Risk Management

Identify Risks: Hardware failure, communication issues, false alarms, or cloud downtime.

Mitigation Plans: Use backup systems, redundant connections, and robust error-handling mechanisms.

Monitoring: Continuously track potential risks throughout the project lifecycle.

5. Deployment

Install the system in the target environment.

Conduct final validation to ensure reliability.

Train end-users on system operation and maintenance.

6. Monitoring and Maintenance

Monitor system performance post-deployment.

Provide periodic updates for software and firmware.

Offer technical support to users.

7. Documentation and Reporting

Prepare comprehensive documentation, including system architecture, installation guidelines, and user manuals.

Create regular progress and final reports for stakeholders.

8. Review and Feedback

Collect feedback from users and stakeholders.

Analyze feedback to improve system design for future iterations.

By following this structured project management approach, the IoT-Based Fire Detection & Alarm System can be developed efficiently and effectively while meeting all functional, time, and budgetary requirements.

Chapter 2

Literature Review

2.1 Introduction

IoT devices are used in our day-to-day life to monitor and control the electrical, electronic, and mechanical systems used in homes, commercial places, industries, and buildings. IoT stands for ” Internet of Things” which means connecting the physical things or objects to the digital world by using various sensors and software connected to a central hub that measures the boundary of the real world as they change time-tot-time and can make a database of the readings or values gathered. When the data gets to the cloud, software processes the data, and then it decides to act, such as sending an alert message without the help of a human. The Internet of Things inter-connect and inter-relate objects, devices, and people through the wireless network. Readings or values gathered. When the data gets to the cloud, software processes the data, and then it decides to act, such as sending an alert message without the help of a human. The Internet of Things inter-connect and inter-relate objects, devices, and people through the wireless network.

The requirement of placing a smart fire & smoke detection system is important within buildings especially in the buildings where many people are inside or valuable belongings. Fire detection systems are important to avoid the loss of personal items caused by both man-made and induced fire. The fire detection system is essential to alert people in time before fire engulfs the building. They help in the early detection and early warning of fire so that we can extinguish the fire quickly and avoid great disaster and property loss. However, FDS, requires a lot of wiring and labor to install. Hence, we have planned to make an IoT based wireless fire detection system that is very easy to use.

2.2 Internet of Things (IoT) Basic Concept

The intercommunication between gadget to gadget or AI associated through the web with inserted innovation frameworks utilizing remote sensors, actuators which is distantly controlled, screen and upgraded by the client for mechanization is alluded as Internet of things (IoT). Here the expression "Things" signifies actual gadgets, for example, chips, cameras, sensors and other such gadgets. These actual gadgets are capable to impart, gather data and trade information by interfacing an organization.

The implanted innovation of these actual gadgets makes this trade of data each other conceivable. There are an arrangement of modern robotization incorporates that can help making life at mechanical progressively invaluable and less difficult to administer, especially for involved, immense families. Assume you could therefore oversee and control the contraptions that you usually turn on and off every day. With a modern computerization structure, you can oversee apparatuses when you're out of the house and contemplating whether you made sure to kill light or not, savvy framework will be there to address the inquiry. The creating proximity of the Internet of Things in person's lives has made turn of events and progression in the clever mechanical space, empowering customers to relate their devices through the web to their telephones and tablets, and improve than at any other time benefits for nuclear families. Also, as house proprietor are changing their devices to one central application, device or focus, they further comprehend the value these modern robotization things can bring to a family. It is the network separated from the regular gadgets utilizing web, for example, work area, PCs, Smartphone, tablets and so on.

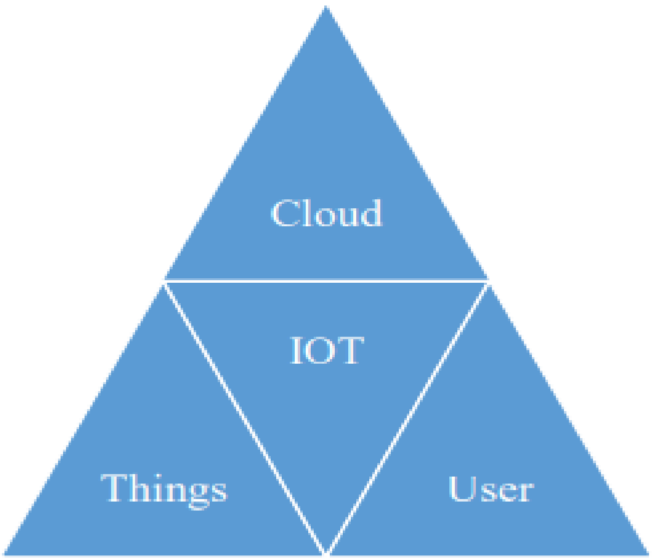

Fig-2.1: IoT Basic Concept

2.3 Software Tools

The software that is used to program the microcontroller is open-source-software and can be downloaded for free on www.arduino.cc. With this “Arduino software” we can write little programs with the microcontroller. These programs are called “Sketch”.In the end the sketches are transferred to the microcontroller by USB cable. More on that later on the subject "programming".

Installation Now one after another the Arduino software and the USB driver for the board have to be installed.

Installation and setup of the Arduino software

1. We have downloaded the Arduino software from www.arduino.cc and installed it on the computer (This was NOT connected to the PC). After that we opened the software file and installed the program named arduino.exe.

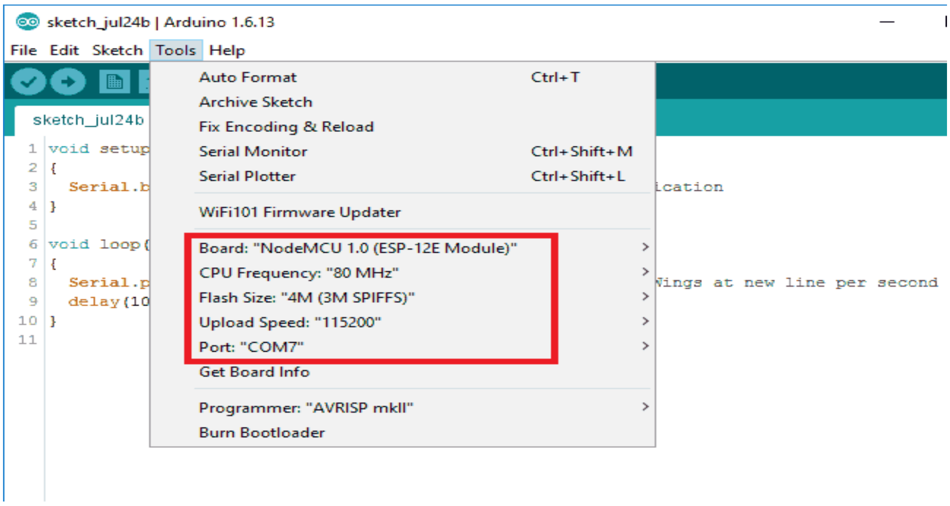

Fig- 2.2: Program Installation Process

Two set ups on the program are important and should be considered.

a) The board that we want to connect has to be selected on the arduino software. The "Arduino Uno" is here known as "Arduino / Genuino Uno".

b) We have to choose the right "Serial-Port", to let the Computer know to which port the board has been connected. That is only possible if the USB driver has been installed correctly. It can be checked this way:

At the moment the Arduino wasn't connected to the PC. If we now choose "Port", under the field "Tool", we will already see one or more ports here (COM1/ COM2/ COM3…). The quantity of the shown ports doesn't depend on the quantity of the USB ports on the computer. When the board gets connected to the computer, we will find one more port.

2.4 Programming

The development cycle is divided into 4 phases:

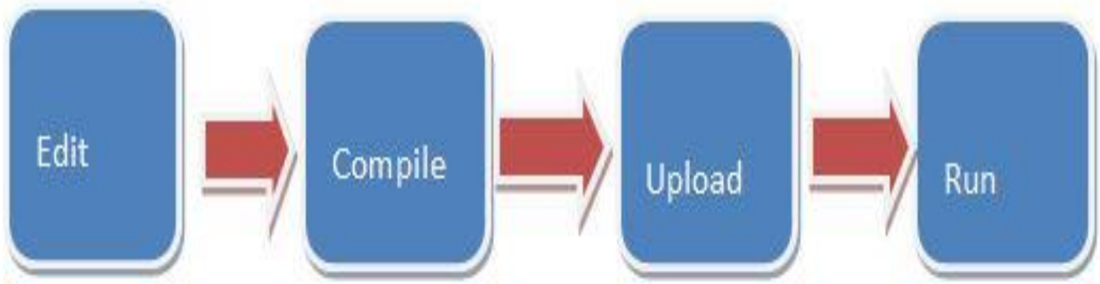

Fig-2.3: Flowchart of the Compiling Process

Compile: Compile means to translate the sketch into machine language, also known as object. **Code Run:** Arduino sketch is executed as soon as terminates the step of uploading on the board.

2.5 Arduino Program Development

Based on C++ without 80% of the instructions.

- A handful of new commands.
- Programs are called 'sketches'.
- Sketches need two functions:
- void setup ( )
- Void loop ( )
- Setup ( ) runs first and once.
- loop ( ) runs over and over, until power is lost or a new sketch is loaded.

2.6 Blynk IoT

The Blynk software is mainly operated over the Internet. This software has a specific server for sending data. This software has to be registered on the specified server, then login to the software with user name and password. Data is passed to the server through the controller's Internet head, the server sends software data, which we can monitor from anywhere.

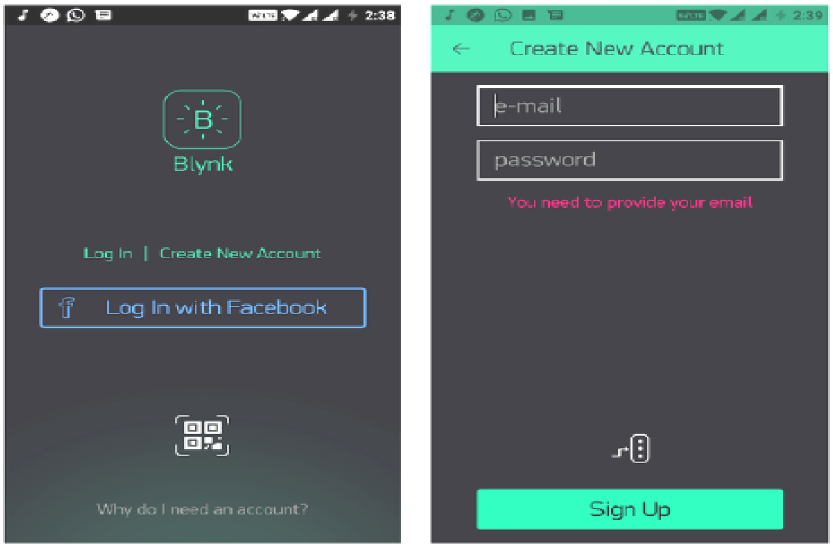

Fig- 2.4: Blynk Android Webapps

2.7 Proposed Project in Proteus

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

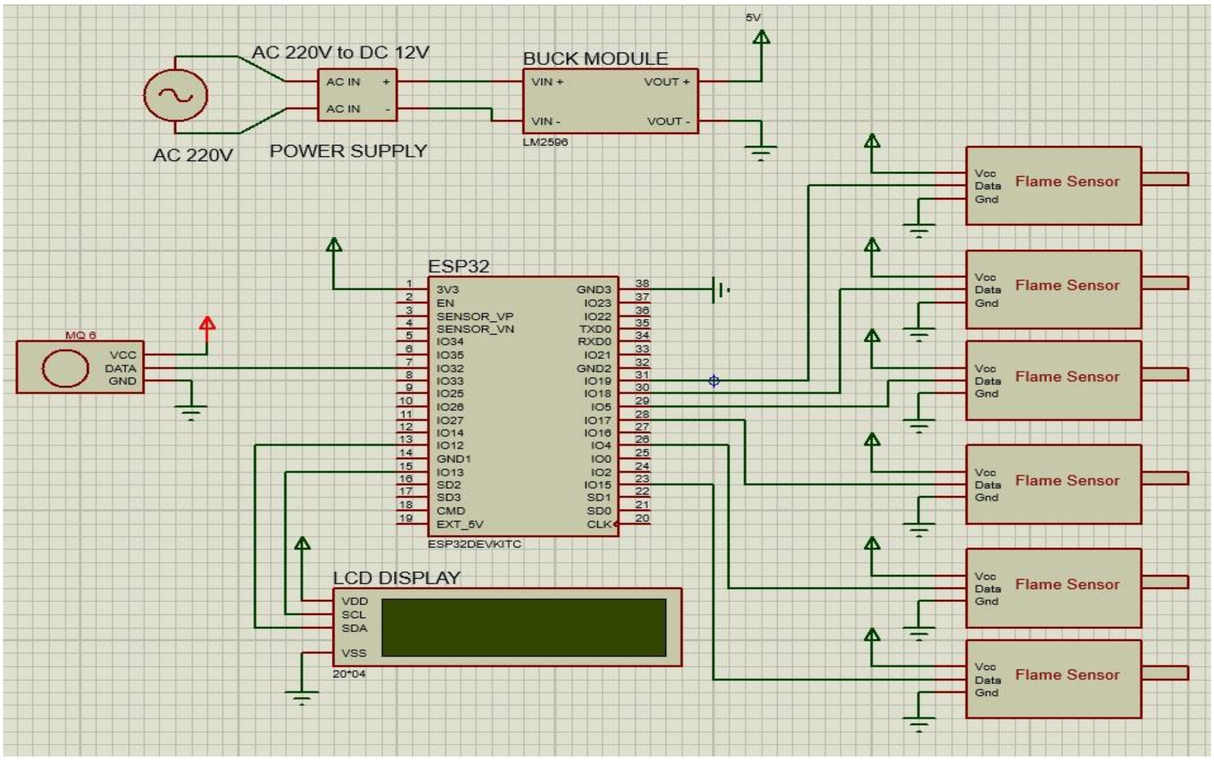

Fig-2.5: User Interface of Proteus

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998. Shape based autorouting was added in 2002 and 2006 saw another major product update with 3D Board Visualisation. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017.Feature led product releases are typically biannual, while maintenance based service packs are released as it is required.

2.8 Literature Survey

Abhijeethrathi et.al (2013); introduced a golem based on automatic gas detection and indication golem. They planned image depicts a mini mobile golem that is capable to observe gas leak in unsafe places. Whenever there's an occasion of gas leak during a specific place the golem instantly scan and sends the information to golem mobile through wireless communication like Bluetooth. We have a tendency to develop a golem application for golem primarily based good phones which may receive knowledge from golem directly through Bluetooth. The applying warns with a sign whenever there's an occasion of gas leak and that we can even management the golem movements via Bluetooth by exploitation text commands yet as voice commands. The previous mobile robots a supported heterogeneous technologies like GSM, GPS, net primarily based etc., however the most disadvantage of these prototypes were the absence of communication specially areas. So, with the speedy developments and tremendous changes in technology we've ample techniques to eradicate previous issues. Wireless communication protocols play an important role in gift trends. Bluetooth, Wi-Fi, Zigbee etc., we have a tendency to use one among the simplest feature of good phone, i.e., the Bluetooth technology to regulate and monitor parameters driven by a golem [3].
In the slide share document (2014); They introduce a golem and mobile application for the in the meantime, the system image has impressively incontestable its use and capability in intensive series of tests. The drive unit, the navigation system and, therefore, the complementary detector systems performed fantastically throughout the tests. Moreover, it helps to avoid practice of human inspectors in in all probability dangerous environments. However, before activity in industrial settings, a lot of development is required (e.g., in explosion protection, package development, etc.), and if truth be told legal issues ought to be

processed before activity in business settings. Still, it's sure that AN autonomous, mobile gas detection and leak localization golem is feasible these days and might considerably enhance safety [4].

Pal-Stefan et.al (2008); Introduced few old and new technologies to detect the gas. In this the proposed techniques are nontechnical, acoustic methods, optical methods and active methods. Survey says wide range of techniques are available for Gas detection. However, each applications has few of the limitations [5]

Manichandana Simrah et.al (2019); in this paper they told about their research on leakage detection and analysis of leakage point in the gas pipeline system. In this paper they gave various model which used SCADA I/F Model: The SCADA system has the function of transferring the acquired data from a pipeline system to Transient Simulation Model every 30 seconds. This module communicates with SCADA.Dynamic parameters are collected every 30 seconds, such as pressure, flow and temperature. Transient Simulation Model: Transient flow is simulated utilizing perfect numerical methods based on actual data. Pressure and temperature served as independent variables are provided in order to get average pressure and average temperature [6].

Rahul Nalawade et.al, (2018); in this paper ARM7 primarily based machine-driven high performance system is used for LPG refill booking and outpouring detection. That decreases the outpouring resistance.Microcontroller sends a message “EMERGENCY ALERT: LPG gas outpouring found in your home to needed cell numbers via GSM module and therefore the same are going to be displayed on digital display. This technique detects the outpouring of the LPG

associated alerts the patron regarding the leak by SMS and as an emergency live the system can shut down the ability offer, whereas activating the alarm [7].

Vasudev Yadav et.al (2016); in this paper MQ-9 computer circuit is used associated with embedded system. Such systems sometimes haven't any keyboard, screen, disks, printers, or different recognizable I/O devices of a private pc, and will lack human interaction device. MQ-9 sensor that activate a buzzer and alert the semiconductor diode within the event of gas [8].

In the scribd document (2013) mentioned how LPG Gas is important, While LPG is an important would like of each social unit, its leak may lead to a disaster.To alert on LPG leak and forestall any miss happening there square measure varied product to observe the leak. Here we have developed associate degree Arduino based LPG gas detector alarm. If gas leak happens, this technique detects it associate degreed makes an alert by a buzz the buzzer hooked up with the circuit. This technique is straightforward to create and anyone World Health Organization have some data of physics and programming to build [9].

[10] LPG Gas Leakage Detection Using IOT, Dr. Simmi Dutta, DOI:10.32628/CSEIT2174121.

LPG is the abbreviation or short kind for liquefied oil gas. Like all fossil fuels, it's a non-renewable supply of energy. It is extracted from fossil oil and gas. LPG gas is largely gas and alkane and it's scentless in its state of nature.The smell that we tend to notice once there's a run is really of a wholly totally different agent, referred to as alkyl radical Mercaptan.This substance is additional to the gas once it leaves the most storage terminals. Humans cannot detect the presence of natural gases as fast as the sensor does. Thus, the use of gas sensing system is hugely needed to give real-time monitoring of the gas system. In certain cases, gas leakage can cause fire that will destroy human property. The large scale of fire also could contribute to serious injury or death. This is due to the firestation getting delayed information about the occurrence of fire .The current products that are in the market function as a gas detector. It will only detect a gas and trigger an alarm. The main problem is that even the alarm is triggered but if the user is not at home or premise, the user will not get to know about the leakage of gas.

The prime aim of paper is to detect Gas leakage in home, hotels, schools and other domestic areas, and gives alert message to the surrounding people. Nowadays Gas sensors are being used globally in the field like safety, health, instrumentation etc.This paper is an implementation of the same using MQ-5 gas sensor.The MQ5 sensor is commonly used for detecting gas leakage for various applications.The MQ-5 gas sensor detects the concentration of gas in ppm and outputs analog value which can be converted to a digital signal. The paper allows the user to set the low, medium and dangerous level for leakage based on the same digital measure.The intensity values are compared with two predetermined thresholds and based on that, it classifies it into three different classes of concentration of leakage.Besides that, it is more efficient information wise as it is also capable to send out an SMS to the owner.

[12] Internet of Things (IOT) Based Gas Leakage Monitoring and Alerting System with MQ-2 Sensor, Rohan Chandra Pandey,

The Internet of Things is an emerging topic of technical, social, and economic significance.Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play. Projections for the impact of IoT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.

The Internet of Things (IoT) is an important topic in technology industry, policy, and engineering circles. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities.The large-scale implementation of IoT devices promises to transform many aspects of the way we live. For consumers, new IoT products like Internet-enabled appliances, home automation components, and energy management devices are moving us toward a vision of the “smart home’’, offering more security and energy efficiency.

IoT systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of “smart cities’’, which help minimize congestion and energy consumption.IoT technology offers the possibility to transform agriculture, industry, and energy production and distribution by increasing the availability of information along the value chain of production using networked sensors.

In the year of 2008, LIU zhen-ya, WANG Zhen-dong and CHEN Rong, “Intelligent Residential Security Alarm and Remote Control System Based On Single Chip Computer”, the paper focuses on, Intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage remote automatic sound alarm and remote control system, which is based on 89c51 single chipcomputer.The system can perform an automatic alarm, which calls the police hotline number automatically. It can also be a voice alarm and shows alarm occurred address. This intelligent security system can be used control the electrical power remotely through telephone.

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[13] IoT Based LPG Cylinder Monitoring System, Lokesh Chandak.

LPG Cylinders are widely used in Indian Subcontinent. The demand for LPG Cylinder is increasing with time. It was used widely in Urban and sub-urban areas, but in past 5-10 years the demand has reached in rural areas also. Similarly, the demand of LPG Cylinder has increased in the Industrial Sector. Liquid petroleum gas is highly flammable gas. With the increase of usage of LPG Cylinders, there has been a rise in accidents pertaining to gas leakages. Leakage of this gas raises risk of building fire, suffocation and explosion.

There have been many accidents due to explosion of LPG cylinders and in some of circumstances it is due to negligence of gas leakage. Arduous and diligent work is required to monitor gas leakages all the time. In view to address above problem, IOT system is proposed which diligently monitors the gas leakages with great precision & accuracy. Whenever there is any gas leakage, the MQ-6 gas sensor will sense it and the corresponding alarm circuitry will be activated. Also the SMS will be sent to the customer. Another major predicament faced by the users of LPG Cylinders is untimely exhaustion of gas cylinder. It continuously monitors and displays the weight of the LPG cylinder. This will ultimately help the customer knowing when to replace the cylinder.

LPG is one of the clean fuel.It is most widely being used in India. It is being used for household purposes as well as for industrial purposes also. In case of household use it is mostly used in kitchen for cooking, whereas in case of industrial purpose it is being used in various industrial processes such as gas cutting, gas welding, metallurgical industries, steel plants, glass cutting, pharmaceutical industries and many more. Apart from this the gas cylinders are also used in schools, colleges, hospitals, hotels and restaurants and many other places. In the past years the demand for use of LPG have increased sustainably and will continue to rise. But with the increase in demand of use of LPG the rate of accidents caused due to it have also increased in the past few years. The majority of the accidents are due to the explosion of LPG cylinder. But, sometimes very small quantity of gas leakage is unnoticed and is responsible for the further major accident. This paper discusses the solution to it.The other problem which is faced by the users of LPG cylinder is the untimely emptying of the cylinder. We have used IoT (Internet of Things) in this project. It is the cloud service which will gather and store the data.

[14] Iot-Based Automatic Gas Leakage Detection And Fire Protection System, Md. Mobarak Hossain.

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

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

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

[15] Internet Of Things (Iot) Based Gas Leakage Monitoring And Alerting System With Mq-6 Sensor, Lumesh Kumar Sahu.

The Internet of Things is an emerging topic of technical, social, and economic significance.Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play.Projections for the impact of IoT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.The Internet of Things (IoT) is an important topic in technology industry, policy, and engineering circles and has become headline news in both the specialty press and the popular media. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities not previously possible.An abundance of conferences, reports, and news articles discuss and debate the prospective impact of the “IoT revolution”—from new market opportunities and business models to concerns about security, privacy, and technical interoperability.The large-scale implementation of IoT devices promises to transform many aspects of the way we live.For consumers, new IoT products like Internetenabled appliances, home automation components, and energy management devices are moving us toward a vision of the “smart home’’, offering more security and energy efficiency.Other personal IoT devices like wearable fitness and health monitoring devices and network enabled medical devices are transforming the way healthcare services are delivered.This technology promises to be beneficial for people with disabilities and the elderly, enabling improved levels of independence and quality of life at a reasonable cost.IoT systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of “smart cities’’, which help minimize congestion and energy consumption.IoT technology offers the possibility to transform agriculture, industry, and energy production and distribution by increasing the availability of information along the value chain of production using networked sensors.

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2.9 Time Plan

The following tables define the main tasks in the project introduction and project itself.

T1	Project Definition	1 Week
T2	Collecting data	11 Weeks
T3	Analysis	7 Weeks
T4	Theoretical calculation	4 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table- 01: Time Scheduled Table for Project Introduction

The time of the project introduction is scheduled over 16 weeks, table 2 shows how the work was scheduled over this time:

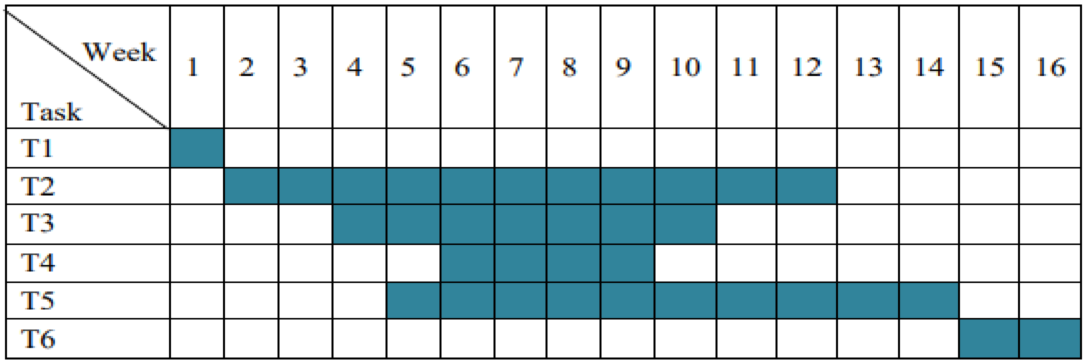

Table-02: Time Plan Table for Project Introduction

The following table defines the main tasks in the project:

T1	Collecting data	3 Week
T2	Implementation	10 Weeks
T3	Analysis	5 Weeks
T4	Building and testing the system	8 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table-03: Time Scheduled Table for Project

The time of the project is scheduled over 16 weeks, table 4 shows how the work was scheduled over this time:

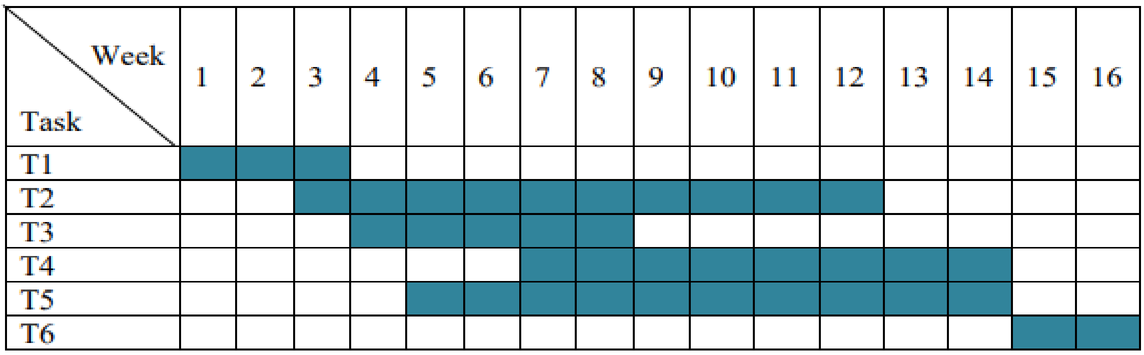

Table-04: Time Plan Table for Project

Chapter 3
Hardware Implementation

3.1 Introduction

Fires and smoke are among the most destructive hazards, posing a significant threat to human lives, property, and the environment. Timely detection and rapid response are crucial to minimizing the devastating impacts of fire incidents. However, traditional fire detection systems are often limited to local alarms, lack real-time monitoring capabilities, and require human presence for effective operation.

With the advent of the Internet of Things (IoT), a new frontier in fire safety systems has emerged. IoT technology enables devices to communicate, process data, and perform automated actions, transforming fire detection systems into intelligent, interconnected solutions. The IoT-Based Fire Detection & Alarm System leverages these capabilities to provide advanced features such as early detection, real-time monitoring, remote accessibility, and automated alerts.

This system integrates fire detection sensors (e.g., smoke, temperature, and flame sensors) with IoT-enabled microcontrollers and cloud-based platforms. It continuously monitors environmental parameters and triggers alerts to users and authorities through mobile applications, emails, or SMS when potential fire hazards are detected. The system can also interface with other safety mechanisms, such as sprinklers or emergency shutdowns, to mitigate risks effectively.

The IoT-Based Fire Detection & Alarm System is designed to be scalable, user-friendly, and cost-effective, making it suitable for deployment in homes, offices, industries, and public spaces. By providing real-time fire monitoring and faster response times, this project aims to enhance safety standards and reduce fire-related losses.

This document outlines the problem statement, objectives, methodology, and implementation details of the project, showcasing how IoT technology can revolutionize fire safety systems for a safer and smarter future.

3.2 Block Diagram of This Project

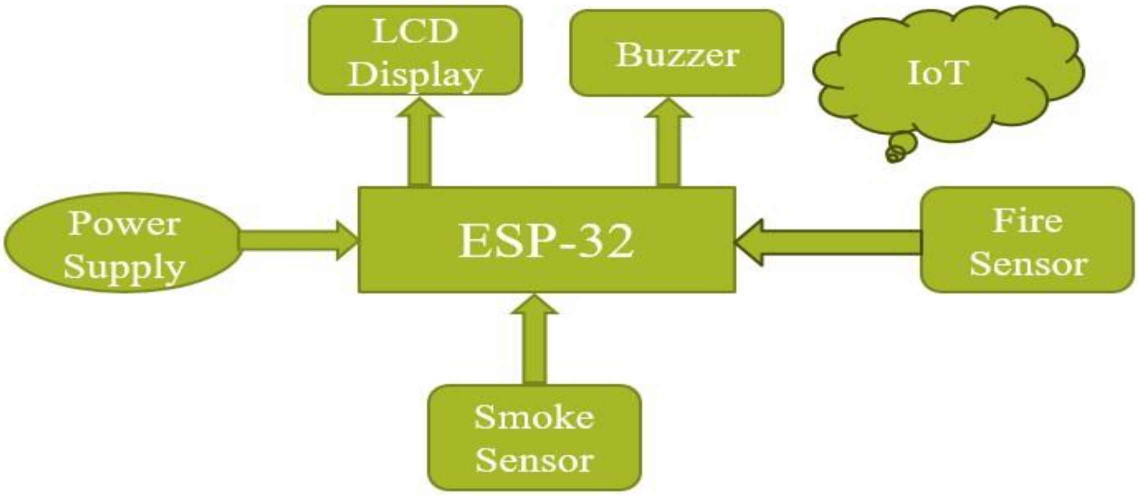

Fig-3.1: Block Diagram

3.3 Circuit Diagram of This Project

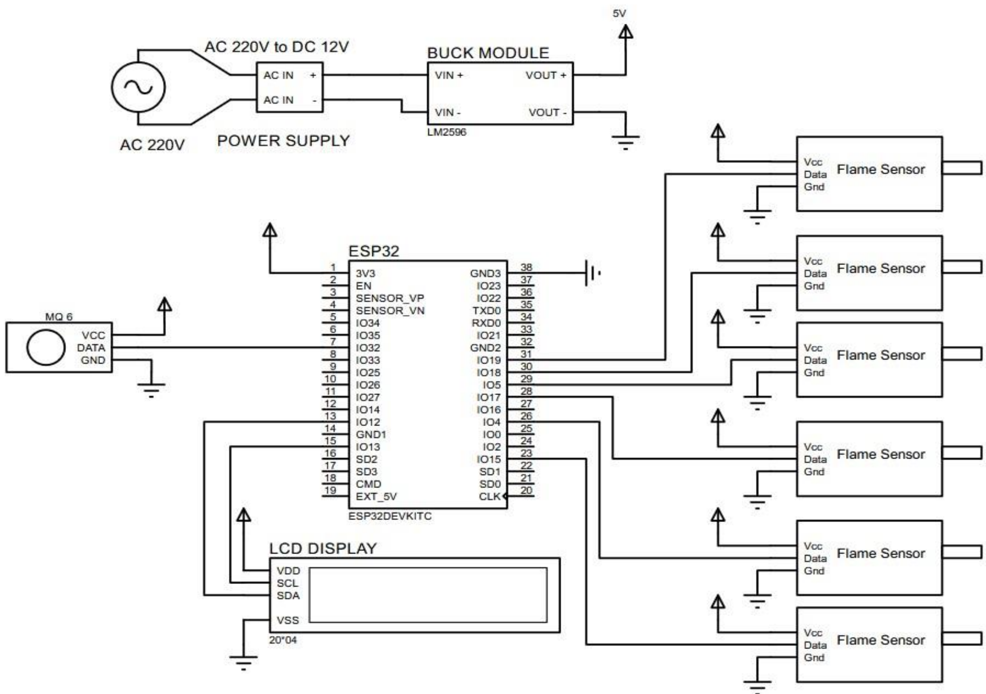

Fig-3.2: Circuit Diagram

3.4 The list of Devices used in the Project is Given Below

- ESP-32.
- Buck Module.
- Power Supply.

- LCD Display.
- Fire Sensor.
- Buzzer.
- Smoke Sensor.

3.5 ESP-32

The ESP32 is a powerful microcontroller and system-on-chip (SoC) developed by Espressif Systems. It's widely used in various IoT (Internet of Things) applications due to its versatility, low cost, and rich set of features. Here are some details about the ESP32:

Microcontroller: The ESP32 features a dual-core Xtensa LX6 microprocessor, which can be clocked at up to 240 MHz. Having dual cores allows for better multitasking capabilities and performance optimization.

Wireless Connectivity: One of the key features of the ESP32 is its built-in Wi-Fi and Bluetooth connectivity. It supports Wi-Fi 802.11 b/g/n/e/i, Bluetooth v4.2 BR/EDR and BLE (Bluetooth Low Energy), making it suitable for a wide range of IoT applications that require wireless communication.

Memory: The ESP32 typically comes with various configurations of Flash memory (up to 16 MB) and RAM (up to 520 KB SRAM), providing ample storage space for program code and data storage.

Peripheral Interfaces: The ESP32 offers a rich set of peripheral interfaces, including SPI, I2C, UART, I2S, PWM, ADC, DAC, and more. These interfaces allow the ESP32 to interact with a wide variety of sensors, actuators, displays, and other external devices.

Security Features: Security is a priority in IoT applications, and the ESP32 includes several security features such as hardware-accelerated encryption (AES, SHA-2, RSA), secure boot, and flash encryption to protect data and firmware integrity.

Low Power Consumption: The ESP32 is designed to operate efficiently in low-power scenarios, making it suitable for battery-powered IoT devices. It includes various power-saving modes and features such as deep sleep mode, which allows the device to consume minimal power when idle.

Development Environment: Espressif provides comprehensive development tools and resources for programming the ESP32, including the ESP-IDF (Espressif IoT Development Framework) for low-level programming and the Arduino IDE with ESP32 board support for easier development using the Arduino ecosystem.

Community Support: The ESP32 has a large and active community of developers and enthusiasts who contribute libraries, examples, and tutorials, making it easier for newcomers to get started and for experienced developers to find solutions to their problems.
Overall, the ESP32 is a versatile and capable microcontroller platform that has become a popular choice for IoT projects due to its combination of features, performance, and affordability.

3.5.1 Technical Specification

- Microcontroller: Tensilica 32-bit Single-/Dual-core CPU Xtensa LX6
- Operating Voltage: 3.3V
- Input Voltage: 7V to 12V DC
- Digital I/O Pins (DIO): 25
- Analog Input Pins (ADC): 6
- Analog Outputs Pins (DAC): 2
- UARTs: 3
- SPIs: 2
- I2Cs: 3
- Flash Memory: 4 MB
- SRAM: 520 KB
- Clock Speed: 240 Mhz
- Wi-Fi: IEEE 802.11 b/g/n/e/i

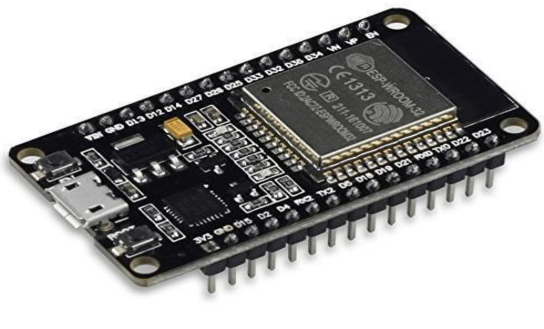

Fig- 3.3: ESP-32

3.6 Buck Module

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation.

Fig-3.4: LM2596 Voltage Converter

These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed frequency oscillator. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators. Available in a standard 7-pin TO-220 package with several different lead bend options, and a 7-pin TO-263 surface mount package.

3.7 Power Supply

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently.

Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power, see AC adapter) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. The switched-mode power supply's higher electrical efficiency is an important advantage.

Switched-mode power supplies can also be substantially smaller and lighter than a linear supply because the transformer can be much smaller. This is because it operates at a high switching frequency which ranges from several hundred kHz to several MHz in contrast to the 50 or 60 Hz mains frequency. Despite the reduced transformer size, the power supply topology and the requirement for electromagnetic interference (EMI) suppression in commercial designs result in a usually much greater component count and corresponding circuit complexity.

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight is required. They are, however, more complicated; switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

Fig- 3.5: Switched Mode Power

3.7.1 Technical Specifications

- Input Voltage: AC 85-265V
- Output Voltage: DC 12V
- Current: 10A
- Size:128mm*98mm*40mm
- Shell Material: Metal case / Aluminum base
- Protection: Shortage Protection, Overload Protection, Over Voltage Protection
- Widely used in Industrial automation, LED display, communications, etc.
- Safety Compliance: CCC/ FCC / CE
- Working Temperature: 0~40℃
- Storage Temperature: -20~60℃
- Ambient Humidity: 0~95% Non-Condensation

3.8 LCD Display

A Liquid crystal display (LCD) is a flat display that uses the light modulating properties of liquid display. They are common in consumer devices such as video players, gaming devices, clocks, telephones, computers, calculators etc.

A (20×4) LCD panel consists of 20 columns and 4 rows.It can show upto 16 characters in 2 lines.

You may want to have a look on these similar products:

1. LCD Display (20×4) with Header soldered
2. LCD display module (20×4)
3. LCD display module advanced (20×4)
4. 3 wire LCD module (20×4)
5. I2C LCD Display (20×4)
6. Arduino LCD keypad shield
7. LCD Display (20×4)

Pin	Function
VSS	connected to ground
VDD	connected to a +5V power supply
VO	to adjust the contrast
RS	A register select pin that controls where in the LCD's memory you are writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next.
R/W	A Read/Write pin to select between reading and writing mode
E	An enabling pin that reads the information when High level (1) is received. The instructions are run when the signal changes from High level to Low level.
D0-D7	to read and write data
A	Pins that control the LCD backlight. Connect A to 3.3v.
K	Pins that control the LCD backlight. Connect K to GND.

Table 05: LCD Display Outline

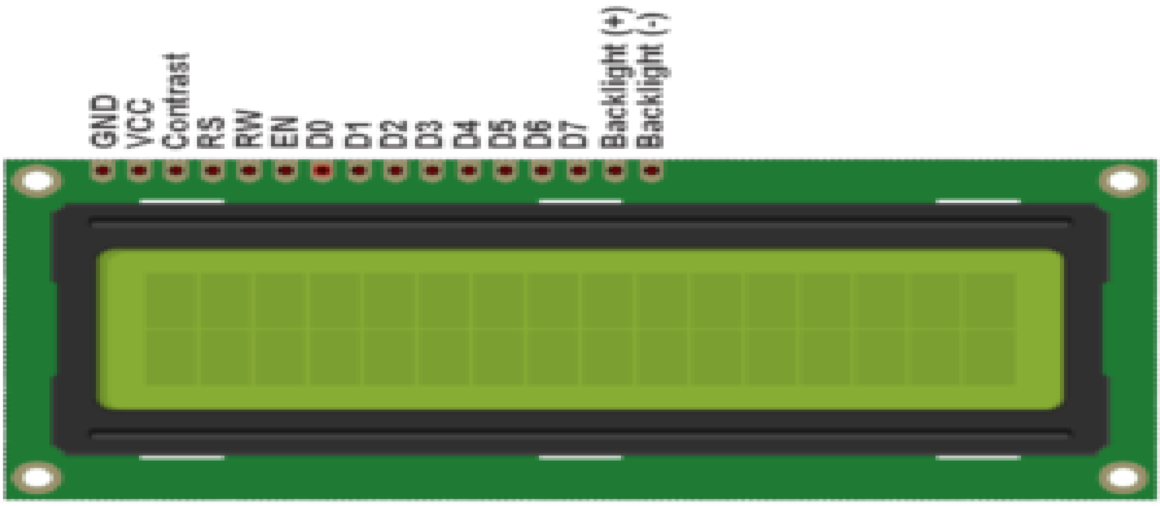

Fig-3.6: LCD Display

3.9 Fire Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; it can be used to turn off the ignition system though in many cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

Fig-3.7: Flame Sensor

3.9.1 Technical Specifications

- Output Channel: 1
- Power Supply: 3.3/5V
- Built in a potentiometer for sensitivity control.
- Onboard signal output indication, output effective signal is high, at the same time the indicator light up, the output signal can directly connect to microcontroller IO.
- Detection angle about 60 degrees, the flame spectrum especially sensitive.
- The flame of the most sensitive sensors flame, the regular light is also a response, generally used for fire alarm purposes.

3.10 Buzzer

A buzzer is an electronic device that produces sound when activated. It is commonly used in various applications to provide audible alerts or signals. Buzzers are often found in alarm systems, timers, electronic devices, and other systems where a sound signal is required to indicate a specific condition or event.

Fig- 3.8: Buzzer

3.11 Smoke Sensor

This is a simple to use smoke Sensor Module which can sense the presence of combustible gases mainly smoke, isobutane, and propane in the air. The module uses our MQ-6 sensor. It simplifies the interface to the odd pin spacing of the sensor and provides an interface through 4 0.1" header pins. It provides both an analog output corresponding to the concentration of the gases in the air and an easy to use digital output.

Fig- 3.9: Smoke Sensor

Chapter 4

Experimental Results

4.1 Introduction

Fire incidents are a critical concern worldwide, causing significant loss of life, property, and resources. The devastating effects of fire hazards demand effective prevention, early detection, and quick response. Traditional fire detection systems, while helpful, often fall short in providing real-time notifications, remote monitoring, or automated actions, especially when human supervision is unavailable.

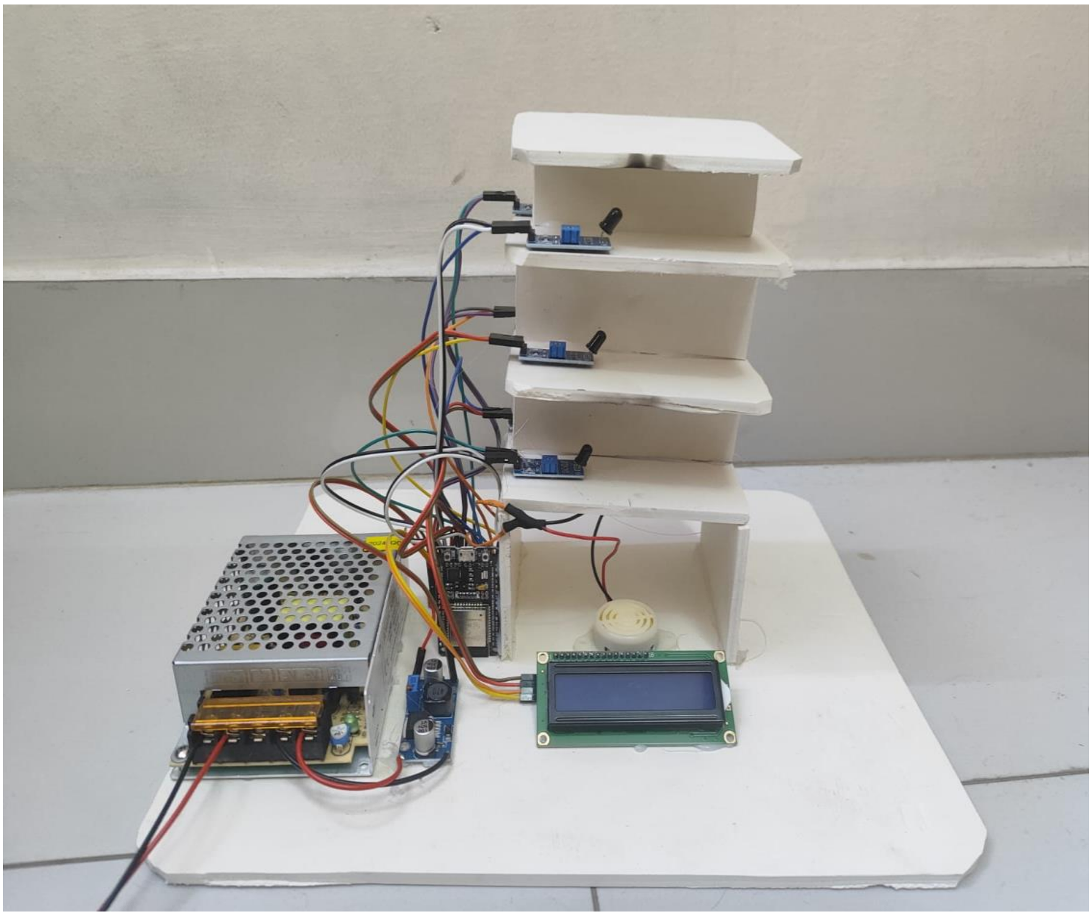

Fig- 4.1: Project Picture

The emergence of the Internet of Things (IoT) offers innovative solutions to these challenges by enabling interconnected devices to monitor, detect, and communicate autonomously. An IoT-Based Fire Detection & Alarm System uses sensors to identify early signs of fire, such as smoke, elevated temperatures, or flames, and sends alerts instantly to users or emergency responders. It can also trigger safety mechanisms, such as activating sprinklers or shutting down critical systems, to mitigate damage.

This system is designed to be scalable, cost-effective, and suitable for various environments, including homes, offices, industries, and public spaces. By integrating IoT technology, the system provides real-time data monitoring, remote accessibility through smartphones or computers, and immediate notifications via email, mobile applications.

The project aims to enhance safety standards, reduce response times, and minimize losses by leveraging IoT's power to deliver a smart, automated, and efficient fire detection solution. This document explores the objectives, methodology, and implementation strategy for developing this cutting-edge safety system.

4.2 Result

The IoT-Based Fire Detection & Alarm System successfully achieves the following outcomes:

Early Detection of Fire Hazards: The system reliably detects early signs of fire, such as abnormal temperature increases, smoke, or flame presence, using integrated sensors.

Real-Time Monitoring: Environmental data is monitored continuously and transmitted to a cloud-based platform, allowing real-time tracking of conditions.

Instant Alerts: Notifications are sent instantly to users and emergency contacts via mobile application alerts when fire indicators exceed predefined thresholds.

Remote Accessibility: Users can monitor the system remotely through a user-friendly IoT dashboard on smartphones or computers, ensuring 24/7 accessibility.

Automated Safety Mechanisms: The system demonstrates integration with external safety devices such as sprinklers, alarms, or emergency shutdowns, activating them upon fire detection.

Accuracy and Reliability: During testing, the system exhibited high accuracy in detecting fire-related events with minimal false positives or false negatives.

User-Friendly Interface: The application interface allows users to easily configure settings, view real-time data, and manage notifications.

Cost-Effectiveness and Scalability: The system is designed to be affordable and scalable, suitable for deployment in homes, offices, industries, or public spaces.

Energy Efficiency: The system operates efficiently, optimizing energy use to support long-term functionality.

Fig- 4.2: LCD Display System

Fire Detection Systems are now widely used in various safety and security applications. The major amount of fire starts due to the electric short circuit. It leads to damage to property and also loss of life. To avoid that or to minimize the damage caused by fire outbreaks due to electric short circuits an IoT technology is used to control such a kind of risk.

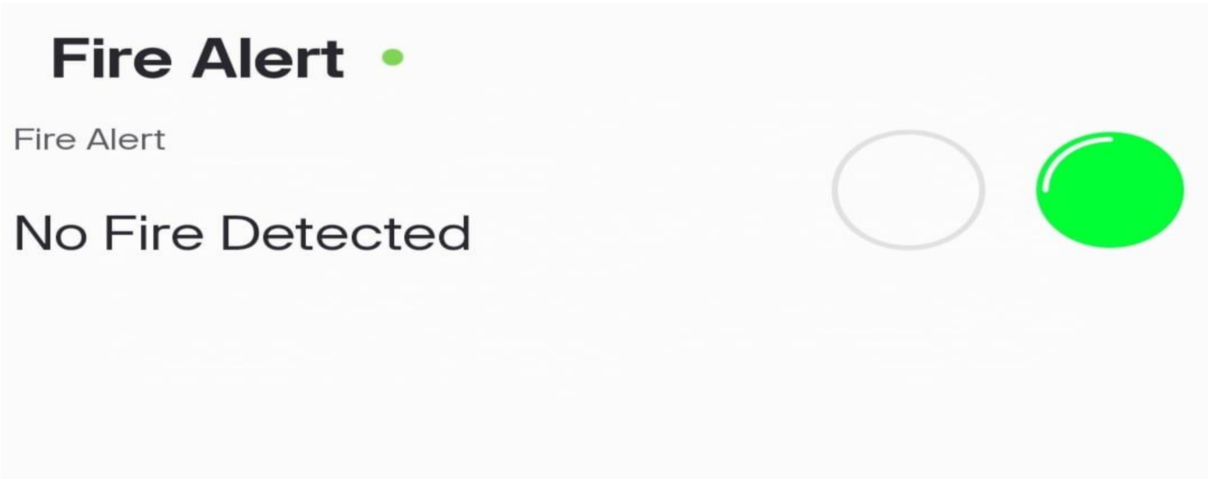

Fig- 4.3: Online Monitoring System

Traditional fire detection systems are not that effective and quick to alert the owner about fire, in case no one is present on the location. To overcome this problem in this paper we present the design and development of IoT based Fire Detection System. A system that for fire detection, sending alert the fire to the user along with onsite alarm(buzzer), floor number on blynk cloud every 3 seconds, and it also moves manually with the help of Android

Application. We will be able to get updates on each floor from the display, as well as monitor it via the internet. As soon as a fire is detected, the alarm will sound, the specific floor number will be known from the display, and monitoring and notifications will be available via the internet.

Chapter 5

Conclusion and Recommendations

5.1 Discussion

The IoT-Based Fire Detection & Alarm System demonstrates the potential of IoT technology to enhance fire safety measures by providing advanced features such as early detection, real-time monitoring, and remote accessibility. The project addresses critical gaps in traditional fire detection systems and offers innovative solutions for mitigating fire hazards.

5.2 Advantage

The IoT-Based Fire Detection & Alarm System offers numerous benefits over traditional fire safety systems, leveraging the power of IoT technology to enhance functionality, efficiency, and reliability.

1. Early Detection

Detects fire hazards such as smoke, heat, or flames at an early stage, providing a critical time window to prevent escalation and minimize damage.

2. Real-Time Monitoring

Continuously monitors environmental parameters and transmits data in real-time to a cloud platform, allowing constant surveillance of the premises.

3. Instant Alerts

Sends immediate notifications to users and authorities via SMS, email, or mobile applications when potential fire risks are detected, enabling swift action.

4. Remote Accessibility

Allows users to monitor and control the system from anywhere using smartphones or computers, eliminating the need for physical presence.

5. Automation of Safety Responses

Integrates with safety mechanisms such as sprinklers, emergency shutdown systems, or ventilation controls, enabling automated actions to mitigate risks.

6. Cost-Effectiveness

Uses affordable sensors and IoT devices, making the system economically viable for homes, offices, and small businesses.

7. Scalability

The modular design allows the system to be easily scaled to monitor multiple areas or larger premises, making it suitable for a wide range of applications.

8. User-Friendly Interface

Provides an intuitive IoT dashboard for configuring settings, viewing real-time data, and managing alerts, ensuring ease of use for non-technical users.

9. Integration with IoT Ecosystem

Can be integrated with other IoT-enabled devices, such as smart home systems, for a comprehensive safety and automation solution.

10. Energy Efficiency

Designed to operate with minimal power consumption, making it suitable for long-term use even in resource-constrained environments.

11. Reduction of False Alarms

Incorporates smart algorithms and sensor calibration to minimize false positives, improving system reliability and user confidence.

12. Data Analytics and Insights

Enables logging of environmental data for analysis, helping users identify patterns, assess risks, and improve fire prevention strategies.

13. Enhanced Safety Standards

Helps improve overall fire safety standards by providing a proactive and intelligent approach to fire detection and response.

5.3 Application

The IoT-Based Fire Detection & Alarm System is versatile and can be deployed in various settings to improve safety and mitigate fire-related risks. Its applications span across residential, commercial, industrial, and public spaces.

- Residential Applications.
- Smart Homes.
- Apartment Complexes.
- Commercial Applications.
- Offices and Workspaces.
- Industrial Applications
- Public and Community Spaces
- Railway Stations and Airports.

5.4 Future Scope

The IoT-Based Fire Detection & Alarm System has significant potential for future enhancements and applications. As technology advances, the system can be further improved to offer more intelligent, efficient, and robust fire safety solutions. The following outlines the future scope of this project:

- Advanced Sensor Technology.
- Integration with Artificial Intelligence (AI).
- Enhanced Connectivity Options.
- Improved User Interfaces.
- Integration with Smart Building Systems.
- Data Analytics and Reporting.
- Renewable Energy Integration.

5.5 Conclusion

The **IoT-based Fire Detection & Alarm System** project aims to enhance safety and responsiveness by integrating fire detection with real-time monitoring through the Internet of Things (IoT). The system utilizes sensors to detect heat, smoke, or gas, and triggers an alarm to notify the occupants or relevant authorities. The key features of this system are its ability to provide remote monitoring and alerts, thereby reducing response time and preventing potential damage caused by fires.

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Appendix:

Program:

```
#define BLYNK_PRINT Serial

#define BLYNK_TEMPLATE_ID "TMPL6zhkPytE9"
#define BLYNK_TEMPLATE_NAME "Fire Alert"
#define BLYNK_AUTH_TOKEN "MrshucCe90Q8DX04ZOpl5OSVvRn42FaU"
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x3f, 16, 2);
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "student";
char pass[] = "iotstudent";
int fire1 = 34;
int fire2 = 35;
int fire3 = 32;
int fire4 = 33;
int fire5 = 25;
int fire6 = 26;
int fire_data1;
int fire_data2;
int fire_data3;
int fire_data4;
int fire_data5;
int fire_data6;

int buzzer = 27;
```

```
void setup() {
  Serial.begin(9600);

  lcd.init();  // initialize the lcd

  pinMode(fire1, INPUT);
  pinMode(fire2, INPUT);
  pinMode(fire3, INPUT);
  pinMode(fire4, INPUT);
  pinMode(fire5, INPUT);
  pinMode(fire6, INPUT);

  pinMode(buzzer, OUTPUT);

  delay(100);

  Blynk.begin(auth, ssid, pass);
}

void loop() {
  Blynk.run();

  fire_data1 = digitalRead(fire1);
  fire_data2 = digitalRead(fire2);
  fire_data3 = digitalRead(fire3);
  fire_data4 = digitalRead(fire4);
  fire_data5 = digitalRead(fire5);
  fire_data6 = digitalRead(fire6);



  delay(1000);
  lcd.clear();

  Serial.print("Fire1: ");
```

```
  Serial.println(fire_data1);
  Serial.print("Fire2: ");
  Serial.println(fire_data2);
  Serial.print("Fire3: ");
  Serial.println(fire_data3);
  Serial.print("Fire4: ");
  Serial.println(fire_data4);
  Serial.print("Fire5: ");
  Serial.println(fire_data5);
  Serial.print("Fire6: ");
  Serial.println(fire_data6);
  Serial.println(".....................................");

  if (fire_data1 == 1 && fire_data2 == 1 && fire_data3 == 1 && fire_data4 == 1 &&
fire_data5 == 1 && fire_data6 == 1) {
    lcd.setCursor(0, 0);
    lcd.print("No Fire Detected");
    digitalWrite(buzzer, LOW);
    Blynk.virtualWrite(V0, "No Fire Detected");
    Blynk.virtualWrite(V1, 0);
    Blynk.virtualWrite(V2, 1);
  }

  if (fire_data1 == 0) {
    lcd.setCursor(0, 0);
    lcd.print("Fire Detected");
    lcd.setCursor(7, 1);
    lcd.print("1A");
    digitalWrite(buzzer, HIGH);
    Blynk.virtualWrite(V1, 1);
    Blynk.virtualWrite(V2, 0);
    Blynk.virtualWrite(V0, "Fire Detected, 1A");
  }

  if (fire_data2 == 0) {
```

```
  lcd.setCursor(0, 0);
  lcd.print("Fire Detected");
  lcd.setCursor(7, 1);
  lcd.print("1B");
  digitalWrite(buzzer, HIGH);
  Blynk.virtualWrite(V1, 1);
  Blynk.virtualWrite(V2, 0);
  Blynk.virtualWrite(V0, "Fire Detected, 1B");
}

if (fire_data3 == 0) {
  lcd.setCursor(0, 0);
  lcd.print("Fire Detected");
  lcd.setCursor(7, 1);
  lcd.print("2A");
  digitalWrite(buzzer, HIGH);
  Blynk.virtualWrite(V1, 1);
  Blynk.virtualWrite(V2, 0);
  Blynk.virtualWrite(V0, "Fire Detected, 2A");
}

if (fire_data4 == 0) {
  lcd.setCursor(0, 0);
  lcd.print("Fire Detected");
  lcd.setCursor(7, 1);
  lcd.print("2B");
  digitalWrite(buzzer, HIGH);
  Blynk.virtualWrite(V1, 1);
  Blynk.virtualWrite(V2, 0);
  Blynk.virtualWrite(V0, "Fire Detected, 2B");
}

if (fire_data5 == 0) {
  lcd.setCursor(0, 0);
  lcd.print("Fire Detected");
```

```
    lcd.setCursor(7, 1);
    lcd.print("3A");
    digitalWrite(buzzer, HIGH);
    Blynk.virtualWrite(V1, 1);
    Blynk.virtualWrite(V2, 0);
    Blynk.virtualWrite(V0, "Fire Detected, 3A");
  }

  if (fire_data6 == 0) {
    lcd.setCursor(0, 0);
    lcd.print("Fire Detected");
    lcd.setCursor(7, 1);
    lcd.print("3B");
    digitalWrite(buzzer, HIGH);
    Blynk.virtualWrite(V1, 1);
    Blynk.virtualWrite(V2, 0);
    Blynk.virtualWrite(V0, "Fire Detected, 3B");
  }
}
```