IOT BASED AUTOMATIC FIRE DETECTING AND NOTIFICATION SYSTEM

A MINOR PROJECT-III REPORT

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BONAFIDE CERTIFICATE

Certified that this **18ECP105L-Minor Project III** report "IOT BASED AUTOMATIC FIRE DETECTING AND NOTIFICATION SYSTEM**"** is the Bonafide work of "**ANBARASI S (927622BEC009) , ARCHANA V (927622BEC015) , DHARSHINI K (927622BEC038) , DIVYAASRI (927622BEC044) "**who carried out the project work under my supervision in the academic year (2024–2025)**ODD SEM**.

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This report has been submitted for the**18ECP105L – Minor Project III** final review held at M. Kumarasamy College of Engineering, Karur on________________________.

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: Core Competence: Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: Professionalism: Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: Lifelong Learning: Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfill the industrial expectations.

Abstract	**Matching with POs, PSOs**
IoT, ESP8266, Flame sensor, Gas sensor, GPS module, GSM module, Relay.	**PO1, PO2, PO3, PO4, PO5, PO6,PO7, PO8, PO9,PO10, PO11, PO12, PSO1, PSO2**

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ABSTRACT

The IoT-based Automatic Fire Detection and Notification System is an advanced fire safety solution that utilizes IoT technology to detect fire hazards and notify relevant stakeholders promptly. The system is centred on the ESP8266 microcontroller, which integrates various sensors and communication modules to provide real-time monitoring and notifications. The system employs a flame sensor to detect open flames and a gas sensor to monitor the presence of smoke or combustible gases, ensuring comprehensive detection of potential fire hazards. When a fire risk is identified, the system immediately processes the data and activates a series of automated responses. A GPS module is used to determine the precise location of the incident, while a GSM module sends real-time notifications via SMS or calls to preconfigured contacts, including property managers and emergency services. These messages include crucial details such as the nature of the detected hazard and its exact location, enabling swift and accurate responses.

Additionally, the system leverages a relay module to control external safety mechanisms. For example, it can automatically activate water sprinklers to contain a fire or shut down electrical circuits to prevent further risks. The real-time data from sensors is uploaded to an IoT platform or mobile application, enabling users to remotely monitor and manage the environment from any location. This system is designed to be versatile and scalable, making it suitable for various applications, including residential, commercial, and industrial settings. By integrating real-time detection, automated responses, and remote monitoring capabilities, this system provides an efficient and reliable fire safety solution. It reduces response time during emergencies, minimizes damage, and enhances safety while being adaptable to diverse use cases. This project demonstrates the transformative potential of IoT technology.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACRONYM		ABBREVIATION
IoT	-	Internet of Things

CHAPTER 1

INTRODUCTION

Fire incidents can lead to devastating consequences, including loss of life, property damage, and environmental harm. Traditional fire detection systems often rely on manual intervention or localized alarms, which may result in delayed response times. To address these limitations, advancements in technology have enabled the development of smart, automated systems that can detect fire hazards and notify users in real time. The IoT-based Automatic Fire Detection and Notification System with Blynk app integration provide a reliable, efficient, and user-friendly solution to enhance fire safety. This system utilizes the ESP8266 microcontroller as its core, integrating multiple sensors and modules to provide real-time fire detection and notification. A flame sensor is employed to detect open flames, while a gas sensor monitors for smoke or combustible gases, ensuring early identification of potential fire hazards. When the system detects a fire hazard, the GPS module determines the exact location of the incident, and the GSM module sends instant alerts via SMS or calls to predefined emergency contacts. Additionally, a relay module is used to control external safety mechanisms, such as activating sprinklers or disconnecting electrical circuits, to contain the fire and minimize its impact.

The integration of the Blynk app provides a user-friendly interface for real-time monitoring, eliminating the need for cloud storage or third-party platforms. The simplicity and scalability of the design make it suitable for various applications, including residential, commercial, and industrial settings. By combining IoT technology with the Blynk app, this project demonstrates an innovative approach to fire safety, offering early detection, rapid notification. This system ensures a faster response to fire hazards, reduces damage, and enhances safety through smart and efficient automation.

CHAPTER 2
OBJECTIVE

The objective of the IoT-Based Automatic Fire Detection and Notification System is to enhance fire safety by providing an advanced, automated solution that ensures early detection of fire hazards and facilitates a rapid response. The system aims to continuously monitor environmental conditions for potential fire risks, such as the presence of open flames and hazardous gases. By integrating flame sensors and gas sensors**,** the system is designed to detect fires at the earliest stage, allowing for quicker intervention and minimizing potential damage. Upon detecting a fire hazard, the system sends instant alerts through the GSM module via SMS or phone calls to pre-configured contacts, including emergency services, property managers, or responsible individuals. To further improve safety, the system incorporates a GPS module to identify the precise location of the fire, which is critical for efficient and accurate emergency response, particularly in larger areas or industrial settings.

In addition to notifications, the system automatically activates safety measures to control the situation before manual intervention is possible. Using the relay module**,** the system can trigger external devices such as sprinklers or power shutdown mechanisms to reduce fire risk, prevent further escalation, and minimize potential property damage. The system also features a Blynk app interface, which allows users to monitor the system's status and receive real-time updates remotely. This interface enables users to track environmental parameters, such as temperature and gas levels, from anywhere, enhancing the system's usability and accessibility. Importantly, this setup does not rely on cloud infrastructure, making it a cost-effective and scalable solution for various environments, including residential buildings, commercial properties, and industrial facilities.

CHAPTER 3
LITERATURE REVIEW

The development of IoT-based fire detection and notification systems has gained significant attention in recent years due to their ability to provide early detection, automate responses, and offer real-time alerts, ensuring faster intervention during fire incidents. Many studies have focused on integrating various sensors, communication technologies, and safety mechanisms to create smarter fire safety systems. For example, Sundararajan et al. (2017) proposed an IoT-based fire monitoring system using flame, smoke, and temperature sensors with an Arduino microcontroller, which triggered SMS alerts via a GSM module. Similarly, Al-Fuqaha et al. (2015) explored smart homes equipped with IoT sensors, which provided continuous monitoring and sent real-time fire alerts via cloud platforms. These studies highlight the importance of sensors in detecting fire hazards and the role of communication modules like GSM and Wi-Fi in sending immediate notifications.

Additionally, the integration of relay modules and fire suppression systems, such as automatic sprinklers, has been explored in many studies. Wang et al. (2016) demonstrated a system where IoT sensors were used to detect fires and activate sprinklers or fire extinguishers, reducing the damage caused by fires. This integration of safety mechanisms with IoT offers automated fire mitigation, significantly enhancing fire safety.

GPS modules have also been incorporated to improve the accuracy of emergency responses. Research by Ravi et al. (2017) highlighted the use of GPS for pinpointing the location of a fire incident, ensuring that emergency teams can quickly reach the affected area. The integration of real-time location data in fire detection systems is particularly useful for large-scale facilities or areas with complex layouts.

The use of mobile applications like Blynk has revolutionized the user interface for IoT-based fire detection systems. Liu et al. (2019) proposed a system where real-time fire data could be monitored and controlled through mobile apps, giving users direct access to sensor data, fire alerts, and control over the system's safety features. This integration of user-friendly interfaces makes it easy for non-technical users to interact with and manage the system.

However, despite the advancements, several challenges remain. Reliability and accuracy of fire detection are critical, as false alarms or missed detections can lead to unnecessary panic or undetected hazards. Rao et al. (2019) emphasized the importance of sensor calibration and data validation to minimize errors and increase system reliability. Moreover, network connectivity can be a significant issue, particularly in remote locations or large buildings, where continuous data transmission might be disrupted. Research on low-power, energy-efficient sensors is crucial for ensuring the sustainability of such systems in environments with limited power resources, as discussed by Karthikeyan et al. (2020), who proposed a low-power fire detection system that used battery-powered IoT devices.

CHAPTER 4

EXISTING METHOD

Manual detection has traditionally formed the basis of fire detection systems, but it can lead to slower response times and an increased risk of damage. Many current systems use wired sensors**,** which are often costly to install and maintain. In recent years, various IoT-based fire detection technologies have been proposed, typically utilizing wireless sensors to detect fires and alert first responders. While these IoT solutions offer advantages, they also present several challenges. One of the major drawbacks is the high false alarm rates**.** Many existing systems rely on simple threshold-based detection algorithms, which can result in frequent false alarms. These unnecessary alerts can waste emergency resources, disrupt operations, and cause unnecessary evacuations. Another limitation is the lack of real-time notifications in some systems. Without immediate alerts, response times are delayed, which can be critical in emergency situations where every second counts. Additionally, the limited battery life of wireless sensors is a significant concern. These sensors often need frequent replacements, leading to increased costs, system downtime, and reduced reliability.

During emergencies, internet connections can become unstable or fail altogether, resulting in delayed or missed alerts, which can have severe consequences. These challenges highlight the need for more reliable, efficient, and real-time fire detection and notification solutions. While IoT-based fire detection and notification systems offer numerous benefits over traditional manual methods, such as faster detection and automated responses, they still face several key challenges. These include high false alarm rates, delayed or inadequate notifications, limited sensor battery life, and reliance on internet connectivity. Addressing these issues is essential to ensure that IoT-based fire detection systems are more reliable, efficient, and capable of providing real-time responses.

CHAPTER 5

PROBLEM STATEMENT

The primary challenge in fire detection systems today lies in the slow response times and inefficiency of traditional manual detection methods, which can lead to significant damage and loss of life. Current IoT-based fire detection systems, while offering automated solutions, still face several issues that hinder their effectiveness. These issues include high false alarm rates due to simplistic threshold-based detection algorithms, resulting in unnecessary resource wastage and disruption of operations. Additionally, many systems suffer from a lack of real-time notifications, delaying emergency responses in critical situations where every second counts. The limited battery life of wireless sensors also contributes to system unreliability, leading to frequent maintenance requirements and potential failures. Moreover, a significant dependency on internet connectivity for alert transmission poses a risk, as communication can be disrupted during emergencies, leading to missed or delayed alerts. Therefore, there is a need for a more efficient, reliable, and real-time fire detection and notification system that minimizes false alarms, ensures immediate alerts, improves system reliability, and operates effectively even during communication failures or limited power scenarios.

CHAPTER 6

PROPOSED METHOD

The project is aim to design and address the limitations of traditional fire detection systems by providing a more efficient, reliable, and real-time solution for fire safety. The system utilizes a network of advanced sensors, including flame and gas sensors, to detect the presence of a fire as early as possible. These sensors continuously monitor the environment and provide real-time data on potential fire hazards, ensuring that any abnormal changes in the atmosphere are quickly identified. The ESP8266 microcontroller serves as the central processing unit, receiving input from the sensors, analysing it, and making decisions based on predefined thresholds for each sensor type. If a fire hazard is detected, the system triggers an immediate response, such as activating fire suppression mechanisms like sprinklers or fire extinguishers via relay modules. This automatic response reduces the time between detection and action, helping to contain or suppress the fire before it spreads.

The system's key feature is its integration with the Blynk app, which allows users to monitor the fire detection system remotely through their smartphones. The app provides a user-friendly interface where real-time sensor data can be viewed, and alerts can be received whenever a fire is detected. This ensures that users can respond quickly, even when they are not on-site. Furthermore, the system sends SMS alerts through a GSM module to notify both users and emergency responders, ensuring that critical notifications reach the necessary parties in case of an emergency. This design minimizes the need for frequent maintenance and battery replacements, making it cost-effective over time. Additionally, the system can function independently of internet access, thanks to its SMS-based notifications and voice calls.

CHAPTER 7
METHODOLOGY

The IoT-based automatic fire detection and notification system integrates multiple components to enhance safety and ensure a quick response to fire hazards. At the core of the system is the ESP8266 microcontroller, which acts as the central hub, connecting various sensors and modules to monitor environmental conditions and detect fire hazards. The system uses a flame sensor, which detects infrared radiation from flames, and a gas sensor, which monitors for harmful gases such as carbon monoxide (CO) or carbon dioxide (CO_2) that are often present during a fire. These sensors continuously monitor the environment, and when fire or gas levels exceed predefined thresholds, they trigger the microcontroller to process the data.

Upon detection of a fire hazard, the ESP8266 processes the sensor input and activates the GSM module, which sends an SMS with the fire's location (provided by the GPS module) to emergency contacts or responders. This feature ensures that emergency teams are informed immediately, even if they are not on-site. Additionally, the system uses a relay to control external fire suppression systems, such as sprinklers or fire extinguishers, to help mitigate the fire’s spread until emergency responders arrive.

The system can be monitored remotely through the Blynk app, which provides a user-friendly interface to track real-time sensor data, such as flame, and gas levels. This feature allows users to stay informed and take timely actions if needed. The integration of these components ensures an automated, reliable, and efficient fire detection and response system, capable of minimizing fire damage.

CHAPTER 8

BLOCK DIAGRAM

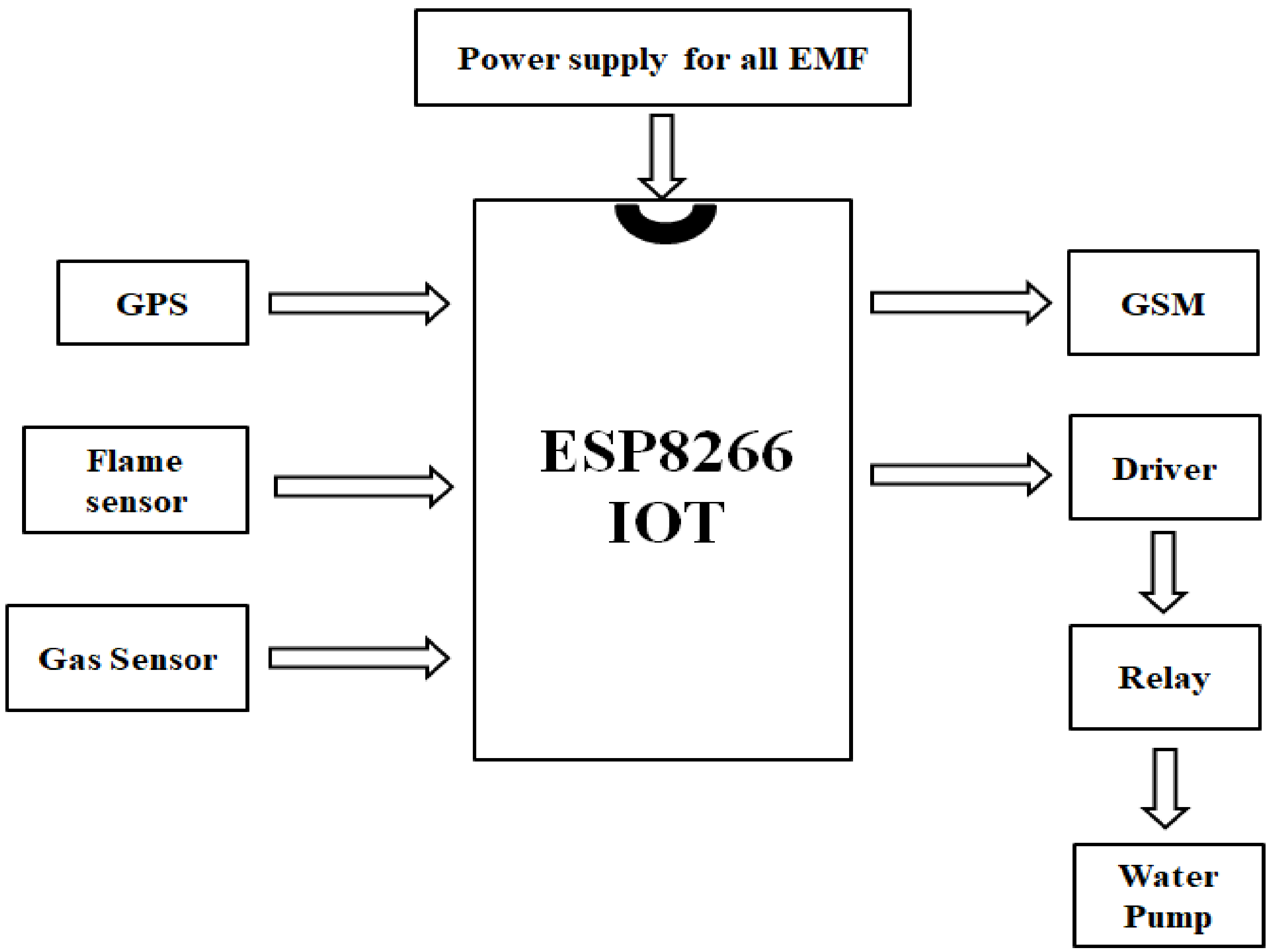

Fig 8.1 Block Diagram of IoT Based Automatic Fire Detecting and Notification System

CHAPTER 9
WORKING

The IoT-Based Automatic Fire Detection and Notification System leverage a combination of advanced sensors, microcontrollers, and communication modules to detect fire hazards in real time and ensure a rapid response to minimize damage. At its core, the system uses a Flame Sensor and a Gas Sensor to continuously monitor the environment for signs of fire or hazardous gases. The Flame Sensor detects infrared radiation emitted by flames, and when the intensity of infrared light exceeds a predefined threshold, it triggers the system to take action. Similarly, the Gas Sensor detects gases such as carbon monoxide (CO) or carbon dioxide (CO2). The data from these sensors is processed by the ESP8266, a low-cost Wi-Fi-enabled microcontroller. The ESP8266 serves as the heart of the system, processing the sensor inputs, analysing them, and making decisions on whether the readings indicate the presence of a fire or hazardous gas levels. If a fire is detected, the ESP8266 triggers an alarm system, which can either send an SMS alert via the GSM module. The GSM module is connected to the system and facilitates real-time communication, sending SMS messages to a list of pre-configured phone numbers, notifying the user or emergency responders of the detected fire and the GPS location.

In addition to alerting users and responders, the system also includes a Relay, which acts as a switch to control external devices like sprinklers, water pumps. Once a fire is detected, the ESP8266 triggers the relay, which then activates the connected fire suppression devices, providing an automated response to reduce or stop the fire. The GPS module plays a critical role in ensuring that emergency responders are directed to the exact location of the fire. By providing real-time location coordinates, the system ensures that responders can reach the affected area quickly and accurately, even in large or complex structures where the fire's location might not be immediately apparent.

In addition to local notifications and responses, the system can be monitored remotely through the Blynk app, which provides a user-friendly interface for tracking the status of the sensors and the fire suppression systems. This enables users to monitor the system's performance, review real-time data such as temperature, gas concentration, and flame detection, and receive timely alerts. The use of wireless sensors, cloud-based notifications, and automated response mechanisms ensures that fires are detected and addressed as quickly as possible, reducing the risk of damage.

CHAPTER 10
COMPONENTS

1. FLAME SENSOR:

A flame sensor is an essential component in IoT-based automatic fire detection and notification systems, designed to detect the presence of fire through the radiation emitted by flames. These sensors are highly effective in quickly identifying the initial stages of a fire, enabling the system to take immediate action, such as alerting emergency responders. Flame sensors work by detecting specific wavelengths of light or radiation that are characteristic of flames, primarily in the infrared (IR) or ultraviolet (UV) spectrum.

10.1 : FLAME SENSOR

2. GAS SENSOR:

Gas sensors are an essential component in many IoT-based fire detection and notification systems. They play a crucial role in identifying hazardous gases. The detection of these gases can provide an additional layer of protection and early warning, especially in fire scenarios where smoke and flames may not be immediately visible. Gas sensors complement other fire detection sensors like smoke, flame, and temperature sensors by offering a broader detection spectrum, thereby improving the overall safety and responsiveness of the system.

Fig 10.2 : GAS SENSOR

3. ESP8266:

The ESP8266 is a popular, low-cost microcontroller with built-in Wi-Fi capabilities, making it an ideal choice for IoT-based applications, including automatic fire detection and notification systems. Its flexibility and ease of integration with various sensors and modules make it highly suitable for real-time data processing and communication in fire safety applications.

Fig 10.3: ESP8266

4. GSM MODULE:

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem is a critical part here. These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

Fig 10.4: GSM MODULE

5. RELAY:

A relay is an essential component in IoT-based fire detection and notification systems, serving as an intermediary device that allows an IoT system to control high-power devices, such as fire suppression systems, alarms, sprinklers, or ventilation systems. In the context of fire detection, the relay plays a critical role by receiving control signals from the microcontroller (e.g., ESP8266, Arduino) and activating or deactivating these external systems based on the fire detection data provided by sensors.

Fig 10.5: RELAY

6. GPS:

In an IoT-Based Automatic Fire Detection and Notification System, GPS (Global Positioning System) plays a crucial role in enhancing the overall effectiveness of the system, particularly in situations where precise location tracking is vital for emergency response. Integrating GPS with fire detection systems allows for the accurate identification of the fire's location, which is critical in large buildings, remote areas, or outdoor environments.

CHAPTER 11

RESULTS AND DISCUSSIONS

The system primarily utilizes various sensors, including flame and gas sensors**,** to detect fire hazards. The flame sensors proved to be highly effective in detecting open flames, while smoke sensors were sensitive to even small amounts of smoke, which made them suitable for early-stage fire detection. The notification mechanism is one of the key features of the system.

Real-time notifications are sent via the Blynk app using the ESP8266 microcontroller, which connects the system to the internet. The Blynk app provided a user-friendly interface, allowing users to monitor the system remotely and receive instant push notifications when a fire hazard was detected. The notification system worked efficiently in terms of delivery speed, with minimal delay in alerting users.
Additionally, local notification systems like SMS via GSM modules could be used as a backup communication method to ensure alerts are delivered even when the internet is down.

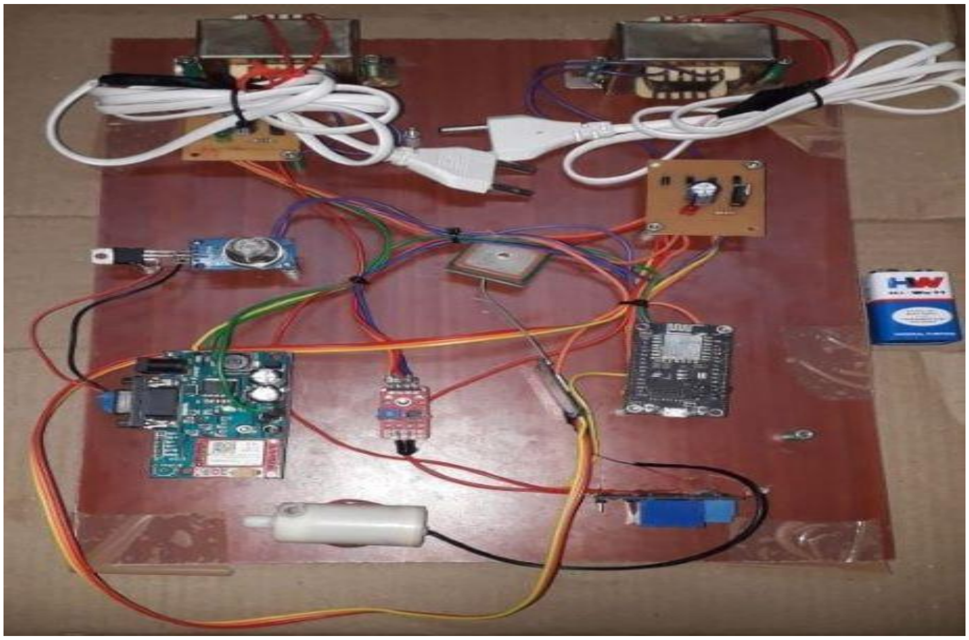

Fig 11.1: HARDWARE SETUP

CHAPTER 12

CONCLUSION AND FUTURE WORK

The development of IoT-based automatic fire detection and notification systems represents a significant advancement in the field of fire safety. These systems utilize wireless sensors to detect fire hazards, providing faster response times. By integrating technologies like flame and gas sensors with communication modules such as GSM and Wi-Fi, IoT-based systems can send real-time alerts to emergency responders or individuals, facilitating quick action to mitigate damage. The added benefit of integrating mobile applications, such as Blynk, allows for remote monitoring and control, improving overall convenience and safety.

However, despite these advancements, several challenges persist in current IoT-based fire detection systems, such as high false alarm rates, limited battery life, and dependence on internet connectivity. To address these challenges, future work should focus on improving the reliability and accuracy of fire detection algorithms. Additionally, future systems should focus on enhancing integration with existing smart home and smart building systems, enabling automatic responses like shutting off HVAC systems or activating fire suppression mechanisms when a fire is detected. Furthermore, more emphasis could be placed on real-time location tracking using GPS modules to provide precise location data to emergency services, ensuring faster and more efficient responses.

In conclusion, IoT-based fire detection and notification systems have the potential to revolutionize fire safety by offering automated, real-time, and remote monitoring. Continued research and development to overcome the current limitations and integrate new technologies will pave the way for more reliable, scalable, and efficient fire safety solutions in the future. These advancements could ultimately save lives, reduce property damage, and improve overall fire safety in residential, commercial, and industrial settings.

CHAPTER 13

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