SMART NOTICE BOARD DISPLAY

A

MAJOR PROJECT-II REPORT

Submitted in partial fulfillment of the requirements

for the degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING

By

GROUP NO.25

Devendra Upadhyay	**0187CS211061**
Devendra Mehra	**0187CS211059**
Dev Dabi	**0187CS211057**
Dharmeet Singh	**0187CS211063**

Under the guidance of

Prof. Shweta Singh

(Assistant Professor)

Department of Computer Science & Engineering

Sagar Institute of Science &Technology (SISTec), Bhopal (M.P)

Approved by AICTE, New Delhi & Govt. of M.P.

Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P.)

June 2025

Sagar Institute of Science & Technology (SISTec), Bhopal (M.P)

Department of Computer Science & Engineering

CERTIFICATE

We hereby certify that the work which is being presented in the B.Tech. Major Project-II Report entitled **SMART NOTICE BOARD DISPLAY ,** in partial fulfillment of the requirements for the award of the degree of ***Bachelor of Technology,*** submitted to the Department of **Computer Science & Engineering**, Sagar Institute of Science & Technology (SISTec)**,** Bhopal (M.P.) is an authentic record of our own work carried out during the period from Jan-2025 to Jun-2025 under the supervision of **Prof. Shweta Singh .**

The content presented in this project has not been submitted by me for the award of any other degree elsewhere.

Devendra Upadhyay	**Devendra Mehra**	**Dev Dabi**	**Dharmeet Singh**
0187CS211061	**0187CS211059**	**0187CS211057**	**0187CS211063**

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date:

Prof. Shweta Singh	**Dr. Amit Kumar Mishra**	**Dr. D.K. Rajoriya**
Project Guide	**HOD, CSE**	**Principal**

ACKNOWLEDGEMENT

We would like to express our sincere thanks to **Dr. D. K. Rajoriya**, **Principal, SISTec and Dr. Swati Saxena, Vice Principal SISTec** Gandhi Nagar, Bhopal for giving us an opportunity to undertake this project.

We also take this opportunity to express a deep sense of gratitude to **Dr. Amit Kumar Mishra, HOD, Department of Computer Science & Engineering** for his kindhearted support

We extend our sincere and heartfelt thanks to our guide, **Prof. Shweta Singh,** for providing us with the right guidance and advice at the crucial junctures and for showing us the right way.

I am thankful to the **Project Coordinator, Prof. Deepti Jain** who devoted her precious time in giving us the information about various aspects and gave support and guidance at every point of time.

I would like to thank all those people who helped me directly or indirectly to complete my project whenever I found myself in any issue,

TABLE OF CONTENTS

ABSTRACT

The "Smart Notice Board Display" project aims to revolutionize the traditional method of conveying information through notice boards by integrating smart technology. This system enables the real-time display of notices and announcements using an IOT-based platform. It eliminates the need for manual updates and paper usage, promoting efficiency and sustainability. The project utilizes a Microcontroller connected to a wireless communication module to receive and display content on a digital screen. Administrators can remotely upload or modify messages via a web or mobile interface, ensuring instant updates. This system can be implemented in educational institutions, offices, and public spaces, enhancing accessibility and communication. By leveraging cutting-edge technologies like IOT, the Smart Notice Board Display provides an eco-friendly and user-friendly solution to streamline the dissemination of information in various environments.

LIST OF ABBREVIATIONS

ACRONYM	FULL FORM
IOT	Internet of Things
MCU	Microcontroller Unit
ESP	Espressif Systems ESP8266
LED	Dot Matrix Display MAX7219
PS	Power Supplier
PCB	Printed Circuit Board
Wi-Fi	Wireless Fidelity

LIST OF FIGURES

LIST OF TABLES

Chapter 1
Introduction

CHAPTER 1
INTRODUCTION

The **Smart Notice Board Display** is an innovative solution designed to modernize traditional notice boards by incorporating advanced technology for dynamic and efficient communication. This project aims to address the limitations of conventional notice boards, such as manual updates, physical labor, and environmental concerns due to paper usage.

1.1 ABOUT PROJECT

The **Smart Notice Board Display** project is an innovative effort to digitize the conventional method of sharing information through notice boards. In traditional setups, notice boards are physical structures that require manual effort to update content, making the process labor-intensive, time-consuming, and prone to inefficiencies. Additionally, traditional systems heavily rely on paper, leading to significant environmental concerns due to waste generation. These drawbacks limit the flexibility and scalability of such systems, especially in environments where quick and frequent updates are required. This project seeks to address these challenges by introducing a smart, automated solution that incorporates modern technologies such as the Internet of Things (IoT), wireless communication, and digital display systems. The core idea is to create a centralized platform where administrators or users can remotely upload and manage notices. These notices are transmitted wirelessly to a microcontroller-based system, which processes the data and displays it on an LCD, LED, or other digital screens in real-time.

The system's backbone is a microcontroller unit, such as an ESP8266, Arduino Uno, or which acts as the primary processing and control unit. It interfaces with a Wi-Fi module, enabling seamless connectivity to a web or mobile application. Through this application, users can upload, edit, or delete notices instantly, making it a dynamic and versatile solution for diverse environments such as educational institutions, offices, shopping malls, and public spaces. The Wi-Fi module ensures that notices can be transmitted wirelessly over long distances, eliminating the need for physical proximity or direct connections to the display.

Through this application, users can upload, edit, or delete notices instantly, making it a dynamic and versatile solution for environments such as educational institutions, offices, shopping malls, and public spaces. The Wi-Fi module ensures notices can be transmitted wirelessly over long distances, enabling seamless updates without the need for physical proximity or direct display connections.

The **Smart Notice Board Display** project is a modern solution aimed at replacing traditional, manually updated notice boards with an intelligent and automated system. It leverages technologies such as the Internet of Things (IoT), wireless communication, and microcontroller-based processing to create a more efficient and eco-friendly way of disseminating information. . Designed for scalability and ease of use, the project can manage multiple notice boards from a central platform, making it suitable for educational institutions, offices, shopping malls, and public spaces. Optional features like brightness adjustment, text-to-speech functionality, and multi-language support further enhance its adaptability to diverse environments The **Smart Notice Board Display** is not only a technological upgrade but also a step toward greener practices and improved communication. It ensures instant updates, reduces operational costs, and simplifies information management, providing a sustainable and efficient solution for the modern era. The project also aligns with sustainability goals by reducing paper usage, promoting eco-friendly practices, and lowering operational costs over time. It offers scalability by supporting multiple interconnected notice boards that can be managed from a single platform, making it an ideal solution for environments like schools, universities, corporate offices, shopping malls, and public information hubs.

The Smart Notice Board Display incorporates additional features to enhance user experience and adaptability. These features include automated brightness adjustment using light sensors, multi-language support for diverse audiences, and text-to-speech capabilities for audio announcements.

Such enhancements make the system more versatile and capable of meeting the needs of a wide range of users and applications. From a broader perspective, the project represents a step forward in the digital transformation of communication tools. By integrating automation, remote accessibility, and eco-conscious design, the Smart Notice Board Display not only streamlines communication but also contributes to global sustainability efforts. Its ability to deliver instant updates, support centralized management, and adapt to diverse operational requirements positions it as a future-ready solution for modern information dissemination. In conclusion, the **Smart Notice Board Display** is a comprehensive system that combines functionality, efficiency, and sustainability.

1.2 PROJECT OBJECTIVES

The primary objective of the **Smart Notice Board Display** project is to create a sophisticated, intelligent, and user-friendly system that redefines how notices and announcements are managed, updated, and shared in real-time. This project aims to address the limitations of traditional notice boards, which require manual updates, incur recurring costs due to paper usage, and are time-consuming and labor-intensive. By integrating advanced technologies such as IoT (Internet of Things), microcontroller systems, and wireless communication, the **Smart Notice Board Display** provides a seamless and efficient solution for real-time communication..

This system enables administrators to remotely upload, edit, and manage notices using a web or mobile application, which is then wirelessly transmitted to the **Microcontroller** for processing and display on a digital screen. This approach eliminates the need for physical interaction with the board, allowing for instant updates from any location, significantly improving operational efficiency.

Additionally, the **Smart Notice Board Display** project places a strong emphasis on sustainability by reducing dependency on paper, thereby contributing to environmental conservation and aligning with global sustainability goals. By introducing a digital platform, the system minimizes waste, reduces the ecological footprint of traditional notice boards, and provides a cost-effective, long-term communication solution.

The project also prioritizes user accessibility and scalability by offering a centralized platform to manage multiple interconnected displays, making it ideal for diverse environments such as schools, colleges, corporate offices, shopping malls, and public spaces. To enhance usability and adaptability, the system includes optional features such as automatic brightness adjustment based on ambient light conditions, optimizing visibility while reducing energy consumption. The integration of text-to-speech functionality allows for audio announcements, making the system more inclusive for individuals with visual impairments or for use in noisy environments. Additionally, multi-language support ensures accessibility for a diverse audience, further improving the effectiveness of the Smart Notice Board Display

- **Enhance Operational Safety for Fleets and Businesses** : The objective of enabling real-time information sharing lies at the core of the **Smart Notice Board Display** project. Traditional notice boards are inherently limited by the need for manual updates, which often result in delays, errors, and inefficiencies, especially in environments requiring frequent updates. The Smart Notice Board Display overcomes these challenges by leveraging advanced technologies such as wireless communication and IoT.

- **To Promote Sustainability** : Promoting sustainability is a significant objective of the **Smart Notice Board Display** project, addressing the environmental impact associated with traditional notice boards. Conventional systems rely heavily on printed materials, such as posters, memos, and announcements, which contribute to paper waste and result in the excessive consumption of natural resources like wood and water used in paper production. Additionally, the frequent disposal of outdated notices generates waste that often ends up in landfills, further harming the environment.

This eco-friendly initiative aligns with global sustainability goals by promoting the conservation of forests, which act as vital carbon sinks and play a crucial role in combating climate change. Furthermore, the system reduces the energy and water consumption required for paper manufacturing, as well as the greenhouse gas emissions associated with the transportation and disposal of paper waste.
Adopting such a digital solution not only minimizes the carbon footprint but also encourages organizations and communities to embrace greener practices. The system sets an example for sustainable innovation by integrating advanced technology with environmental consciousness. It highlights how digital transformation can be leveraged to create smarter, more efficient, and environmentally responsible communication systems, paving the way for a future where technology and sustainability go hand in hand.

The Smart Notice Board Display eliminates the need for physical paper by replacing it with a digital platform, significantly reducing paper consumption and waste generation.
By adopting this eco-friendly approach, the system contributes to global sustainability efforts and aligns with green practices aimed at reducing deforestation and minimizing the carbon footprint The system sets an example for sustainable innovation by integrating advanced technology with environmental consciousness.

Increase Operational Efficiency: The **Smart Notice Board Display** is designed to significantly enhance operational efficiency by automating and streamlining the process of managing notices and announcements. Traditional notice boards often require considerable manual effort, including printing, transporting, and physically updating information. Moreover, the system supports automation of routine tasks, such as scheduling notices to appear or expire at specific times, eliminating the need for constant manual oversight. With centralized management, multiple displays across various locations can be controlled simultaneously from a single platform, further optimizing administrative efforts. By reducing the dependence on physical materials and manual labor, the system minimizes operational bottlenecks, cuts down on recurring costs, and frees up resources for other important tasks.

The Smart Notice Board Display eliminates these inefficiencies by leveraging a digital platform that allows administrators to remotely upload, edit, and schedule notices in real-time through a web or mobile application. This instant communication capability ensures that updates are immediately visible to the intended audience, reducing the turnaround time for information sharing money.

Chapter 2

Software & Hardware Requirements

CHAPTER 2
SOFTWARE & HARDWARE REQUIREMENTS

SOFTWARE REQUIREMENTS

- **Programming Language (C++ or Arduino IDE):** The microcontroller is programmed using C++ or Arduino IDE, which offers user-friendly libraries and functions. This enables efficient coding for handling inputs, processing data, and controlling hardware components**.**
- **Microcontroller IDE (Arduino IDE or ESP8266 IDE**) : These development environments are specifically designed for programming microcontrollers like Arduino or ESP8266. They provide tools to write, compile, and upload code seamlessly to the hardware**.**
- **Web/Mobile Application**: A dedicated web or mobile application is used to input and update messages on the notice board. This user-friendly interface simplifies message management and enables real-time updates, enhancing system convenience**.**

HARDWARE REQUIREMENTS

- **Wi-Fi Module ESP8266 :** This module enables wireless communication, allowing users to interact with the system remotely via smartphones or other devices**.**
- **DOT MATRIX LED Display:** The LED display, powered by the MAX7219 driver, serves as the primary output medium for displaying messages. Its multi-segment structure is suitable for showing short and concise updates or instructions efficiently.
- **Breadboard:** The breadboard is used to simulate and test connections before finalizing the circuit. It provides a convenient platform for integrating and debugging various components without soldering.
- **Jumper Wires :** Connectors and wires are essential for establishing proper communication between the hardware components. They ensure stable and reliable integration, enabling smooth data flow throughout the system**.**
- **PORT-B cable :** The Type-B end connects to the **ESP8266**, Or the Type-B end plugs into a computer's USB port or a compatible USB power adapter. This cable delivers a regulated 5V power supply to **PORT-B**, enabling it to power the microcontroller and connected components.

Chapter 3
Problem Description

CHAPTER 3
PROBLEM DESCRIPTION

In traditional environments like schools, offices, and public spaces, notice boards have been the primary method of communicating important information, such as announcements, schedules, events, and alerts. These conventional notice boards, however, have several limitations that hinder their effectiveness and efficiency in fast-paced and information-driven settings..

3.1 OVERVIEW

Smart Notice Board Display project is to design, develop, and implement a digital communication system that replaces traditional, manual notice boards with an intelligent, automated solution. This system aims to address the inefficiencies and environmental challenges associated with conventional notice boards while incorporating modern technologies for improved functionality and usability.

- **Lack of Interactivity:** Traditional notice boards are static, and users cannot interact with the displayed content. For example, if a user wants more details about a particular notice, they cannot access additional information unless it is explicitly provided on the board.
- **Inefficient Communication in Large or Multi-location Environments:** n large organizations or campuses with multiple locations, managing several traditional notice boards becomes increasingly complex. It is difficult to synchronize updates across multiple boards in different areas, leading to inconsistency in the information shared.
- **Outdated Information:** In such dynamic settings, relying on traditional methods like printed notices or handwritten updates can lead to delays in communication, resulting in important messages not being displayed on time. As a result, users may miss critical announcements or updates, which can cause confusion or inefficiency. Additionally, manual updates are prone to human errors, which further heighten the risk of inaccurate or outdated information being shared. This highlights the need for a more automated, reliable, and real-time system for information dissemination.
- **Space Constraints:** Physical notice boards have a limited space for displaying information, and this limitation may lead to managing space on the notice board can become challenging in high-traffic areas where people frequently remove or replace notices, leading to disorganization and confusion.

The **Smart Notice Board Display** project aims to address the above challenges by leveraging digital technology to create a more efficient, sustainable, and accessible method of communication. The smart system allows for real-time updating of information via a web or mobile platform, reducing the need for manual intervention. It eliminates paper waste by displaying digital notices and offers a more dynamic and interactive medium for sharing content.

By integrating technologies like Wi-Fi , the system ensures that information is updated remotely and in real-time, reaching a wider audience. It offers an easy-to-use interface that allows users to access information from any location, making communication faster and more reliable. Furthermore, the digital nature of the board opens the door to multimedia integration, enabling the display of images, videos, and live updates, thus enhancing user engagement.

Ultimately, the Smart Notice Board Display solves the problems of outdated information, limited reach, environmental impact, space constraints, and interactivity while streamlining the process of managing notices and ensuring that important information is shared efficiently with everyone, regardless of their location.

Chapter 4
Literature Survey

CHAPTER 4
LITERATURE SURVEY

Over the years, digital technologies have dramatically transformed the way information is communicated in various environments such as educational institutions, offices, and public spaces. The traditional notice board, a staple in schools, colleges, and workplaces, has remained largely unchanged for centuries, relying on paper-based notices that require manual updating. This approach, while effective to an extent, has several drawbacks, including inefficiency, outdated information, limited reach, and environmental impact due to paper waste. To address these issues, researchers and developers have explored the implementation of smart notice board system**s** that integrate digital displays, IoT technology, and cloud services to modernize communication and improve operational efficiency.

The evolution from traditional paper-based notice boards to digital displays has been driven by advancements in LCD and LED technologies. Early work in this field focused on simple electronic displays, which allowed for static information to be presented on a screen, often requiring physical media like USB drives or SD cards to update the content. However, these systems were limited by the need for manual intervention and lack of real-time updates.

In their 2016 paper, **Smith et al.** presented a system that used **Raspberry Pi** as the control center for a digital notice board, connected to a Wi-Fi network. They noted that cloud-based systems significantly reduced manual labor in updating content, allowing for automated scheduling of notices. This study demonstrated the feasibility of using low-cost hardware and open-source software for creating an efficient smart notice board system.

The integration of **IoT technology** in smart notice boards has opened up new possibilities for wireless, real-time communication. Early implementations of IoT-based notice boards utilized technologies like **Wi-Fi** and **Bluetooth** to allow remote management of notices. **Wi-Fi modules** such as **ESP8266** and **ESP32** have been widely used due to their affordability and ability to connect to the internet, enabling real-time updates to the notice boards from remote locations. In contrast, **Bluetooth modules**, such as the **HC-05**, have been employed for **local control** of notice boards, allowing for direct communication between a smartphone or tablet and the board without internet .

A study by **Zhang et al. (2017)** demonstrated how **WiFi Module** could be used to provide a cost-effective, energy-efficient solution for local control of digital notice boards. Their work showed that Bluetooth-based solutions were particularly useful for small- scale or single-location implementations, where Wi-Fi connectivity was not required.

One of the key advantages of smart notice boards is their ability to display dynamic content, including text, images, videos, and even interactive elements. This ability to showcase multimedia enhances communication and engages users more effectively than static paper notices. As the demand for multimedia content increases, modern smart notice boards have begun to integrate touchscreen functionality, allowing users to interact with the display for more detailed information.

Recent studies have highlighted the use of touchscreen interfaces in smart notice boards for applications in schools and corporate environments. In a 2018 paper, **Lee et al.** developed a smart notice board with touch functionality that allowed users to interact with notices by tapping on them for more information. This added an interactive layer, making the system more user-friendly and accessible. The integration of QR codes in digital notices has also become popular, enabling users to scan the code with their smartphones and access more detailed information, links, or videos directly from the notice board..

A key driver for the adoption of smart notice boards is the growing concern over environmental sustainability. Traditional notice boards contribute to paper waste, and the printing process itself consumes significant amounts of energy and resources. Sustainable design practices are becoming a critical aspect of modern technology systems, with a focus on reducing paper usage and promoting digital communication as a more eco-friendly alternative. Research conducted by **Wang et al. (2019)** investigated the environmental benefits of digital notice boards, showing that they could significantly reduce paper consumption in organizations, thus contributing to sustainability The literature on smart notice boards illustrates a significant shift from traditional, static notice boards to dynamic, digital platforms that leverage advanced technologies like IoT, cloud computing, and multimedia. These advancements have paved the way for real-time communication, sustainability, multimedia integration, and interactive features, all of which enhance the efficiency, accessibility, and usability of notice systems in various environments. As technologies continue to evolve, future research will likely focus on improving energy efficiency.

Conclusion

The literature reviewed indicates that Bluetooth technology is widely adopted in IoT-based public information systems due to its reliability, cost-effectiveness, and ease of integration. Using Wi-Fi in a smart notice board system provides an efficient means of delivering real-time messages to the public, making it an ideal choice for this project. These studies collectively support the feasibility and practicality of implementing a Wi-Fi based smart notice board .

Using Wi-Fi in a smart notice board system not only ensures seamless communication but also allows for flexibility in managing the system remotely. The wireless nature of Bluetooth enables real-time updates and changes to the displayed content from a mobile or web application, providing an efficient way of delivering messages to the public. This eliminates the need for manual updates or physical interaction with the notice board, reducing human errors and improving overall efficiency.

Additionally, Wi-Fi low power consumption is an important consideration, especially in systems that require continuous operation without frequent maintenance. The technology's cost-effectiveness further supports its suitability for projects that aim to offer an affordable solution for public communication.

Chapter 5

Software Requirements Specification

CHAPTER 5
SOFTWARE REQUIREMENTS SPECIFICATION

This document outlines the software requirements for the **Smart Notice Board Display** system, which will automate the process of displaying and updating notices, announcements, and other important information in a digital format. The software requirements include both functional and non-functional specifications to ensure the system meets the desired objectives and performs efficiently.

5.1 FUNCTIONAL REQUIREMENTS

The **functional requirements** of the Smart Notice Board Display system outline the essential features and capabilities that the software must support to ensure its proper operation and meet user needs. The system should allow administrators to add, edit, and delete notices that will be displayed on the digital board. Notices can include text, images, and videos, and the system should support scheduling these notices for specific times, days, or recurring events. It must also provide an easy-to-use interface to manage the content, allowing users to organize notices based on urgency or importance.

- **Notice Management:** Notice Management is a fundamental feature of the Smart Notice Board Display system, responsible for organizing and overseeing all notices. It ensures that each notice is categorized, prioritized, and displayed correctly according to the designated schedule. This system enables administrators to easily track, update, and remove outdated or irrelevant notices, keeping the display current and relevant to the audience.
- **Scheduling of Notice:** The system includes a scheduling feature that allows administrators to specify the time and date each notice will be displayed. This ensures that notices appear at the appropriate moment, whether it's for an event, meeting, or announcement. Additionally, the system supports repeating notices, which can be set to recur on specific days, such as daily, weekly, or monthly, reducing the need for constant manual updates.
- **User Authentication: User** Authentication ensures that only authorized personnel can make changes to the notice board. This is achieved through a secure login system where users must enter valid credentials, such as a username and password, before gaining access. By restricting access, the system prevents unauthorized changes, ensuring that only trusted individuals can add, update, or delete notices, maintaining the integrity of the information displayed.

5.2 NON-FUNCTIONAL REQUIREMENTS

Performance Requirements: The Smart Notice Board Display should support real-time updating of notices across all connected devices, ensuring that any changes made by administrators or authorized personnel are instantly reflected on the display. The system must guarantee a response time of less than 3 seconds for updates, providing a seamless and efficient user experience. This is crucial for environments such as educational institutions, corporate offices, and public spaces where timely communication is essential.

Data Processing: The system must be capable of processing sensor inputs in real time, particularly for features like automatic content adjustment based on audience presence, ambient lighting, or motion detection. It should instantly update the displayed content based on predefined conditions, ensuring relevant and dynamic information is always visible. Additionally, the system must operate continuously without lag or interruptions, ensuring reliable performance in high-traffic areas.

Security Requirements: To ensure the safety and privacy of users, the system shall encrypt all sensitive data, including user credentials and notice content. Advanced encryption algorithms, such as AES or RSA, will be used to protect the data both during transmission and storage. Additionally, secure access protocols will be implemented to prevent unauthorized modifications to notices, ensuring that only verified users can update or delete content.

Usability: The Smart Notice Board Display shall prioritize ease of use, featuring an intuitive interface that allows non-technical users to manage notices effortlessly. Features like drag-and-drop functionality, clear navigation, and simple controls will enable administrators to add, update, and delete notices with ease. The system will also provide user-friendly dashboards and help guides to assist users in managing content efficiently. The goal is to make the system accessible and effective for a wide range of users.

5.3 PERFORMANCE

Performance is a crucial non-functional requirement for the Smart Notice Board Display system, as it directly influences how efficiently and reliably the system operates, particularly in terms of responsiveness, speed, and resource management.

Key performance requirements include:

- **Responsiveness and Speed:** One of the main aspects of performance in this system is **responsiveness**—how quickly the system reacts to user inputs or changes made by administrators.
- **Scalability:** Efficient resource utilization is another important performance consideration. The system should be optimized to use minimal hardware resources, such as CPU, memory (RAM), and storage, while still providing all the necessary functionalities.
- **Resource Utilization:** Efficient **resource utilization** is another important performance consideration. The system should be optimized to use minimal hardware resources, such as CPU, memory (RAM), and storage, while still providing all the necessary functionalities.
- **Load Handling:** The system must be able to handle high user load or traffic. For example, during peak times or special events when there is a significant amount of data being uploaded or notices being changed frequently, the system should still perform effectively.

5.4 USABILITY

Usability is a critical non-functional requirement for the Smart Notice Board Display system, as it directly affects how easily users, especially administrators and end-users, can interact with and navigate the system. A system with high usability ensures that all users can efficiently perform their tasks with minimal learning curve, errors, or frustrations. The usability of the Smart Notice Board Display system is paramount for ensuring that administrators can manage content quickly and effectively, while end-users can easily view notices in a seamless and engaging.

Chapter 6
Software and Hardware Design

CHAPTER 6
SOFTWARE AND HARDWARE DESIGN

6.1 DATA FLOW DIAGRAM

A **Data Flow Diagram (DFD)** Illustrates how data moves within a system and how it is processed at various stages. For the **Smart Notice Board Display** project, the DFD would help show the flow of data from the input (admin notice management) to the output (displayed notice on the board), including how different components of the system interact.

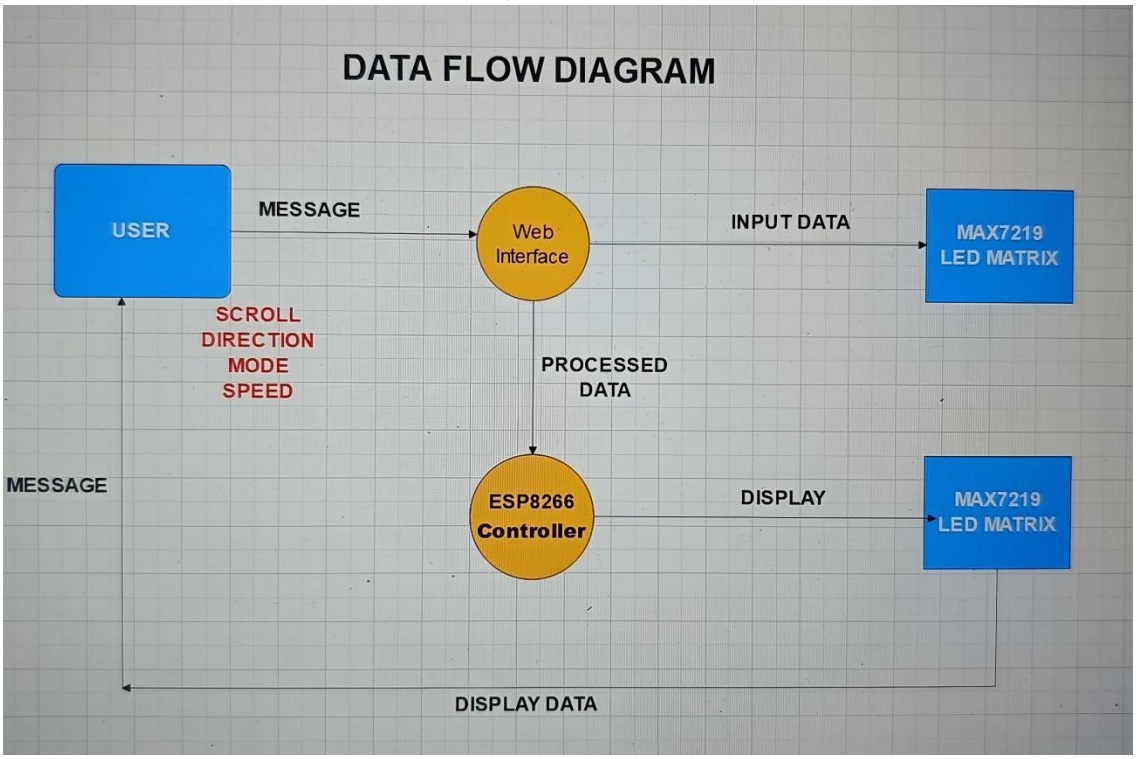

Figure 6.1: Data flow Diagram

6.2 USE CASE DIAGRAM

The **Smart Notice Board Display** system, the use case diagram defines the interactions between the actors (Administrator and Users) and the system. Below is a description of the use case for this project, detailing the primary functionalities and how the actors interact with the system

.

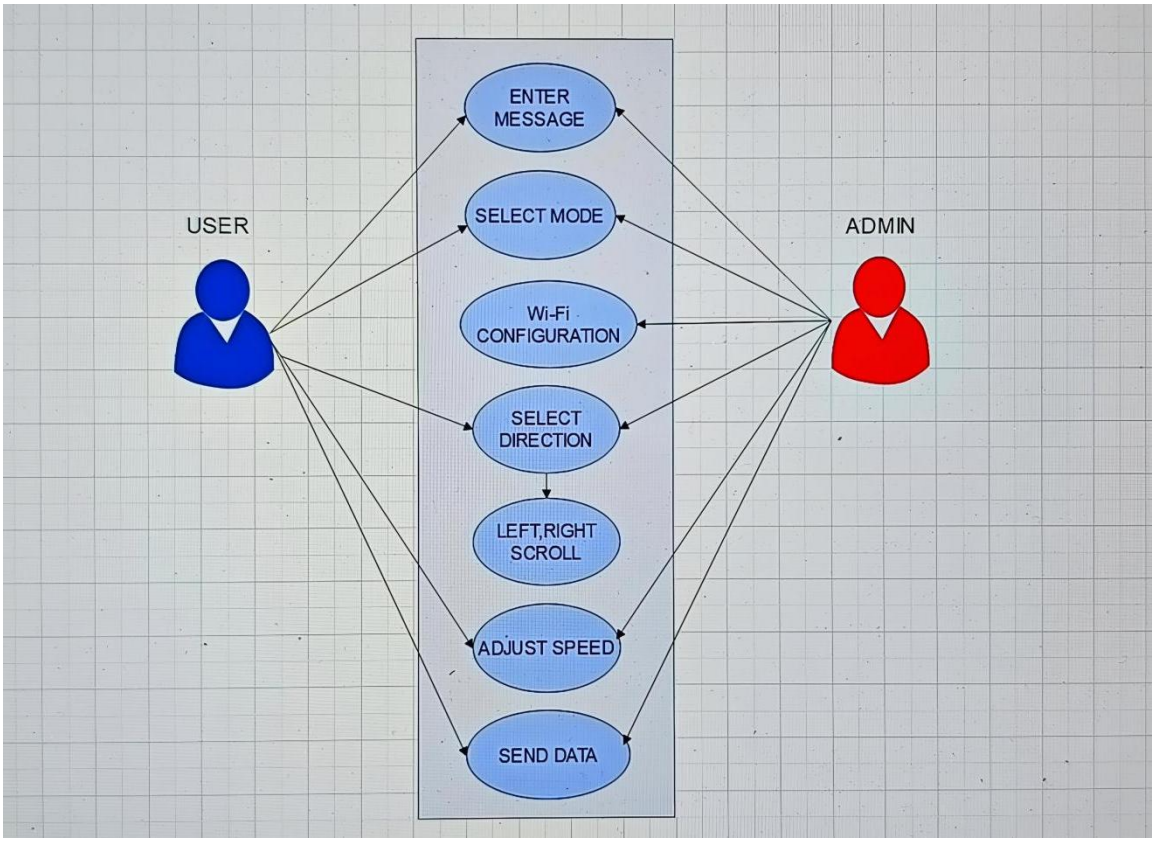

Figure 6.2: Use Case Diagram

6.3 ARCHITECTURE

The architecture of the **Smart Notice Board Display** project is designed to enable seamless integration of various hardware and software components that facilitate dynamic display of notices through the use of an, **Wi-Fi Module ESP8266**, **DOT LED MATRIX MAX7219**, and a **Notice Database**. Below is a detailed description of the system architecture for this project.

Figure 6.3: Architecture of System

6.4 CIRCUIT DIAGRAM

The hardware of the Smart Notice Board project consists of a 4-in-1 Dot Matrix LED Display and an ESP8266 WiFi Module. The input port is on the left side of the display and **is** connected to a Microcontroller's GPIO pins**.** The output port, on the right side, allows for expanding or adding additional LED Displays.

The diagram also shows:

- **Wi-Fi Module ESP8266**: Wireless communication module to receive notices/command.
- **DOT Matrix LED Display**: Displays the notices .

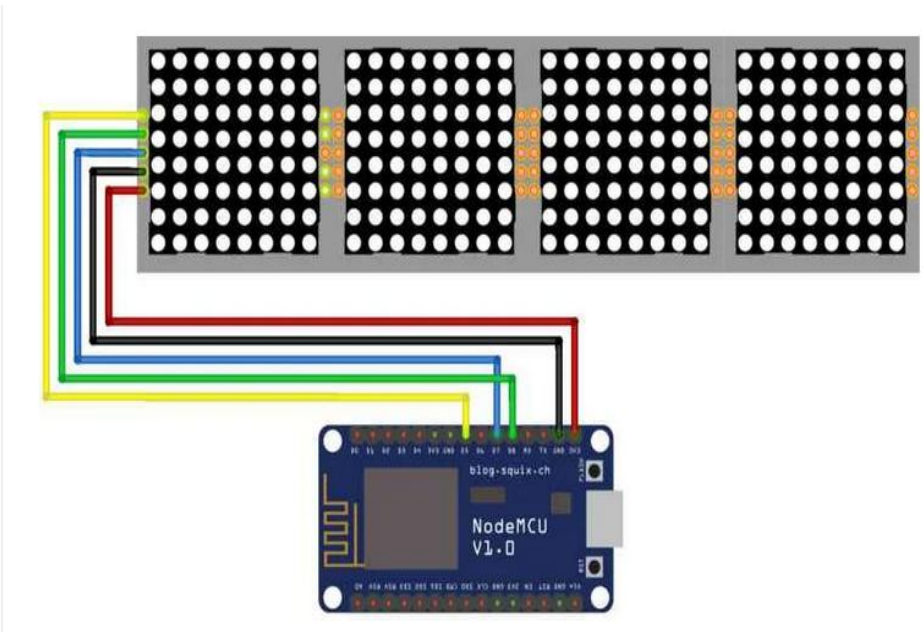

Figure 6.4: Circuit Diagram

6.5 PIN DIAGRAM

The Pin Diagram provides a detailed layout of the **Microcontroller** or other key components used in the system. It shows the purpose of each pin (e.g., input, output, power) and how it connects to other parts of the system.

The **4-in-1 8×8 LED matrices** are connected via **MAX7219 pins**

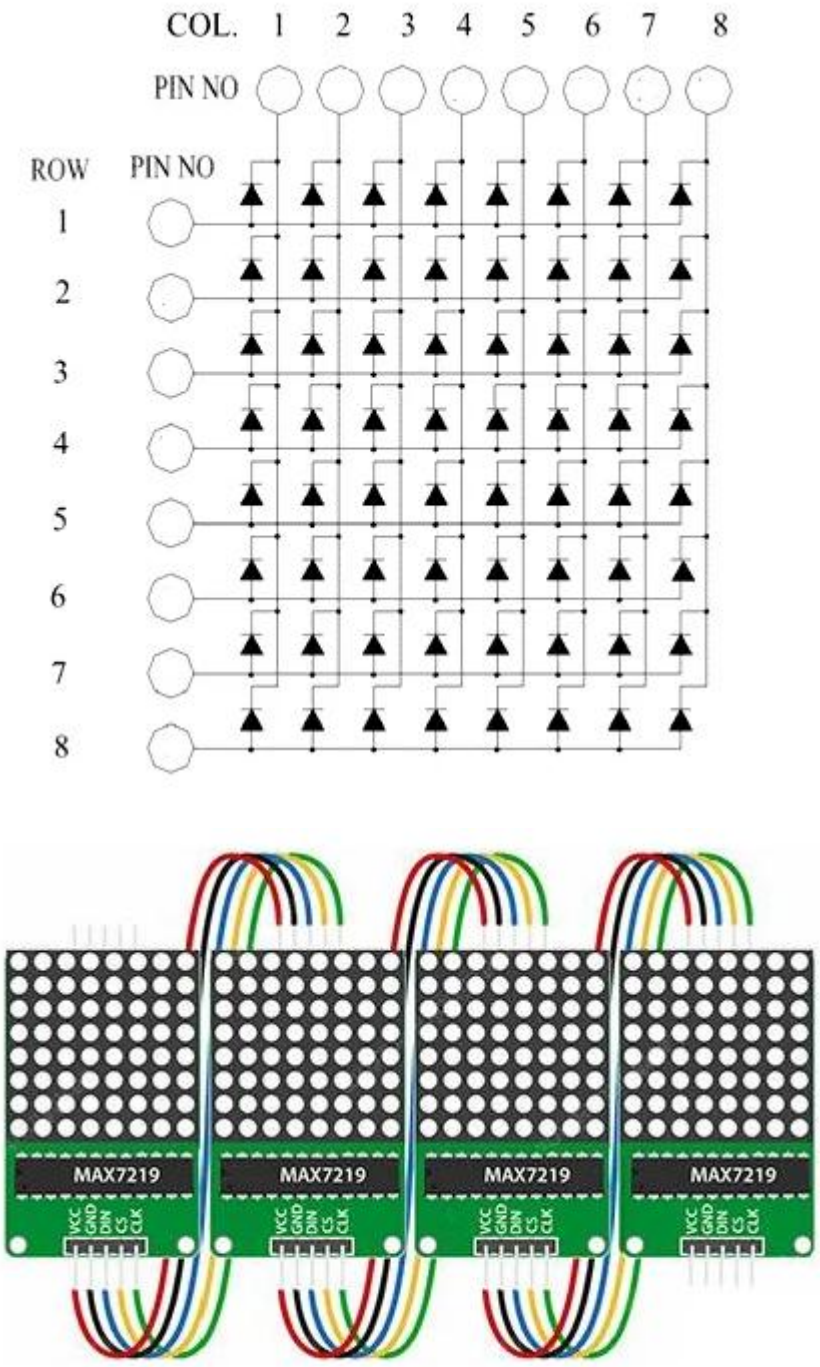

Figure 6.5: Pin Diagram

Chapter 7
IoT Module

CHAPTER 7
IOT MODULE

7.1 PRE-PROCESSING

In the context of your Smart Notice Board Display project, **Pre-processing** refers to the steps or operations that prepare the data before it is displayed on the notice board or sent to the system. Pre-processing ensures that the data is formatted, cleaned, and optimized for display, making it more efficient and user-friendly.

7.2 SIGNALS-PROCESSING

Signal Processing in the Smart Notice Board Display Project refers to the manipulation and management of the signals (data) received by the system to ensure they are suitable for display on the board. The goal of signal processing in this project is to handle the raw input data (whether it's from Bluetooth, IoT, or local inputs) and convert it into a format that is readable and meaningful for the **DOT MATRIX LED DISPLAY** This process involves several key steps to ensure the system's operation is efficient, accurate, and reliable.

First, **signal acquisition** is the initial step, where the system receives input data. This data can be in the form of text or multimedia, sent via **Wi-Fi Module ESP8266** or an **IoT module (ESP8266/ESP32)**. The raw signal, which might be a long string of text or even command data, is processed to filter out noise or irrelevant information. This can include checking for errors in transmission or filtering out unwanted characters that cannot be displayed on the LED The **processed signal** is then ready to be displayed. The processed text is sent to the **ESP8266** , which controls the **DOT MATRIX LED DISPLAY**. The final signal is transmitted in a format that the display can interpret, ensuring the correct message is shown to the end-user.

If the system is connected to an IoT network, signal processing can include the synchronization of real-time data, fetching new notices from the cloud, and ensuring the system stays up to date with the latest information. The system applies thresholding techniques to the filtered data to determine the relevance and priority of notices, ensuring that important messages are highlighted. Signal processing, therefore, plays a vital role in maintaining the integrity, clarity, and responsiveness of the notice board, ensuring real-time, accurate communication between the user and the display.

The processed signal is then ready to be displayed. The processed text, for instance, is sent to the **Arduino Uno** or **ESP32**, which controls the **DOT MATRIX LED DISPLAY** The final signal is transmitted in a format that the display can interpret, ensuring the correct message is shown to the end-user.

Moreover, if the system is connected to an IoT network, signal processing can include the synchronization of real-time data, fetching new notices from the cloud, and ensuring the system stays up to date with the latest information. The system may also perform error-checking and validation of incoming signals to ensure the content displayed is accurate and not outdated.

In summary, signal processing in the Smart Notice Board Display project ensures that all incoming signals (data) are appropriately formatted, error-free, and optimized for display, thereby enabling a smooth and efficient user experience. This ensures that the system works reliably, whether the data comes from Bluetooth, an IoT connection, or manual updates.

7.3 IOT MODEL DESCRIPTION

The **IoT (Internet of Things) model** in the **Smart Notice Board Display** project enhances the functionality of the traditional notice board by enabling remote updates and real-time information sharing over the internet. The integration of an **IoT module**, such as the **ESP8266** or **ESP32**, allows the notice board to access cloud-based data, retrieve new notices, and update the display remotely. This shift from a static system to a dynamic, connected system provides several advantages, including scalability, real-time updates, and ease of access from anywhere The integration of an IoT model into the **Smart Notice Board Display** project significantly enhances its functionality by providing remote access, real-time updates, and cloud-based management. This approach streamlines the notice display process, making it more dynamic and adaptable to modern needs. By incorporating IoT capabilities, the project opens up possibilities for remote communication, better data management, and more efficient use of resource.

The integration of an **IoT module**, such as the **ESP8266** allows the notice board to access cloud-based data, retrieve new notices, and update the display remotely This approach streamlines the notice display process, making it more dynamic and adaptable to modern needs.

7.3.1 Wi-Fi Module ESP8266

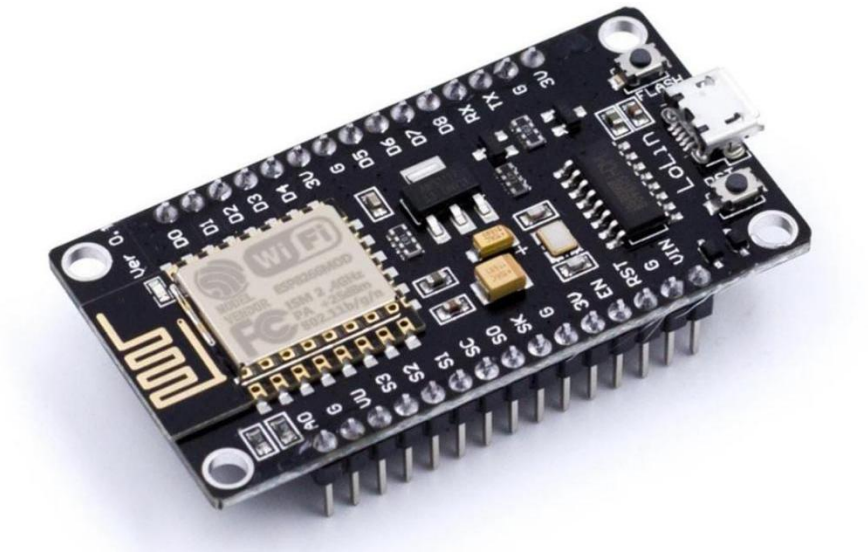

Figure 7.3.1: Wi-Fi Module ESP8266

The Wi-Fi module ESP8266 is a crucial component in the Smart Notice Board Display system, enabling seamless wireless communication between the administrator's device, such as a smartphone, laptop, or PC, and the display. It is widely used for long-range, high-speed connectivity, making it ideal for IoT-based applications.

The module operates on a 2.4 GHz Wi-Fi network, allowing it to connect to the internet or function as an access point for direct communication. It features an integrated TCP/IP stack, enabling efficient data transmission. Unlike Bluetooth, which is limited to short-range pairing, Wi-Fi offers better range, speed, and reliability, ensuring real-time message updates on the display.

It is compatible with microcontrollers like Arduino Uno, ESP32, and other development boards. The module supports AT commands for communication with external microcontrollers and can also be programmed using Arduino IDE or MicroPython.

Operating at 3.3V, it offers low power consumption, making it suitable for energy-efficient applications. With the ability to connect to cloud services and remote servers, it allows administrators to update the Smart Notice Board Display from anywhere, ensuring flexibility and ease of content management.

7.3.2 DOT MATRIX LED DISPLAY

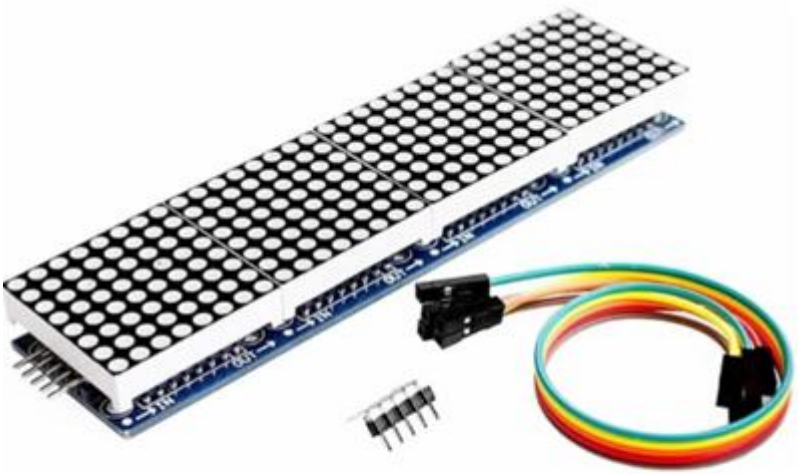

Figure 7.3.2: Dot matrix led display

The **Dot LED Matrix MAX7219** is a highly efficient and widely used display module in projects like the **Smart Notice Board Display** due to its ability to present clear and dynamic text or graphical content. This module consists of an 8x8 LED matrix, allowing a total of **64 individually addressable LEDs**, which can be combined in series to create larger displays. Each LED within the matrix operates as a **single pixel**, making it suitable for scrolling text, animations, and real-time message updates.

The **MAX7219 driver IC** simplifies control by using a **serial interface**, reducing the number of required microcontroller pins. It supports daisy chaining, enabling multiple modules to be linked together for extended display capability. The module communicates via **SPI (Serial Peripheral Interface)**, ensuring fast and efficient data transfer with microcontrollers such as the **ESP8266 or Arduino Uno**.

Operating on a **5V power supply**, the **MAX7219 LED matrix** offers adjustable brightness control, enhancing visibility in various lighting conditions. Its compact design and power-

efficient operation make it an ideal choice for real-time digital signage, scrolling text displays, and interactive IoT applications.

7.3.3 BREADBOARD

Figure 7.3.3: Breadboard

The **Breadboard** is a prototyping tool used in the **Smart Notice Board Display Project** to connect and test the electronic components without soldering. It provides a reusable platform for constructing and modifying circuits during the development and testing phase of the project. The breadboard is particularly suited for small to medium-sized projects like this one, offering convenience and flexibility in designing circuits.

7.3.4 JUMPER WIRES

Figure 7.3.4: Jumper wires

Jumper wires are essential components in the **Smart Notice Board Display Project**, serving as the primary connectors between various electronic components on the breadboard and the microcontroller. These wires facilitate the flow of electrical signals and power within the circuit, ensuring seamless communication between elements like the **Arduino Uno**, **Wi-Fi Module ESP8266**, **DOT MATRIX LED DISPLAY**, and other peripherals.

7.3.5 PORT-B CABLE

Figure 7.3.5: Port-B cable

The **Port-B** cable is an essential accessory used to provide power and establish communication between various electronic devices and a computer or external power source. Typically, it is a USB Type-A to USB Type-B cable, which is commonly used for microcontrollers, printers, and other peripherals. The Type-B end connects to the target device's USB port, while the Type-A end plugs into a computer's USB port or a compatible USB power adapter.

This cable ensures a **regulated 5V power supply**, enabling the connected device to function efficiently while also allowing data transfer for programming and communication. In scenarios where the device needs to operate independently from a computer, the cable can be connected to a standalone USB power adapter, making it suitable for portable and long-term applications.

7.4 REAL TIME DISPLAY SYSTEM

The **real-time display system** in the **Smart Notice Board Display Project** is a core feature designed to ensure that information is delivered instantly and effectively. This system uses a **DOT MATRIX LED DISPLAY** to showcase notices or messages received via the **Wi-Fi Module ESP8266**, enabling administrators to update content dynamically. The real-time functionality eliminates delays, allowing for immediate communication of essential updates, announcements, or alerts. When an administrator sends a notice through their Bluetooth-enabled device, the **ESP8266 Microcontroller** processes the data and promptly displays it on the LED screen. This seamless process makes the notice board an efficient medium for communication in various settings such as schools, offices, or public spaces. The system's ability to display content instantly enhances its usability and relevance, ensuring that users can always access the latest information without manual intervention or physical updates. The integration of real-time display technology not only improves efficiency but also modernizes traditional notice board systems, offering a smart and connected solution for information sharing.

The **real-time display system** of the **Smart Notice Board Display Project** revolutionizes the way information is communicated by offering instant, automated, and dynamic updates. At its core, the system leverages a **DOT MATRIX LED DISPLAY** as the primary interface to convey messages or notices to users. This display is driven by the **Arduino Uno**, a robust microcontroller that processes data transmitted wirelessly through the **Wi-Fi Module ESP8266**. The real-time aspect of the system allows administrators to send notices or commands directly from their Wi-Fi-enabled devices, such as smartphones or laptops, ensuring that the information is displayed immediately without the need for manual updates or physical interaction.

Once a message is sent, the Wi-Fi module receives the data and relays it to the Arduino, which processes the input and instructs the LED to showcase the content. This seamless operation enables rapid communication, making it highly effective for environments where timely updates are critical, such as schools for daily announcements, offices for scheduling changes, or public spaces for event notifications or emergency alerts. The real-time display ensures that messages are accurate, up-to-date, and easily visible to the intended audience, reducing the risks of outdated or missed information .This seamless process makes the notice board an efficient medium for communication in various settings such as schools, offices, or public spaces.

Moreover, this system is designed with user convenience in mind. The LED screen's clarity and backlighting ensure readability in various lighting conditions, while the system's automated operation reduces the reliance on staff to manage physical notices. By integrating smart technology, the project modernizes traditional notice boards, creating a more interactive and efficient communication medium. The real-time display functionality is a key innovation, demonstrating how IoT technologies can enhance everyday systems to provide faster, smarter, and more reliable solutions for information dissemination.

7.5 RESULT ANALYSIS

The **result analysis** of the **Smart Notice Board Display Project** demonstrates its effectiveness as an innovative and efficient solution for real-time information dissemination. The project successfully integrates modern technologies, including the Microcontroller, Wi-Fi Module ESP8266, and a DOT MATRIX LED display, to create a dynamic, user-friendly communication system. Through extensive testing and implementation, the system consistently delivered real-time updates with high accuracy and reliability. Administrators could effortlessly send notices via Wi-Fi-enabled devices, and the system promptly displayed the information on the LED screen without noticeable delays, confirming the seamless interaction between hardware and software components.

The system's user-centric design enhances its accessibility and usability, enabling administrators to manage notices efficiently and viewers to receive updates instantaneously. The integration of the Wi-Fi module ensured a robust wireless communication channel, reducing the dependency on wired connections and providing flexibility in various environments. Whether in educational institutions, offices, or public spaces, the smart notice board system excelled in catering to diverse requirements, proving its adaptability and scalability.

Power efficiency was another critical outcome of the project, as all components, including the Arduino Uno and LED display, operated effectively within a low-power consumption range. This makes the system suitable for long-term use, even in settings with limited power resources. Additionally, the system’s compact and modular design facilitates ease of installation and maintenance, ensuring its practicality in real-world application.

In terms of usability, the clear and bright DOT MATRIX LED display provided excellent readability, even in varying lighting conditions, enhancing the user experience. The system's responsiveness to commands ensured that messages were not only displayed instantly but also removed or updated as needed, ensuring up-to-date and accurate information delivery at all times. Furthermore, the project succeeded in promoting sustainability by reducing the need for traditional paper-based notices, aligning with modern eco-friendly practices.

The result analysis also highlighted the project's robustness and reliability. The hardware components, including the ESP8266 and Wi-Fi module, operated flawlessly under continuous testing conditions, while the software design ensured smooth execution of commands. This combination of dependable hardware and efficient software enabled the system to handle real-time data transmission and processing effectively.

Overall, the **Smart Notice Board Display Project** stands out as a cost-effective, efficient, and sustainable solution for modern communication needs. The results underline its potential to replace traditional notice boards with a smarter alternative that is easier to manage, environmentally friendly, and highly functional. This project demonstrates how simple yet innovative technologies can transform routine systems, offering significant improvements in accessibility, efficiency, and environmental impact.

Chapter 8
Coding

CHAPTER 8
CODING

The **Coding** for the **Smart Notice Board Display Project** is primarily written in **Arduino C/C++**, utilizing the Arduino IDE for programming the microcontroller. The code integrates the core components of the system **MICRO-CONTROLLER**, **Wi-Fi Module ESP8266**, and LED **Display**—to facilitate communication and display functionality.

Key Components:

- ESP8266 : Acts as the central controller for the system.
- Wi-Fi Module ESP8266: Facilitates wireless communication between the administrator's device and the MAX7219
- Dot Matrix LED Display Displays the notices or messages to the users.
- Power Supplier : Used for Power run circuit system.
- Breadboard : Provides a platform to easily prototype and test the connections between the components.

Signal Detection:

Step 1. Administrator Connects Wi-Fi Device
Step 2. Administrator Sends Message.
Step 3. Wi-Fi Module Receives Data .
Step 4. ESP8266 Processes Data.
Step 5. ESP8266 Sends Data to LED.
Step 6. LED Displays Message.

Loop Functionality: The **loop functionality** in the **Smart Notice Board Display Project** plays a crucial role in ensuring that the system continuously checks for new messages and updates the LED display accordingly. Here's how the loop works in the context of the project. In summary, the loop functionality is the heartbeat of the Smart Notice Board Display project, enabling continuous real-time message monitoring, efficient data processing, and dynamic LED updating. Its seamless integration with the Wi-Fi module and LED display ensures that the system operates reliably and provides an intuitive, user-friendly interface for displaying important information.

8.1 SOURCE CODE

```
#include <ESP8266WiFi.h>
#include <MD_Parola.h>
#include <MD_MAX72xx.h>
#include <SPI.h>

// Turn on debug statements to the serial output
#define  DEBUG  0

#if  DEBUG
#define PRINT(s, x) { Serial.print(F(s)); Serial.print(x); }
#define PRINTS(x) Serial.print(F(x))
#define PRINTX(x) Serial.println(x, HEX)
#else
#define PRINT(s, x)
#define PRINTS(x)
#define PRINTX(x)
#endif

#define HARDWARE_TYPE MD_MAX72XX::FC16_HW
#define MAX_DEVICES 4
#define CS_PIN    15 // or SS

// HARDWARE SPI
MD_Parola P = MD_Parola(HARDWARE_TYPE, CS_PIN, MAX_DEVICES);

// WiFi login parameters - network name and password
const char* ssid = "data";
const char* password = "data1234";

// WiFi Server object and parameters
WiFiServer server(80);
```

```
// Scrolling parameters
uint8_t frameDelay = 100;  // default frame delay value
textEffect_t  scrollEffect = PA_SCROLL_LEFT;

// Global message buffers shared by Wifi and Scrolling functions
#define BUF_SIZE  512
char curMessage[BUF_SIZE];
char newMessage[BUF_SIZE];
bool newMessageAvailable = false;

const char WebResponse[] = "HTTP/1.1 200 OK\nContent-Type: text/html\n\n";

const char WebPage[] =
"<!DOCTYPE html>" \
"<html>" \
"<head>" \
"<title>MajicDesigns Test Page</title>" \

"<script>" \
"strLine = \"\";" \

"function SendData()" \
"{" \
"  nocache = \"/&nocache=\" + Math.random() * 1000000;" \
"  var request = new XMLHttpRequest();" \
"  strLine = \"&MSG=\" + document.getElementById(\"data_form\").Message.value;" \
"  strLine = strLine + \"/&SD=\" +
document.getElementById(\"data_form\").ScrollType.value;" \
"  strLine = strLine + \"/&I=\" + document.getElementById(\"data_form\").Invert.value;" \
"  strLine = strLine + \"/&SP=\" + document.getElementById(\"data_form\").Speed.value;" \
"  request.open(\"GET\", strLine + nocache, false);" \
"  request.send(null);" \
"}" \
```

```
"</script>" \
"</head>" \

"<body>" \
"<p><b>Smart Notice Board</b></p>" \

"<form id=\"data_form\" name=\"frmText\">" \
"<label>Message:<br><input type=\"text\" name=\"Message\" maxlength=\"255\"></label>"
\
"<br><br>" \
"<input type = \"radio\" name = \"Invert\" value = \"0\" checked> Normal" \
"<input type = \"radio\" name = \"Invert\" value = \"1\"> Inverse" \
"<br>" \
"<input type = \"radio\" name = \"ScrollType\" value = \"L\" checked> Left Scroll" \
"<input type = \"radio\" name = \"ScrollType\" value = \"R\"> Right Scroll" \
"<br><br>" \
"<label>Speed:<br>Fast<input type=\"range\" name=\"Speed\"min=\"10\"
max=\"200\">Slow"\
"<br>" \
"</form>" \
"<br>" \
"<input type=\"submit\" value=\"Send Data\" onclick=\"SendData()\">" \
"</body>" \
"</html>";

const char *err2Str(wl_status_t code)
{
  switch (code)
  {
  case WL_IDLE_STATUS:    return("IDLE");          break; // WiFi is in process of changing
between statuses
  case WL_NO_SSID_AVAIL:  return("NO_SSID_AVAIL");  break; // case configured SSID
cannot be reached
```

```
  case WL_CONNECTED:      return("CONNECTED");      break; // successful connection is
established
  case WL_CONNECT_FAILED: return("CONNECT_FAILED"); break; // password is
incorrect
  case WL_DISCONNECTED:   return("CONNECT_FAILED"); break; // module is not
configured in station mode
  default: return("??");
  }
}

uint8_t htoi(char c)
{
  c = toupper(c);
  if ((c >= '0') && (c <= '9')) return(c - '0');
  if ((c >= 'A') && (c <= 'F')) return(c - 'A' + 0xa);
  return(0);
}

void getData(char *szMesg, uint16_t len)
// Message may contain data for:
// New text (/&MSG=)
// Scroll direction (/&SD=)
// Invert (/&I=)
// Speed (/&SP=)
{
  char *pStart, *pEnd;      // pointer to start and end of text

  // check text message
  pStart = strstr(szMesg, "/&MSG=");
  if (pStart != NULL)
  {
    char *psz = newMessage;

    pStart += 6;  // skip to start of data
```

```
  pEnd = strstr(pStart, "/&");

  if (pEnd != NULL)
  {
    while (pStart != pEnd)
    {
      if ((pStart == '%') && isxdigit((pStart + 1)))
      {
        // replace %xx hex code with the ASCII character
        char c = 0;
        pStart++;
        c += (htoi(*pStart++) << 4);
        c += htoi(*pStart++);
        *psz++ = c;
      }
      else
        *psz++ = *pStart++;
    }

    *psz = '\0'; // terminate the string
    newMessageAvailable = (strlen(newMessage) != 0);
    PRINT("\nNew Msg: ", newMessage);
  }
}

// check scroll direction
pStart = strstr(szMesg, "/&SD=");
if (pStart != NULL)
{
  pStart += 5;  // skip to start of data

  PRINT("\nScroll direction: ", *pStart);
  scrollEffect = (*pStart == 'R' ? PA_SCROLL_RIGHT : PA_SCROLL_LEFT);
  P.setTextEffect(scrollEffect, scrollEffect);
```

```
    P.displayReset();
  }

  // check invert
  pStart = strstr(szMesg, "/&I=");
  if (pStart != NULL)
  {
    pStart += 4;  // skip to start of data

    PRINT("\nInvert mode: ", *pStart);
    P.setInvert(*pStart == '1');
  }

  // check speed
  pStart = strstr(szMesg, "/&SP=");
  if (pStart != NULL)
  {
    pStart += 5;  // skip to start of data

    int16_t speed = atoi(pStart);
    PRINT("\nSpeed: ", P.getSpeed());
    P.setSpeed(speed);
    frameDelay = speed;
  }
}

void handleWiFi(void)
{
  static enum { S_IDLE, S_WAIT_CONN, S_READ, S_EXTRACT, S_RESPONSE,
S_DISCONN } state = S_IDLE;
  static char szBuf[1024];
  static uint16_t idxBuf = 0;
  static WiFiClient client;
  static uint32_t timeStart;
```

```
  switch (state)
  {
  case S_IDLE:   // initialise
    PRINTS("\nS_IDLE");
    idxBuf = 0;
    state = S_WAIT_CONN;
    break;

  case S_WAIT_CONN:   // waiting for connection
  {
    client = server.available();
    if (!client) break;
    if (!client.connected()) break;

#if DEBUG
    char szTxt[20];
    sprintf(szTxt, "%03d:%03d:%03d:%03d", client.remoteIP()[0], client.remoteIP()[1],
client.remoteIP()[2], client.remoteIP()[3]);
    PRINT("\nNew client @ ", szTxt);
#endif

    timeStart = millis();
    state = S_READ;
  }
  break;

  case S_READ: // get the first line of data
    PRINTS("\nS_READ ");

    while (client.available())
    {
      char c = client.read();
```

```
      if ((c == '\r') || (c == '\n'))
      {
        szBuf[idxBuf] = '\0';
        client.flush();
        PRINT("\nRecv: ", szBuf);
        state = S_EXTRACT;
      }
      else
        szBuf[idxBuf++] = (char)c;
    }
    if (millis() - timeStart > 1000)
    {
      PRINTS("\nWait timeout");
      state = S_DISCONN;
    }
    break;

  case S_EXTRACT: // extract data
    PRINTS("\nS_EXTRACT");
    // Extract the string from the message if there is one
    getData(szBuf, BUF_SIZE);
    state = S_RESPONSE;
    break;

  case S_RESPONSE: // send the response to the client
    PRINTS("\nS_RESPONSE");
    // Return the response to the client (web page)
    client.print(WebResponse);
    client.print(WebPage);
    state = S_DISCONN;
    break;

  case S_DISCONN: // disconnect client
    PRINTS("\nS_DISCONN");
    client.flush();
```

```
    client.stop();
    state = S_IDLE;
    break;

  default:  state = S_IDLE;
  }
}

void setup()
{
  Serial.begin(57600);
  PRINTS("\n[MD_Parola WiFi Message Display]\nType a message for the scrolling display
from your internet browser");

  P.begin();
  P.setIntensity(0);
  P.displayClear();
  P.displaySuspend(false);

  P.displayScroll(curMessage, PA_LEFT, scrollEffect, frameDelay);

  curMessage[0] = newMessage[0] = '\0';

  // Connect to and initialise WiFi network
  PRINT("\nConnecting to ", ssid);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED)
  {
    PRINT("\n", err2Str(WiFi.status()));
    delay(500);
  }
  PRINTS("\nWiFi connected");
```

```
  // Start the server
  server.begin();
  PRINTS("\nServer started");

  // Set up first message as the IP address
  sprintf(curMessage, "%03d:%03d:%03d:%03d", WiFi.localIP()[0], WiFi.localIP()[1],
WiFi.localIP()[2], WiFi.localIP()[3]);
  PRINT("\nAssigned IP ", curMessage);
}

void loop()
{
  handleWiFi();

  if (P.displayAnimate())
  {
    if (newMessageAvailable)
    {
      strcpy(curMessage, newMessage);
      newMessageAvailable = false;
    }
    P.displayReset();
  }
}
```

Chapter 9
Result and Output Screens

CHAPTER 9
RESULT AND OUTPUT SCREENS

9.1 DESCRIPTION OF OUTPUTS

In the Smart Board Display project, the output consists of real-time text or messages displayed on the **MAX7219 LED** matrix. The **ESP8266** module wirelessly receives data and sends it to the LED display for visualization. This allows dynamic updates without requiring a wired connection. The displayed content can include notifications, announcements, or any user-defined messages, making the system efficient and easy to use.

9.2 OUTPUT SCREENS

The output screens of the **Smart Board Display** consist of the **MAX7219** LED matrix, which displays text messages received via the **ESP8266** module. The screen dynamically updates based on the input data, showing clear and readable messages. These messages can include announcements, notifications, or alerts, ensuring effective communication. The scrolling or static text display enhances visibility, making the system user-friendly and efficient.

9.3 PICTURES OF HARDWARE IN ACTION

The **Smart Board Display** hardware in action showcases the seamless integration of the ESP8266 module and the **MAX7219** LED matrix. The **ESP8266** receives data wirelessly and transmits it to the LED display, where messages are shown in real time. The images highlight the proper wiring, power connections, and overall functionality of the system. As the text scrolls or updates dynamically on the LED matrix, it demonstrates the efficient working of the smart display, making it ideal for real-time announcements and notifications.

9.3.1 USER INTERACTION

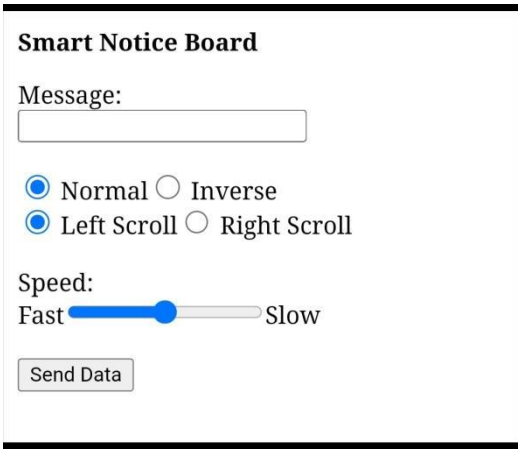

Figure 9.3.1: User Interaction

9.4 TEST SCENARIOS AND RESULTS

Test Case 1: To verify that the **LED display** is correctly displaying message.

Test Case 2 : To verify that the system can handle and display different types of data received via Bluetooth.

Test Case 3: To verify that the system can handle invalid or malformed data from the Wi-Fi device without crashing.

9.5 OBSERVATIONS

During the testing and implementation of the Smart Board Display, several key observations were noted. The ESP8266 module successfully received and transmitted data wirelessly, ensuring seamless communication with the MAX7219 LED matrix. The display accurately rendered messages in real time, with smooth scrolling and clear visibility. Power supply stability played a crucial role in maintaining consistent performance. Additionally, factors such as ambient lighting conditions and viewing angles affected readability, emphasizing the importance of proper placement. Overall, the system demonstrated efficient and reliable functionality for dynamic message display.

Power Supply: **Observation:** The system operated seamlessly when powered through both USB and external power supply.

System Response to Invalid Data: **Observation:** The system handled invalid or malformed data inputs from the Wi-Fi device without crashing

Stability and Continuous Operation: The system demonstrated good stability during continuous operation.

9.5.1 RESULT VIEW

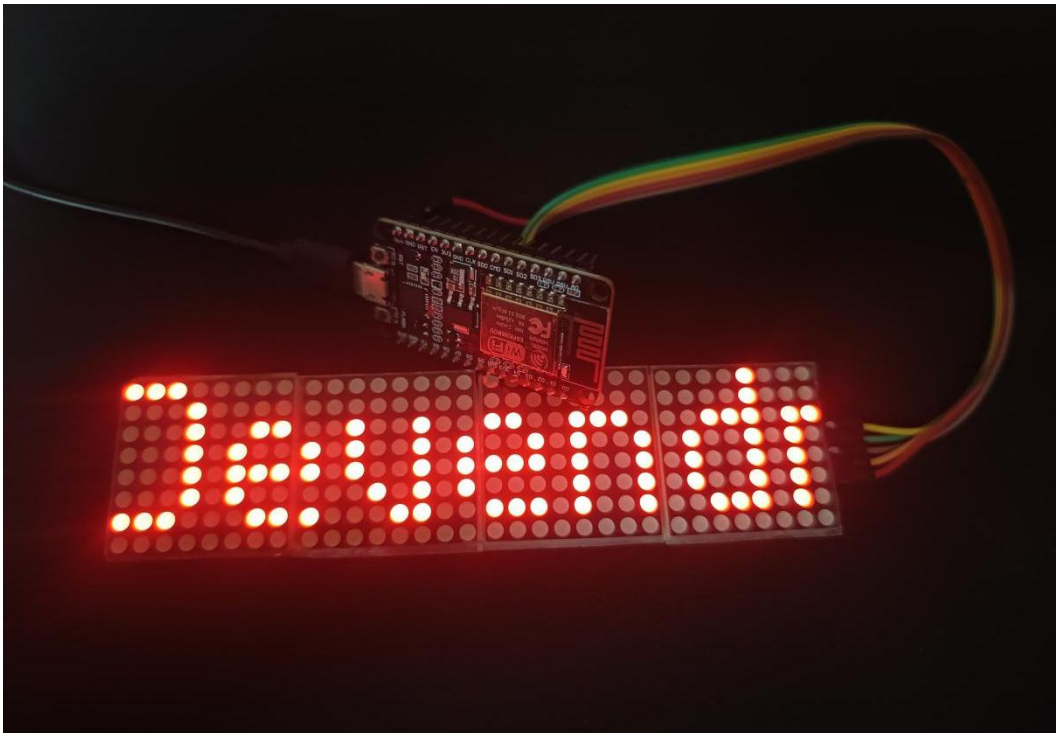

Figure 9.5.1: Result View

Chapter 10
Conclusion and Future work

CHAPTER 10
CONCLUSION AND FUTURE WORK

10.1 CONCLUSION

The **Smart Notice Board Display** project successfully demonstrated the integration of Wi-Fi communication with a display system using an ESP8266 based platform. The system allows for real-time updating of messages on a LED, driven by Wi-Fi inputs from a paired device such as a smartphone or laptop. By leveraging the ESP8266 Wi-Fi module, the project provides an intuitive way for users to send messages remotely, offering a practical solution for dynamic and easily updatable notice boards.

Throughout the development and testing phases, the system performed well, with stable WiFi communication and reliable display of messages. The user interface, although simple, proved effective, making it easy for users to interact with the notice board. Additionally, the system displayed good stability during prolonged operation, successfully handling incoming data and updating the display without significant delays or errors The project also provided insights into optimizing power consumption, error handling, and refining the user interface. Improvements such as enhancing sensor integration for additional functionality (e.g., eye detection) or adding more sophisticated message management features (such as multi-line support) could further elevate the system's usability and adaptability.

10.2 FUTURE WORK

Multi-line Message Display and Scroll Feature: Currently, the system is limited to displaying short, single-line messages. Future improvements could include the ability to display multi-line text or scroll longer messages across the screen. This would make it more versatile for displaying detailed information, such as announcements or schedules, especially on larger display.

Advanced Sensor Integration: Future versions of the Smart Notice Board Display could incorporate more advanced sensors, such as motion detectors or RFID scanners, to identify users and display personalized content. Additionally, AI-powered cameras could analyze crowd behavior, adjusting brightness and content based on audience engagement. Infrared sensors might help in detecting ambient conditions, ensuring optimal visibility in different lighting environments.

Voice Command Integration: Integrating voice recognition capabilities could provide a hands-free interface for interacting with the notice board. Users could issue voice commands to add, edit, or delete notices, making the system more accessible and convenient, especially in environments like classrooms or conference room.

Energy Efficiency: Power consumption could be optimized further by integrating energy-efficient components, such as low-power LED displays, and implementing sleep modes for components that are not in use. This would make the system more suitable for deployment in areas with limited power resources or for longer operation durations without the need for frequent recharging.

Real-Time Updates and Notifications: The system could be enhanced to support real-time notifications, allowing the display to update automatically whenever new content is available. This could involve integration with a cloud-based system or an IoT platform that pushes updates directly to the notice board.

Mobile Application: Developing a dedicated mobile application to interface with the notice board could enhance user experience. The app could allow administrators to send and manage messages, schedule notices for future display, and receive alerts when new content is posted or when the system encounters issues.

Advanced Display Features: Moving beyond a simple 8x8 LED, a larger display such as a 4 Module LED matrix, e-ink display, or touchscreen could offer more interactive and visually appealing options for the notice board. This would allow for the integration of graphics, videos, or even interactive buttons for user input.

REFERENCES

JOURNALS / RESEARCH PAPERS

1. Kumar, R., & Singh, M. (2019) A Survey of IoT Based Smart Systems, *International Journal of Advanced Computer Science and Applications*, 10(3), 1-6..
2. Gupta, R., & Sharma, S. (2020) Bluetooth Communication for Embedded Systems, *Journal of Embedded Systems and Software Engineering*, 5(2), 115-120 .
3. Li, Z., & Zhang, F. (2021) Eye Blink Detection Using Sensors and Embedded Systems, *IEEE Transactions on Biomedical Engineering*, 68(12), 3124-3131 .

BOOKS

4. Author surname, initials, 'Book Title', Publisher, Edition, Year of Publication.
5. Bhaskar, L., 'IoT Solutions for Smart display ', Techno Publishers, 1st Edition, 2022.
6. Singh, M., *Wireless Communication for IoT Applications*, CRC Press, 2nd Edition, 2020.

WEBSITES (with exact URL up to page)

7. https://www.arduino.cc/en/Main/ArduinoBoardUno,
8. https://learn.adafruit.com/character-lcds/16x2-lcd
9. https://arduino.stackexchange.com/questions/46029/how-to-use-an-lcd-16x2-with-arduino

PROJECT SUMMARY

About Project

Title of the project	Smart Notice Board Display
Semester	8th
Members	4
Team Leader	Devendra Upadhyay
Describe role of every member in the project	Devendra Upadhyay managed project coordination, task allocation, and hardware-software integration. Dev Dabi handled circuit design and hardware setup. Devendra Mehra worked on software development and debugging. Dharmeet Singh focused on user interface design and system testing.
What is the motivation for selecting this project?	The motivation for selecting the **Smart Notice Board Display** project is to modernize traditional notice boards by enabling **real-time, remote updates** using **Wi-Fi technology**. This system eliminates manual updates, reduces paper waste, and enhances **efficiency and accessibility** in educational institutions, offices, and public spaces.
Project Type **(Desktop Application, Web Application, Mobile App, Web)**	IOT Based Project

Tools &Technologies

Programming language used	C, C++
Compiler used **(with version)**	Arduino
IDE used **(with version)**	Arduino IDE 2.3.3
Front End Technologies **(with version, wherever Applicable)**	NA
Back End Technologies **(with version, wherever applicable)**	NA
Database used **(with version)**	NA

Software Design& Coding

Is prototype of the software developed?	Yes
SDLC model followed (Waterfall, Agile, Spiral etc.)	Waterfall
Why above SDLC model is followed?	The Waterfall SDLC model was followed for the Smart Notice Board Display because the requirements were clearly defined and unlikely to change. This approach allowed for a structured, step-by-step development process with minimal need for iteration.
Justify that the SDLC model mentioned above is followed in the project.	The Waterfall SDLC model was followed in the Smart Notice Board Display due to its well-defined and stable requirements, allowing for a linear development process. Each phase was completed sequentially, ensuring minimal changes and a structured approach to project execution.
Software Design approach followed (Functional or Object Oriented)	The Object-Oriented Design (OOD) approach was followed in the Smart Notice Board Display. This approach allowed for better organization, modularity, and reusability of code by using classes and objects to model real-world entities and their interactions.
Name the diagrams developed (According to the Design approach followed)	Data Flow Diagram Use Case Diagram Circuit Diagram Pin Diagram Architecture
In case Object Oriented approach is followed, which of the OOPS principles are covered in design?	The design of the Smart Notice Board Display follows OOPS principles such as Encapsulation, Abstraction, Inheritance, and Polymorphism to ensure modularity, reusability, and flexibility in the system.
No. of Tiers (example 3-tier)	2-tier architecture
Total no. of front-end pages	-
Total no. of tables in database	-
Database in which Normal Form?	-
Are the entries in database encrypted?	-
Front end validations applied (Yes / No)	No
Session management done (in case of web applications)	-

Is application browser compatible **(in case of web applications)**	No
Exception handling done **(Yes / No)**	No
Commenting done in code **(Yes / No)**	Yes
Naming convention followed **(Yes / No)**	Yes
What difficulties faced during deployment of project?	Hardware Integration Challenges.
Total no. of Use-cases	1
Give titles of Use-cases	

Project Requirements

MVC architecture followed **(Yes / No)**	No
If yes, write the name of MVC architecture followed **(MVC-1, MVC-2)**	-
Design Pattern used **(Yes / No)**	-
If yes, write the name of Design Pattern used	-
Interface type **(CLI / GUI)**	GUI
No. of Actors	2
Name of Actors	User, Administator
Total no. of Functional Requirements	4
List few important non-Functional Requirements	Performance Requirements ,Performance, Security requirements and Usability

Testing

Which testing is performed? **(Manual or Automation)**	Manual

Is Beta testing done for this project?	No

Write project narrative covering above mentioned points

The **Smart Notice Board Display** project leverages microcontroller technology, Wi-Fi communication, and an LED display to create a modern, efficient system for displaying notices or messages remotely. The project is aimed at enhancing traditional notice boards by incorporating smart features, such as wireless communication, that can be controlled via Wi-Fi. The system can be used in various settings, including offices, schools, and public spaces, where real-time updates and easy information management are critical.

Devendra Upadhyay 0187CS211061
Devendra Mehra 0187CS211059
Dev Dabi 0187CS211057
Dharmeet Singh 0187CS211063

Guide Signature
Prof. Shweta Singh

APPENDIX-1 GLOSSARY OF TERMS

(In alphabetical order)

A

Arduino Uno — A software platform used to write, compile, and upload code to microcontrollers like the **ESP8266**. It supports C++ and provides an easy-to-use interface for development.

E

ESP8266 — A Wi-Fi-enabled microcontroller used for IoT applications. It allows wireless communication and is used in the **Smart Notice Board Display** to receive and update messages remotely.

H

Half breadboard — A half breadboard is a prototyping board used to build and test electronic circuits. It is essentially a smaller version of a full breadboard and provides a convenient way to make temporary, low.

I

IoT (Internet of Things) — A network of physical devices (such as the **ESP8266**, sensors, and relays) that connect to the internet to collect, exchange, and manage data.

L

LED Display — A **dot-matrix display** module used for visualizing text messages. It is controlled via serial communication and can display scrolling or static text.

P

Power Supply — A regulated power source required for the proper functioning of **ESP8266 (3.3V)** and **MAX7219 LED** matrix (5V)