IoT based Wireless Notice Board

Project report submitted in partial fulfilment of the requirements for the course- Embedded System and Internet of Things (23IC002) of

Bachelor of Engineering

in

Computer Science and Engineering

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DICE
DEPARTMENT OF INTERDISCIPLINARY COURSES IN ENGINEERING

CHITKARA UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY, PUNJAB

(Accredited by NAAC with Grade 'A+')

DEPARTMENT OF INTERDISCIPLINARY COURSES IN ENGINEERING

CERTIFICATE

This is to certify that the project titled "**IoT based Wireless Notice board"** submitted to the **Chitkara University Institute of Engineering and Technology (CUIET)** by **Liza (2310990725) , Madhu (2310990727) , Manisha (2310990731) , Muskan (2310990743) , Liza Garg (2310991334)** is a bonafide record of the work done by the students towards partial fulfilment of requirements for the course- Embedded System and Internet of Things (23IC002) of **Bachelor of Engineering in Computer Science and Engineering.**

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Place: Chitkara University, Rajpura, Punjab

Date: 4 November, 2024

Candidates' Declaration

We ***Liza (2310990725), Madhu (2310990727), Manisha (2310990731), Muskan (2310990743), Liza Garg (2310991334)*** of **Group- 9B**, B.E. -2023 batch of Chitkara University, Punjab hereby declare that the Embedded System and Internet of Things (ES&IoT) project entitled **"IoT based Wireless Notice Board"** is an original work and data provided in the project report is authentic and to the best of our knowledge. This project has not been submitted by us to any other institute for the award of any other course.

#Paste here color picture of your project along with students involved in the project (standing or sitting behind the project)

Contribution Details:

Sr. No.	Student Name	Roll No.	Contact Number	Contribution in Project	Signature
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PROBLEM STATEMENT

In educational institutions and workplaces, traditional notice boards have long been used to display important announcements, schedules, and notifications. However, managing these boards is often time-consuming, inefficient, and limited in reach, as the notices need to be printed, physically posted, and frequently updated. This manual process not only incurs additional costs and delays but also results in significant paper wastage, impacting environmental sustainability. Additionally, important information may not be communicated effectively to all intended recipients, especially in large campuses or organizations with multiple buildings.

A wireless, Bluetooth-based digital notice board offers a modern solution to these challenges. Using Bluetooth technology, authorized personnel can update notices directly from a mobile device or computer, eliminating the need for physical updates. This real-time, remote management enhances efficiency, reduces environmental impact, and ensures that information is consistently accessible. Such a system can be especially beneficial in dynamic environments where timely updates are crucial, such as educational campuses, corporate offices, and public spaces. With minimal installation and maintenance costs, Bluetooth-based notice boards provide an affordable and eco-friendly alternative to traditional notice display methods, fostering improved communication and operational efficiency.

ABSTRACT

The IoT-based Wireless Notice Board project aims to modernize traditional notice boards using Internet of Things (IoT) technology. This system facilitates the remote transmission and display of messages on digital screens via a user-friendly web or mobile application. Utilizing Bluetooth connectivity, the notice board can be updated instantly from anywhere, eliminating the need for manual updates and reducing paper usage. The system architecture includes microcontrollers and display units, ensuring efficient and real-time communication. This innovative solution is designed to enhance communication efficiency in educational institutions, corporate offices, and public spaces, offering a seamless and eco-friendly alternative to conventional notice boards. and cost-effective alternative to conventional notice boards. This technology promotes sustainability while meeting the growing demand for quick, accessible, and automated information sharing in dynamic environments.

Application Area:

1.) Instant updates on academic schedules, events, and announcements.

2.) Display of real-time data such as stock prices, performance metrics, and company news.

Technology Stack:

Arduino UNO, HC-05 Bluetooth Module, 32*16 P10 LED Module

Sustainable Development Goals (SDGs) Covered:

SDG 9 (Industry, Innovation, and Infrastructure)

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

In today's fast-paced world, efficient communication systems play a vital role in the smooth functioning of organizations and institutions. Traditionally, notice boards have been used in educational institutions, corporate offices, hospitals, and public spaces to display information regarding events, announcements, and updates. However, traditional notice boards are often outdated in their functionality. They require physical posting of information, which is both time-consuming and environmentally unsustainable due to the use of paper. In response to these challenges, a wireless, Bluetooth-based notice board has been developed to modernize the process of information dissemination.

This project focuses on creating a digital notice board that allows authorized personnel to update notices using Bluetooth technology from a compatible device, such as a smartphone or a computer. This system streamlines the communication process by enabling quick and easy updates to the notice board without the need for physical presence. The Bluetooth-based notice board is designed to be user-friendly, cost-effective, and eco-friendly, providing a practical alternative to traditional notice boards.

Problem Identification

In many educational institutions, workplaces, and public spaces, the reliance on traditional notice boards presents several issues. First, the manual posting and updating of notices require regular printing and the physical presence of personnel to replace outdated notices, leading to delays in information delivery. Additionally, the frequent printing and disposal of paper notices contribute to environmental waste, conflicting with sustainable practices. This setup also limits accessibility, as notices are confined to a specific location, potentially causing important updates to be missed by some members of the intended audience. In high-traffic environments or large campuses, these limitations become increasingly evident, highlighting the need for a more efficient, environmentally conscious solution.

Project Solution

The Bluetooth-based digital notice board offers a solution to these challenges by providing a platform that enables instant updating of information without the need for physical adjustments. Through Bluetooth connectivity, an authorized user can send text-based notifications directly to the digital notice board from their device. This solution not only saves time and resources but also eliminates the need for paper, contributing to environmental sustainability. Furthermore, the system supports frequent updates in real-time, ensuring that the latest information is readily available to viewers.

The system is also secure, as access to the Bluetooth-based notice board is restricted to authorized devices only, ensuring that only verified personnel can post or edit notices. By reducing the dependency on paper-based notifications and allowing remote management, this solution modernizes communication methods, making them more efficient, accessible, and eco-friendly.

Project Objectives

The primary objective of the Bluetooth-based notice board is to enhance communication within organizations and institutions by providing a more efficient and eco-friendly method of displaying information. Specific objectives of this project include:

- **Real-Time Information Sharing:** Enable instant updates to the notice board, ensuring that viewers have access to the latest announcements.
- **Cost Reduction:** Minimize the costs associated with printing, replacing, and managing traditional notice boards.
- **Environmental Sustainability:** Reduce paper usage, supporting eco-friendly practices within the organization.
- **Enhanced Accessibility:** Improve the reach of important information, making it readily accessible in real-time.

By addressing these objectives, the Bluetooth-based notice board provides a comprehensive solution to the limitations of traditional notice boards.

CHAPTER 2

RELATED WORK

Introduction

In recent years, digital communication methods have increasingly replaced traditional approaches in institutions and workplaces. Various projects have been developed to create digital notice boards, each utilizing different technologies, such as Wi-Fi, Bluetooth, and cloud-based systems. These projects share a common goal: to improve the efficiency and accessibility of information sharing. This chapter provides an overview of several similar projects that have been undertaken to address the limitations of traditional notice boards, highlighting their unique approaches, advantages, and disadvantages.

Wi-Fi-Based Digital Notice Boards

One of the more popular approaches to digital notice boards is the use of Wi-Fi technology. Wi-Fi-based digital notice boards allow users to remotely update content from a device connected to the same Wi-Fi network as the notice board. A notable project in this category is the "IoT-Based Wireless Notice Board Using Wi-Fi Technology," which was developed to enable institutions to manage notices using a mobile app that communicates with a notice board display through Wi-Fi. This system connects to a server where content is updated and then displayed on the board in real-time.

Advantages:

- **Remote Accessibility:** Wi-Fi-based systems allow users to update the notice board from a greater distance, as long as both devices are connected to the same Wi-Fi network.
- **Integration with Cloud Services:** These systems can be easily integrated with cloud platforms, enabling data storage and management, as well as access from multiple devices.

- **Higher Data Transfer Rate:** Wi-Fi provides a high-speed connection, making it suitable for transferring multimedia content such as images or videos to the notice board.

Disadvantages:

- **Limited Range:** Wi-Fi coverage is limited by the range of the network, which may not cover the entire institution or large buildings.
- **Higher Energy Consumption:** Wi-Fi-based systems typically consume more power than Bluetooth-based systems, which can be an issue for batteryoperated notice boards.
- **Network Dependency:** Any disruption in Wi-Fi connectivity can prevent the notice board from updating, creating a potential single point of failure.

SMS-Based Digital Notice Boards

Another approach to creating digital notice boards involves the use of SMS (Short Message Service). In an SMS-based system, users can send a text message to a designated number that is connected to the notice board, which then displays the message. This system is particularly popular in rural areas where internet access may be limited but mobile phone connectivity is available. The "GSM-Based Wireless Electronic Notice Board" is an example of this type of project, designed to allow message posting from any mobile phone with SMS capabilities.

Advantages:

- **Widespread Compatibility:** SMS-based notice boards can be accessed using any mobile phone, making them suitable for remote areas where smartphone usage may be limited.
- **No Internet Requirement:** These systems work without requiring an internet connection, relying instead on mobile network coverage.
- **Low Cost:** SMS-based systems are relatively affordable to implement and require minimal hardware.

Disadvantages:

- **Message Length Limitation:** SMS services often limit the length of messages, which restricts the amount of information that can be displayed.
- **Delayed Delivery:** SMS messages may experience delivery delays, especially in areas with low mobile network connectivity.
- **Recurrent Costs:** SMS-based systems incur costs per message, which can become expensive over time for organizations with frequent updates.

Cloud-Based Notice Boards

Cloud-based digital notice boards utilize internet connectivity to sync data between a cloud server and the notice board display. A well-known example is the "Smart Notice Board Using Cloud Storage," where content is uploaded to a cloud server and displayed on multiple digital notice boards across different locations. This setup is especially useful for large organizations with multiple departments, as it enables centralized management and easy content updates across various displays.

Advantages:

- **Centralized Management:** Cloud-based notice boards enable centralized content management, allowing administrators to update all displays simultaneously from a single location.
- **Large Storage Capacity:** Cloud servers provide ample storage for multimedia content, allowing users to post images, videos, and longer text updates.
- **Multi-Location Syncing:** This system allows notices to be updated across multiple locations instantly, making it ideal for institutions with multiple buildings or campuses.

Disadvantages:

- **Internet Dependency:** A stable internet connection is required for cloudbased systems to function effectively; any disruption can hinder notice updates.
- **Data Privacy Concerns:** Using cloud storage raises concerns about data privacy and security, especially in organizations handling sensitive information.

- **Higher Implementation Costs:** Cloud-based systems may involve higher costs for data storage, maintenance, and security protocols.

CHAPTER 3

HARDWARE & SOFTWARE

Introduction

In this chapter, we will discuss the hardware and software components that make up the Bluetooth-based digital notice board. The system's core components include the Arduino UNO microcontroller, HC-05 Bluetooth Module, 32x16 P10 LED Module, and a power supply. Each component serves a unique role in enabling the notice board to display real-time information. This chapter will detail these components' features, functions, and pin configurations and cover the software tools necessary for programming and operation.

Hardware Components

1. Arduino UNO

The Arduino UNO is the primary microcontroller used in this project. It is responsible for processing data received via Bluetooth and controlling the LED display.

- **Features**: The Arduino UNO is an ATmega328P-based microcontroller board. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and an ICSP header. The UNO can be powered via USB or with an external power supply (7-12V).
- **Operation**: The Arduino UNO reads text data transmitted via Bluetooth from an external device, processes it, and sends the necessary instructions to the LED display.

- **Pin Diagram**: The Arduino UNO has multiple pins, including:
    - **Digital Pins (0-13)**: Used for general input/output functions.
    - **Analog Pins (A0-A5)**: Used to read analog data.
    - **Power Pins**: Includes 5V, 3.3V, and GND.

- **TX/RX (0, 1)**: Used for serial communication, important for connecting to the Bluetooth module.

Fig 3.1 Arduino Uno

2. HC-05 Bluetooth Module

The HC-05 Bluetooth Module enables wireless data transmission between the Arduino and an external device, such as a smartphone or computer.

- **Features**: The HC-05 is a Bluetooth SPP (Serial Port Protocol) module with a range of 10 meters. It can operate in both Master and Slave modes, though it is commonly set to Slave mode for receiving data.
- **Operation**: The module receives text data sent from an authorized Bluetooth device, such as a smartphone. This data is then transferred to the Arduino UNO through serial communication, where it is processed and displayed.

- **Pin Diagram**:
  - **VCC**: Connects to the 5V supply on the Arduino.
  - **GND**: Connects to the ground. ○ **TXD**: Transmit pin, connects to Arduino RX (Pin 0). ○ **RXD**: Receive pin, connects to Arduino TX (Pin 1). ○ **EN**: Used to switch between Command and Data modes.

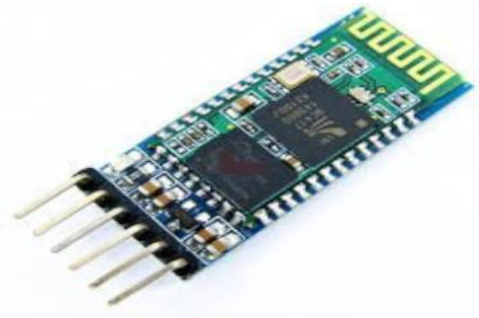

Fig 3.2 HC-05 Bluetooth Module

3. 32x16 P10 LED Module

The 32x16 P10 LED Module serves as the display for this project, allowing text-based notifications to be clearly shown.

- **Features**: The P10 LED module consists of 512 LEDs arranged in a grid of 32 columns by 16 rows. It can display text and graphics and is often used in projects requiring large, readable displays. The module is capable of producing bright, highly visible text even in outdoor settings.
- **Operation**: The P10 LED module is connected to the Arduino through specific digital pins. Data processed by the Arduino is sent to the module, where it is displayed in real-time.
- **Pin Diagram**:
    - **Data Input Pins**: Typically requires data, clock, and enable pins connected to Arduino digital pins.
    - **Power Supply Pins**: Needs 5V and GND connections from an external power source.

Fig 3.3 P10 LED Matrix

4. Power Supply

The system operates on a 5V DC power supply. Both the Arduino and the P10 LED module require reliable power to function effectively, especially the P10 module, which has high power requirements due to its large number of LEDs.

- **Operation**: The power supply provides stable 5V power, ensuring that the Arduino, Bluetooth module, and LED display operate without interruption. For portable setups, a 5V USB power bank or a rechargeable battery pack can be used.

Fig 3.4 Power Supply

5. Jumper Wires

Jumper wires play a crucial role in connecting the different components of the system.

- **Features:** Jumper wires are flexible and come in various lengths, with male or female connectors to make circuit connections easier. They ensure reliable communication and power connections between the Arduino, Bluetooth module, and LED display.
- **Operation:** The jumper wires are used to connect digital pins on the Arduino to the Bluetooth and LED module, as well as to distribute power from the 5V power supply to the various components. They help achieve secure and stable connections across the setup.

Fig 3.5 Jumper Wires

Software Components

1. Arduino IDE

The Arduino Integrated Development Environment (IDE) is the primary software tool used to write, compile, and upload code to the Arduino UNO. It is compatible with several programming languages, including C and C++.

- **Features**: The Arduino IDE provides an interface to write code, compile it, and upload it directly to the Arduino board. It supports a range of libraries, including Bluetooth communication and display control, which are essential for this project.
- **Operation**: Code is written in the IDE, and after compiling, it is uploaded to the Arduino via a USB connection. The IDE also includes a Serial Monitor tool for debugging.

2. DMD Library

The DMD (Dot Matrix Display) library is used to manage and control the 32x16 P10 LED module. It provides functions for text display, scrolling, and font management, making it suitable for dynamic message display.

- **Features**: The DMD library works with LED matrix displays, supporting various fonts, including system fonts and custom fonts such as Arial Black. It allows for marquee effects and custom animations.
- **Operation**: The library is configured to handle a single P10 LED module (1 row by 1 column) in this setup. The Arduino sends data to the LED matrix to display text, scroll messages, and control other visual effects. This library enables smooth integration of text animations on the LED display.

3. TimerOne Library

The **TimerOne** library is used to manage timing functions for the LED display. It allows precise control over intervals, enabling the smooth scanning of the display to avoid flickering.

- **Features**: This library provides a way to set up periodic interrupts, ensuring that the display is scanned consistently and efficiently for stable visuals.
- **Operation**: This library provides a way to set up periodic interrupts, ensuring that the display is scanned consistently and efficiently for stable visuals.

Integration of Hardware and Software

The integration of hardware and software components is achieved in the following way:

1. **Bluetooth Connection**: The HC-05 Bluetooth module is paired with a smartphone or computer. Authorized users can send text messages via Bluetooth, which the Arduino receives through serial communication.
2. **Data Processing and Display**: When the Arduino receives new text data via the Serial interface, it clears the previous message on the P10 LED matrix. Using the DMD library, the Arduino displays the new message with a marquee scrolling effect, ensuring the message appears smoothly across the screen.
3. **Power Supply and Operation**: The system is powered by a 5V supply, which ensures stable performance for both the Arduino and the P10 LED module. The setup is designed for efficient power usage, keeping all components operational without power fluctuations.

CHAPTER 4

PROJECT DETAILS

Introduction

This Bluetooth-based digital notice board project aims to replace traditional bulletin boards with a digital solution that enables the display of real-time notifications. Through wireless Bluetooth connectivity, authorized users can send text messages directly from their smartphones or computers to be displayed on an LED screen. This system is both cost-effective and efficient for applications in schools, offices, and public spaces. The project uses an Arduino UNO microcontroller, HC-05 Bluetooth Module, and a 32x16 P10 LED Module to facilitate easy, on-demand communication.

Circuit Diagram

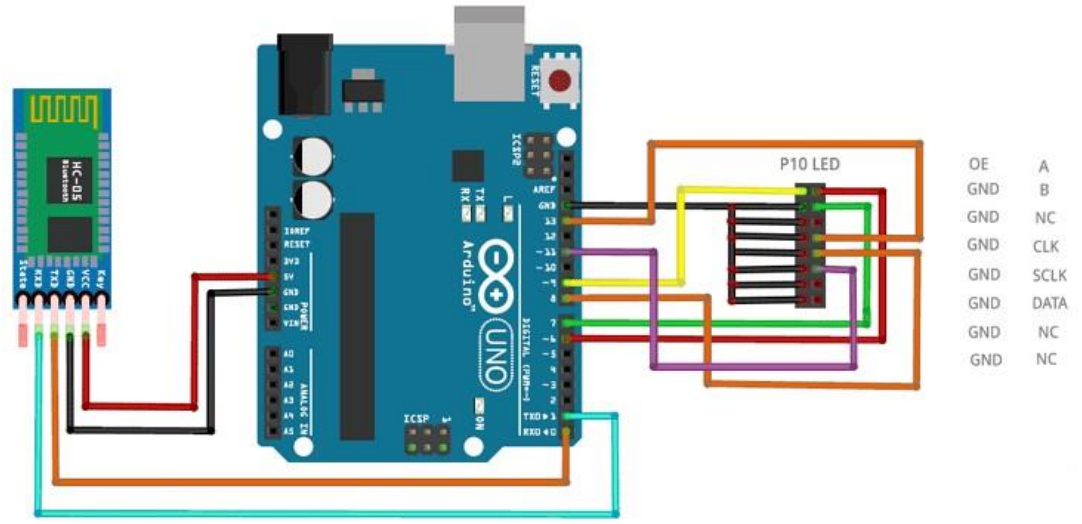

Fig 4.1 Circuit Diagram

Full Working of the Project

1. Bluetooth Communication

The HC-05 Bluetooth Module serves as a communication bridge between the Arduino and external devices. When paired with a smartphone or computer, users can send text

messages over Bluetooth, which the module receives Only paired and authorized devices can interact with the system, ensuring secure message transmission.

2. Data Processing

Upon receiving data from the Bluetooth module, the Arduino UNO processes the text message. It verifies that the data is valid and formats it for display. The Arduino is programmed to check the message length and break it into smaller segments if it exceeds the display's limit. This prevents screen overflow and maintains readability.

3. Display Function

The 32x16 P10 LED module displays the processed text message. The **DMD** (Dot Matrix Display) library for managing this LED module, along with **SystemFont5x7** and **Arial_black_16** for font rendering allows the Arduino to update the display and add effects such as scrolling. After formatting the message, the Arduino sends it to the LED module, where it is shown in real time. The message remains on the display until a new one is received or the system is reset.

Software Used

1. Arduino IDE

The Arduino IDE is used to write, compile, and upload code to the Arduino UNO. This code includes setting up the Bluetooth module, processing incoming messages, and controlling the LED display.

2. DMD Library

The DMD library is used to control the 32x16 LED matrix display. It provides functions for initializing the display, formatting text, and managing scrolling effects.

3. TimerOne Library

The **TimerOne** library enables precise timing functions within the Arduino code, allowing consistent updates to the display. It is especially useful for maintaining a steady refresh rate for the LED module.

Methodology Followed to Implement Project

The project implementation involved several stages:

Requirements Gathering

The initial phase focused on defining the project requirements, including the desired display size, wireless range, and compatibility with standard smartphones and computers. We researched various LED modules and Bluetooth options to choose components that meet these requirements.

Hardware Setup

The selected hardware components were connected according to the circuit design. Wiring the components accurately was critical to ensure reliable communication between the Bluetooth module and Arduino and successful transfer to the LED module.

Software Development

The code for the system was written in the Arduino IDE. This phase involved setting up Bluetooth communication, message processing, and display control. We integrated the DMD library for LED management and the TimerOne library for a steady rate.

Testing and Debugging

Testing involved sending various text messages to the Arduino to check the response time, display accuracy, and Bluetooth connection stability. We debugged common issues, such as connectivity disruptions and text overflow, to ensure smooth functioning.

Final Integration

Once the hardware and software were successfully tested, the final integration was done. The system was tested in a real-world environment to confirm that it could display messages on demand and maintain stable Bluetooth connectivity.

CHAPTER 5

RESULTS

Results

The Bluetooth-based digital notice board successfully achieved its main objective of displaying real-time messages sent from a smartphone or computer. Testing demonstrated that the system could reliably display incoming text within a few seconds of transmission, with clear and readable text visible from various distances. The 32x16 P10 LED module displayed messages smoothly, and the scrolling effect allowed longer messages to be displayed without compromising readability. Additionally, the HC-05 Bluetooth module provided a stable connection within a 10meter range, allowing convenient message updates.

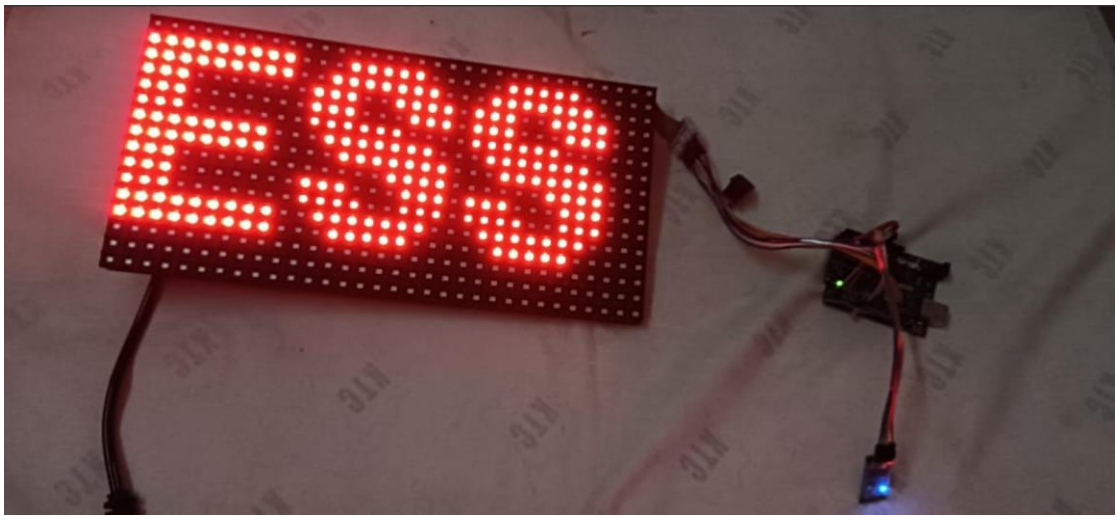

Fig 5.1 Result 1

Fig 5.2 Result 2

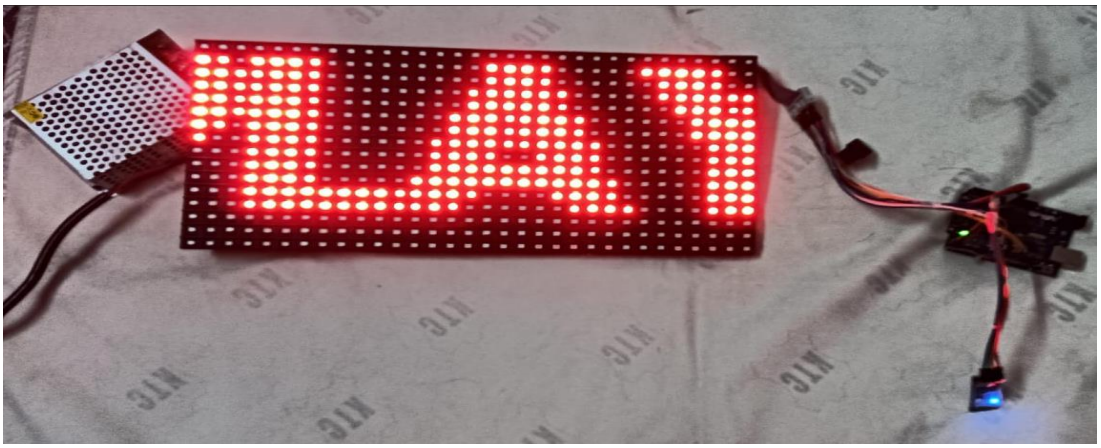

Fig 5.2 Result 3

Application Areas

This Bluetooth-based digital notice board has versatile applications in various settings, including:

- **Educational Institutions**: Schools and universities can use this notice board system to display important announcements, upcoming events, class schedules, and exam notifications. The system's wireless capabilities allow administrators to update information instantly, saving time and reducing manual efforts.
- **Offices and Corporate Environments**: Companies can use digital notice boards in their lobbies, meeting rooms, and break areas to display announcements, meeting schedules, and other internal messages. This tool helps keep employees informed about important updates without requiring an extensive PA system.
- **Hospitals and Healthcare Facilities**: Hospitals can display critical information for patients, such as departmental locations, waiting times, and health guidelines. This notice board can help reduce the need for manual communication, making it easier for visitors to navigate the facility.
- **Public Spaces and Transportation Hubs**: Airports, train stations, and bus terminals can use digital notice boards to display arrival and departure schedules, emergency announcements, and general information. Since it is wireless, the system allows for quick updates without any physical modification to the setup.

Justification of Results with Respect to Chapter 2 (Related Work)

When comparing our project to related works discussed in Chapter 2, several improvements and differences stand out. Some previous notice board systems used Wi-Fi or GSM for wireless communication, but these setups often required complex configurations and were more susceptible to network disruptions. In contrast, using a Bluetooth-based system provides simplicity and better security, as only paired devices can send messages.

Furthermore, unlike traditional digital notice boards that might require specialized hardware and complex programming, our project uses readily available components and open-source libraries. This makes our system highly accessible and affordable for a wide range of users, from educational institutions to small businesses.

Advantages

1. **Ease of Use**: The system is straightforward to operate and requires only a Bluetooth-enabled device for message input.
2. **Real-time Updates**: Authorized users can instantly send updates, which are immediately displayed on the LED module.
3. **Low Cost**: The system uses cost-effective components, making it an affordable solution for various applications.
4. **Security**: The Bluetooth-based system is less vulnerable to external hacking attempts compared to Wi-Fi-based setups, as only paired devices can access the notice board.

Disadvantages

1. **Range Limitation**: Bluetooth's typical range is around 10 meters, limiting its use in large open areas.
2. **Message Length Constraints**: The P10 LED module has a finite display capacity, which restricts the length of messages that can be displayed at one time.

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APPENDIX A

Source Code of the Project :

```
#include <SPI.h>
#include <DMD.h>
#include <TimerOne.h>
#include "SystemFont5x7.h"
#include "Arial_black_16.h"
#define ROW_MODULE 1
#define COLUMN_MODULE 1

DMD p10(ROW_MODULE, COLUMN_MODULE);
char message[200];
char char_read; byte
pos_index = 0;
int i;
char welcome_screen[] = "Welcome to IoT Design";

void p10scan()
{
  p10.scanDisplayBySPI();
} void setup(){
Timer1.initialize(2000);
Timer1.attachInterrupt(p10scan);
p10.clearScreen( true );
Serial.begin(9600);
strcpy(message,welcome_screen);
} void
loop() {
if(Serial.av
ailable(){
```

```
for(i=0;
i<199;
i++) {
message[i]
= '\0';
Serial.print
(message[i
]);
       }
       pos_index=0;
    }
   while(Serial.available() > 0){
p10.clearScreen( true );        if(pos_index
< (199)){                    char_read =
Serial.read();            message[pos_index]
= char_read;            pos_index++;
      }
  }

  p10.selectFont(Arial_Black_16);
p10.drawMarquee(message ,200,(32*ROW_MODULE)-1,0);
  long start=millis();
long timer_start=start;
boolean flag=false;
while(!flag)
  {
    if ((timer_start+30) < millis())
    {
      flag=p10.stepMarquee(-1,0);
timer_start=millis();
    }
  }
}
```