Wireless Notice Board Using Esp32 and Ws2812b Led

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Abstract—**This study details the design, development, and deployment of a wireless scrolling text notice board used an ESP32 microcontroller and a WS2812B LED strip arranged in a 60x7 matrix configuration. The system receives real-time messages via Bluetooth communication and presents them as animated scrolling text. It is powered by 5V 5A switched-mode power supply (SMPS), ensuring efficiency, stability, and reliability. The software development leverages the Arduino IDE in conjunction with widely used libraries such as Fast LED and Adafruit Neo Pixel, streamlining the programming process. This cost-effective and portable solution offers a modern, scalable alternative to conventional notice boards that necessitate manual updates. The paper elucidates the technical architecture, implementation, and potential applications of this system, establishing it as a practical and efficient tool for real-time information dissemination in educational institutions, workplaces, and public spaces.**

Index Terms—**Wireless Text Display, WS2812B LED Matrix, ESP32 Microcontroller, Smart Notice Board, IoT Display System, Fast LED Library.**

I. INTRODUCTION

This research showcases a modern and practical solution—a wireless text display board using a 60×7 LED matrix (WS2812B) and powered by the ESP32 microcontroller. With this setup, you can show scrolling text messages that update instantly over Bluetooth, making it perfect for keeping people informed in real-time. The system is designed for places where quick and clear communication is a must—think schools sharing announcements, offices displaying updates, stores promoting special offers, or public spaces issuing alerts. Essentially, it's for any scenario were delivering information remotely and effectively is a key. This project combines the ESP32 and WS2812B to create a new type of wireless notice board that can be remotely updated via a website or mobile app, thus lowering the need for manual effort, improving communication productivity, and enabling real-time updates. The system architecture, communication protocols, software architecture, and system performance evaluation were discussed to demonstrate the efficiency and scalability of the proposed solution. The heart of project is the ESP32 microcontroller, programmed using the Arduino IDE. It connects with Bluetooth and interface where users can type in their messages. Those messages then appear on the LED matrix with the help of the Fast LED library. To keep the whole setup running smoothly, a reliable 5V 5A SMPS ensures stable power, even when the system is handling heavy loads. The ESP32 provides, featuring both Wi-Fi and Bluetooth, makes it suitable for IoT applications, even remote display systems. The cost-effective design and compact structure allow for wireless data transmission and reception. WS2812B LED Strip is a type of addressable RGB LED where each message can be displayed in RED BLUE and GREEN in colour. It is widely used in wireless notice board, electronics DIY project, where each LED has a built-in controller allowing individual control over its colour and brightness through mobile phone. The aim of this project is to create a wireless notice board that can be remotely updated through a mobile application or web interface by integrating the WS2812B and ESP32. The project objectives include reducing manual effort, improving communication efficiency, and facilitating real-time information updates and broadcasting.

II. LITERATURE REVIEW

A paper [1] their work is done by using Bluetooth Module HC-05 Terminal. This apparatus has the capability of displaying the latest message; however, it does have a few limitations - so it is difficult to update the message at once.

According to a paper [2] they have state that Using Traditional (paper- based) techniques is a wastage of paper and paper-ink. The system is design using a

GSM Module, Bluetooth Module, Arduino Microcontroller, LCD, Buzzer and LED; however, it has limited range and slower data transfer.

In work paper [3] it provides remote, real-time updates wirelessly for efficient digital information display; however, it consumes more power and it has high security risk.

A paper [4] It allows to send message from Mobile phone to Notice board; however, it has limited display capabilities and depend on GSM Network.

A paper [5] they have used HC-05 Bluetooth Module to enable short range mobile app-controlled communications for notice board but it has limited range (9-10 meters).

A paper [6] GSM based system offers flexibility to display flash news or announcement faster than the programmable system; However, it has security risk and limited capacity.

Another study [7] in this system they have used ESP8266, WI-FI Blynk App to provide a cloud-integrated platform for real time remote updates but it depends upon internet connectivity and it has security risk.

A paper [8] they have used ESP32, WS2812B LED Strip high brightness Led display controlled via Bluetooth for dynamic messaging but it was small in size and only one colour was available.

A work done in paper [9] they have made seamless mobile- controlled text updates on an LCD notice board using Android App, Bluetooth, LCD display but it has no remote access.

A paper [10] they have used WI-FI that passes data but it has low range about (90-100 meter) distance and data rate has 1or 2 Mbps.

III SUMMERY TABLE OF ALL THE JOURNAL

Sl. No	Title of the paper/Author	Technology used	Key finding	Gap
1	Bluetooth Based Electronic Notice Board/Ashutosh Pandya, Chinmay Raut, Mihir Patel, Siddhart Das, Amol Desh Pande.	HC-05 Bluetooth Module	HC-05 Bluetooth Module Facilitates wireless message transfer within short distances	Does not support instant message refresh
2	Smart wireless Electronic Notic Board System/ Mulugeta Tegegn Gemeda, Ayane Labeta Gushu, Mohammednur Worku Sherif, and Lebeta Goshu.	GSM Module, Bluetooth Module, Arduino Microcontroller, LCD, Buzzer and LED	Enables real-time updates without manual input.	Signal range and transmission speed are limited.
3	Wireless Electronic Notic Board Using GSM/ R. Naveen Kumar, R. Sriaishwarya, S. Vishali, G. vivekanandhan, S. Karthikeyan.	SIM inserted and GSM.	Supports remote data transmission	Consumes more power and lacks advanced security
4	Wireless electronics notice board/A.Sharma	Arduino, GSM.	Permits wireless communication with basic display control	Has minimal display features and relies solely on GSM.
5	Bluetooth Based Wireless Notice Board / R. Mehta, S. Singh.	Arduino, HC-Bluetooth Module.	Allows cable-free communication via Bluetooth.	Short communication range (around 10 meters).

6	IOT Based Digital Notice Board using Arduino ATmega 328/ Pooja Pawar, Suvarna Langade, Mohini Bandgar.	GSM, Arduino.	Facilitates online message transfer through IoT.	Limited data capacity and security risks
7	IOT- Based Smart Notice Board/ P. kumar.	ESP8266, WI-FI, Blynk Ap	Provides real-time message control using a cloud platform.	Requires consistent internet access.
8	LED Matrix Display system using Arduino / J. Thomase.	ESP32, WS2812B LED Strip	Displays programmable LED matrix.	Smaller display with single-color limitation.
9	Smart Notice Board Using Arduino/S. Patel, K. Verma.	Android App, Bluetooth, LCD Display.	Text updates through mobile app and Bluetooth	No internet-based control capability.
10	smart Electronic Notice Board using WI-FI / S. Arulmurugan, S. Anitha, A. Priyanga, S. Sangeethaptiya.	ESP8266, ESP32, LED Matrix.	Offers wireless message broadcasting via Wi-Fi..	Short transmission range and basic data rates.

IV. METHODOLOGY

This section describes the design, implementation, and operation of the wireless LED matrix board based on an ESP32 microcontroller, utilizing its built-in Bluetooth and a WS2812B 60×7 RGB LED matrix. The methodology comprises hardware setup, firmware architecture, Bluetooth communication protocol, message storage, and performance validation as depicted in Fig 1.

Fig 2 decribes the circuit configuration ……..

System workflow is also stated and shown in Fig 3.

Bluetooth-Enabled Device
A smartphone, tablet, or PC runs any Bluetooth-terminal app. And pair the device to the ESP32 and type or send the text/commands over Bluetooth SPP.

ESP32 Microcontroller
The ESP32 hosts the firmware. It listens on its built-in Bluetooth Serial interface for incoming messages. When data arrives, it parses commands and updates its internal buffers and parameters.

Fast LED Library Control
Inside the ESP32 code that call the Fast LED library to translate the bitmap buffer into actual LED color values. Fast LED takes care of generating the precise timing waveforms the WS2812B LEDs require, and handles color.

WS2812B 60×7 RGB LED Matrix
This is the physical display: 60 columns by 7 rows of individually addressable RGB LEDs wired in a serpentine pattern. Fast LED drives these LEDs so that lit pixels form the scrolling alphanumeric text in full color.

5 V 5 A SMPS Power Supply
We use a regulated 5 V, 5 A switch-mode power supply. It provides stable 5 V power both to the LED matrix (via its +5 V rail) and—through the ESP32's onboard regulator or a separate 3.3 V rail—to the microcontroller.
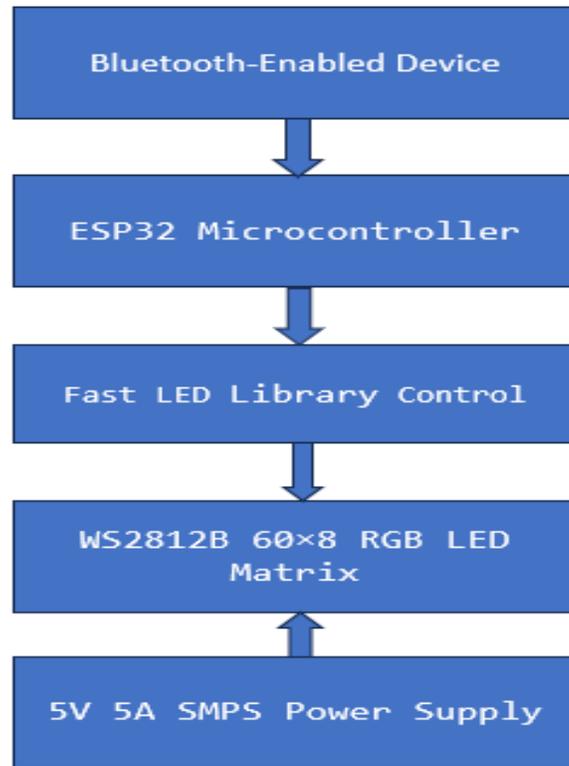
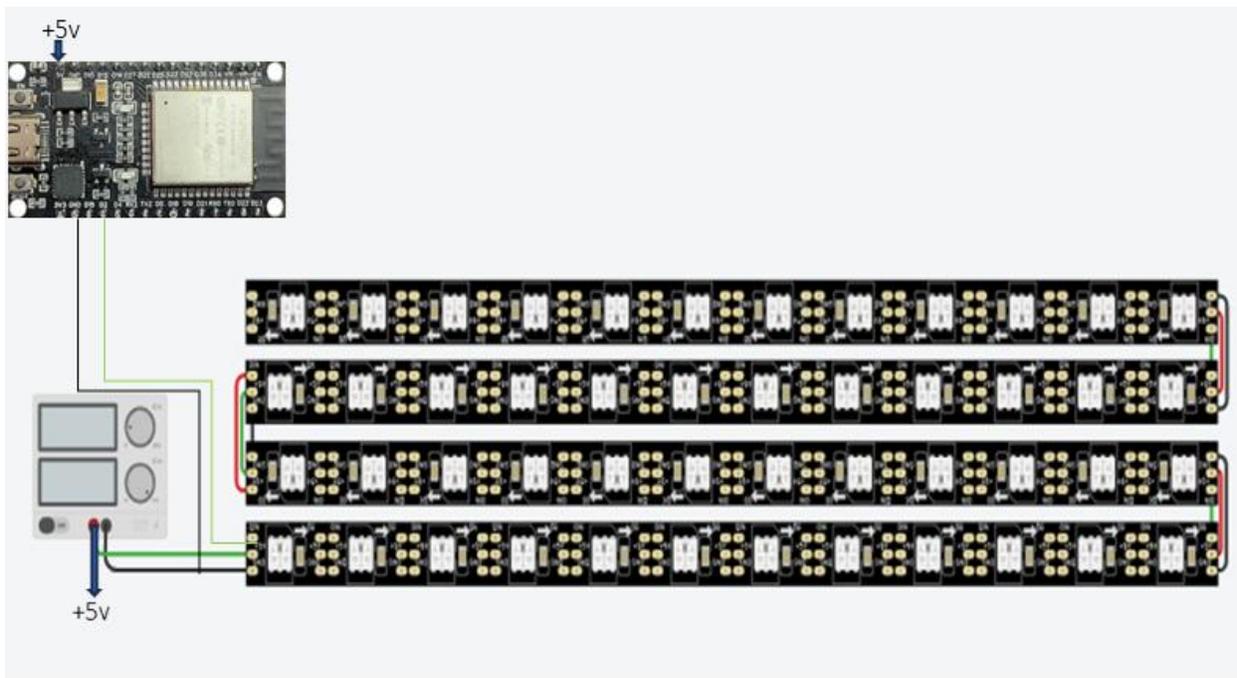Fig 1: Block Diagram of Wireless Notice Board

Circuit Diagram

Fig 2: Circuit diagram of wireless notice board.
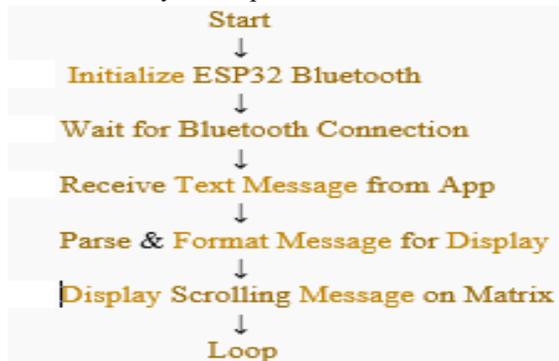
Flowchart of System Operation

Fig 3: System work flow.

V. EXPERIMENT CONDUCTION

This section describes the setup, implementation, and testing process of the wireless text board using an ESP32 microcontroller and WS2812B 60×7 RGB LED matrix. The aim is to evaluate performance parameters such as display clarity, communication reliability, and power efficiency under practical conditions.

1 Objectives of Experimentation
- Validate Bluetooth-based wireless message transfer to the ESP32.
- Check correct parsing and scrolling of messages on the 60×7 LED matrix.
- power consumption and brightness performance.

It performs an experiment using various hardware and software components such as:

An ESP32 development board serves as the system's core, powered by a stabilized 5 V/5 A SMPS. The ESP32's 3.3 V logic directly drives the data line of the WS2812B LEDs without level shifting.
A 60 × 7 WS2812B strip is arranged in a serpentine (zig-zag) layout. LED_PIN 2 on the ESP32 connects to the matrix's DIN input; the matrix height is constrained to seven rows to match the chosen font height.
The ESP32's built-in Bluetooth Serial module (Bluetooth Classic) is initialized under the device name "LED Matrix" for pairing with any standard Bluetooth-terminal application on a smartphone or PC.

Firmware Architecture
- Libraries & Initialization
The firmware is implemented in Arduino IDE using three key libraries:
1. Bluetooth Serial.h – for Bluetooth SPP communication
2. FastLED.h – for driving WS2812B LEDs and color management
3. Preferences.h – for non-volatile storage of the latest message
- Data Structures
- A one-dimensional CRGB, LEDs [NUM_LEDS] array holds color values for each LED.
- A dynamically allocated column Buffer encodes each character's 7-column bitmap, enabling smooth horizontal scrolling.
- Font & Mapping
A custom 8×8 monochrome font array covers space, A–Z, and 0–9. The get LED Index (x, y) function maps 2D coordinates (x,y) to the physical LED index, accounting for alternate row direction in the serpentine layout.

Bluetooth Communication & Command Processing
- Pairing & Message Reception
On setup, SerialBT begin ("LED Matrix") makes the ESP32 discoverable. Incoming data is read via Serial BT read String Until('\n'), trimmed, and processed.
- Command Protocol
- If the input string begins with SPEED: the substring after the colon is parsed as an integer and assigned to scroll Delay, controlling the scrolling interval (in milliseconds). Confirmation is echoed back over Bluetooth.
- Otherwise, any non-empty string is treated as the new display message. It is stored persistently in flash via preferences put String ("message", input), and triggers a rebuild of the column Buffer.

The components were assembled as per the block diagram below. A test message (e.g., *"Hello World!"*) was sent from a smartphone through Bluetooth to the ESP32, which then rendered it on the LED matrix using the Fast LED library. The matrix scrolled the text continuously, and the brightness was set at 30% for power conservation.

VI. RESULT

The wireless notice board system uses an ESP32 microcontroller paired with WS2812B LED strips. Bluetooth connectivity on the ESP32 allowed users to communicate with mobile phones, enabling wireless text message sending. System tests showed stable connections maintaining ranges between 8 to 10 meters in standard indoor environments. The mobile application sent messages through the ESP32, which was displayed on the LED matrix with a processing delay of 1 to 2 seconds ensuring updates were almost instantaneous.

The scrolling text was rendered clearly and vibrantly due to the WS2812B RGB LEDs. The display capable of smooth scrolling messages across the screen from right to left as they were set to various speed settings to further enhance their ease of reading. Best readability was achieved through the use of white, red, and green high contrast colours against the unlit LEDs which created a dark background.

The system's power needs were met with a 5V, 5A SMPS, that offered enough current for stable powering of the entire matrix during peak usage at bright settings. The unlighted voltage drop flickering issue with the matrix during extreme brightness scenarios was avoided. When powering all LEDs to white, they reached the simulated limit power usage of 4.2A which confirmed the used power supply was optimal. Throughout the entirety of the stress test, which exceeded 12 hours, the system did not present an overheating issue, memory problem, or undergo a crash; all of which, confirmed the functionality of the software and soundness of the hardware.

The interface for the mobile application was straightforward; users could easily customize messages along with scrolling settings. The ability to preview messages, adjust scroll speed, and start/stop scrolling were accomplished without any issues. The results confirm that this design is well-suited for applications in schools, offices, or public information systems where wireless message updates are desirable.
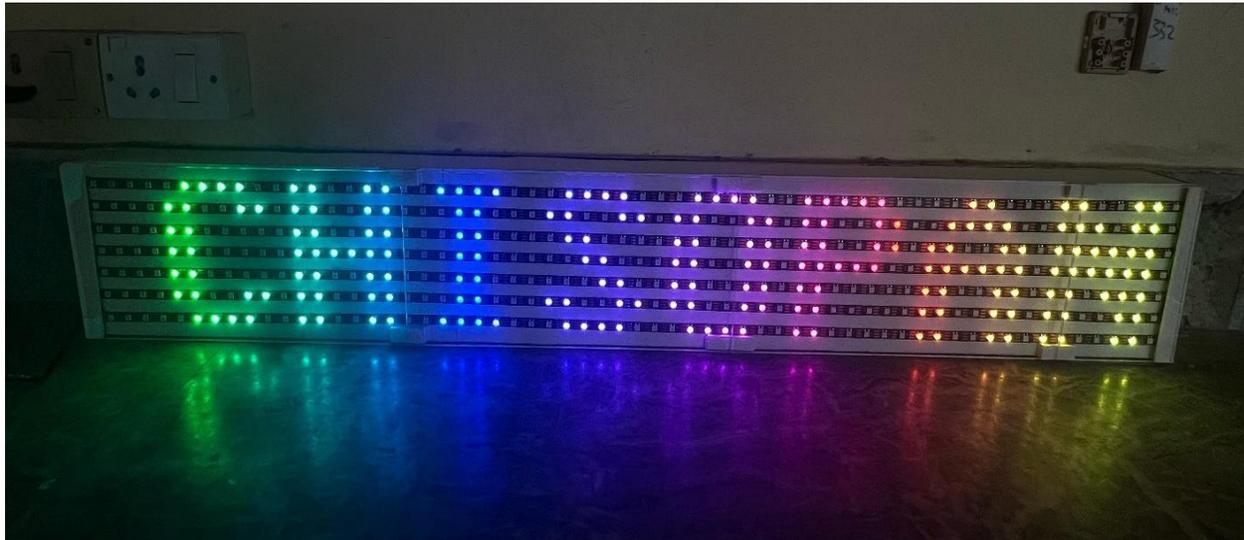

Fig 4: Final output of wireless notice board

SL.NO	TEST CASE	OBSERVATION
1	Message Delay	0.5-1.2 sec (Bluetooth to Display rendering)
2	Scroll Smoothness	Smooth at 20ms Frame update rate
3	Power efficiency	Consumed 1.8A at 30% Brightness (8-9W)
4	Max character limit	More than 1000 characters
5	Bluetooth Stability	Stable up to 10 meters, indoors
6	Brightness adjustment	Lower brightness reduce current to 1.2A (6W)

VII. DISCUSSION

The implementation of wireless notice board controlled by mobile proves the concept of integrating wireless communication technology into day-to-day information systems. With our system, the mobile application enables the real-time updating of information which eliminates the need for manual updates and presence at the notice board. The updates can now be performed remotely. The project successfully achieves its primary goals by enabling mobile message input through an interfacing application, ensuring safety and efficiency during the wireless data transmission and guaranteeing clarity in the displayed messages on the mobile notice board. This system features a cost-effective design as one of its major benefits. The system can be expanded in the future, for example, by adding message scheduling, multimedia functionality, or remote internet administration, and the components required are inexpensive. With the addition of a mobile interface, updates can now be posted by authorized users from any location within the transmission range, increasing access. Further expanding the range to incorporate GSM or IoT technologies would be a good start. Usability could also be enhanced by the integration of voice commands or other AI-based features.

VIII. CONCLUSION AND FUTURE SCOPE

The wireless notice board system developed in this project offers a modern and efficient solution for dynamic message display. By integrating an ESP32 microcontroller with a WS2812B 60×8 LED matrix and using Bluetooth communication, the system reduces the need for physical message updates, reducing time and effort. The high-brightness, full-colour LED matrix ensures visibility and readability, even in varied lighting conditions. The project successfully demonstrates how wireless communication can enhance public information dissemination, especially in educational institutions, offices, transport stations, and other public spaces. Overall, the system is cost-effective, scalable, and easy to maintain. This paper contains several future scopes which are mentioned below

Seamless Connectivity: Integrating Wi-Fi or GSM capabilities would enable remote updates via the internet or cloud services, making message management even more convenient.

Mobile App Accessibility: A user-friendly mobile app could provide an intuitive way to interact with the notice board, ensuring updates are quick and effortless.

Wider Reach with Synchronization: Synchronizing multiple boards would allow messages to be broadcast across larger venues, ensuring consistent communication in schools, offices, or public spaces.

Smart Interaction: Incorporating voice commands or IoT integration with platforms like Google Assistant or Alexa could allow for hands-free operation, making updates even more seamless.

Automated Updates: Features such as scheduled messaging and automatic updates from a database or API would ensure timely and relevant information is displayed without manual intervention.

Enhanced Security: Implementing authentication measures would safeguard against unauthorized access, keeping the system secure and reliable.

Energy Efficiency: Optimizing power consumption, potentially through battery or solar-powered options, would make the system more sustainable and adaptable to different environments.

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