Smart Voice-Controlled LED Display System

Rohan Lekurwale[1], Gopal Pawar[2], Prashant Patange[3]
[1,2,3]*Department of Information Technology, Final Year Project*

Abstract— Display systems play a crucial role in broadcasting information across educational institutes, offices, transportation hubs, and public environments. Conventional notice boards rely on manual updates, resulting in de- lays, paper wastage, and inefficiency. To overcome these issues, this paper presents a Smart Voice-Controlled LED Display System that leverages voice recognition and wireless data transmission. The system utilizes an Android application with speech-to-text functionality, enabling the user to send spoken commands to a microcontroller via Bluetooth or Wi-Fi. The controller processes the received message and displays it on an LED matrix in real time. Experimental evaluation demonstrates that the proposed approach ensures fast, hands-free, and eco-friendly communication with minimal setup and maintenance. The system is suitable for applications requiring frequent or urgent message updates, particularly in smart campus and smart city environments.

Index Terms— Voice Recognition, LED Display, Arduino, Bluetooth, Speech-to-Text, IoT, Smart Notice Board

I. INTRODUCTION

Traditional notice boards require manual handling, which makes them time-consuming and prone to human error. Updating printed notices also incurs recurring costs and delays. With the advancement of embedded systems and Internet of Things (IoT) technologies, digital and automated solutions are increasingly preferred. However, most digital notice boards still rely on manual text entry through computers or mobile apps, limiting accessibility.

To overcome these challenges, this research proposes a *Smart Voice-Controlled LED Display System* that enables users to update display content using voice commands. The system integrates speech recognition, wire- less data transmission, and microcontroller-based LED control, ensuring real-time message delivery.

II. LITERATURE REVIEW

Table 1 summarizes previous studies relevant to this work.

III. SYSTEM DESIGN AND COMPONENTS

The proposed system consists of five main modules:

1. Voice Input: Android app captures speech and converts it to text using the Google Speech-to-Text API.
2. Wireless Communication: Text data is sent via Bluetooth (HC-05) or Wi-Fi (ESP32).
3. Microcontroller: Arduino/ESP32 receives and processes the data.
4. Display Module: P10 LED matrix shows scrolling or static messages.

Table 1: Summary of Related Work

No.	Author/Year	Technology Used	Key Outcomes
1	A. Sahoo et al. (2022)	Arduino, Bluetooth	Voice controlled digital display.
2	P. Murali KrIshna et al. (2019)	Android app, LED matrix	Efficient wireless text transfer.
3	J. Felix et al. (2025)	Mobile speech-to-text	Real-time scrolling display.
4	P. Anuradha et al. (2022)	IoT (ESP32, Wi-Fi)	Cloud-based LED sync.
5	R. Verma et al. (2020)	Android speech API	Reliable speech recognition.

5. Power Supply: Stable 5V DC regulated supply for components.

IV. WORKING PRINCIPLE

The working process involves:

1. Establish Bluetooth/Wi-Fi connection between the smartphone and controller.
2. Capture the user’s speech and convert it to text.
3. Transmit the text to the microcontroller.
4. Process and format the text message.

5. Display it on the LED matrix in real time.

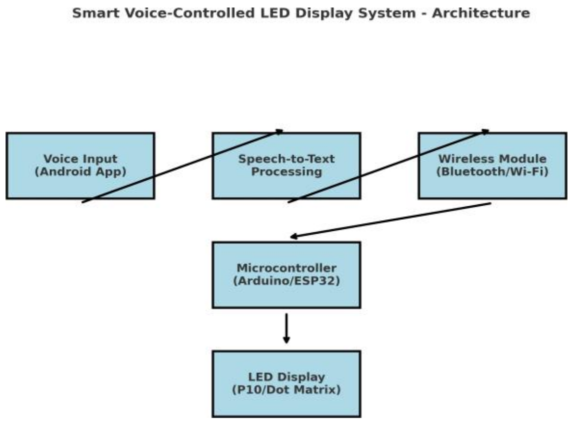

Figure 1: Architecture of the Proposed System

V. HARDWARE AND SOFTWARE REQUIREMENTS

V.1. Hardware Components

Arduino UNO or ESP32, Bluetooth HC-05, P10 LED Matrix, 5V DC adapter, connecting wires.

V.2. Software Tools

Arduino IDE, MIT App Inventor or Android Studio, and Google Speech-to-Text API.

VI. EXPERIMENTAL SETUP AND RESULTS

A prototype was developed using Arduino UNO and a P10 display module. The voice commands were transmitted through an Android app built using MIT App Inventor. The system was tested under different environments.

- Average Response Time: 2.3 seconds.
- Speech Accuracy: 95% under normal noise.
- Range: Up to 10 m (Bluetooth), 30 m (Wi-Fi).

Figure 2: Prototype Implementation and Output Display

VII. ADVANTAGES

- Hands-free and quick updates.
- Eco-friendly and low maintenance.
- Accessible for differently-abled users.
- Cost-effective and scalable for institutions.

VIII. LIMITATIONS

- Limited Bluetooth range.
- Speech accuracy drops in noisy environments.
- Requires stable power supply.

IX. FUTURE SCOPE

Future improvements include IoT-based remote control via cloud servers, multi-language support, GSM- based messaging, and AI-based command optimization. Integration with solar energy and real-time data analytics will further enhance sustainability.

X. CONCLUSION

The proposed Smart Voice-Controlled LED Display System is an efficient, eco-friendly, and accessible communication solution. It reduces human effort and enables real-time updates via voice. The prototype con- firms the feasibility and effectiveness of the system for educational, industrial, and public environments.

REFERENCE

[1] A. Sahoo et al., ”Voice Controlled Notice Board Using Arduino,” Dogo Rangsang Research Journal, 2022.
[2] P. Murali Krishna et al., ”Voice Controlled LED Matrix Display,” JES Publication, 2019.
[3] P. Anuradha et al., ”IoT-Based Real-Time LED Display Board Using ESP32,” IEEE, 2022.
[4] N. Sharma, ”Bluetooth-Based Smart Display Control System,” International Journal of Emerging Technology, vol. 8, no. 4, 2021.
[5] R. Verma and A. Gupta, ”Speech-to-Text Conversion Using Android API,” IJRET, vol. 9, no. 2, 2020.
[6] S. Patil, ”Smart Digital Notice Board Using IoT,” IJERT, vol. 11, no. 5, 2021.
[7] M. Patel and K. Rao, ”Wi-Fi Enabled ESP32 Microcontroller for IoT Applications,” IEEE

Access, 2020.
[8] R. Singh, ”A Survey on IoT-Based Smart Display Systems,” IJERT, vol. 10, no. 9, 2021.
[9] J. Deshmukh, ”Automation of LED Display Boards via Speech Commands,” IJSRT, 2023.
[10] L. Mehta, ”Data Security in Wireless IoT Systems,” Springer IoT Conf., 2021.
[11] B. Kumar, ”Development of Mobile Applications Using MIT App Inventor,” IJARCET, vol. 8, no. 6, 2019.
[12] T. Roy and D. Das, ”Energy Efficient Embedded Systems for Smart Displays,” Elsevier Procedia Computer Science, 2020.
[13] S. Mishra, ”Cloud Connected LED Display for Real-Time Communication,” IEEE IoT Symposium, 2022.
[14] A. Pandey, ”Multi-Language Speech Recognition for IoT Devices,” IJSRET, vol. 12, no. 1, 2023.
[15] K. Nair, ”Trends and Challenges in Future IoT-Based Communication Systems,” IJIRT, vol. 9, no. 10, 2024.