Wireless Text Scrolling LED Display Using Arduino and Bluetooth

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Abstract- In many public places such as colleges, railway stations, bus stands and shopping centres, display boards are used to provide information to people. Traditional display boards require manual updating, which can take time and effort. To overcome this problem, a Wireless Text Scrolling Display System is developed. This project uses an Arduino UNO, HC-05 Bluetooth module and LED matrix display to create a wireless communication system. A mobile phone with a Bluetooth Terminal application is used to send text messages. The HC-05 module receives the message and sends it to the Arduino through serial communication. The Arduino processes the message and displays it on the LED matrix in scrolling form. The system allows users to update display messages easily without physical connection to the display board. This project provides a low-cost, simple and efficient solution for wireless information display in various public and commercial places.

Index Terms- Arduino UNO, HC-05 Bluetooth Module, LED Matrix Display, Wireless Communication, Text Scrolling Display, Bluetooth Terminal Application, Embedded System.

I. INTRODUCTION

In today's modern world, electronic display boards are widely used to share information with people in public places such as colleges, railway stations, bus stands, shopping malls and offices. These display systems help in delivering important messages quickly and clearly to a large number of people. Traditional notice boards require manual updating, where a person needs to physically go and change the information. This process takes time and may not be convenient when messages need to be updated frequently. Because of these limitations, wireless communication technologies are being used to develop smarter display systems that can update messages remotely [1].

With the advancement in embedded systems and wireless communication, it has become possible to control electronic devices using mobile phones and microcontrollers. Bluetooth technology is one of the most commonly used wireless communication methods for short-range communication. It allows devices such as mobile phones and microcontrollers to exchange data without using wires. By using Bluetooth modules like HC-05, messages can be sent from a smartphone directly to a microcontroller system. This makes the system simple, cost-effective and easy to operate [2].

In this project, a Wireless Text Scrolling Display System is designed using Arduino UNO, HC-05 Bluetooth module and LED matrix display. The Arduino UNO acts as the main controller of the system. The HC-05 Bluetooth module is used to receive the text message sent from the mobile phone. A Bluetooth Terminal application installed on the smartphone allows the user to type and send the desired message. The received message is processed by the Arduino and then displayed on the LED matrix in the form of scrolling text. The scrolling display makes the message easily visible and attractive for viewers [3].

The LED matrix display is made up of multiple light-emitting diodes arranged in rows and columns. By controlling these LEDs, different characters and symbols can be displayed. When the text scrolls from one side of the display to the other, it allows longer messages to be shown even on a small display panel. This system is useful for displaying announcements, advertisements, notifications and public information. Since the messages are transmitted wirelessly through Bluetooth, there is no need for physical access to the display board, which improves convenience and efficiency [4].

The proposed system is simple, reliable and economical. It can be easily installed in various locations where information needs to be updated frequently. The use of Arduino makes the system flexible and easy to program, while the Bluetooth module enables quick wireless communication. Therefore, the wireless text scrolling display system provides a practical solution for modern digital information display systems.

II. LITERATURE REVIEW

In recent years, many researchers have worked on wireless display systems to improve the way information is shared in public places. Traditional display boards require manual updating, which can be slow and inconvenient. To solve this problem, different wireless communication technologies such as Bluetooth, Wi-Fi and GSM have been used to develop digital notice boards and scrolling display systems. These systems allow users to send messages remotely and display them on electronic boards without physical contact with the display device [5].

Several studies have focused on using Bluetooth technology for wireless communication between mobile devices and microcontroller-based systems. Bluetooth modules like HC-05 are commonly used because they provide reliable short-range communication and are easy to interface with microcontrollers such as Arduino. Researchers have shown that Bluetooth-based systems can successfully transmit text messages from smartphones to embedded systems. These messages can then be processed and displayed on LED displays or LCD screens. Such systems are useful in educational institutions and offices where information needs to be updated regularly [6].

Another important area of research is the use of Arduino microcontrollers in display systems. Arduino platforms are widely used in embedded system projects because they are simple to program and support many hardware components. Researchers have developed various Arduino-based display systems that receive data through serial communication and control LED displays accordingly. These systems demonstrate that Arduino can effectively manage communication with wireless modules and control LED matrices for displaying scrolling text messages [7].

Researchers have also studied the use of LED matrix displays for information presentation. LED matrix displays consist of multiple LEDs arranged in rows and columns, which can be controlled to form characters and symbols. Compared to traditional displays, LED matrices are bright, energy efficient and suitable for outdoor or public display applications. Many studies show that combining LED matrix displays with wireless communication technologies can create flexible and efficient information display systems. These systems can display announcements, advertisements and notifications in a clear and attractive scrolling format [8].

From the existing literature, it can be understood that wireless communication combined with embedded systems provides an effective solution for modern information display. Bluetooth-based systems are especially useful for short-range communication because they are simple, low-cost and easy to implement. Based on these studies, the present project focuses on developing a wireless text scrolling display system using Arduino UNO, HC-05 Bluetooth module and LED matrix display to provide an efficient method for updating messages through a mobile phone.

III. KEY FINDINGS

During the design and implementation of the Wireless Text Scrolling Display System using Arduino UNO and HC-05 Bluetooth Module, several important observations and results were identified. These findings show how the system works effectively and how wireless communication improves the display system.

A. Wireless Message Transmission

One of the important findings of this project is that Bluetooth communication allows messages to be transmitted wirelessly from a mobile phone to the display system. By using the HC-05 Bluetooth module, the system can easily receive text messages sent from a Bluetooth Terminal application. This eliminates the need for physical connection between the mobile device and the display system. As a result, messages can be updated quickly and conveniently from a short distance [9].

B. Efficient Communication Between Mobile Device and Arduino

Another key finding is that the Arduino UNO can successfully communicate with the HC-05 module using serial communication. The Bluetooth module receives the message and sends it to the Arduino through TX and RX pins. The Arduino reads the received data and processes it to display the message. This communication process is reliable and works smoothly for transmitting simple text messages [10].

C. Effective Display Using LED Matrix

The use of an LED matrix display allows characters and symbols to be displayed in a scrolling format. The LEDs arranged in rows and columns form different characters when controlled by the Arduino. The scrolling feature allows longer messages to be shown on a limited display area. This makes the information clearly visible and attractive for users in public places [11].

D. Low Cost and Easy Implementation

The project also shows that a wireless display system can be developed using low-cost components such as Arduino UNO, HC-05 Bluetooth module and LED matrix panels. These components are easily available and simple to connect. The programming is done using Arduino IDE, which is user-friendly and suitable for beginners. Because of these advantages, the system can be implemented easily in educational institutions, offices and public areas for information display purposes [12].

Overall, the findings of this project demonstrate that the wireless text scrolling display system is reliable, economical and effective for updating messages remotely. The integration of Bluetooth communication and embedded systems provides a practical solution for modern digital display applications

IV. SYSTEM ARCHITECTURE

The system architecture of the Wireless Text Scrolling Display using Arduino and Bluetooth explains how different hardware and software components work together to display messages on the LED matrix. The system mainly consists of a mobile device, Bluetooth module (HC-05), Arduino UNO microcontroller and LED matrix display. These components communicate with each other to receive, process and display text messages wirelessly. The overall architecture is designed to be simple, efficient and easy to implement in real-time applications such as information display boards and advertising systems [13]. The architecture of the system can be understood through the following components and their functions.

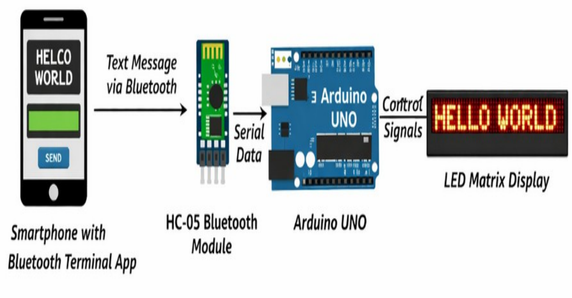

Fig.1-System Architecture Diagram

A. Mobile Phone with Bluetooth Terminal Application

The mobile phone acts as the input device of the system. A Bluetooth Terminal application installed on the smartphone is used to send messages to the display system. The user types the desired message in the application and sends it through Bluetooth communication. When the mobile phone connects to the HC-05 Bluetooth module, it forms a wireless communication link. After the connection is established, the text message typed by the user is transmitted as serial data through Bluetooth. This allows the user to update the display message without physically interacting with the display board. This wireless approach makes the system more flexible and convenient for practical use [14].

B. HC-05 Bluetooth Module

The HC-05 Bluetooth module is responsible for receiving the message sent from the mobile phone. It works as a wireless communication interface between the mobile device and the Arduino microcontroller. The module operates using Bluetooth technology and supports serial communication. When the mobile phone sends a message, the HC-05 module receives the data and forwards it to the Arduino through its TX and RX pins. The module converts the Bluetooth signal into serial data that the Arduino can understand. Because of its easy interface and reliable communication, the HC-05 module is widely used in embedded system projects involving wireless communication [15].

C. Arduino UNO Microcontroller

The Arduino UNO acts as the main controller of the entire system. It receives the serial data from the HC-05 Bluetooth module and processes the received message. Arduino is programmed using the Arduino IDE, where a program is written to read incoming serial data and convert it into a format suitable for the LED matrix display. After receiving the message, the Arduino stores the text and sends control signals to the LED matrix display. These signals control which LEDs should turn ON or OFF to form characters and symbols. The Arduino also manages the scrolling function of the display so that the text moves smoothly from one side of the display panel to the other. Arduino is widely used in embedded system development because it is easy to program, flexible and compatible with many electronic components. Its ability to handle communication and display control makes it an ideal choice for this project [16].

D. LED Matrix Display

The LED matrix display is the output component of the system. It is used to visually display the messages received from the mobile phone. The display consists of many small LEDs arranged in rows and columns. By controlling the LEDs individually, characters and symbols can be formed. In this project, the Arduino controls the LED matrix to display text in a scrolling format. The scrolling effect allows longer messages to be displayed even on a small display panel. This makes the display more effective and attractive for viewers. LED matrix displays are commonly used in digital boards, advertising panels and public information systems because they provide bright and clear visibility.

E. Communication Flow of the System

The communication process of the system follows a simple sequence. First, the user types a message on the mobile phone using the Bluetooth Terminal application. The message is transmitted through Bluetooth to the HC-05 module. The module receives the message and sends it to the Arduino using serial communication. The Arduino processes the received data and generates the required control signals for the LED matrix display. Finally, the message appears on the LED panel as scrolling text. This communication flow ensures that the system works efficiently and allows quick updating of messages without manual intervention.

F. Advantages of the Proposed Architecture

The system architecture provides several advantages:

a) Wireless operation – Messages can be updated without physical connection.
b) Low cost implementation – Components used in the system are inexpensive and easily available.
c) Simple design – The architecture is easy to understand and implement.
d) Flexible communication – Bluetooth allows easy data transfer from mobile devices.
e) Energy efficient display – LED matrix displays consume less power while providing bright output.

Because of these advantages, the system architecture is suitable for developing wireless display boards for various real-world applications.

G. Applications of the System Architecture

The architecture developed in this project can be applied in different areas such as:

a) College and school notice boards
b) Railway station information displays
c) Bus stand announcement boards
d) Shopping mall advertisement displays
e) Office information boards
f) Public information systems

The use of wireless communication makes it easy to control and update the display content whenever required.

Overall, the proposed system architecture successfully integrates Bluetooth communication, embedded system control and LED display technology to create a simple and effective wireless text scrolling display system. The design ensures reliable message transmission and clear visual output, making it suitable for practical applications in modern digital information systems.

V. RESULTS AND DISCUSSION

The Wireless Text Scrolling Display System using Arduino UNO and HC-05 Bluetooth module was successfully designed and implemented. The purpose of this project was to create a simple and wireless method for displaying messages using a mobile phone. After assembling the hardware components and uploading the program to the Arduino, the system was tested under different conditions to observe its performance. The obtained results show that the system works effectively for transmitting and displaying text messages wirelessly. The following points describe the main results and observations obtained during the implementation of the project.

A. Successful Wireless Communication

One of the main results of the project is the successful establishment of wireless communication between the mobile phone and the display system. The Bluetooth Terminal application was used to connect the smartphone with the HC-05 Bluetooth module. Once the connection was established, text messages typed on the mobile phone were transmitted instantly to the system. During testing, the Bluetooth communication was stable and reliable within the normal operating range of Bluetooth technology. The data was transmitted without noticeable delay, and the messages were received correctly by the Arduino. This confirms that Bluetooth technology is suitable for short-range wireless communication in embedded systems [17].

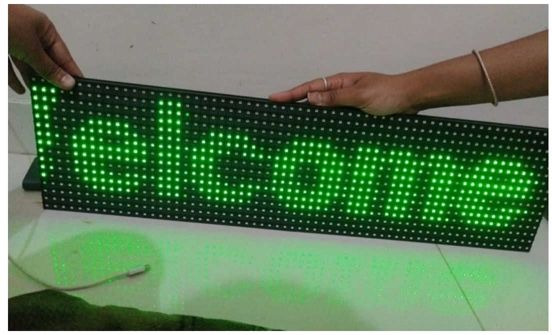

Fig.2- Bluetooth Terminal Application Connected to HC-05 Module

B. Accurate Message Reception by Arduino

Another important result observed in this project is the accurate reception of messages by the Arduino UNO microcontroller. The HC-05 module sends the received Bluetooth data to the Arduino through serial communication using the TX and RX pins. The Arduino program continuously checks for incoming serial data. When a message is received, the program reads the text and processes it for display. During the testing phase, the Arduino was able to correctly interpret the characters sent from the mobile device. Even when different messages were sent multiple times, the system consistently received the correct data without errors. This shows that the communication between the Bluetooth module and Arduino is reliable and effective [18].

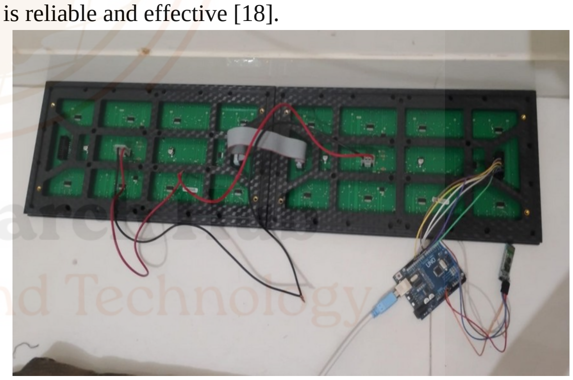

Fig.3- Hardware Setup of Arduino UNO with HC-05 Bluetooth Module

C. Clear Scrolling Display on LED Matrix

The LED matrix display successfully showed the received messages in a scrolling text format. After the Arduino processed the message, it sent the required control signals to the LED matrix panel. The LEDs turned on and off in a specific pattern to form characters and symbols. The scrolling feature allowed longer messages to be displayed smoothly across the panel. This is especially useful when the display area is limited. The brightness of the LED matrix provided clear visibility even from a distance. During testing, the display showed characters clearly without distortion or flickering. This confirms that LED matrix displays are suitable for information boards and digital display systems [19].

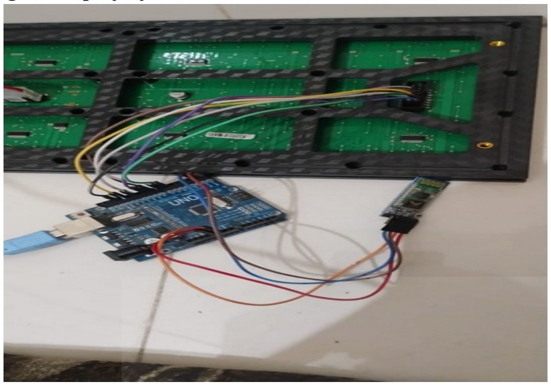

Fig.4- LED Matrix Display Showing Scrolling Text

D. Response Time of the System

The response time of the system was observed to be very fast. When a message was sent from the mobile phone through the Bluetooth Terminal application, the system received and displayed the message almost immediately. The small delay observed was mainly due to the time required for Bluetooth data transmission and processing by the Arduino. However, the delay was minimal and did not affect the performance of the system. This quick response makes the system practical for real-time message display applications such as announcements and notifications.

E. Reliability of the System

During multiple tests, the system demonstrated stable and reliable performance. The Bluetooth connection remained stable when the mobile device was within the normal communication range. The Arduino program continuously processed incoming data and displayed messages correctly. The hardware components also worked without major issues. The LED matrix panel operated smoothly, and the Arduino successfully controlled the display. This indicates that the system can be used for long-term operation in real-world environments such as public display boards.

F. Cost Effectiveness of the System

Another important observation from this project is that the system can be implemented using low-cost components. Arduino UNO, HC-05 Bluetooth module and LED matrix panels are easily available in the market at affordable prices.

Because of the low cost and simple design, this system can be implemented in many locations such as schools, offices, shops and public areas. The system also requires minimal maintenance, which further reduces operational cost. This makes the project a practical and economical solution for wireless display systems [20].

G. Practical Applications of the Developed System

Based on the experimental results, the developed system can be applied in many real-world situations. Some practical applications include:

a) Digital notice boards in colleges and schools
b) Information display in railway stations and bus stands
c) Advertisement displays in shops and malls
d) Office information boards
e) Event announcement systems

The wireless nature of the system allows administrators to update messages easily without physically accessing the display board.

H. Overall Discussion

From the results obtained during testing, it is clear that the Wireless Text Scrolling Display System performs efficiently and reliably. The integration of Bluetooth communication with Arduino and LED matrix technology provides a simple yet effective solution for digital message display.

The system demonstrates that wireless communication can significantly improve the convenience of updating information displays. By using commonly available hardware components and simple programming techniques, a functional and reliable wireless display system can be developed. This makes the project suitable for educational purposes as well as practical applications in real-world environments.

VI. FUTURE SCOPE

The Wireless Text Scrolling Display System using Arduino and Bluetooth can be further improved in many ways to increase its functionality and performance. Some possible future improvements are given below.

A. Integration with Wi-Fi Technology

In the future, the system can be upgraded by using Wi-Fi modules such as ESP8266 or ESP32 instead of Bluetooth. This will allow messages to be sent through the internet from any location.

B. Development of a Mobile Application

A dedicated mobile application can be developed to send messages easily. The application can include features such as message editing, scheduling and saving frequently used messages.

C. Multi-Colour LED Display

The current system uses a basic LED matrix display. In future, multi-colour or RGB LED displays can be used to make the display more attractive and visually appealing.

D. Message Scheduling Feature

A scheduling feature can be added so that messages can be displayed automatically at specific times, such as announcements for events, classes or meetings.

E. Integration with Sensors

Different sensors such as temperature, humidity or motion sensors can be connected to the system so that environmental information can also be displayed on the LED board.

F. Larger Display System

The system can be expanded by connecting multiple LED matrix panels together to create a larger display board suitable for outdoor advertisements or public information systems.

G. Voice or Internet Based Control

Future systems may allow voice commands or cloud-based control, enabling users to update messages through voice assistants or web applications.

VII. CONCLUSION

In this project, a Wireless Text Scrolling Display System using Arduino UNO and HC-05 Bluetooth module was successfully designed and implemented. The system allows users to send text messages from a mobile phone using a Bluetooth Terminal application. The message is received by the HC-05 Bluetooth module and processed by the Arduino UNO microcontroller. After processing, the text is displayed on the LED matrix display in a scrolling format.

The project demonstrates how wireless communication and embedded systems can be combined to create a simple and effective information display system. The system works reliably and allows messages to be updated easily without physical connection to the display board. The use of Arduino makes the system easy to program and modify, while the LED matrix provides clear and visible message display.

Overall, the developed system is low cost, simple to implement and useful for many practical applications such as notice boards, advertisement displays and public information systems. This project also provides a good understanding of wireless communication, microcontroller programming and digital display technology.

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