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Raspberry Pi Based Android App Controlled Digital Display Notice Board

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Abstract- — Digital notice board systems have emerged as an efficient alternative to traditional paper-based information dissemination methods. By enabling real-time message updates, such systems improve communication efficiency in educational institution, offices and public spaces. This project presents the design and implementation of a Raspberry Pi based Android application controlled digital display notice board that allows wireless transmission of notices using Bluetooth communication. The proposed system integrates an Android application with voice-to-text functionality, enabling users to input messages through speech, which are then converted into text and transmitted to the Raspberry Pi. Despite the advantages of digital notice boards, challenges such as reliable wireless communication, real-time data processing, system scalability and secure access control must be addressed. Bluetooth-based communication, while cost-effective and suitable for offline operation, is limited by range and device pairing constraints. Additionally, handling dynamic message updates and ensuring smooth system performance require efficient software design and robust hardware integration. The Raspberry Pi zero 2W saves as the central processing unit, leveraging Python-based scripts to manage incoming data and display operations through an HDMI-connects screen. Despite these challenges, addressing them through improved modelling techniques, automated data collection, and interdisciplinary collaboration can significantly enhance the effectiveness of software testing and support more informed decision-making.

Keywords: Android app, Bluetooth, Notice Board, Raspberry Pi.

I. INTRODUCTION

Wireless digital display systems have become an essential component of modern information dissemination, supporting efficient, real-time communication in educational institutions, organizations, and public spaces [3].

Raspberry Pi-based notice board systems combined with Android applications enable users to transmit messages wirelessly, reducing manual effort and improving accessibility [1]. However, implementing such systems is not straightforward due to the complexity of embedded platforms and wireless communication technologies [12]. Factors such as limited bluetooth range, power dependency, and security concerns introduce significant challenges in system design and deployment [4].

Understanding the key issues related to hardware–software integration, communication protocols is necessary to effectively develop a reliable and user-friendly Android app controlled digital display notice board [2],[13].

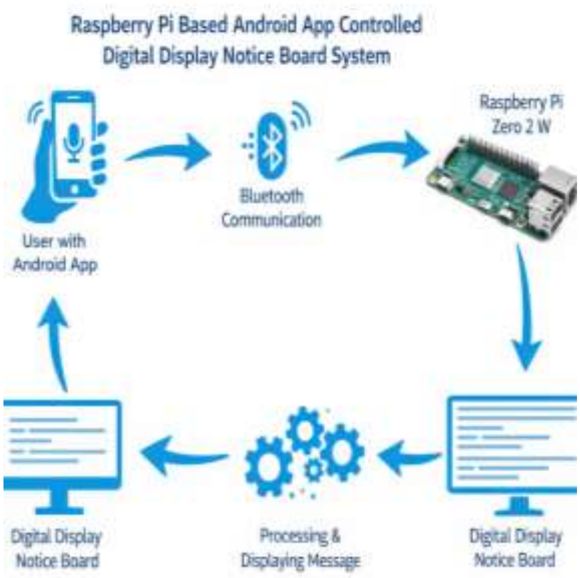


Fig. 1.1: Procedure of Raspberry Pi [1]

Issues, Challenges, Techniques/Methods, Analysis Parameters and Recent tools & methodology

Table-2.1: Issues for Raspberry Pi Based Android App Controlled Notice Board [7], [14].

Issues	Description
Wireless Communication Limitations	1) Bluetooth communication has a limiters operating range, restricting message transmission distance. 2) Signal interference and device pairing issues can affect reliable data transfer.
Device Compatibility	Different Android versions and device configurations may affect application performance..
Data Transmission Reliability	Packet loss or delays may occur during wireless transmission
Real-Time Performance Constraints	Delays in message reception and display reduce system responsiveness..
Voice-to-text Accuracy	Speech recognition accuracy depends on microphone quality and ambient noise
Security and Unauthorized Access	1. Unauthorized Bluetooth pairing may allow unintended users to send messages. 2. 2. Lack of authentication mechanisms increases security risks.
Scalability Issues	1. The system may not efficiently handle multiple users simultaneously. 2. Expanding the system to support multiple displays requires additional configuration..
Power Reliability	1. Continuous operation depends on stable power supply. 2. Power interruptions may cause system crashes or data loss.
System Maintenance and Updates	1. Software updates on the android app or Raspberry Pi may introduce compatibility issues. 2. Manual maintenance is required for long-term deployment.
User Interface and Usability	1. Poor UI design can reduce ease of use for non-technical users. 2. Lack of feedback on successful message transmission may confuse users.

Table-2.2: Challenges for Raspberry Pi Based Android App Controlled Digital Display Notice Board [6], [15]

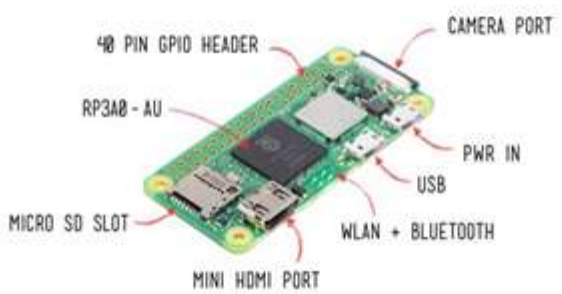
Challenges	Description
Limited Wireless Range	Bluetooth communication operates within a restricted range, limiting message transmission distance and system coverage
Connection stability	Wireless connections may suffer from interference, pairing failures or disconnections, affecting reliable data transfer.
User Usability Challenges	Designing an intuitive interface for both technical and non-technical users is essential yet challenging.
Environmental Factors	Temperature, dust and physical placement of hardware can impact long-term reliability.
Real-Time Message Processing	Ensuring instant reception and display of message requires efficient processing and optimized software design.
Security and Authentication	Preventing unauthorized access and ensuring secure Bluetooth pairing remains a major challenge.
Device Compatibility	Variations in Android versions, hardware configurations and Bluetooth standards can impact system interoperability.
Scalability Constarints	Supporting multiple users or multiple display units simultaneously increases system complexity.
Power Reliability	Continuous system operation depends on a stable power supply interruptions may cause system failure or data loss.
System Maintenance an Updates	Regular updates to the Android app or Raspberry Pi software may introduce compatibility or configuration issues.
Hardware Limitations	Limited processing power and memory of the Raspberry Pi Zero 2W may affect performance under heavy usage.

Table-2.3: Recent software tools & methodology for Digital Display Notice Board [5].[10]

Software tools	Methodology
Micocontroller/core Hardware	Raspberry Pi , Micro Sd card
Operating System (pi)	Raspberry Pi Operating System
Mobile Application Development	MIT App Inventor
Programming and Scripting Language	Python Programming Language
Wireless Communication Protocols	Bluetooth (HC-05/06 or Built-in), Wi-Fi (HTTP/MQTT)
Display Interface	HDMI Monitor.
IDE & Development Environment	Python, MIT App Inventor
Power Management & Circuitry	Power Supply, HDMI Cable.

Hardware Specification for Raspberry Pi Based Android App Controlled Digital Display Notice Board

Raspberyy Pi



Specifications

- Model: Raspberry pi zero 2W
- Works on 5V, 2Amp
- 40 pins GPIO header
- Builtin bluetooth 4.2
- Builtin Wi-Fi
- 512 MB RAM
- Quad core processor 1GHz Quatex A53 CPU
- HDMI output [ort and USB input port
- MicroUSB port for power.[9],[11]

USB Power Adapter

Specifications

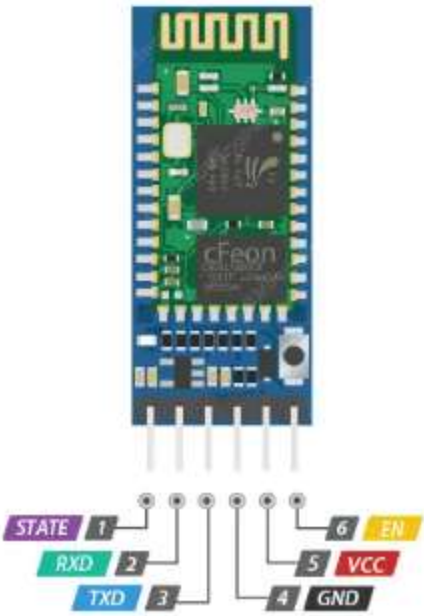
- Output Voltage: +5.1V DC
- Output Plug: USB
- Max. Output Current: 4.0A
- Power Storafe: 5V, 4000mAHr
- Efficiency: 81% min.
- Short circuit, Overcurrent, Over temperature protection

MicroSD card

Specifications

- Memory Size: 16 Gigabyte
- Card Type: MicroSD
- Speed: up to 98MB/s
- Class: 10
- High-speed Card can be used for both Mobile phone and Raspberry Pi
- Safty Protections: Shockproof, temperature-proof, waterproof and X-ray proof. [8]

Bluetooth Module



Specifications

- Bluetoth Protocol: Bluetooth Specification v2.0 + EDR
- Frequency: 2.4 GHz ISM band
- Modulation: GFSK
- Range: Up to 10 meters
- Operating Voltage: 3.3 V to 5V DC
- Operating current 30 mA
- Communication Interface: UART .

Connection Details

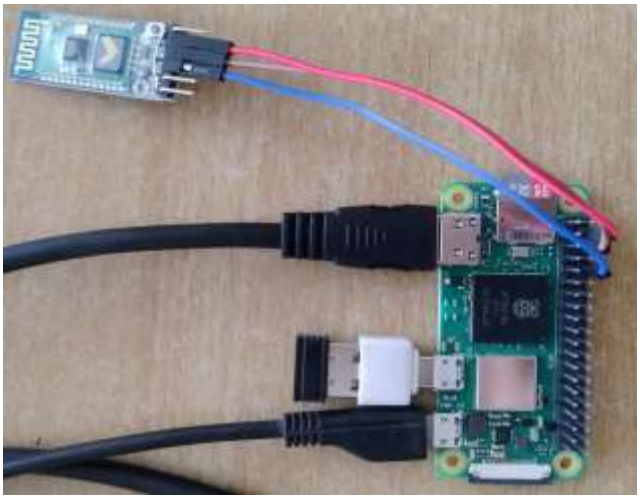


Fig:- 3.1 Connection Diagram.

This Connection Shows the Raspberry Pi Connected to a Bluetooth Module using Serial Communication. The Module gets Power from the Pi , & the Tx/Rx. Pins are cross Connected to send & Receive Data. This Allows the Raspberry pi to communicate Wirelessly with a Mobile phone or other Bluetooth Devices.

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