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SMART NOTICE BOARD USING ESP-32

Ishita Singh[1], Amrita Singh[2], Preeti Yadav[3], Nandini Gupta[4], Parmendra Kumar Verma
[1,2,3,4]UG students, [5]Asst. Professor

Department of Electronics and Communication Engineering,
Buddha Institute of Technology, Gida, Gorakhpur, UP, India

Abstract: Traditional notice boards, although functional, often require significant effort to update and maintain. The Smart Notice Board using ESP32 aims to revolutionize this process by employing modern IoT technologies. Utilizing the versatile ESP32 microcontroller, which boasts integrated Wi-Fi and Bluetooth capabilities, this system offers a dynamic, user-friendly, and remotely manageable solution for displaying information. The primary objectives of this project include enabling real-time updates, allowing remote access, ensuring secure user management, and maintaining energy-efficient operation. The system is designed to be scalable, accommodating future expansions and additional features. Key components of the Smart Notice Board include the ESP32 microcontroller, a display unit (LED or LCD screen), a web server hosted on the ESP32, and a reliable power supply. Optional sensors can be integrated for additional functionalities like touch input or environmental monitoring.

Index Terms: Wi-Fi and Bluetooth Connectivity, Microcontroller Program Arduino IDE Real-time Updates, Low Power Consumption, Digital Notice Board, Dynamic Display, Testing and Deployment, Educational Applicatioon,Corporate Applications, Healthcare Applications

I. INTRODUCTION

In today's fast-paced world, the demand for real-time information dissemination is higher than ever. Traditional notice boards, while useful, are often inefficient and labor-intensive to update. The Smart Notice Board using ESP32 addresses these limitations by leveraging modern IoT technologies. This project utilizes the ESP32 microcontroller, known for its robust processing power and integrated Wi-Fi and Bluetooth capabilities, to create a dynamic, user-friendly, and remotely manageable notice board system. The aim is to revolutionize the way information is displayed in educational institutions, corporate offices, healthcare facilities, and public places. Moreover, if the user is unable to press the panic button, the system can be activated through predefined voice commands. These commands are integrated into the system's code, allowing the user to initiate the safety protocols using specific phrases. This dual activation method ensures that the system is accessible and functional in various emergency scenarios, providing a reliable safety net for women on the move.

II. EXISTING HARDWARE

Creating a Smart Notice Board using the ESP32 microcontroller involves integrating several key hardware components. Here are the primary components typically used in such a setup:

1. ESP32 Microcontroller

- **Description:** The core of the system, the ESP32 is a low-cost, low-power system on a chip (SoC) with integrated Wi-Fi and dual-mode Bluetooth. It includes a dual-core processor, which makes it highly capable for various tasks including real-time updates and web server hosting.

Figure 1 : ESP-32 Microcontroller

2. Display Unit

- **Description:** The visual output device for displaying notices. Commonly used display units include LED and LCD screens.

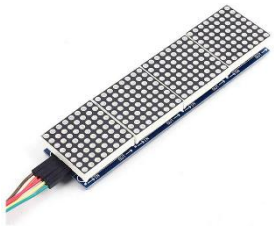


Figure 2: Dot Matrix

3. Power Supply

- **Description:** A stable power source is crucial for consistent operation of the ESP32 and the display unit.

Figure 3: Power supply

4. Storage

- **Description:** While the ESP32 has some internal storage, external memory may be required for larger applications.

5. Connectivity Modules (Optional)

- **Description:** Additional modules might be used to extend the functionality of the ESP32.

6. Input Devices (Optional)

- **Description:** These are used to interact with the notice board directly.

7. Sensors (Optional)

- **Description:** Used to add extra functionalities like environmental monitoring.

8. Enclosure

- **Description:** Protects the hardware components and gives a professional appearance.

9. Communication Interfaces

- **Description:** Interfaces for connecting the ESP32 with other hardware components.

III. WORKING METHODOLOGY

The working methodology of a Smart Notice Board using the ESP32 microcontroller involves several stages, from hardware setup and software development to real-time operation and management. Here's a detailed breakdown of each stage:

1. Hardware Setup

Components:

- ESP32 microcontroller
- Display unit (TFT LCD screen)
- Power supply (USB power adapter or DC power supply)
- Optional: MicroSD card module, touch input devices, sensors (e.g., DHT22 for temperature and humidity), enclosure

Connections:

- Connect the ESP32 to the display unit using appropriate GPIO pins.
- Power the ESP32 and the display unit using a stable 5V power source.
- Connect the MicroSD card module to the ESP32 using SPI interface pins.
- Connect any additional sensors to the ESP32 via digital or analog pins.

2. Software Development

Programming Environment:

- Use Arduino IDE or Platform IO to program the ESP32.

Libraries:

- TFT_eSPI or Adafruit GFX for the display.
- SD for MicroSD card handling.
- DHT for temperature and humidity sensors.
- WiFi for network connectivity.

- ESPAsyncWebServer for web server functionality.

IV. BLOCK DIAGRAM

[Part-1] MANUAL ACTIVATION (Figure-1)

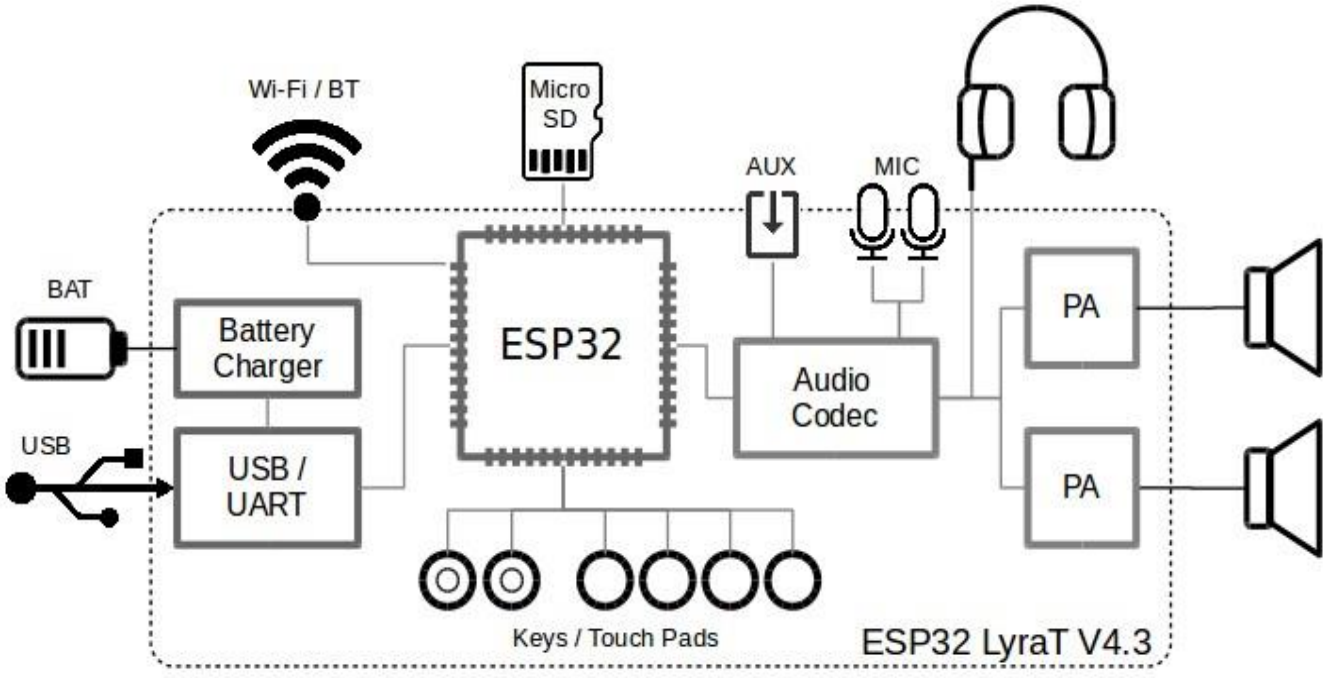


Figure 1. MANUAL ACTIVATION of the System

V. HARDWARE DETAILS

The hardware of the Smart Notice Board project consists of a 4-in-1 Dot Matrix LED Display and an ESP8266 WiFi Module. The input port is on the left side of the display and is connected to a Microcontroller's GPIO pins. The output port, on the right side, allows for expanding or adding additional LED Displays. ESP-32 Module: The ESP32 module is a popular, low-cost microcontroller with integrated Wi-Fi and Bluetooth capabilities, developed by Espress if Systems. It is widely used in Internet of Things (IoT) applications due to its powerful features and flexibility. Here are some key aspects of the ESP32 module

1. ESP-32

Figure 3. ESP-32 Module

2. Dot Matrix Dispaly

Figure 4. Dot Matrix Borad

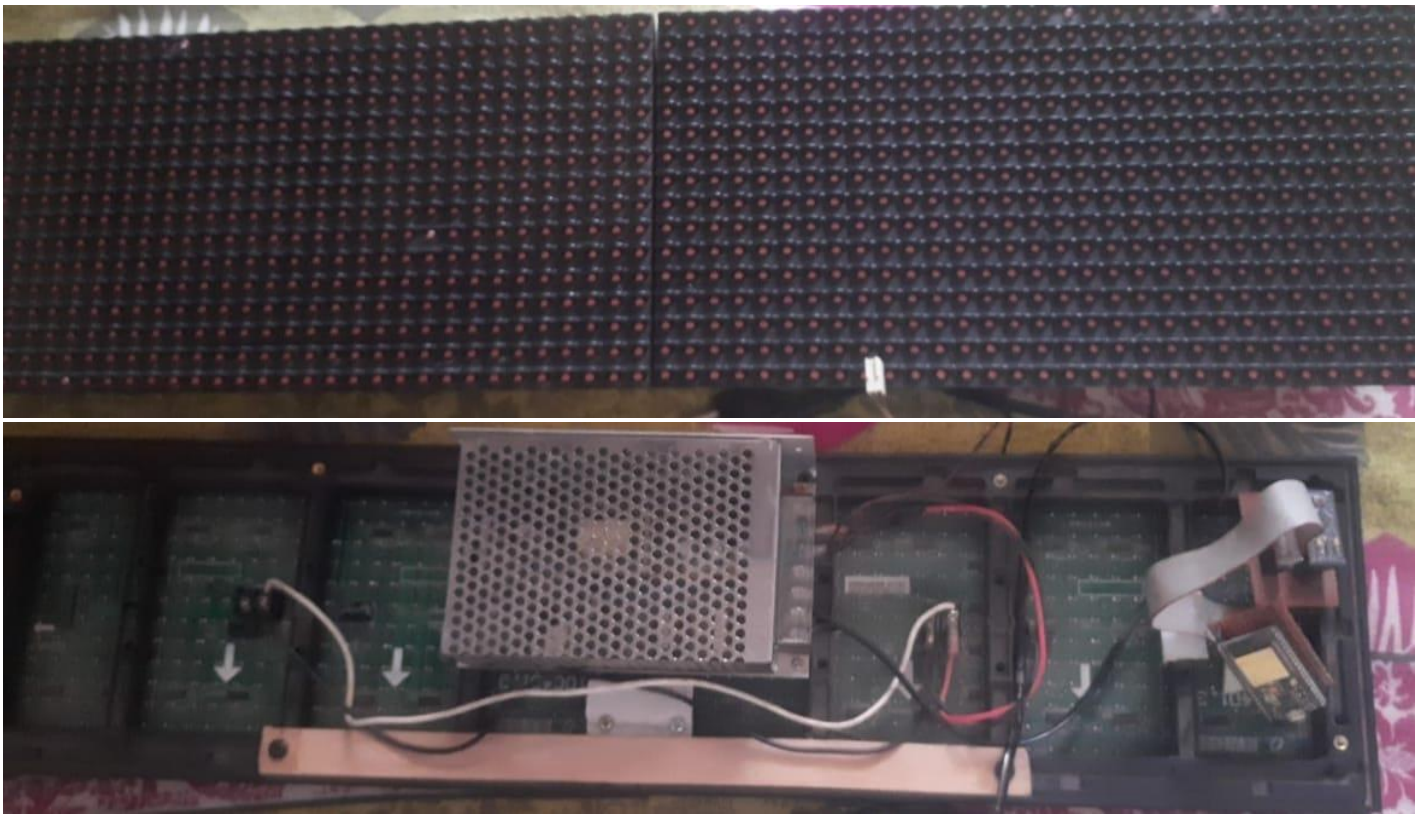
A dot matrix board, often referred to as a dot matrix display, is a type of display device used to show information in the form of text or simple graphics. It consists of a grid of small dots, usually LEDs, that can be individually controlled to create images or characters. Here's an overview of its key features and applications

- **Dual-Core Processor**: The ESP32 features a dual-core Tensilica LX6 microprocessor, with clock speeds up to 240 MHz, allowing for efficient multitasking.
- **Wi-Fi and Bluetooth**: It includes both 2.4 GHz Wi-Fi and Bluetooth (including Bluetooth LE) connectivity, making it suitable for a wide range of wireless applications.
- **GPIO**: The ESP32 has numerous General Purpose Input/Output (GPIO) pins, which can be used for interfacing with sensors, actuators, and other devices.
- **Integrated Peripherals**: It includes various peripherals such as SPI, I2C, UART, ADC, DAC, PWM, and touch sensors, providing versatility for different applications.
- **Memory**: The ESP32 comes with built-in RAM and ROM, with external flash memory support.

VI. HARDWARE RESULT

Creating a smart notice board using an ESP32 module involves integrating various hardware components to achieve functionality such as displaying messages, updating content remotely, and possibly interacting with users. Here is a detailed breakdown of the hardware components and their roles in such a project

- **Assemble the Hardware**: Connect the ESP32 to the display, RTC, input devices, and power supply.
- **Program the ESP32**: Use the Arduino IDE or ESP-IDF to write and upload the code.
- **R Temperature and Humidity Sensor**: DHT22 or similar.
- **Motion Sensor**: PIR sensor for activating the display on movement.
- **emote Updates**: Implement a method to receive messages over Wi-Fi, such as a simple web server or MQTT.
- **Enclosure**: Place everything in an enclosure, ensuring the display and input devices are accessible.



Photos as Smart Notice Board Using ESP-32

VII. ADVANTAGES

Here are five advantages of the project titled "Smart Notice Board Using ESP-32"
Using an ESP32 module for a smart notice board offers numerous advantages, combining the module's advanced features with the flexibility needed for modern IoT applications. Here are the key benefits:

1. Cost-Effective

- **Low-Cost Hardware**: The ESP32 is affordable, making it an excellent choice for budget-conscious projects.
- **Reduced Infrastructure Costs**: Minimal additional hardware is needed due to the ESP32's integrated features.

2. Wireless Connectivity

- **Wi-Fi Integration**: Enables remote updates and management of the notice board over the internet, facilitating real-time content updates.
- **Bluetooth Capabilities**: Allows for local wireless interactions, such as updates via a smartphone app.

3. Versatility and Flexibility

- **Multiple GPIOs**: Support for various peripherals like sensors, displays, and input devices, allowing for customization based on specific needs.
- **Compatibility with Different Displays**: Works with a wide range of display types, from simple LED matrices to sophisticated LCD or e-ink screens.

4. Ease of Development

- **Rich Development Ecosystem**: Compatibility with multiple development environments, including Arduino IDE, ESP-IDF, and PlatformIO, along with extensive libraries and community support.
- **Abundant Resources**: Numerous tutorials, example codes, and forums to assist in development and troubleshooting.

5. Low Power Consumption

- **Energy-Efficient**: Various power modes (deep sleep, light sleep, etc.) help to minimize power usage, which is ideal for battery-operated or energy-conscious applications.
- **Suitable for Remote Locations**: Can be powered by batteries or solar panels, enabling installation in places without direct power access.

6. Scalability

- **Network Integration**: Easy to scale by adding more devices to the network, making it suitable for large campuses or office buildings.
- **Cloud Connectivity**: Can integrate with cloud services for centralized control and monitoring, enhancing scalability and functionality.

7. Interactive Capabilities

- **User Input**: Support for touch sensors, buttons, and other input devices enables user interaction, making the notice board more dynamic and responsive.
- **Sensors Integration**: Ability to integrate environmental sensors (temperature, humidity, motion) for more intelligent features.

8. Real-Time Clock (RTC) Integration

- **Accurate Timekeeping**: With an RTC module, the notice board can display time-sensitive information accurately and can schedule content updates.

9. Portability

- **Compact and Lightweight**: The ESP32 and associated components can be housed in a compact enclosure, making the notice board easy to relocate.

10. Customizable and Expandable

- **Firmware Updates**: Easy to push firmware updates over the air (OTA), ensuring the system can be improved or fixed without physical intervention.
- **Modular Design**: Components can be added or modified based on evolving needs, allowing the system to grow with requirements.

Practical Advantages:

- **Educational Institutions**: Efficiently distribute announcements, schedules, and event updates.
- **Corporate Offices**: Display important notices, meeting schedules, and company news.
- **Public Places**: Provide information in waiting areas, transportation hubs, and community centers.
- **Smart Homes**: Central hub for family notices, reminders, and smart home status updates.

Example Use Case:

Imagine a university campus with multiple buildings. A smart notice board system using ESP32 can display different messages in each building, such as class schedules, event notices, and emergency alerts. Administrators can update all boards remotely, ensuring information is always current without needing to visit each board physically.

VIII. CONCLUSION

Implementing a smart notice board using the ESP32 module offers a myriad of benefits that make it an ideal choice for modern communication systems across various environments. The ESP32's combination of low cost, advanced features, and extensive connectivity options creates a versatile and efficient platform for developing smart notice boards. Here are the key takeaways:

1. **Cost-Effectiveness**:
   - Affordable hardware with integrated Wi-Fi and Bluetooth reduces overall project costs.
   - Minimizes the need for additional infrastructure, keeping expenses low.
2. **Wireless Connectivity**:
   - Enables remote content updates via Wi-Fi, facilitating real-time information dissemination.
   - Bluetooth allows for local interactions and easy updates from mobile devices.
3. **Versatility**:
   - Supports various peripherals and display types, catering to diverse application requirements.
   - Offers multiple GPIOs and compatibility with numerous sensors, enhancing functionality.
4. **Ease of Development**:
   - Supported by a rich development ecosystem with multiple IDEs and extensive community resources.
   - Availability of numerous tutorials and example codes simplifies the development process.
5. **Energy Efficiency**:
   - Low power consumption with various power-saving modes makes it suitable for battery-operated setups.
   - Can be powered by renewable energy sources, making it ideal for remote or off-grid locations.
6. **Scalability**:
   - Easily scalable by adding more devices to the network, suitable for large institutions or public spaces.
   - Cloud integration allows for centralized management and monitoring.

7. **Interactivity**:
    - Supports user input through touch sensors and buttons, making the notice board dynamic and responsive.
    - Integration with environmental sensors can add intelligent features and enhance user experience.
8. **Portability and Customizability**:
    - Compact and lightweight, making it easy to deploy and relocate.
    - Firmware updates can be pushed over the air, ensuring the system stays up-to-date and secure.

Practical Applications:

- **Educational Institutions**: Display schedules, announcements, and event updates efficiently across campus.
- **Corporate Offices**: Share important notices, meeting schedules, and company news in real-time.
- **Public Areas**: Provide information in transportation hubs, community centers, and other public spaces.
- **Smart Homes**: Serve as a central hub for family notices, reminders, and smart home status updates.

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