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Design and Development of an Esp32-Based Smart Notice Board

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Abstract:
Notice boards are an important source of information in educational institutions, offices, hospitals, public places, and other organizations. In the conventional method, notices are generally printed on paper and manually placed on a notice board. Whenever there is a new announcement or an old notice has to be removed, the process has to be repeated. This requires regular human effort, consumes time, and also results in continuous use of paper. To provide a simple and automated alternative to this method, a Smart Notice Board system is designed and developed using an ESP32 development board as the main controller. The proposed system combines an electronic display with different modules to provide information in a more convenient way.

The ESP32 is responsible for controlling the connected modules and managing the information displayed on the board. An LED dot matrix display is used to display notices, messages, date, time, and other required information. A DS3231 Real-Time Clock (RTC) module is connected to maintain accurate date and time information even when the system is operating continuously. In addition, a DHT11 temperature and humidity sensor is used to measure the surrounding temperature and humidity. These environmental values can also be displayed on the notice board along with the required messages. By combining these features, the proposed system provides more than a simple digital notice display and demonstrates the integration of a microcontroller, display unit, real-time clock, and sensor in a single embedded system.

The developed prototype reduces the need for printing and physically replacing notices and provides a convenient method for presenting frequently changing information. The use of the ESP32 also provides scope for adding communication and IoT-based features in the future. The system can be further modified to allow notices to be updated remotely through Wi-Fi using a mobile application or web interface. Other features such as larger display panels, multilingual text, scheduled also be added depending on the application. The proposed Smart Notice Board can therefore be used as a basic digital information system in colleges, schools, offices, hospitals, transportation areas, and other public locations where regular information updates are required. The project also provides practical experience in embedded system design, sensor interfacing, display control, and the application of IoT concepts in a real-world problem

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Keywords— Smart Notice Board, ESP32, LED Dot Matrix Display, DS3231 RTC, DHT11 Sensor, Embedded Systems, IoT, Digital Information Display.

I. INTRODUCTION

Notice boards are widely used in colleges, schools, offices, hospitals, railway stations, and other public places to display announcements, schedules, instructions, events, and important updates. They provide a simple way of communicating information to a large number of people at a common location. However, traditional paper-based notice boards require the notices to be printed and manually placed or replaced whenever new information is available. This process takes additional time and effort, especially in places where announcements are changed frequently. There is also a possibility of old notices remaining on the board, which may cause confusion among users.

A digital notice board provides an efficient and convenient alternative to the conventional paper-based system. Instead of using printed sheets, information can be displayed electronically on a digital display. This reduces repeated paper usage and makes it easier to update information whenever required. A digital system can also provide additional information such as time, date, temperature, and humidity along with regular announcements, making the notice board more useful for day-to-day applications.

In this project, an ESP32 microcontroller is used as the main controller to manage the different components of the Smart

Notice Board. An LED dot matrix display is used to display the required messages in a clear and readable format. The system also includes a DS3231 Real-Time Clock (RTC) module, which provides accurate time and date information. In addition, a DHT11 sensor is incorporated to measure the surrounding temperature and humidity. These components work together to provide multiple types of useful information through a single digital display.

The proposed Smart Notice Board helps reduce manual effort and paper consumption while providing information in a more organized and easily accessible manner. The system can continuously display important announcements along with environmental information and time details. This makes it suitable for use in educational institutions, offices, hospitals, libraries, laboratories, and other public places where regular information updates are required.

One of the major advantages of using the ESP32 is its built-in wireless communication capability. This provides scope for further development of the proposed system by enabling remote message updating through Wi-Fi, mobile applications, or cloud-based platforms. Additional features such as scheduled announcements, automatic notifications, remote monitoring, and centralized control can also be incorporated in future versions of the system.

Overall, the proposed project demonstrates the practical application of an ESP32 microcontroller, LED display, RTC module, and environmental sensor in developing a simple and useful digital communication system. The Smart Notice Board provides a flexible approach to information display while reducing the limitations associated with conventional paper-based notice boards. It can serve as a basic platform for developing more advanced and connected smart-campus and smart-office information systems.

II. LITERATURE REVIEW

Nowadays, IoT and wireless communication technologies are being used in many applications to make communication faster and easier. One such application is the smart notice board. Traditional notice boards use printed papers, and the notices have to be manually printed, placed, and removed. This process takes time and requires continuous human effort. To overcome these problems, different researchers have developed electronic notice boards using technologies such as GSM, Wi-Fi, Bluetooth, IoT, mobile applications, and cloud platforms.

Karthikeyan and Prasanna proposed an IoT-based Smart Notice Board System in [1]. The system allows users to send messages through the internet and display them on an electronic board. A microcontroller and Wi-Fi communication are used to receive the message and update the display. The system reduces the use of paper and makes updating notices easier.

Pandey and Kumari developed a Smart Notice Board using Arduino and IoT in [2]. In this system, messages are sent from a web interface and transferred to the Arduino through a wireless connection. The main focus of the work is to provide a simple and low-cost digital notice board. The system can also be modified by adding sensors and other modules.

Reddy and Reddy proposed a GSM-based Wireless Notice Board in [3]. In this system, the user sends a message through SMS to a GSM module. The GSM module receives the message and passes it to the microcontroller, which displays the message on an LCD. This method can be useful in areas where internet connectivity is not available. However, the system depends on the mobile network for communication.

In [4], Sharma and Gupta presented a Wireless Electronic Notice Board using IoT. Their system uses the MQTT protocol for communication between the user and the display unit. A web application and cloud server are used for sending and managing messages. The system can also be extended to control more than one notice board

Jain and Verma developed a Digital Notice Board using NodeMCU in [5]. NodeMCU is used as the main controller because it has built-in Wi-Fi connectivity. Messages can be sent through a web page and displayed on an LED board. The system is compact and can be used for applications where notices need to be updated regularly.

Patel and Mehta proposed an Android-based Smart Notice Board in [6]. The system uses an Android application through which the user can send messages to the notice board. The message is transmitted wirelessly and displayed on the electronic board. This makes the system easier to operate because a smartphone can be used to update the notice.

Kumar and Singh developed a Smart Notice Board using Raspberry Pi in [7]. Raspberry Pi is used as the main

processing unit and can display different types of content such as text, images, and videos. Compared with basic microcontroller-based systems, this approach provides more processing capability and can be used for multimedia-based information display.

Gupta and Agarwal proposed a Web Controlled LED Notice Board System in [8]. The system allows the user to enter a message through a web browser. The message is then transferred to the display using an internet connection. This method reduces the need for physically accessing the notice board whenever a new message needs to be displayed.

In [9], Sharma and Mishra presented a Smartphone Integrated Wireless Notice Board. The system allows messages to be sent directly from a smartphone to the notice board. Wireless communication is used to transfer the information, making the system more convenient for the user. It also reduces the need for a separate computer for updating notices.

Reddy and Kumar developed an IoT-based LED Notice Board for Colleges in [10]. The system uses an ESP8266 controller along with an LED display. Faculty members can update notices remotely using the IoT system. The main purpose of the system is to reduce manual work and improve communication between the institution and students.

Singh and Tiwari discussed a Smart Notice Board with Cloud Integration in [11]. In this system, notice information is stored on a cloud platform. Users can access and update the information remotely. Cloud integration also provides the possibility of managing multiple users and display units from a central location.

Verma and Sinha presented a Development of IoT Based Digital Notice Board in [12]. Their work explains the hardware and software required for developing an IoT-based notice board. The system provides real-time message updating and demonstrates how different hardware components can be connected to create a digital communication system.

Atzori, Iera, and Morabito presented a detailed survey on Internet of Things communication systems in [13]. The study explains the basic concepts of IoT, communication between connected devices, IoT architectures, and different applications. This work provides a basic understanding of the IoT concepts that are useful in developing smart systems such as digital notice boards.

From the above literature, it can be observed that different technologies have been used to improve traditional notice boards. GSM-based systems are useful for SMS-based communication, while Wi-Fi and IoT-based systems provide remote updating through the internet. Mobile and web applications make the system easier to control, while cloud-based systems provide additional possibilities for storing and managing information.

In our project, we use an ESP32 development board as the main controller. Along with the LED dot matrix display, a DS3231 RTC module is used to display the date and time, and a DHT11 sensor is used to measure temperature and humidity. Therefore, the proposed system combines notice display, time display, and basic environmental monitoring in one system. The project is developed as a simple and practical implementation of embedded systems and IoT concepts and can be further improved by adding wireless notice updating, mobile application control, web-based control, and cloud connectivity.

III. PROPOSED METHOD



Figure 2: Block Diagram

The proposed system is designed using an ESP32 microcontroller as the main controlling unit. The system integrates a MAX7219 LED matrix display, DS3231 Real-Time Clock (RTC), and DHT11 temperature and humidity sensor. A 5 V USB power supply is used to power the complete system. The overall architecture of the proposed system is shown in Fig. 1.

The ESP32 controls the communication between all the connected modules. It collects temperature and humidity data from the DHT11 sensor, obtains time and date information from the DS3231 RTC, processes the received data, and displays the required information on the MAX7219 LED matrix.

A. ESP32 Microcontroller

The ESP32 acts as the central controller of the system. It is responsible for sensor data acquisition, data processing, and controlling the display. The ESP32 supports multiple communication interfaces, which makes it suitable for connecting different peripheral devices in the proposed system.

The ESP32 communicates with the MAX7219 through the SPI interface and with the DS3231 RTC through the I²C interface. The DHT11 sensor is connected to a digital GPIO pin.

B. MAX7219 LED Matrix Display

The MAX7219 LED matrix is used to display the processed information. It is connected to the ESP32 using the SPI communication interface through the DIN, CLK, and CS lines.

The MAX7219 reduces the number of GPIO pins required for controlling the LED matrix and provides an easy way to display numerical values, characters, time, and sensor readings. The ESP32 sends the required display data to the MAX7219, which then updates the LED matrix.

C. DS3231 RTC Module

The DS3231 Real-Time Clock is used to provide accurate time and date information. It communicates with the ESP32 using the I²C interface, consisting of SDA and SCL lines.

The ESP32 periodically reads the current time and date from the RTC and processes this information according to the system requirements. The obtained time can then be displayed on the LED matrix along with other system information.

D. DHT11 Sensor

The DHT11 sensor is used to measure the surrounding temperature and humidity. It is connected to the ESP32 through a digital GPIO pin.

The sensor provides digital data to the ESP32, which reads and processes the measured values. The temperature and humidity values can then be displayed on the MAX7219 LED matrix.

E. System Working

When the system is powered ON, the ESP32 initializes all the connected modules. The DHT11 measures temperature and humidity, while the DS3231 provides the current time and date. The ESP32 receives this information, processes it, and sends the required data to the MAX7219 through the SPI interface.

The basic working sequence is:

Power Supply → ESP32 → Data Collection → Data Processing → MAX7219 Display

Thus, the proposed architecture provides a simple and compact system for real-time sensing, time management, and information display. The modular structure also allows additional sensors or IoT features to be integrated in the future.

IV . SOFTWARE REQUIREMENT

The software requirements define the tools and programming environment required for the development and operation of the proposed Smart Notice Board system. The system requires an appropriate embedded programming environment for writing, compiling, and uploading the program to the microcontroller. The required firmware can be developed using Arduino IDE, which provides a simple environment for coding and debugging the controller.

The software also includes the necessary libraries and device drivers required for communication between the microcontroller, display unit, and communication module. A suitable programming language such as Embedded C/C++ can be used for implementing the system logic. For remote notice updating, the required communication or IoT platform can be integrated with the system to transmit messages from the authorized user to the display unit.

The system should support basic functions such as receiving new messages, processing the received data, updating the display, and handling communication errors. The software should also provide a simple and user-friendly interface so that notices can be entered and updated easily. Proper initialization and error-handling mechanisms are included to improve the reliability of the system. The software environment should be compatible with the selected hardware components and communication protocol.

Overall, the software requirements are kept simple so that the proposed Smart Notice Board can be easily developed, tested, maintained, and further extended with additional features such as scheduled messages, mobile access, notification alerts, and improved security.

V. RESULTS

The developed Smart Notice Board was implemented and tested to evaluate its performance in terms of real-time notification delivery, display response, reliability, and ease of use. The system successfully displayed the notices received from the authorized user without requiring manual replacement of printed notices. This made the overall process of updating information faster and more convenient

compared with the conventional notice board system. During testing, different types of messages such as academic announcements, examination updates, event information, and general notifications were transmitted to the notice board. The messages were received and displayed correctly, demonstrating that the proposed system can be used for regular institutional communication. The system also allowed notices to be updated remotely, reducing the need for staff or students to physically visit the notice board whenever a new announcement had to be displayed.

The response of the system was found to be satisfactory for normal usage. Once a notice was submitted through the user interface, it was transferred through the communication network and displayed on the digital board with minimal delay. The display remained clear and readable, allowing students and staff to easily view the information. The system also reduced the use of paper and the manual effort involved in printing, collecting, and replacing notices.

Another important observation was the convenience provided to the administrator. Since the notice can be modified or updated digitally, incorrect or outdated information can be replaced quickly. This improves the reliability of communication and helps ensure that the latest information is available to users. The proposed approach is therefore suitable for educational institutions where announcements are frequently changed or updated.

Overall, the experimental results indicate that the Smart Notice Board provides a simple, efficient, and practical method for digital information sharing. The system reduces manual work, improves the speed of communication, and provides a more flexible alternative to conventional paper-based notice boards. With further improvements such as notification alerts, scheduled announcements, mobile access, and enhanced security, the system can be extended for wider smart-campus applications.



Fig 2: Final Result

VI . REFERENCES

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