IOT-Based Digital Notice Board

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***Abstract*—The "Digital Notice Board using ESP32 with LCD Monitor (RCA/AV Display)" is an innovative and cost-effective solution designed to replace traditional notice boards and manual communication methods [5]. The system integrates wireless communication, embedded systems, and display technology to provide real-time updates in educational institutions, offices, hospitals, and public places [2]. The project utilizes the ESP32 as the central processing unit, which receives messages wirelessly from a mobile device through WiFi and processes the data efficiently [1]. These messages are processed by the ESP32 and converted into analog VGA signals using a resistor ladder network, a simple and efficient Digital-to-Analog Converter (DAC). The VGA signals are then transmitted to a VGA to AV converter, which outputs the signal in RCA format suitable for any standard LCD monitor with AV input [3]. This design eliminates the need for manual notice updates, significantly reducing time and effort while ensuring instant communication. The system provides an affordable, scalable, and low-power solution with easy operation, making it accessible for both technical and non-technical users [2]. Furthermore, the project demonstrates practical applications of digital-toanalog conversion, GPIO control, and embedded system programming [1]. Although the system has limitations in terms of display resolution and signal precision compared to commercial digital display boards, it effectively achieves the primary goal of displaying text-based notices in real time. Overall, this project represents a modern, efficient, and practical approach to digital communication and can be further expanded with cloud connectivity, multimedia support, and IoT integration for future applications [6].**

***Index Terms*—ESP32, Digital Notice Board, Wifi, VGA2AV, LCD Display**

I. INTRODUCTION

In the present era of rapid technological advancement, communication has become one of the most essential aspects of daily life, especially in environments such as educational institutions, corporate offices, industries, and public service areas where timely and accurate dissemination of information is extremely important [2]. The need to share information quickly, efficiently, and reliably has increased significantly over time due to the growing population and the expansion of organizational structures. Traditionally, notice boards have been used as a common medium to display important information, announcements, schedules, circulars, and alerts. Although these conventional notice boards have served their purpose for many years, they come with several limitations. They require manual effort for updating the information, which is not only time-consuming but also inefficient in situations where frequent updates are required [5]. The process of physically removing old notices and replacing them with new ones can lead to delays, especially when urgent information needs to be communicated immediately. Moreover, traditional notice boards lack flexibility as they do not support real-time updates, remote accessibility, or dynamic content display. These limitations can create communication gaps and reduce the overall effectiveness of information sharing in fast-paced environments. Therefore, there is a strong need for a more advanced, automated, and reliable system that can overcome these drawbacks and provide a modern solution for effective communication [1].

To address these challenges, digital notice board systems have been introduced as an innovative and efficient alternative to traditional methods of information display [5]. A digital notice board enables users to update and manage information electronically, eliminating the need for physical presence and significantly reducing manual efforts. With the

integration of embedded systems and wireless communication technologies, it has become possible to design smart and intelligent display systems that can operate in real time and provide instant updates [2]. The project titled "Digital Notice Board using ESP32 with VGA to AV Display on TV" focuses on the design and implementation of such a system using modern and cost-effective hardware components. In this project, the ESP32 microcontroller is used as the central processing unit due to its high performance, low power consumption, and built-in WiFi capability, which allows it to establish wireless communication with external devices such as smartphones or computers [1]. Through this wireless interface, messages can be sent easily and received by the ESP32 without any physical connection.

Once the data is received, the ESP32 processes the information and generates a VGA (Video Graphics Array) signal, which is a standard video output format used for display systems [1]. However, since most televisions do not support direct VGA input, a VGA to AV converter is used to convert the VGA signal into an AV (Audio Video) signal that is compatible with standard TV sets [3]. The converted AV signal is then transmitted through RCA connectors and displayed on the television screen, where the text messages are clearly visible. This system is primarily designed to display text-based notices, announcements, instructions, and alerts in real time, making it highly useful in places such as schools, colleges, offices, hospitals, railway stations, and other public areas where quick and effective communication is required [2]. In addition to improving communication efficiency, the system also reduces the use of paper, making it an environmentally friendly solution. Furthermore, the use of easily available and affordable components ensures that the system is economical and simple to implement, while also providing flexibility for future enhancements such as graphical user interfaces, mobile application integration, internetbased cloud connectivity, and support for multimedia content [6]. Overall, this project represents a practical application of embedded systems, wireless communication, and signal conversion technologies to create a modern digital notice board system that enhances the speed, reliability, and effectiveness of information sharing in various real-world scenarios.

II. LITERATURE REVIEW

The concept of digital notice boards has evolved significantly with the advancement of embedded systems and wireless communication technologies. In earlier systems, notice boards were completely manual, where information was displayed using paper-based methods. Although simple, these systems were inefficient, timeconsuming, and required continuous human effort for updating the content. With the introduction of electronic display systems, researchers and developers began working on automated solutions to overcome these limitations, as discussed in **[5]**. Several studies have proposed digital notice board systems using microcontrollers such as Arduino and PIC. These systems were designed to display messages on LED or LCD displays. In many cases, communication was established using GSM modules, where messages were sent via SMS and displayed on the screen, as presented in **[7]**. While these systems improved the speed of communication compared to traditional methods, they had certain limitations such as higher operational costs, limited message capacity, and dependency on network availability. Later, Bluetooth-based systems were introduced, allowing users to send messages from mobile devices over short distances, as explained in **[4]**. However, Bluetooth communication has a limited range, which restricts its practical applications in larger areas.

With the development of WiFi-enabled microcontrollers like ESP8266 and ESP32, more advanced digital notice board systems have been implemented. These systems allow wireless communication over a larger range and provide faster data transmission. ESP32, in particular, has gained popularity due to its high performance, low power consumption, and built-in WiFi and Bluetooth capabilities, as discussed in **[1]**. Many modern systems use ESP32 to receive data from mobile applications or web servers and display it on various types of screens such as LCD, LED matrices, or TFT displays. However, most of these systems are limited to small display sizes and do not utilize larger display units like televisions.

In recent developments, VGA signal generation using microcontrollers has opened new possibilities for displaying content on larger screens such as monitors and TVs. By generating VGA signals and using signal converters like VGA to AV modules, it becomes

possible to interface microcontrollers with standard television sets. This approach provides a cost-effective solution for large-scale display without the need for expensive display modules, as highlighted in [3]. The proposed project builds upon these advancements by combining ESP32-based wireless communication with VGA signal generation and AV conversion to display text messages on a TV screen. This system aims to overcome the limitations of previous methods by providing a low-cost, efficient, and scalable solution for digital notice boards.The proposed system focuses on designing and implementing a Digital Notice Board using ESP32 with VGA to AV display on a television screen. The main objective of this system is to provide a wireless and real-time method for displaying text-based messages on a large screen. Unlike traditional notice boards, which require manual updates, the proposed system allows users to send messages remotely using a mobile device or computer through WiFi communication [2].

In this system, the ESP32 microcontroller acts as the central processing unit. Due to its built-in WiFi capability, it can easily receive messages from a wireless source such as a smartphone or a web-based application. Once the message is received, the ESP32 processes the data and converts it into a format suitable for display, as explained in **[1]**. The ESP32 is also responsible for generating a VGA (Video Graphics Array) signal, which is used to produce video output. Since most televisions do not support direct VGA input, a VGA to AV converter is used to convert the VGA signal into an AV (Audio Video) signal. This AV signal is then transmitted through RCA connectors (yellow for video) and connected to the television's AV input port. As a result, the text message sent from the mobile device is displayed on the TV screen in real time. Furthermore, the system can be expanded in the future to support additional features such as graphical display, scrolling text, internet-based updates, and mobile application integration, as highlighted in **[6]**. This makes the proposed system flexible and scalable for various real-world applications. Overall, the proposed system provides an efficient and modern approach to digital communication by combining embedded systems, wireless technology, and display conversion techniques.

III. BLOCK DIAGRAM

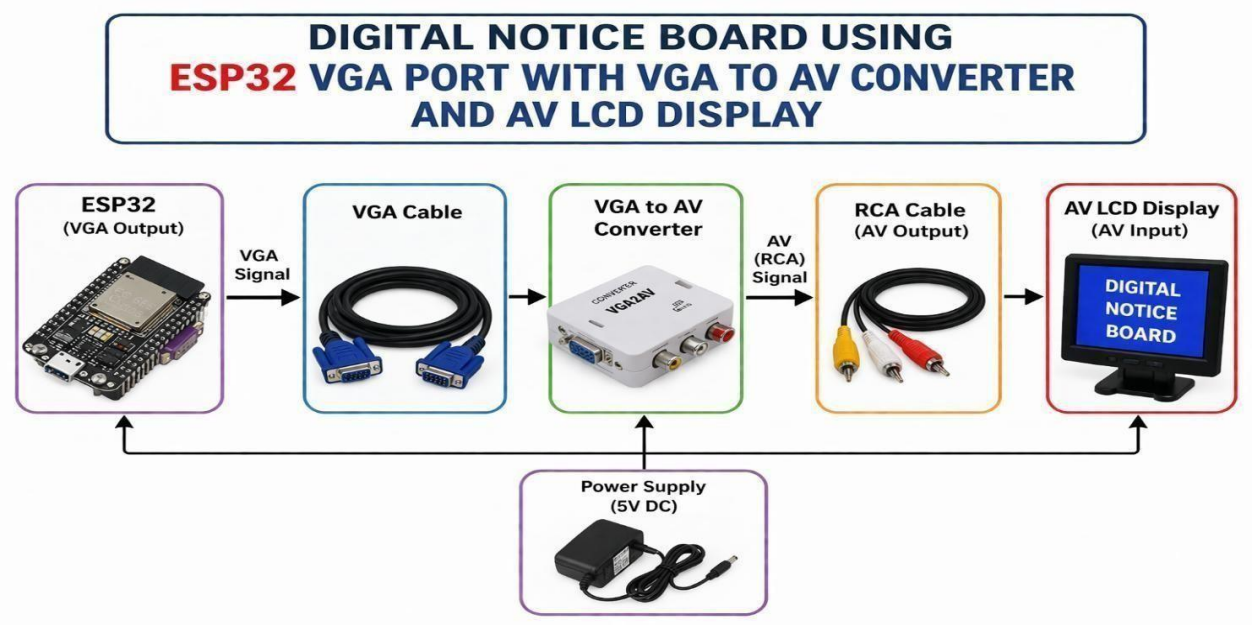

Fig.1 Block Diagram of Notice Board

The block diagram illustrates the complete architecture of the Digital Notice Board system based on the ESP32 microcontroller with a VGA output interface. The ESP32 serves as the core component of the system, responsible for generating and controlling the display content such as text messages, notices, or

announcements. It processes the input data and converts it into VGA-compatible video signals using its internal programming and timing mechanisms, as discussed in **[1]**.

These VGA signals, which include horizontal and vertical synchronization along with RGB data, are transmitted through a VGA cable to the next stage of the system. However, since the LCD display used in this project does not support VGA input directly and instead operates on AV (composite video) input, a VGA to AV converter is required. This converter acts as an interface between two different video standards, converting high-resolution VGA signals into standard composite video signals, as explained in **[3]**.

Once the conversion is completed, the AV signal is sent through an RCA cable, typically using the yellow connector designated for video transmission. This cable carries the analog video signal to the AV LCD display. The LCD display then interprets this signal and renders the visual output on the screen, displaying the intended digital notice clearly.

In addition to signal flow, a stable power supply is provided to the converter and display unit to ensure continuous and reliable operation. The overall system is efficient, cost-effective, and eliminates the need for a traditional computer system, making it suitable for applications such as schools, offices, and public information displays **[2]**.

IV. METHODOLOGY

The methodology of the Digital Notice Board system is designed to explain the systematic process of developing and implementing the project using the TTGO T7 ESP32 microcontroller. In the initial stage, all the required hardware components such as the ESP32 board, VGA interface, VGA to AV converter, and LCD display with AV input are selected and properly connected to form the system setup. After hardware setup, the ESP32 is programmed using suitable software tools and libraries to enable Wi-Fi communication and VGA signal generation, as discussed in [1]. The ESP32 is configured to connect to a wireless network, allowing it to receive messages from a user through a mobile device or laptop. Once the message is received, the ESP32 processes the data by converting the text into pixel format suitable for display. The processed data is then used to generate VGA signals through the GPIO pins, including RGB and synchronization signals. Since the LCD display supports only AV input, a VGA to AV converter is used to convert the VGA signals into composite video format, as explained in [3]. The converted AV signal is transmitted through an RCA cable to the LCD display, where the message is displayed in real-time.The system is then tested to ensure proper communication, accurate signal generation, and clear display output. Thus, the methodology provides a structured approach for the successful implementation of the digital notice board system [2].

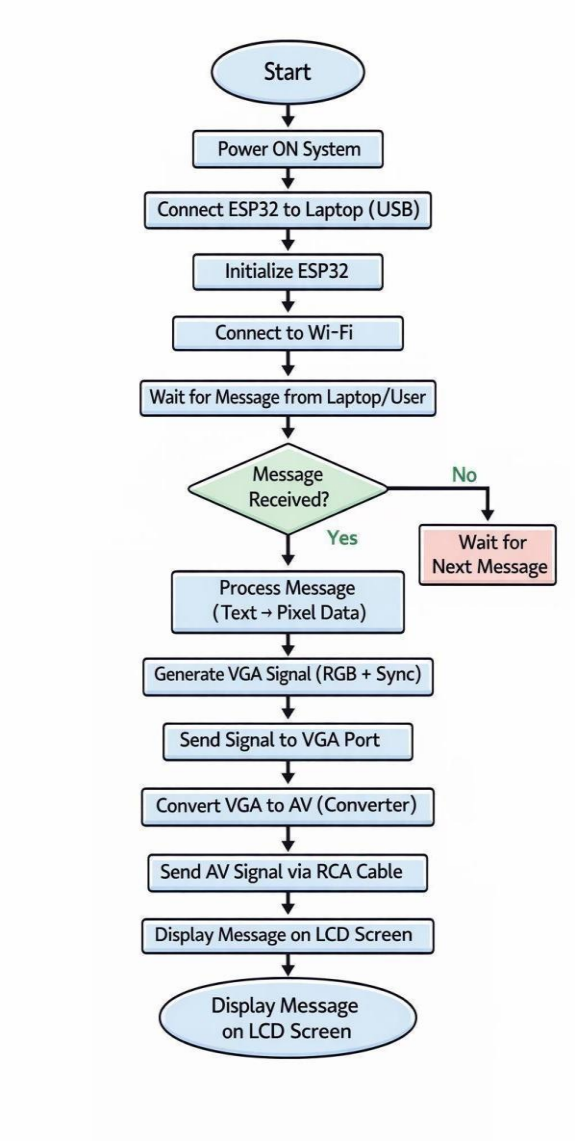

Fig.2 Flow Chart

RESULTS:

The working principle of the Digital Notice Board system is based on wireless communication, data

processing, and video signal conversion using the TTGO T7 ESP32 microcontroller. In this system, a user sends a text message through a mobile phone or laptop over a Wi-Fi network, which is received by the ESP32 due to its inbuilt Wi-Fi capability. The ESP32 acts as the main controller, where it processes the received data, converts the text into pixel format, and prepares it for display, as explained in **[1]**. It then generates VGA signals using its GPIO pins, including Red, Green, Blue, Horizontal Sync, and Vertical Sync signals, which are required to produce a proper video output. However, since the LCD display used in the system supports only AV (composite video) input, the VGA signals cannot be directly displayed, so a VGA to AV converter is used to convert these signals into a composite video format, as discussed in **[3]**. The converted signal is then transmitted through a yellow RCA cable to the LCD display, which is set to AV mode. Finally, the LCD screen displays the message, such as "Good Morning Everyone," confirming successful operation of the system. Thus, the entire process enables real-time wireless message transmission and display by integrating ESP32-based processing with VGA signal generation and AV conversion **[2]**.

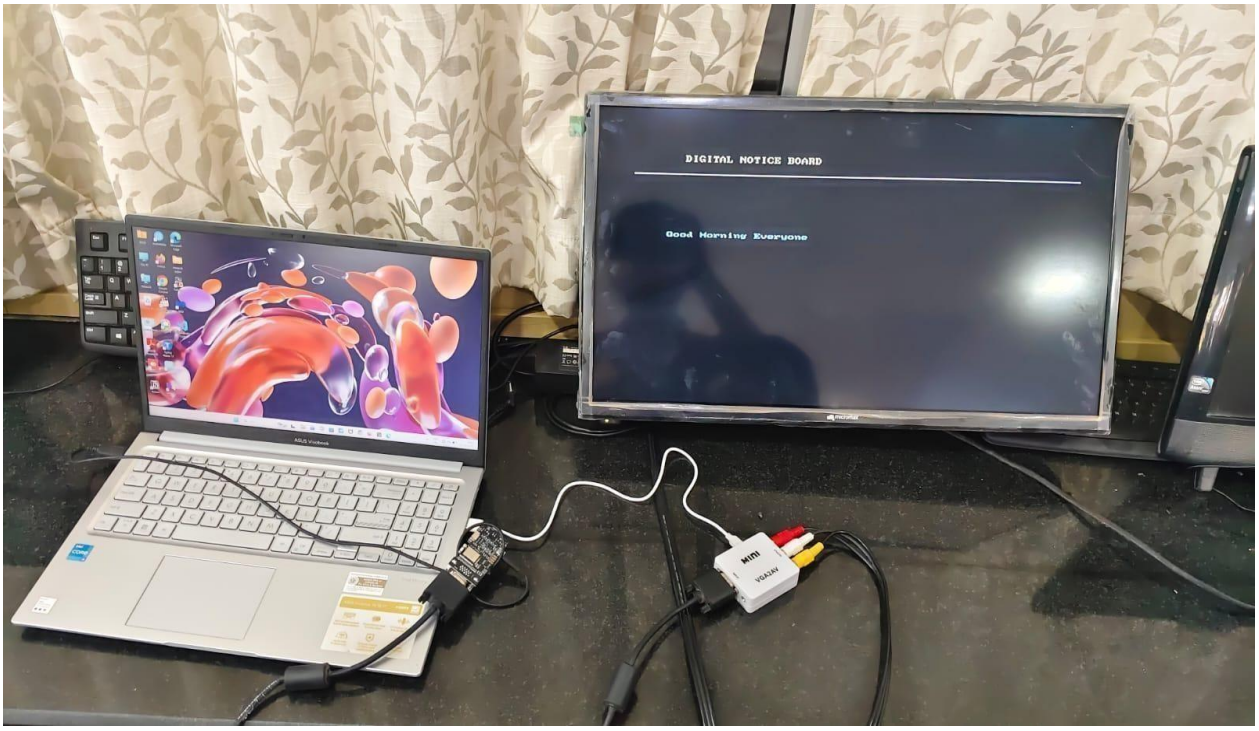

Fig.3 Experimental Result

Furthermore, the system ensures smooth and continuous operation by maintaining proper synchronization between data processing and signal generation. The ESP32 continuously refreshes the display by generating VGA frames at a fixed rate, which helps in stable and flicker-free output on the LCD screen, as explained in **[1]**. Even when no new message is received, the previously stored message remains displayed due to continuous signal generation. In addition, the system can be programmed to update messages dynamically whenever new data is received over Wi-Fi, making it highly suitable for real-time applications such as schools, colleges, offices, and public information systems **[2]**. The use of a VGA to AV converter also increases the flexibility of the system, allowing it to work with older LCD or TV displays that support only AV input. Moreover, the overall system is cost-effective, easy to implement, and requires minimal hardware components, which makes it efficient for practical deployment. Hence, the system not only demonstrates the working of embedded systems and communication technologies but also provides a reliable and scalable solution for digital notice display.

V. CONCLUSION

The Digital Notice Board system developed using the ESP32 successfully demonstrates an efficient and wireless method of displaying information on an LCD monitor [1]. The system allows users to send messages from a mobile device through WiFi, which are then received and processed by the ESP32 in real time. A resistor ladder circuit is used as a simple Digital-to-Analog Converter (DAC) to generate VGA signals from digital outputs, which are further converted into AV (RCA) format using a VGA to AV converter for compatibility with the LCD display [3]. This project eliminates the need for manual notice updates and reduces time and effort, making it highly useful for institutions, offices, and public information systems [2]. Although the system has limitations in terms of display resolution and signal precision, it provides a low-cost, reliable, and practical solution for real-time message display. Overall, the project proves to be an effective integration of wireless communication, embedded systems, and display technology for building a modern digital notice board [6].

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