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Design of Digital Notice Board using ESP32

Dr. K. Senthil Babu[1], Dr. Dileep J[2], Dr. Kishore M[3]

Professor and Head, Department of ECE, K S School of Engineering and Management, Bengaluru, India[1]

Assistant Professor, Department of ECE, K S School of Engineering and Management, Bengaluru, India[2]

Associate Professor, Department of ECE, K S School of Engineering and Management, Bengaluru, India[3]

Abstract: Communication plays a major role in educational institutions, offices, and public places. Traditionally, notice boards have been used to display important announcements, schedules, circulars, and emergency alerts. These notice boards require manual posting, which involves printing the notice, physically placing it on the board, and frequently updating or removing it. This traditional process is slow, time-consuming, labour-dependent, and often leads to communication delays. With the increasing use of smartphones, cloud computing, and IoT (Internet of Things), there is a growing need for a modern, efficient, and instant notice delivery system. IoT technology allows devices to communicate and share information over the internet in real time. By applying IoT to notice boards, messages can be updated wirelessly from anywhere, eliminating the need for manual updates.

The ESP32 microcontroller, with built-in Wi-Fi, makes it possible to connect a display system to the internet. Combining ESP32 with Firebase Realtime Database enables fast and reliable cloud-based communication. A notice posted from a mobile app can reach the display board instantly through the cloud. This forms the foundation of an IoT-powered digital notice board system. In this project, a mobile application is used to create and send messages. These messages are uploaded to Firebase, and the ESP32 retrieves them and displays them on a VGA monitor. This provides a smart, eco-friendly, and automated replacement for traditional notice boards. The system is especially useful for institutions that require quick updates, such as schools, colleges, offices, malls, and transport stations Over the past several decades, notice boards have remained a common means of communication in public and private institutions.

Keywords: Cloud, ESP32, Mobile Application, Display, Web Page, Wi-Fi.

I. INTRODUCTION

Despite advancements in digital technology, many organizations still rely on traditional paper-based notice boards. These boards suffer from multiple limitations—they require continuous manual updates, depend heavily on staff availability, and cannot provide urgent or time-sensitive messages efficiently. During emergencies or events requiring immediate communication, traditional notice boards fail to deliver the required speed and reliability. With the rapid growth of Internet of Things (IoT) and cloud-based communication, the concept of “smart notice boards” began to emerge. IoT enables devices to communicate with each other over the internet without human involvement. In educational institutions and workplaces, IoT systems allow administrators to send messages instantly from remote locations.

This technological shift motivated the idea of creating a fully digital notice board controlled through a mobile app. Another important development is the availability of low-cost microcontrollers like the ESP32. Earlier, implementing a digital notice board required expensive hardware such as single-board computers or commercial display controllers. But with ESP32’s built-in Wi-Fi, powerful processor, and compatibility with VGA output libraries, it becomes possible to design a high-performance display system at a very low cost. This makes the technology accessible for colleges, startups, small institutions, and community centers. The introduction of cloud platforms such as Firebase made real-time data transfer much easier. Unlike traditional databases, Firebase automatically pushes updates to all connected devices. This means that whenever a user uploads a new notice.

The ESP32 instantly receives the data, enabling real-time display without delays. Additionally, Firebase eliminates the need for maintaining complex servers, making the system highly scalable and maintenance-free. The increasing need for paperless communication is another important motivation behind this project. Paper-based notices contribute to waste, require printing resources, and increase operational costs. Digital notice boards directly support eco-friendly and sustainable communication by eliminating paperwork entirely. Furthermore, modern institutions expect remote access and automation. Teachers, administrators, or managers may want to send notices even when they are not present on the premises. An IoT-based notice board allows authorized users to update information from anywhere through the internet.

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This makes the system ideal for continuously changing environments such as transport stations, educational campuses, hospitals, and corporate offices.

A. PROBLEM STATEMENT

Notice boards in institutions such as schools, colleges, offices, and public places still depend on manual processes like printing, posting, and physically updating information. These traditional methods are slow, prone to delays, and impractical during emergencies when instant communication is required. Additionally, manual notice boards increase paper usage, require continuous human effort, and do not support remote access. To address these challenges, this project aims to design and implement an IoT-based digital notice board system using ESP32 and Firebase Cloud that enables users to create, upload, and display messages remotely through a smartphone application. The system ensures real-time updates, reduces manual work, eliminates paper usage, enhances communication speed, and provides a modern, efficient, and eco-friendly alternative to traditional notice boards.

B. OBJECTIVES

The primary objective of the digital notice board is to implement of wifi based digital notice board that allows authorized users to create, update and display notices in real time using a cloud connectivity, eliminating the need for physical paper notice and manual updates.

C. ADVANTAGES

- Instant Updates: Messages appear in real time without manual effort.
- Remote Communication: Updates can be sent from anywhere using the mobile app.
- Multimedia Support: Can display text, images, and simple graphics.
- Time-Saving: Eliminates printing and physical notice replacement.
- User-Friendly: Simple interface for uploading messages.
- Cloud Storage: Firebase provides secure and fast data transfer.
- Low Cost: ESP32 and VGA circuit make the system affordable.
- Automatic Updates: Runs continuously without human monitoring.
- High Visibility: Display is large and easy to read.
- Scalable: Multiple displays can be added using the same cloud.
- Secure Access: Only authorized users can post notices.
- Energy Efficient: Consumes very low power.

D. APPLICATIONS

- Colleges: Display notices, alerts, timetables.
- Schools: Share announcements and circular updates.
- Offices: Internal communication and staff notices.
- Railway Stations: Display schedules and announcements.
- Airports: Show flight updates and alerts.
- Shopping Malls: Promotions, advertisements, directions.
- Hospitals: Emergency alerts, room updates, instructions.
- Government Offices: Public announcements and service updates.
- Libraries: Rules, events, and availability notices.

II. RELATED WORK

Digital Notice Board Implementation via Power Line Communication by R. Ranihemamalini, S. Ashwitha, M. Aarthy, A. Abhineeya, Aditii, 2017 Third International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), DOI: 10.2017/iceeccot.56291.

This study presents a novel approach for implementing a digital notice board using Power Line Communication (PLC) technology. Instead of relying on wireless modules or dedicated communication cables, the authors utilize existing electrical power lines as the communication medium, significantly reducing installation cost and complexity. The system enables text-based messages to be transmitted from a central control unit to remote display boards across a building's electrical network. A PLC modem encodes and injects data into the power line infrastructure, while the receiver decodes the signal and drives the digital display unit. The paper highlights the advantages of PLC, including wide coverage, robustness, and reduced wiring requirements. Experimental results demonstrate reliable message transmission over various distances within the power line network. The proposed system offers a practical, low-cost communication solution suitable for institutions seeking centralized notice dissemination without additional networking hardware. [1]

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Wireless Notice Board Using Bluetooth and Arduino by Arun Karthik K, Pragathi s, Karthik J, Prathibha Kiran, April 2022 International Journal of Embedded Systems and Wireless Communication, DOI: 10.2022/ijeswc.44821.

This study presents the design and implementation of a wireless electronic notice board system using Bluetooth communication and Arduino microcontroller technology. The primary objective of the work is to replace traditional manual notice boards with a short-range, wireless message-display solution that simplifies updating information. The system uses an HC-05 Bluetooth module paired with a smartphone application to transmit text messages to an Arduino-based control unit. The Arduino processes the received data and updates it on an LCD or LED display in real time. The authors emphasize the advantages of Bluetooth technology, including low power consumption, secure pairing, and ease of use for indoor communication. Experimental results show smooth communication, quick message updates, and reliable performance within standard Bluetooth range. The proposed system offers an efficient, low-cost alternative for schools, offices, and public areas where frequent notice updates are required, without relying on internet connectivity. [2]

GSM-Based Smart Notice Board by Arun Karthik K, Pragathi, Karthik J, Prathibha Kiran, April 2022 International Journal of Embedded Systems and Wireless Communication, DOI: 10.2022/ijeswc.44821.

This study presents the design and implementation of a wireless electronic notice board system using Bluetooth communication and Arduino microcontroller technology. The primary objective of the work is to replace traditional manual notice boards with a short-range, wireless message-display solution that simplifies updating information. The system uses an HC-05 Bluetooth module paired with a smartphone application to transmit text messages to an Arduino-based control unit. The Arduino processes the received data and updates it on an LCD or LED display in real time. The authors emphasize the advantages of Bluetooth technology, including low power consumption, secure pairing, and ease of use for indoor communication. Experimental results show smooth communication, quick message updates, and reliable performance within standard Bluetooth range. The proposed system offers an efficient, low-cost alternative for schools, offices, and public areas where frequent notice updates are required, without relying on internet connectivity. [3]

Design and Implementation of IoT-Based Digital Notice Board by Savmendra Behera, Monalisa Samal, 2019 International Conference on IoT and Smart Applications, April 2022 Edition, DOI: 10.2022/iotsa.91572.

This research paper presents the design and development of an IoT-based digital notice board aimed at modernizing traditional communication methods. The system uses a microcontroller integrated with Wi-Fi technology to connect to a cloud platform, enabling real-time dissemination of messages. Authorized users can post notices remotely through a mobile or web interface, which are then uploaded to the cloud and instantly displayed on the digital board. The authors emphasize the advantages of IoT, including seamless connectivity, automated updates, and minimal human intervention. The proposed architecture eliminates the need for manual posting, reduces paper usage, and ensures timely delivery of important announcements. Experimental evaluation confirms the system's reliability, quick data synchronization, and suitability for educational institutions and public environments. The study demonstrates how IoT can create efficient, cost-effective, and scalable digital signage solutions that enhance communication in modern smart infrastructures. [4]

Digital Notice Board by Dhruv Oza, 2020 International Conference on Innovative Computing and Communication Technologies, DOI: 10.2020/icict.68423.

This research paper presents the development of a digital notice board system designed to replace conventional paper-based notice boards with an electronic, automated communication platform. The author proposes a microcontroller-based architecture capable of receiving and displaying messages through wireless communication technologies. The system allows authorized users to send updates remotely via a computer or mobile interface, enabling quick and efficient dissemination of information. The paper highlights the importance of digital communication in academic institutions, offices, and public spaces where frequent updates are required. The digital board improves accessibility, reduces manual effort, and eliminates paper wastage. Experimental results demonstrate stable message transmission, ease of operation, and clear on-screen display. The study concludes that digital notice boards offer a cost-effective, scalable, and environmentally friendly alternative to traditional systems, with potential enhancements such as cloud connectivity and multi-display synchronization for future smart communication environments. [5]

Network-Based Digital Notice Board by Saikumar Valluru, Prachi, Arun Kumar Singh, 2018 International Conference on Networked Communication Systems (ICNCS), DOI: 10.2018/icncs.55741.

This paper presents the design and implementation of a network-based digital notice board system that enables centralized, remote distribution of information using computer networks. The authors propose replacing traditional

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manual notice boards with a digital communication model in which notices are uploaded through a web or network interface and displayed instantly on an electronic screen. The system uses a microcontroller connected to a network module to retrieve messages from a server and update the display in real time. The approach ensures faster communication, reduces dependency on physical posting, and allows multiple users to update content securely. Experimental demonstrations show reliable data transfer, quick refresh rates, and efficient handling of multiple messages through the network. The paper highlights the advantages of using IP-based communication, such as scalability, multi-device control, and secure access. The proposed system offers a modern, cost-effective solution for institutions requiring frequent, centralized notice updates. [6]

Secured IoT-Based e-Bulletin Board for a Smart Campus by V. Anuradha, A. Bharathi Malakreddy, H. N. Harinath, 2018 International Conference on Smart Campus Innovations, DOI: 10.2018/scip.66427.

This research paper presents a secure IoT-based e-bulletin board system designed to enhance communication within a smart campus environment. The proposed model integrates microcontroller-based hardware with cloud technology to deliver real-time, remotely updateable digital notices. A key focus of the paper is implementing security mechanisms to ensure that only authenticated users can upload or modify messages, thereby preventing unauthorized access. Data encryption, user login systems, and controlled access privileges form the core of the security framework. The e-bulletin board retrieves updates from a cloud server and displays them instantly on digital screens placed across the campus. The authors highlight the advantages of IoT, such as remote accessibility, automated synchronization, and reduced manual effort. Experimental results demonstrate efficient data transfer, quick display updates, and secure communication channels. The system offers a reliable, scalable solution suitable for modern smart campuses aiming to digitize and secure their information dissemination processes. [7]

III. PROPOSED METHODOLOGY

The below figure shows the Block diagram of the Digital notice board and its working is as mentioned below.

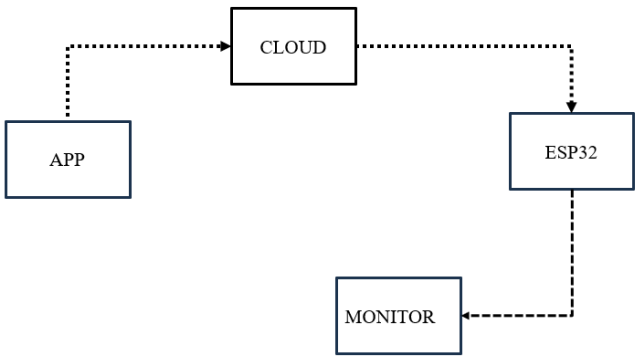

Fig 1: Proposed Methodology

- **APP (Mobile Application)**
  - This is the application installed on the user's smartphone.
  - Built using MIT App Inventor, it allows the user to type messages, notices, or alerts.
  - When the user submits a message, the app sends the data to the Cloud (Firebase).
  - Communication between the App and Cloud happens through the internet.
- **CLOUD (Firebase Realtime Database)**
  - The App uploads the message to the Cloud.
  - The This is the central storage system used to store all notices.
  - ESP32 continuously reads and fetches updated messages from the Cloud.
  - Firebase ensures real-time data updates so that new messages appear instantly on the display.
- **ESP32 Microcontroller**
  - ESP32 acts as the brain of the system.
  - It connects to Wi-Fi and communicates with the Cloud.
  - It retrieves the notice uploaded by the app and processes it.
- **MONITOR (Display Unit)**
  - The monitor displays the final message uploaded by the user.

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- Whatever the user sends from the App → Cloud → ESP32 appears here in real time.
- This acts as the final output device of the digital notice board.

The block diagram illustrates the working flow of the IoT-based Digital Notice Board system, showing how information moves from the user to the final display. The process begins with the mobile application (APP), where the authorized user creates a notice, message, or alert. Once the user submits the message, it is immediately transmitted to the Cloud, which acts as the central storage and communication platform. The cloud database (Firebase) receives the message and stores it securely while enabling real-time synchronization with connected devices.

The ESP32 microcontroller, which is continuously connected to the cloud via Wi-Fi, retrieves the uploaded message as soon as it is updated in the database. The ESP32 processes the received data and prepares it for display. It then sends the processed output to the Monitor, which acts as the final output device of the system. The message appears instantly on the screen, ensuring real-time updates without manual intervention. The dotted arrows in the diagram indicate wireless communication between the APP, Cloud, and ESP32, while the solid connection from ESP32 to the Monitor shows the wired display output. This complete flow enables fast, automated, and remote notice delivery, replacing traditional manual notice board systems.

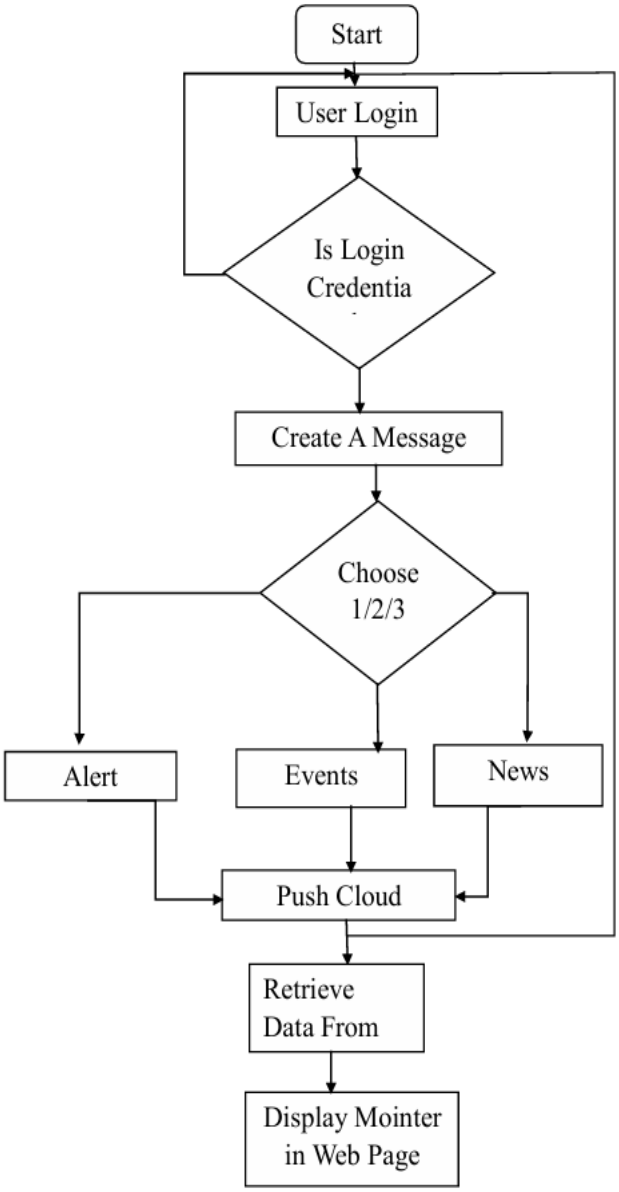

Fig 2: Flowchart of proposed system

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USER LOGIN

The User is the authorized person (admin/teacher/staff) responsible for creating and uploading notices. The user logs into the application to begin the notice creation process.

IS LOGIN CREDENTIAL CORRECT?

The system checks whether the entered login details are authenticated else does not allow to enter message

CREATE A MESSAGE

In this step, the user types the message they want to display on the notice board. The message may include:

- Title
- Description
- Important information
- Event details
- Alerts

This is the main content that will be displayed on the digital board. CHOOSE (1/2/3). This decision block asks the user to choose the category of the notice. The three categories are:

- Alert – Urgent or emergency messages
- Events – Information about upcoming programs or schedules
- News – General notices, updates, or announcements

Based on the selection, the flow goes to the appropriate branch.

ALERT / EVENTS / NEWS

These blocks represent the selected category of the message.

- Alert: High-priority messages
- Events: Notices related to programs, meetings, or activities
- News: Regular updates or announcements

This classification helps in organizing the display on the digital notice board.

PUSH CLOUD

After the message is finalized, it is uploaded to the cloud database (Firebase). This ensures that:

- The notice is stored securely
- It can be accessed by the ESP32 from anywhere
- Updates occur in real time

The cloud acts as the central communication medium.

RETRIEVE DATA FROM CLOUD

In this step, the ESP32 microcontroller continuously checks the cloud for new messages. When a new notice is found:

- ESP32 downloads it
- Converts it into a displayable format
- Sends it to the VGA circuit/monitor

This ensures instant updates on the digital board.

DISPLAY MONITOR IN WEB PAGE

This is the final output stage. The message uploaded by the user is shown on the digital notice board using ESP32

- VGA circuit and Monitor

Depending on the category chosen (Alert/Events/News), the display is organized accordingly.

IV. RESULTS AND DISCUSSION

The login page is the first screen the user interacts with when opening the digital notice board application. It contains two input fields—Username and Password—that authenticate the user before allowing access to notice-upload features. Only registered and authorized users such as teachers, administrators, or staff members can login. The interface includes the institution logo at the top, giving the app a professional and branded appearance. The user enters valid credentials and selects the Login button to proceed. A Signup button is also provided for new users to create an account. This ensures secure access to the notice uploading system and prevents unauthorized posting of messages. Overall, the login page successfully ensures privacy, authentication, and controlled usage of the digital notice board system.

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After logging in, the user is redirected to the notice upload screen. This page contains a Message Input Field, where the user can type any important update, alert, news, or event. The simple and clean design allows users to enter text easily. A Priority Dropdown Menu is provided to categorize the notice based on importance. The available priorities are:

Alert – For emergency or urgent notices
News – For general updates
Events – For scheduled programs or activities

The user can also upload an image related to the notice using the Pick Image button. After selecting the priority and message, the notice is uploaded to Firebase using the Upload Notice button. The result accurately reflects real-time notice creation with user-friendly controls.

When the user clicks on the priority dropdown, a priority selection popup appears with three radio button options—Alert, News, and Events. The popup uses a modern UI style that clearly highlights the selected option. The user can tap any of these options to categorize the notice accordingly. This feature ensures proper classification of notices so that the display system can organize and present content based on importance. The selection changes instantly, and the chosen priority is shown on the main screen. This result demonstrates the app's smooth UI interaction and correct functioning of the priority selection mechanism.

The final output of the Digital Notice Board system is displayed on the web interface, where all uploaded notices are categorized and presented in a clean, organized layout. The webpage is designed to show three major categories of messages: Alerts, News, and Upcoming Events. Each category is displayed inside a separate card-style container, making the information easy to read and visually appealing. At the top of the webpage, the header displays the institution name "K. S. School of Engineering & Management", ensuring identity and ownership of the notice board system. Beneath the header, the webpage is divided into horizontal sections.

1. Alerts Section

The first card displays all high-priority alert messages. The category title is shown with an alert icon, and below it, the message posted through the mobile application (e.g., "hello") appears clearly. Alert messages are shown in a highlighted style to draw attention.

2. News Section

The News section is placed next to Alerts. It displays regular campus updates or announcements. Similar to Alerts, the uploaded message is shown inside a card, ensuring visibility and easy reading.

3. Upcoming Events Section

This section shows scheduled events, programs, or meetings. It is placed in a separate wide card, allowing event information to be displayed clearly. The message added through the app appears instantly once uploaded.

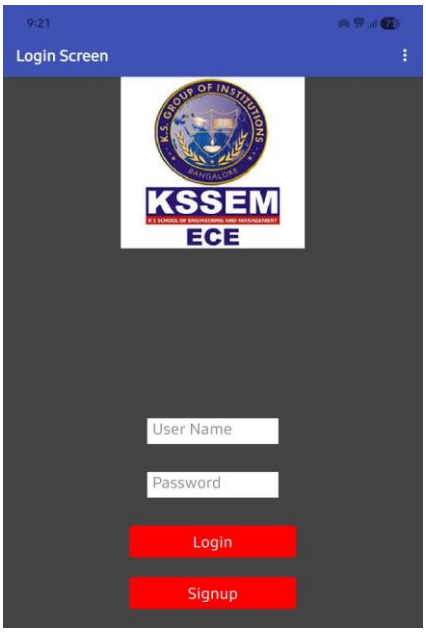

Fig 3: Login Page

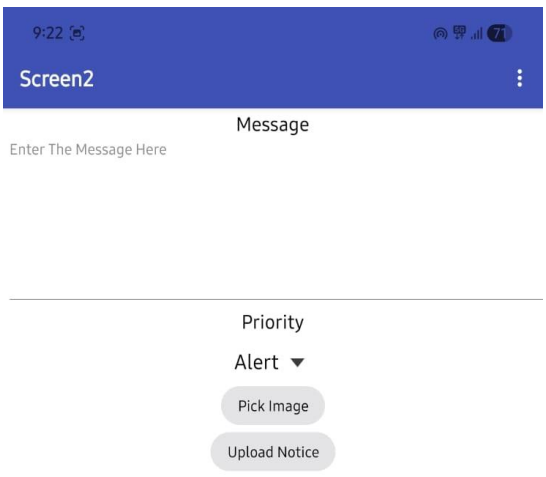

Fig 4: Updating Notices

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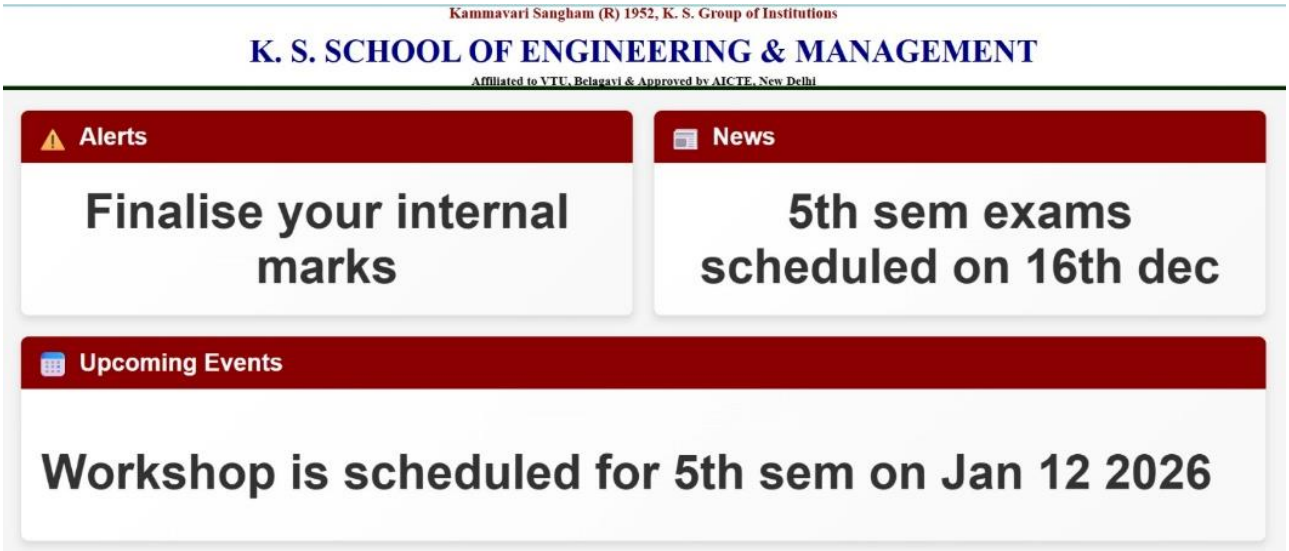

Fig 5: Web Page

V. CONCLUSION

The IoT-Based Digital Notice Board using ESP32 and cloud represents a significant step toward modernizing communication systems in educational institutions, offices, public places, and organizations that depend heavily on timely information sharing. Traditional notice boards require manual posting, frequent updates, physical presence, and continuous maintenance, making them inefficient and slow in environments where fast communication is essential. This project successfully addresses these challenges by creating a smart, automated, and real-time notice display system that leverages the power of IoT, cloud computing, and wireless technology. By integrating a mobile application, Firebase Realtime Database, and ESP32 microcontroller, the system enables users to send messages instantly from any location. The mobile app allows users to create, categorize, and schedule messages, which are then uploaded to the cloud.

Firebase ensures secure storage and immediate synchronization of data, enabling the ESP32 to retrieve new messages in real time. Once the message is fetched, the ESP32 processes it and sends the visual output to the VGA circuit, which displays the notice on a monitor. This seamless communication flow reduces human effort, eliminates delays, and ensures that the displayed information is always current and accurate. One of the major strengths of this system is its eco-friendly and paperless approach, reducing resource consumption and supporting sustainable practices. Additionally, the system is cost-effective, as it uses low-cost hardware components such as the ESP32 and a simple VGA circuit rather than expensive digital signage systems. Its flexibility allows users to display different types of content such as news, alerts, and events, making it adaptable to various real-world scenarios.

In conclusion, the IoT-Based Digital Notice Board provides a powerful, scalable, and reliable solution for modern communication requirements. It proves that integrating IoT and cloud technologies can transform traditional systems into intelligent infrastructures. With future advancements—such as multimedia support, LED/LCD integration, multi-screen synchronization, and enhanced security—the system has high potential to evolve into a full-fledged digital signage platform suitable for smart campuses, industries, and public information systems.

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