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Voice Based Notice Board

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Abstract- — In modern institutions and organizations, effective communication of information is essential, yet traditional notice boards often fail to provide timely updates and accessibility. This project presents a Voice-Based Notice Board system that leverages speech recognition and text-to-speech technologies to automate the process of publishing and delivering notices. The system allows authorized users to input notices through voice commands, which are then converted into text using speech-to-text processing. The processed information is stored in a cloud-based database and can be displayed on a digital screen as well as broadcasted through audio output using text-to-speech synthesis. The integration of Internet of Things (IoT) technology ensures real-time updates and remote accessibility. The proposed system is built using Raspberry Pi, along with a microphone module, speaker system, and display unit. Python is used as the primary programming language, incorporating various speech processing libraries for accurate voice recognition and natural audio output. This solution enhances accessibility, reduces manual effort, and ensures faster dissemination of information. It is particularly useful in environments such as educational institutions, offices, hospitals, and public spaces, where quick and efficient communication is crucial. The system also provides scope for future enhancements, including multilingual support and mobile application integration. Overall, the Voice-Based Notice Board offers a smart, efficient, and user-friendly alternative to traditional notice systems by combining automation, cloud computing, and voice interaction technologies.

Keywords— Voice Recognition, Speech-to-Text, Notice Board System, Digital Notice Board, Voice Command Interface, Audio Processing, Text Display Automation.

I. INTRODUCTION

In today's fast-paced digital world, the need for efficient and real-time communication systems has become increasingly important, especially in institutions such as colleges, offices, hospitals, and public spaces. Traditional notice boards, which rely on manual updates using printed papers, are often inefficient, time-consuming, and lack immediate accessibility. These limitations create a demand for smarter and more interactive solutions.

The Voice-Based Notice Board is an innovative system designed to modernize the way information is conveyed. This system utilizes speech recognition technology to allow users to input notices through voice commands. The spoken input is converted into text using speech-to-text processing and can be displayed on a digital screen. Additionally, the system uses text-to-speech technology to audibly announce the notices, ensuring accessibility for a wider audience, including visually impaired individuals.

The integration of Internet of Things (IoT) technology enables real-time updates and remote management of notices. The system is built using Raspberry Pi as the core processing unit, along with essential hardware components such as a microphone module, speaker system, and optional display unit. Software tools such as Python and cloud-based databases are used to manage data processing, storage, and communication. This project aims to provide a smart, automated, and user-friendly platform for notice dissemination. By reducing manual effort and enhancing communication efficiency, the Voice-Based Notice Board offers a practical solution to the limitations of conventional notice systems and contributes to the development of intelligent and accessible environments.

2. Objective

The primary objective of this project is to design and develop a Voice-Based Notice Board system that enables efficient, real-time, and automated communication using voice commands. The system aims to simplify the process of creating, updating, and delivering notices by integrating speech recognition and audio output technologies.

The specific objectives of the project are as follows:

- To develop a system that allows users to input notices using voice commands through speech-to-text conversion.
- To implement text-to-speech functionality for audible announcement of notices, improving accessibility for all users.
- To design a real-time notice updating mechanism using IoT and cloud-based technologies. To create an easy-to-use

admin interface for managing notices, users, and system operations.
- To reduce manual effort and eliminate dependency on traditional paper-based notice boards.
- To ensure reliable and efficient storage of notices using a cloud database.
- To provide a scalable system that can be extended with features like multilingual support and mobile integration.

Overall, the project aims to build a smart, user-friendly, and accessible notice management system that enhances communication efficiency in various environments such as educational institutions, offices, and public places.

3. Relevance

In the current era of digital transformation, the demand for smart and efficient communication systems has significantly increased. Traditional notice boards are limited in their ability to provide real-time updates and often require manual effort for posting and updating information. This makes them less effective in environments where timely communication is critical.

The Voice-Based Notice Board system is highly relevant as it addresses these limitations by introducing automation and voice interaction. By enabling users to input notices through voice commands, the system simplifies the process of information dissemination and reduces dependency on manual methods. The integration of speech-to-text and text-to-speech technologies ensures that notices are both visually displayed and audibly communicated, making the system more inclusive and accessible, especially for individuals with visual impairments.

Furthermore, the use of Internet of Things (IoT) and cloud-based storage enhances the system's capability to deliver real-time updates and remote access. This is particularly useful in institutions such as colleges, offices, hospitals, and public spaces, where instant communication is essential for smooth operations.

The relevance of this project also lies in its adaptability to modern technological trends, including automation, smart devices, and human-computer interaction. It provides a practical solution that aligns with the growing need for intelligent systems in everyday environments.

Overall, the Voice-Based Notice Board is a relevant and impactful innovation that improves communication efficiency, accessibility, and reliability in today's fast-paced world.

4. Motivation

The motivation behind developing the Voice-Based Notice Board system arises from the limitations and inefficiencies of traditional notice boards. In many institutions and organizations, notices are still communicated through paper-based methods, which are time-consuming, require manual effort, and are not always updated promptly. This often leads to miscommunication, delays, and lack of awareness among users.

With the rapid advancement of technology, especially in the fields of speech recognition, Internet of Things (IoT), and automation, there is a growing opportunity to improve how information is shared. The idea of controlling systems through voice commands has become increasingly popular due to its simplicity and convenience. This inspired the development of a system where notices can be created and managed using voice, making the process faster and more efficient.

Another key motivation is to enhance accessibility. Not all users can easily read visual displays, and a system that provides audio output ensures inclusivity for visually impaired individuals. By incorporating text-to-speech functionality, the system ensures that important information reaches a wider audience without barriers.

Additionally, the project is motivated by the need to reduce human effort and errors in managing notices, while also contributing to a paperless and eco-friendly environment. The integration of modern technologies into a practical application makes this project both innovative and beneficial for real-world use.

Overall, the Voice-Based Notice Board is motivated by the goal of creating a smarter, faster, and more accessible communication system that aligns with current technological advancements and user needs.

5. Scope

The scope of the Voice-Based Notice Board system focuses on developing a smart and efficient platform for creating, managing, and delivering notices using voice commands and automated technologies. The system is designed to be implemented in environments such as educational institutions, offices, hospitals, and public places where timely communication is essential.

The project includes features such as voice input for notice creation using speech-to-text conversion, storage of notices in a cloud-based database, and real-time display on a digital screen. Additionally, the system provides audio output through

text-to-speech technology, ensuring that notices are accessible to a wider audience, including visually impaired users.

The scope also covers the development of an admin interface for managing notices, scheduling announcements, and controlling user access. The integration of Internet of Things (IoT) enables remote operation and real-time updates, making the system more flexible and efficient.

However, the project is limited to basic voice recognition capabilities and may depend on internet connectivity for cloud services and accurate speech processing. Advanced features such as multilingual support, mobile application integration, and AI-based voice recognition improvements are considered beyond the current scope but can be implemented in future enhancements.

Overall, the project aims to provide a reliable, user-friendly, and scalable system that improves communication efficiency while laying the foundation for further advancements in voice-controlled and automated notice systems.

6. Organization of Report

- Chapter 2: Literature survey of Voice-Based Notice Board systems
- Chapter 3: System development (software and hardware details)
- Chapter 4: Implementation and results of the system
- Chapter 5: Conclusion, future scope, and applications
- Chapter 6: References
- Chapter 7: Appendices (datasheets, code, circuit diagrams, etc.)

II. LITERATURE SURVEY

A detailed study of existing digital notice board systems, smart display boards, and voice-enabled communication systems was carried out to understand the technologies, methodologies, advantages, and limitations of currently available solutions. Traditional notice boards require manual writing, printing, and frequent updating of notices, which is time-consuming and inefficient. To overcome these limitations, researchers have proposed various digital notice board systems using technologies such as Raspberry Pi, Arduino, IoT, Wi-Fi modules, GSM, Bluetooth, cloud computing, and mobile applications. Many of these systems allow authorized users to send notices remotely through smartphones, computers, or web applications, enabling faster communication and reducing paper consumption. IoT-based notice boards provide real-time updates and remote accessibility, making them suitable for educational institutions, offices, public places, and organizations. Some systems also incorporate audio output features to improve accessibility for visually impaired users.

Several researchers have further explored voice recognition technology in notice board applications. These systems use speech recognition algorithms to convert spoken words into text and display the generated message on a screen. Voice-controlled systems eliminate the need for manual typing and make the notice updating process faster and more convenient. However, many existing voice-based systems depend on continuous internet connectivity for speech processing, which can affect performance in areas with poor network availability. In addition, some systems have limitations in speech recognition accuracy, support only a limited vocabulary, or require complex hardware and software configurations. Most of the available digital notice boards focus primarily on wireless communication and remote notice transmission rather than direct voice-to-text notice generation.

From the literature survey, it is observed that there is a growing demand for intelligent and automated notice management systems that can provide quick, accurate, and user-friendly communication. Existing systems have successfully reduced manual effort but still face challenges such as dependency on internet services, manual text entry requirements, higher implementation costs, and limited accessibility for non-technical users. Therefore, there is a need for a system that combines the advantages of digital notice boards with speech recognition technology to provide a more efficient solution. The proposed Voice Based Notice Board addresses these limitations by using a Raspberry Pi, microphone, LCD display, and Python programming language to convert voice input directly into text and display the notice instantly. The system offers a simple, cost-effective, paperless, and user-friendly approach for real-time notice generation, making it suitable for educational institutions, offices, hospitals, and other public information display applications. This survey provides the foundation for the design and implementation of the proposed project and highlights the importance of integrating speech recognition technology into modern notice board systems.

A literature survey, also known as a literature review, is a critical and systematic study of existing research, publications, and technological developments related to a specific topic or project. It is an essential part of any research or project report, as it provides a strong theoretical foundation and helps in understanding the current state of knowledge in the chosen field.

The primary purpose of a literature survey is to identify, analyze, and summarize the work already done by researchers, engineers, and scholars. It helps in recognizing the strengths and limitations of existing systems, thereby allowing the developer to improve upon previous methods. By studying earlier research, one can avoid duplication of work and instead focus on innovation and enhancement.

A literature survey typically includes sources such as research papers, journals, books, conference proceedings, and reliable online resources. These sources provide insights into different methodologies, technologies, tools, and approaches used in similar systems. For example, in a voice-based notice board system, the literature survey would cover areas like speech recognition, cloud computing, IoT systems, and digital display technologies.

Another important role of the literature survey is to identify research gaps. These gaps represent areas where existing systems are lacking or where improvements can be made. Identifying such gaps helps in defining the objectives and scope of the project more clearly. It also justifies the need for the proposed system.

In addition, a literature survey helps in selecting appropriate technologies and methodologies for system development. By comparing different approaches, one can choose the most efficient, cost-effective, and reliable solution for implementation.

Overall, the literature survey acts as a bridge between existing knowledge and new development. It ensures that the project is based on well-established concepts while also contributing something new and useful to the field.

1. Voice-Controlled Information Systems

Voice-controlled information systems have gained significant importance with the advancement of speech recognition technologies and artificial intelligence. These systems enable users to interact with machines through spoken commands, eliminating the need for traditional input devices such as keyboards or touchscreens. Research shows that voice interfaces enhance accessibility, especially for physically challenged users and in environments where hands-free operation is necessary. Applications of such systems can be seen in smart homes, virtual assistants, and public information kiosks. In the context of a voice-based notice board, this technology allows users to update and retrieve notices using simple voice commands, making the system more efficient and user-friendly. However, challenges such as background noise, accent variation, and speech ambiguity still affect performance and require robust algorithms to handle them effectively.

2. Interactive Digital Notice Board Systems

The study's primary objective is to advance the field of information technologies by developing a Digital Signage-based system. This system is controlled via a web server and serves as a platform for displaying announcements, date, time, temperature on screens. Notably, the study introduces an innovative feature by incorporating interactive age classification. When individuals of a certain age group are identified using deep learning technology, a subset of machine learning, the system dynamically adjusts the font size on the screen accordingly. This age classification application achieved an impressive 79% accuracy rate in experimental testing.
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3. Speech Recognition Technologies

Speech recognition is a key component of voice-based systems, responsible for converting spoken language into text. Early systems relied on basic pattern recognition techniques, but modern solutions use advanced machine learning and deep learning models such as neural networks. These systems are trained on large datasets to improve accuracy and adaptability. There are two main types of speech recognition systems: offline (embedded) and online (cloud-based). Offline systems work without internet connectivity but have limited vocabulary and accuracy, while cloud-based systems offer higher accuracy and support for multiple languages. Factors affecting performance include noise levels, speaker variation, pronunciation, and microphone quality. Continuous improvements in speech recognition technology have made it feasible to integrate voice commands into real-time applications like notice boards.

4. Cloud-Based Voice Processing Systems

Cloud computing plays a crucial role in modern voice-based applications by providing scalable processing power and storage capabilities. In cloud-based voice processing systems, audio input is sent to remote servers where it is processed using advanced algorithms, and the results are sent back to the device. This approach reduces the computational burden on local hardware and allows the use of highly accurate speech recognition models. Cloud platforms also enable data storage, synchronization, and remote access, making it possible to manage notice boards from different locations. Additionally,

cloud integration allows for features such as automatic updates, analytics, and backup. Despite its advantages, cloud-based systems depend on internet connectivity and may face issues related to latency and data security.

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5. Natural Language Processing in Voice Assistants

Natural Language Processing (NLP) is a branch of artificial intelligence that focuses on enabling machines to understand and interpret human language. In voice-based systems, NLP is used to analyze the meaning and intent behind spoken commands rather than just converting speech into text. This allows the system to respond more intelligently and perform appropriate actions. For example, in a voice-based notice board, NLP can help differentiate between commands like "add notice," "delete notice," or "display notice." Advanced NLP techniques include tokenization, sentiment analysis, and intent recognition. Research in this field has significantly improved the interaction between humans and machines, making voice interfaces more natural and effective. However, handling complex sentences and multiple languages remains a challenge.

6. IoT-Based Smart Notice Board Systems

The integration of the Internet of Things (IoT) has transformed traditional systems into smart and connected devices. IoT-based notice boards use microcontrollers and communication modules to receive and display information from remote sources. These systems can be controlled through mobile applications, web interfaces, or cloud platforms. The use of IoT enables real-time updates, remote monitoring, and automation. In a voice-based notice board, IoT acts as a bridge between the voice input system and the display unit, ensuring seamless data transmission. Research indicates that IoT-based systems improve efficiency, reduce manual effort, and provide better scalability. However, they require proper network infrastructure and security measures to prevent unauthorized access.

7. Real-Time Audio Notification Systems

Real-time audio notification systems are designed to deliver immediate alerts and announcements to users. These systems are widely used in public places such as railway stations, airports, and educational institutions. They ensure that important information is communicated quickly and effectively. In a voice-based notice board, real-time processing allows the system to instantly convert spoken input into displayed messages. This reduces delays and ensures that notices are updated without manual intervention. Studies show that combining audio input with visual output enhances communication efficiency. Challenges in such systems include maintaining low latency, ensuring accuracy, and handling continuous input streams.

8. Study of Voice-Based Interfaces for Public Display Systems

Voice-based interfaces are increasingly being used in public display systems to improve user interaction. These interfaces allow users to control and access information through simple voice commands, making them ideal for environments where traditional input methods are inconvenient. Research highlights that voice interfaces enhance usability, especially in crowded or hands-busy situations. They also provide better accessibility for elderly and disabled individuals. In the context of public notice boards, voice interfaces enable quick updates and easy access to information. However, issues such as environmental noise, privacy concerns, and system reliability need to be addressed for widespread adoption.

III. METHODOLOGY

The methodology of a Voice-Based Notice Board explains the complete working process of the system from capturing a user's voice to displaying the message on the notice board. When the system is powered on, all the hardware components such as the microcontroller (like ESP32 or Arduino), display unit, and communication modules are initialized. The display initially shows a default message indicating that the system is ready to receive input.

The process begins when the user provides a voice command through a mobile application or a connected microphone. This voice input is then captured and sent to a speech recognition system, where it is converted into text using a speech-to-text technology. This conversion can be performed using cloud-based services such as Google Speech API or through the voice recognition feature available in smartphones or through microphone. The accuracy of this step is important because the final displayed message depends on how correctly the speech is interpreted.

Once the voice is converted into text, the message is transmitted to the microcontroller using wireless communication such as Wi-Fi or Bluetooth. In IoT-based systems, platforms like Blynk or Firebase may be used to send the data efficiently. The microcontroller receives this text data and processes it by checking for errors, formatting issues, or unwanted characters. After validation, the message is stored temporarily in the system memory.

The processed message is then sent to the display unit, which can be an LCD or LED matrix. Depending on the length of the message, it is displayed either as a static message or in a scrolling format. This allows longer notices to be shown clearly without losing readability. The display updates automatically

whenever a new voice command is received, ensuring that the notice board always shows the latest information.

The system continues to operate in a loop, constantly monitoring for new voice inputs. If a new message is received, it replaces the previous one or gets updated accordingly. In case of errors such as unclear voice input or network failure, the system handles them by prompting for a retry or displaying an error message like "Network Error." This ensures reliable and continuous operation of the voice-based notice board system.

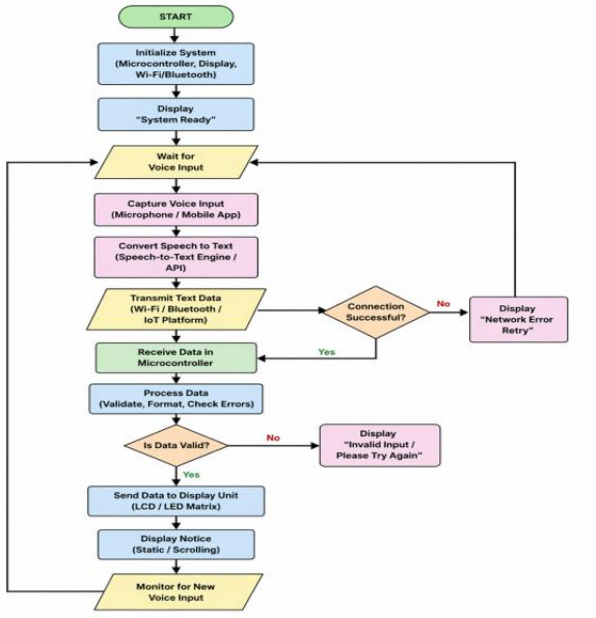

Figure 1 System Flowchart

1. Admin Operations
Voice Notice Management

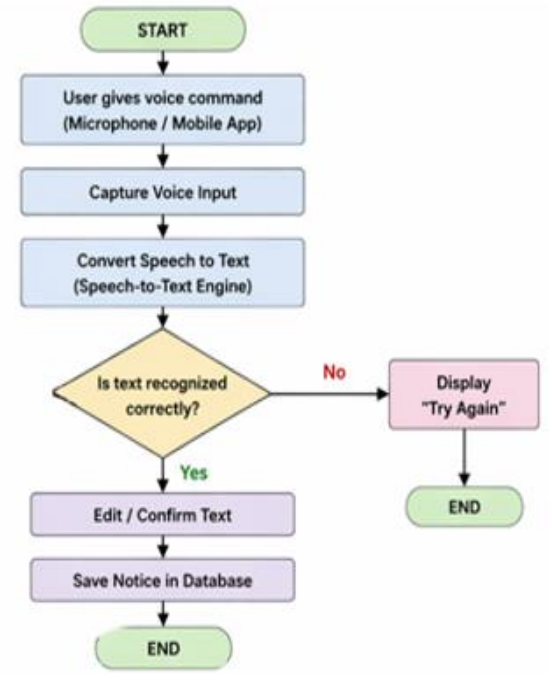

Figure 2 voice notice management

Voice Notice Management is a crucial module of the voice-based notice board system that focuses on capturing, processing, and storing user-provided voice inputs in the form of notices. This module eliminates the need for manual typing by allowing users to generate notices through simple voice commands, thereby making the system more user-friendly and efficient.

The process begins when the user provides a voice input through a microphone or a mobile application integrated with the system. This voice signal is captured and forwarded to a speech-to-text conversion system. The speech-to-text engine, which may be based on cloud services such as Google Speech API or embedded voice recognition systems, converts the spoken words into textual data. The accuracy of this conversion plays a vital role in ensuring the correctness of the displayed notice.

Once the speech is converted into text, the system verifies whether the conversion is successful and meaningful.

If the system fails to recognize the input correctly due to noise, unclear pronunciation, or connectivity issues, it generates an error message and prompts the user to repeat the command. This error-handling mechanism improves system reliability and usability.

After successful conversion, the generated text is presented to the user for confirmation or editing. This step ensures that any errors in recognition can be corrected before the notice is finalized. Once confirmed, the notice is stored in the system database or memory. This stored data can later be retrieved and displayed on the notice board.

Overall, the Voice Notice Management module enhances efficiency, reduces human effort, and provides a fast and convenient way to create notices, making it a key component of the system.

Notice Board Management

Notice Board Management is responsible for handling the display and continuous updating of notices on the electronic notice board. This module ensures that the information provided by the user is effectively presented to the intended audience in a clear and timely manner.

The process begins with retrieving the stored notice data from the system database or memory. Once the data is retrieved, it is sent to the display unit, which may be an LCD display, LED matrix, or any other suitable output device. The display unit is controlled by a microcontroller, which formats and sends the data in a way that can be easily visualized.

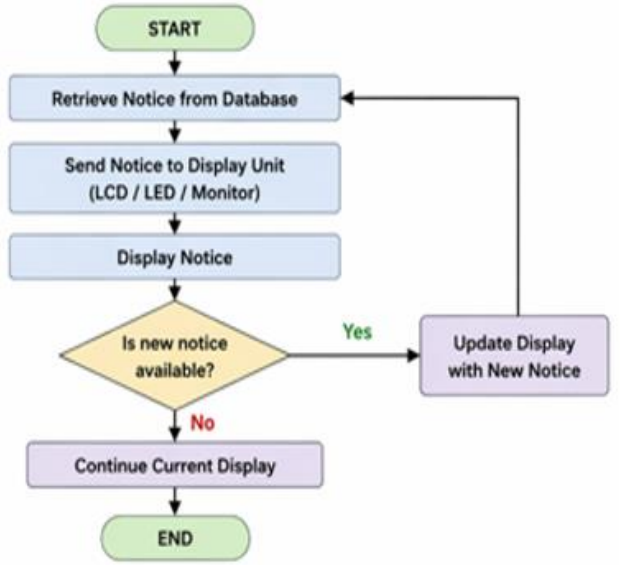

Figure 3. Notice Board Management

The notice is then displayed either as static text or scrolling text, depending on its length and display size. Scrolling text is particularly useful for displaying longer messages on limited screen space. The system ensures proper formatting, readability, and alignment of the text to enhance user experience.

A key feature of this module is its ability to continuously monitor for new notices. The system operates in a loop, checking whether any new notice has been added or updated. If a new notice is available, the display is automatically refreshed to show the latest information. If no new notice is present, the current notice continues to be displayed without interruption.

This real-time updating capability makes the system highly efficient and reliable for environments such as colleges, offices, and public places where timely communication is essential. The Notice Board Management module thus ensures smooth, continuous, and accurate dissemination of information.

User Access Control

User Access Control is an important security module of the voice-based notice board system that ensures only authorized users can access and manage the system. This module protects the system from unauthorized usage and maintains the integrity and confidentiality of the information.

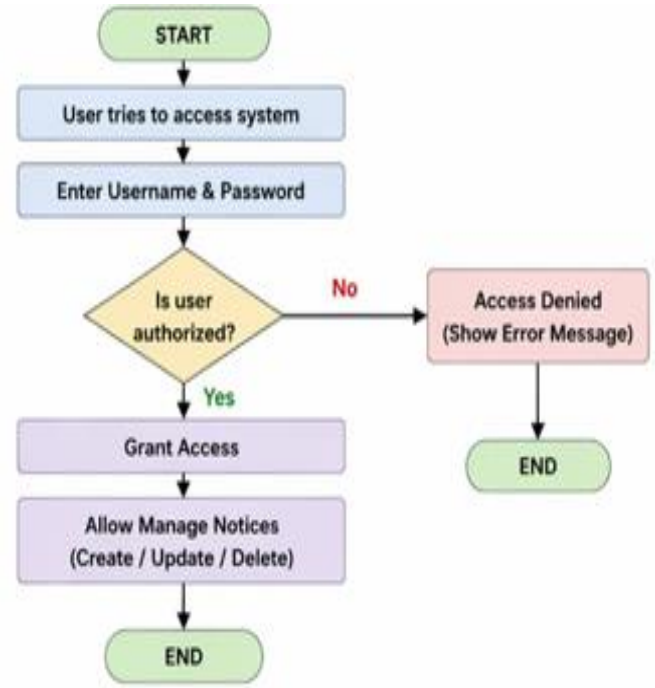

Figure 4 User Access Control

The process starts when a user attempts to access the system. The user is required to provide valid login credentials, typically in the form of a username and password. These credentials are

entered through a user interface, which may be a mobile application or a web-based platform connected to the system.

Once the credentials are submitted, the system verifies them against the stored data in the database. This authentication process determines whether the user is authorized to access the system. If the credentials are incorrect or do not match the stored records, access is denied, and an error message is displayed. This prevents unauthorized users from modifying or viewing sensitive information.

If the user is successfully authenticated, access is granted, and the user is allowed to perform various operations such as creating new notices, updating existing ones, or deleting outdated information.

Different levels of access can also be implemented, where some users may have full control while others may have limited permissions.

This module plays a critical role in maintaining system security, preventing misuse, and ensuring that only trusted individuals can manage the notice board content. By implementing proper authentication and authorization mechanisms, the system achieves a high level of reliability and data protection.

2. Voice Processing Algorithm

Speech-to-Text Conversion

Speech-to-Text Conversion is a fundamental module of the voice-based notice board system that enables the transformation of spoken language into written text. This module acts as the bridge between human interaction and digital processing, allowing users to input notices through voice rather than typing.

The process begins when the user speaks a message through a microphone or a mobile device. The system captures this voice input in the form of an analog audio signal. This signal is then converted into a digital format so that it can be processed by the system. Before actual conversion, the audio signal may undergo preprocessing techniques such as noise reduction, filtering, and normalization to improve clarity and accuracy.

Once the audio signal is processed, it is passed to a Speech-to-Text (STT) engine. This engine may be implemented using cloud-based services such as Google Speech API or embedded algorithms within the system.

The STT engine analyzes the audio using techniques like pattern recognition, acoustic modeling, and language modeling to convert spoken words into corresponding text.

After conversion, the system verifies whether the generated text accurately represents the spoken input.

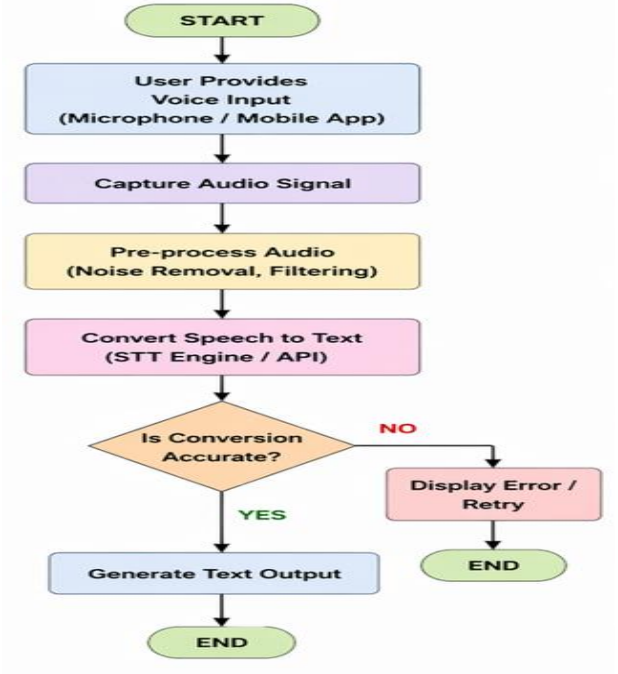

Figure 5. Speech-to-Text Conversion

Text Processing and Storage

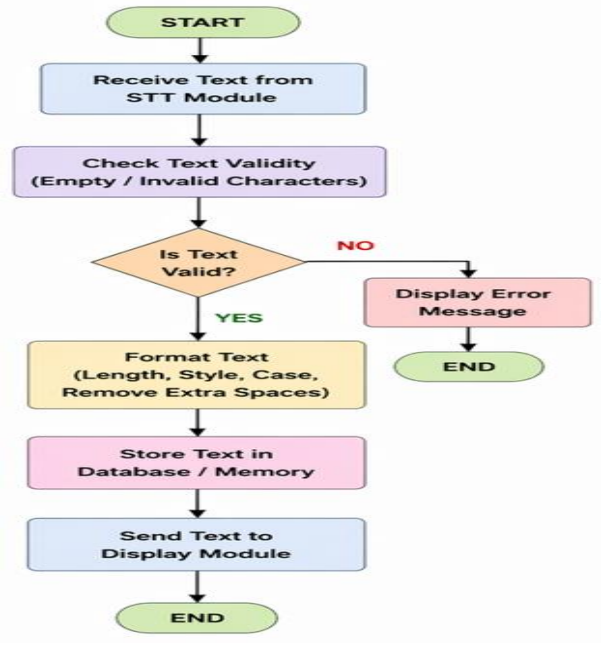

Figure 6 Text Processing and Storage

Text Processing and Storage is an essential module of the voice-based notice board system that ensures the proper handling, formatting, and storage of the text generated from speech input. This module acts as an intermediate stage between speech conversion and final display, ensuring that the data is accurate, organized, and ready for presentation.

The process begins when the text output from the Speech-to-Text module is received by the system. This text is first checked for validity, which includes verifying that it is not empty, does not contain invalid characters, and meets the required format constraints. This validation step ensures that only meaningful and correct data is processed further.

If the text is found to be invalid, the system generates an error message and may request the user to provide input again. If the text is valid, it proceeds to the formatting stage. In this stage, the text may be modified to fit the display requirements, such as adjusting length, adding scrolling features, converting case (uppercase/lowercase), or removing unnecessary spaces and symbols.

IV. SYSTEM DEVELOPMENT

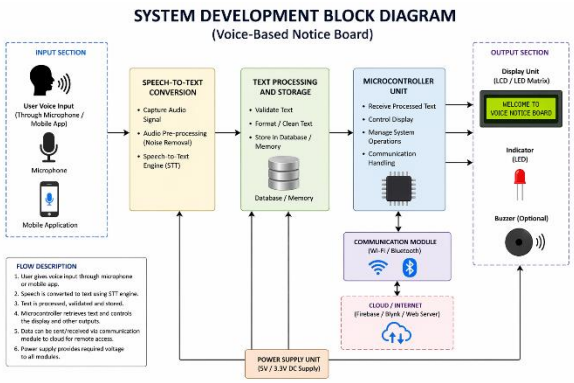

Figure 7 Block Diagram

1. Hardware

Microphone Module

The microphone module is a vital input component of the voice-based notice board system, responsible for capturing the user's voice and converting it into an electrical signal for further processing. It acts as the primary interface between the user and the system, enabling voice-based interaction.

A microphone works on the principle of converting sound waves into electrical signals. When a user speaks, sound waves create vibrations in the air, which are detected by the microphone diaphragm.

These vibrations are then converted into analog electrical signals. In most practical implementations, an electret condenser microphone is used due to its small size, low cost, and high sensitivity.

Figure 8 microphone

The raw output from the microphone is typically very weak and contains noise. Therefore, the microphone module includes an amplifier circuit to increase the signal strength. Additionally, filtering circuits may be used to remove background noise and improve signal clarity. Some advanced modules also include Automatic Gain Control (AGC), which adjusts the signal level dynamically for better performance.

The analog signal generated by the microphone is either sent directly to the microcontroller (if it supports analog input processing) or to an external processing unit such as a smartphone or cloud-based service. In systems using IoT, the audio may be transmitted to a server where speech recognition is performed.

The performance of the microphone module directly affects the accuracy of speech recognition. Factors such as ambient noise, distance from the speaker, and microphone sensitivity play an important role. Hence, proper placement and selection of the microphone are crucial for achieving reliable system performance.

LCD Display

The LED or LCD display is the primary output component of the voice-based notice board system, responsible for presenting the processed information in a human-readable format. It visually communicates the notices generated from voice input to the intended users.

LCD (Liquid Crystal Display) and LED (Light Emitting Diode) displays are commonly used in such systems. An LCD operates

by controlling light through liquid crystals and is known for its low power consumption and compact design. It is suitable for displaying short and static messages. On the other hand, LED displays, especially LED matrix displays, are capable of showing dynamic and scrolling text, making them ideal for displaying longer notices in a limited space.

The display unit is interfaced with the microcontroller, which sends data in the form of digital signals. The microcontroller controls the content, format, and timing of the display. For long messages, scrolling techniques are used to ensure that the entire text is visible within the display area. Brightness control may also be implemented to ensure visibility in different lighting conditions.

LED displays are generally preferred in public places due to their high brightness and long-distance visibility, whereas LCDs are suitable for indoor applications with moderate visibility requirements. The display module must be carefully selected based on factors such as size, resolution, power consumption, and application environment.

Overall, the display module plays a crucial role in delivering information effectively and ensuring that the system fulfills its purpose as a notice board.

Figure 9 LED Display

Microcontroller

The Raspberry Pi is a revolutionized, credit-card-sized single-board computer originally created by the UK-based Raspberry Pi Foundation to advance education in basic computer science and programming. Operating essentially like a standard desktop PC when plugged into a monitor, keyboard, and mouse, this ultra-affordable device runs on open-source Linux operating systems, with the custom-tailored Raspberry Pi OS serving as its official platform. Over the years, the hardware has rapidly evolved from a modest education tool into a powerhouse line of computers, exemplified by the latest flagship Raspberry Pi models which boast high-performance 64-bit multi-core ARM processors, up to 16GB of fast LPDDR4X RAM, and dual-display 4K video support. What truly sets the Raspberry Pi apart from traditional PCs is its built-in row of General Purpose Input/Output (GPIO) pins, which allow users to physically wire the computer directly to external electronic components like sensors, motors, relays, and LED screens.

This unique intersection of traditional computing power and hardware-level electronic control has spawned a massive global community of makers, hobbyists, and industrial engineers.

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Figure 10 Microcontroller

Power Supply

The power supply module is responsible for providing the required electrical energy to all components of the voice-based notice board system. It ensures stable and uninterrupted operation by delivering a regulated voltage to each module.

Most electronic components in the system operate on low DC voltage levels, typically 5V or 3.3V. The power supply may be derived from AC mains using an adapter, or from batteries in portable systems. A voltage regulator is used to maintain a constant output voltage, even when there are fluctuations in the input supply.

The power supply circuit may include components such as transformers (in AC systems), rectifiers, filters, and voltage regulators. These components work together to convert high-

voltage AC into low-voltage DC and ensure smooth and stable power delivery.

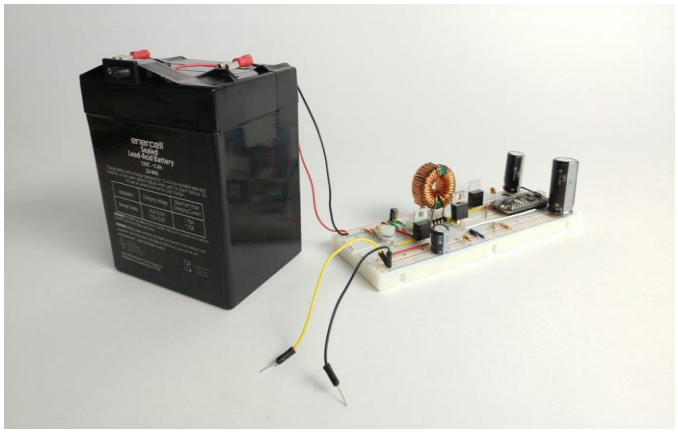

Figure 11 power supply

A stable power supply is critical for the proper functioning of the system. Voltage fluctuations can lead to malfunctioning of components, data loss, or even permanent damage. Therefore, proper design and protection mechanisms such as overvoltage protection and short-circuit protection are important.

In advanced systems, backup power sources such as rechargeable batteries or UPS systems may be used to ensure continuous operation during power failures. This enhances system reliability and makes it suitable for real-time applications.

User Devices

User devices are external devices that interact with the voice-based notice board system and provide an interface for users to input and manage notices. These devices typically include smartphones, tablets, or computers.

In most implementations, a smartphone is used as the primary user device. The user speaks a message into the smartphone using a mobile application or voice assistant such as Google Assistant. The voice input is then converted into text using built-in speech recognition features or cloud-based services.

The processed text is transmitted to the notice board system via communication technologies such as Wi-Fi or Bluetooth. User devices may also provide additional functionalities such as editing messages, scheduling notices, and monitoring system status.

These devices play a significant role in enhancing the usability and flexibility of the system. They allow users to interact with the system remotely, eliminating the need for physical presence near the notice board. This is particularly useful in applications such as colleges, offices, and public information systems.

Furthermore, user devices can be integrated with cloud platforms, enabling centralized control and management of multiple notice boards. This makes the system scalable and suitable for large-scale deployments.

2. Software

Speech Recognition Libraries

Speech Recognition Libraries are essential software components that enable the conversion of spoken language into text. In the voice-based notice board system, these libraries play a crucial role in understanding and interpreting the user's voice commands accurately.

These libraries use advanced algorithms based on digital signal processing, machine learning, and natural language processing to analyze speech patterns. When a user speaks, the audio input is captured and processed through various stages such as noise filtering, feature extraction, and pattern matching. The system then compares the processed input with pre-trained language models to generate the corresponding text output.

Popular speech recognition libraries include Google Speech API, CMU Sphinx, and Microsoft Azure Speech SDK. Among these, cloud-based solutions like Google Speech API provide higher accuracy due to continuous learning and large datasets, whereas offline libraries like CMU Sphinx are useful in environments without internet connectivity.

These libraries support multiple languages, accents, and speech variations, making them suitable for diverse user environments. However, their performance depends on factors such as background noise, microphone quality, and internet speed (for cloud-based systems).

In the voice-based notice board system, the speech recognition library ensures seamless and efficient conversion of voice commands into text, thereby forming the backbone of the system's input mechanism.

Text-to-Speech Engine

A Text-to-Speech (TTS) Engine is a software component that converts written text into spoken audio output. Although the primary function of the voice-based notice board is to display text, the inclusion of a TTS engine enhances the system by providing audio feedback or announcements.

The TTS engine processes text input and generates corresponding speech using techniques such as concatenative

synthesis, formant synthesis, or neural network-based synthesis. Modern TTS systems use deep learning models to produce natural and human-like speech.

Popular TTS engines include Google Text-to-Speech, Amazon Polly, and Microsoft Azure Text to Speech. These platforms offer high-quality voice output, multiple language support, and customization options such as voice tone, speed, and pitch.

In the system, once the text notice is generated and stored, the TTS engine can be used to read the notice aloud through a speaker or buzzer. This feature is particularly useful for accessibility, helping visually impaired users or enabling announcements in public spaces.

The integration of a TTS engine improves user interaction, enhances accessibility, and makes the system more dynamic and interactive.

Internet Connectivity

The Internet is a vast network that connects millions of private, public, academic, business, and government networks. It enables communication and data exchange between devices worldwide.

The Internet is built on a set of protocols, with the Transmission Control Protocol (TCP) and the Internet Protocol (IP) being fundamental. This combination is often referred to as TCP/IP.
As we are using ethernet to connect out system it is defined as: Ethernet is a family of wired networking technologies that define how data is transmitted over a local area network (LAN). It uses a protocol that controls how data packets are placed on the network. Ethernet cables typically use the RJ45 connector and are commonly used to connect devices such as computers, routers, and Raspberry Pi to a local network.

Connecting Raspberry Pi to the Internet via Ethernet

To connect a Raspberry Pi to the Internet using Ethernet, you typically need an Ethernet cable and a network with an available port. Plug one end of the Ethernet cable into the Raspberry Pi's Ethernet port and the other end into an available port on your router or network switch. Ensure that your router is properly configured to assign an IP addres to the Raspberry Pi through DHCP, or you can set a static IP address on the Raspberry Pi.

Mobile Application

The mobile application serves as the user interface for interacting with the voice-based notice board system. It allows users to input voice commands, manage notices, and control system operations conveniently from their smartphones.

The application typically integrates speech recognition features, enabling users to speak their message directly into the app. The app then converts the speech into text using built-in or cloud-based speech recognition services. After processing, the text is transmitted to the notice board system via internet connectivity.

Popular platforms used for mobile app development include Android Studio, MIT App Inventor, and Flutter. These tools provide user-friendly interfaces and support rapid development of applications.

The mobile app may also include additional features such as:

- Editing and deleting notices
- Scheduling messages
- Viewing previous notices
- User authentication and access control

By using a mobile application, the system becomes more user-friendly and accessible. It eliminates the need for physical interaction with the notice board and enables remote operation, making it suitable for moto the Raspberry Pi through DHCP, or you can set a static IP address on the Raspberry Pi.

Datasheet

Sr. No	Component/Software	Specifications	Function
1	Raspberry Pi 4 Model B	Quad-Core Cortex-A72 1.5 GHz Processor, 4GB RAM, 5V Supply, Wi-Fi & Bluetooth	Main controller for processing voice input and controlling display
2	USB Microphone	USB Interface, 20 Hz–20 kHz Frequency Range, High Sensitivity	Captures voice commands from user
3	16×2 LCD Display	16 Characters × 2 Lines, 5V Operating Voltage	Displays notice message in text format
4	Power Supply	5V, 3A USB-C Adapter	Provides power to Raspberry Pi and peripherals
5	Python 3.x	High-Level Programming	Used for coding and

		Language	system control
6	Speech Recognition Library	Python-based Speech-to-Text Library	Converts voice input into text
7	Raspberry Pi OS	Linux-Based Operating System	Provides platform for project execution
8	Internet Connection	Wi-Fi Network	Supports online speech recognition services
9	Voice Based Notice Board System	Speech Recognition Technology	Displays notices automatically through voice commands through voice commands

Summary

Summary

The Voice-Based Notice Board system is an advanced and innovative solution designed to simplify the process of displaying notices using voice commands. The primary objective of this project is to eliminate the need for manual typing and physical notice boards by introducing a smart and automated communication system.

The system integrates both hardware and software components to achieve seamless functionality. The hardware includes modules such as a microphone, microcontroller (ESP32/Arduino), display unit (LCD/LED), and power supply. The software components include speech recognition libraries, text processing modules, and mobile applications. These components work together to convert voice input into text and display it on the notice board in real time.

The working of the system begins with the user providing a voice command through a microphone or mobile application. This voice input is processed using speech recognition technology, which converts it into text. The text is then validated, formatted, and stored in the system. Finally, the processed message is displayed on the notice board using an LCD or LED display.

One of the key advantages of this system is its ability to provide real-time updates, making it highly efficient for environments such as educational institutions, offices, and public places. It reduces human effort, minimizes errors, and ensures faster communication. Additionally, the system can be accessed remotely using internet connectivity, making it flexible and scalable.

Overall, the Voice-Based Notice Board system demonstrates the effective use of IoT and speech recognition technologies to develop a smart communication solution that is user-friendly, efficient, and reliable.

Application

The Voice-Based Notice Board system has a wide range of applications across various fields due to its ease of use, automation, and real-time communication capabilities.

In educational institutions such as schools, colleges, and universities, the system can be used to display important announcements, exam schedules, and event notifications. Faculty members can update notices quickly using voice commands without needing to manually write or type them.

In offices and corporate environments, the system can be used for internal communication, meeting reminders, and important updates. It improves efficiency by allowing quick dissemination of information to employees.

In public places such as railway stations, airports, hospitals, and shopping malls, the system can be used to display announcements and alerts. When integrated with a text-to-speech system, it can also provide audio announcements, improving accessibility for visually impaired individuals.

In industrial environments, the system can be used to display safety instructions, warnings, and operational updates. It ensures that workers receive important information instantly.

The system can also be used in smart homes and smart cities as part of IoT-based communication systems. It can be integrated with other smart devices to create a fully automated environment.

Overall, the Voice-Based Notice Board system is versatile and can be implemented in any environment where fast and efficient communication is required.

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