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VOICE-BASED EMAIL FOR VISUALLY CHALLENGED

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Abstract: Email has become a vital tool due to the growing reliance on digital communication, but because traditional email systems rely on graphical user interfaces and keyboard inputs, visually impaired people experience considerable challenges while utilizing them. The Voice-Based Email System shown in this research allows visually impaired users to send, receive, and navigate emails using only voice instructions. The system creates an accessible and user-friendly communication environment through the employment of Interactive Voice Response (IVR), Text-to-Speech (TTS), and Speech- to-Text (STT) technologies. The system, which is implemented in Python and makes use of modules like SpeechRecognition, Pyttsx3, SMTPLIB, and IMAPLIB, guarantees independence, lessens cognitive strain, and improves digital inclusivity for users who are visually impaired.

Keywords: Voice-based email, Speech-to- Text, Text-to-Speech, IVR, Accessibility,Visually impaired users, Assistive technology.

I. INTRODUCTION

Email communication has become essential to modern life since it makes information sharing easy. However, because typical email systems rely on visual cues, screen navigation, and keyboard-based inputs, visually challenged people have difficulty utilizing them. Despite the availability of assistive devices, such as screen readers, many visually impaired people still rely on others for digital communication since they have steep learning curves.

To remove these obstacles, this proposal suggests a voice-based email system. The system provides total accessibility, independence, and usability by utilizing speech commands for all email functions, including writing, sending, reading, and managing messages.

Implemented in Python with packages that allow for email automation and speech processing, the solution combines STT, TTS, and IVR technologies.

1. Objectives:

- To develop a fully voice-controlled email system that enables visually impaired users to send, receive, and manage emails independently.
- To integrate Speech-to-Text (STT) and Text-to-Speech (TTS) technologies for accurate voice input and natural audio feedback.
- To reduce reliance on keyboards, screens, and assistive devices by enabling complete hands-free email interaction.
- To improve accessibility and digital inclusivity by simplifying email operations through intuitive voice commands.
- To provide real-time audio guidance and confirmations using IVR, ensuring a smooth and error- free user experience.

II. LITERATURE SURVEY

[1] Several researchers have explored the use of **voice-based technologies** to improve email accessibility for visually impaired users. Chavare and Ketkale (2022) highlighted **Text-to-Speech (TTS)** as a core component in voice-based email systems, enabling users to listen to email content, subject lines, and interface elements without visual assistance. Their study emphasizes the importance of natural language processing (NLP) in generating human-like voice outputs and supporting multilingual communication.

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[2] Rajole and Phursule (2023) focused on the role of **context-aware TTS**, which provides real-time and continuous audio feedback during user interactions. Their work demonstrated that reducing latency between user commands and speech output significantly improves usability and user satisfaction. The study also compared traditional screen readers with integrated TTS systems, concluding that voice-based email applications offer more efficient navigation.

[3] Sharma et al. (2024) examined the evolution of TTS using **speech synthesis and neural network models**. Their research implemented Python-based libraries such as **pyttsx3** and **playsound** to deliver natural-sounding speech for email reading, navigation prompts, and task confirmations. The results indicated that voice feedback eliminates dependence on visual cues and enhances user independence.

[4] Noel (2024) discussed the integration of **Web Speech API** in voice-based email platforms, enabling functionalities such as email composition verification, navigation assistance, and auditory confirmation of user actions. The study highlighted that TTS-driven interfaces reduce errors and improve interaction accuracy for visually impaired users.

[5] In addition to TTS, **Interactive Voice Response (IVR)** systems play a vital role in guiding users through email functionalities. Chavare and Ketkale (2022) demonstrated that IVR provides structured voice prompts and confirmations, simplifying tasks such as composing, reading, and deleting emails. This approach minimizes user confusion and ensures accessibility without graphical interfaces.

[6] Rajole and Phursule (2023) further emphasized **keyword-based IVR navigation**, where users issue voice commands such as "Compose Mail" or "Read Inbox." Their research showed that combining IVR with **Speech-to-Text (STT)** and TTS technologies creates a seamless voice-driven environment, allowing independent email management.

[7] Sharma et al. (2024) analyzed IVR systems with predefined menus and real-time voice feedback, enabling visually impaired users to perform complex email operations such as searching and filtering emails. The study confirmed that IVR significantly reduces cognitive load and improves task completion time.

[8] Additional studies by **Kumar et al. (2021)** and **Patil et al. (2020)** explored accessibility-focused voice interfaces and concluded that voice-controlled email systems improve digital inclusion by eliminating reliance on keyboards, mice, and visual displays. Their findings support the integration of AI-driven voice assistants in assistive communication tools.

III. SYSTEM REQUIREMENTS

1. Hardware Requirements

Input Devices

- **Microphone (External or Built- in):**

Required for capturing voice commands clearly. A noise- c a n c e l i n g m i c r o p h o n e i s recommended for optimal speech recognition accuracy.

Output Devices

Speakers/Headphones:

Used to deliver audio output from the Text-to-Speech engine, system prompts, and read-out email content.

Processing Unit

- **Minimum CPU:** Dual- core processor
- **Recommended CPU:** Intel i5 / AMD Ryzen 5 or higher

Provides smooth handling of speech processing and real-time responses.

Memory & Storage

- **RAM:** Minimum 4 GB (8 GB recommended)
- **Storage:** At least 200 MB of free disk space for Python, libraries, and dependent modules.

Network Requirements

- **Stable Internet Connection:** Required for accessing SMTP/ IMAP servers, using cloud-based speech recognition (if selected), and performing email operations.

2. Software Requirements

Operating System

- Windows 10 or newer

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- Linux distributions (Ubuntu, Mint, Fedora)
- macOS

Programming Environment

- **Python 3.x** (3.7 or above preferred)

Python Libraries & Dependencies

- **SpeechRecognition:**

For converting spoken input into text.

- **PyAudio:**

Captures microphone input; essential for real-time speech acquisition.

- **Pyttsx3:**

Provides offline text-to-speech synthesis.

- **SMTPLIB:**

Handles email sending via SMTP protocol.

- **IMAPLIB:**

Fetches and processes incoming emails from IMAP server.

- **Email & MIME Libraries:**

For constructing messages, formatting subjects, and handling attachments (if extended).

Email Server Requirements

- **SMTP Server:** smtp.gmail.com
- **IMAP Server:** imap.gmail.com
- Account must have:
  - IMAP access enabled
  - App-specific password (if 2-factor authentication is ON)

Additional Utilities

- Updated browser drivers if Selenium is used (optional)
- Latest security permissions for microphone access

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- Latest security permissions for microphone access

IV. SYSTEM ARCHITECTURE

The Voice-Based Email System follows a modular, layered architecture designed for reliability, accessibility, and ease of expansion. The architecture combines voice processing, email handling, and interactive guidance to deliver a seamless user experience for visually impaired users.Input layer: The input layer handles user interaction via a Streamlit interface, where users provide a text prompt describing the desired video concept. This layer serves as the starting point of the pipeline, capturing the requirements and context for the subsequent layers.

Components

- **Speech Input Module**

Captures user's voice commands using microphone input.

- **Speech-to-Text (STT) Engine**

Converts spoken commands into text using SpeechRecognition.

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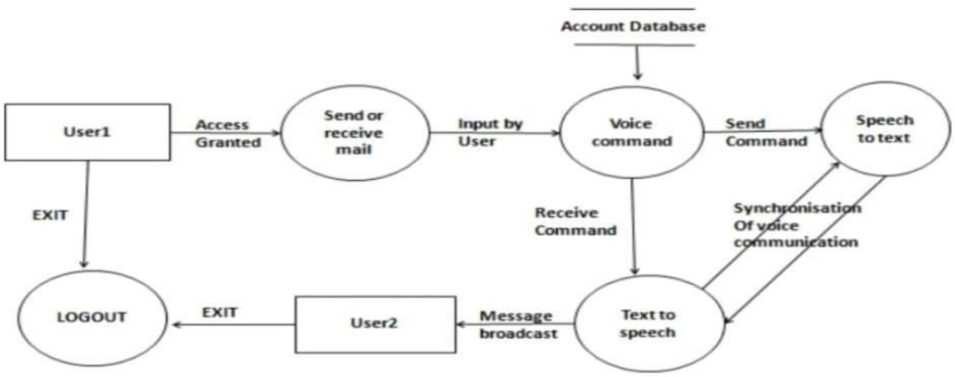

System Architecture

Fig .1 System Architecture

- **Processing Engine**
  - Detects commands such as "compose mail," "read inbox," etc.
  - Uses SMTP for sending mails and IMAP for reading mails.
  - Handles authentication, message formatting, inbox retrieval.

1. **Text-to-Speech (TTS) Engine** Converts email content and system messages into speech using Pyttsx3.

2. **IVR Guidance Layer**

Provides audio prompts so the user is guided throughout the process.

Architecture Flow

1. User speaks a command
2. Voice is converted to text
3. System identifies requested operation
4. Performs SMTP/IMAP action
5. Outputs results via TTS

V. IMPLEMENTATION DETAILS

Speech Recognition

- Implemented using **SpeechRecognition** library.
- Captures microphone input and converts to text.
- Google Web Speech API ensures high accuracy.
- Noise handling via adjust_for_ambient_noise().

Text-to-Speech Conversion

- Implemented using **pyttsx3** for offline speech synthesis.
- Reads instructions, email content, errors and confirmations aloud.

Sending Email (SMTP)

- Uses SMTPLIB to connect to Gmail's SMTP server.
- Sends emails with subject and body formed from user voice input.
- Follows RFC 822 email formatting.

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Reading Emails (IMAP)

- IMAPLIB retrieves unread or important emails.
- Extracts sender, subject, and body.
- Converts them into speech via TTS.

IVR Navigation

System continuously guides user with prompts like:

- "Say the recipient's email ID."
- "Your email has been sent."
- "You have three unread messages."

VI. RESULT

The above figure illustrates the successful execution of the **Voice-Based Email Sender** module designed to assist visually challenged users in composing and sending emails using voice commands. The interface confirms that the email has been sent successfully, indicating the effective integration of speech recognition, text processing, and email transmission services.

In this output screen, the system displays a clear confirmation message "**Email sent successfully ✓**", which is also conveyed to the user through **Text-to-Speech (TTS)** feedback. This auditory confirmation ensures that visually impaired users receive immediate acknowledgment without relying on visual cues. The recipient's email address, subject, and message content shown in the interface are automatically filled based on the user's spoken input, demonstrating accurate speech-to-text conversion

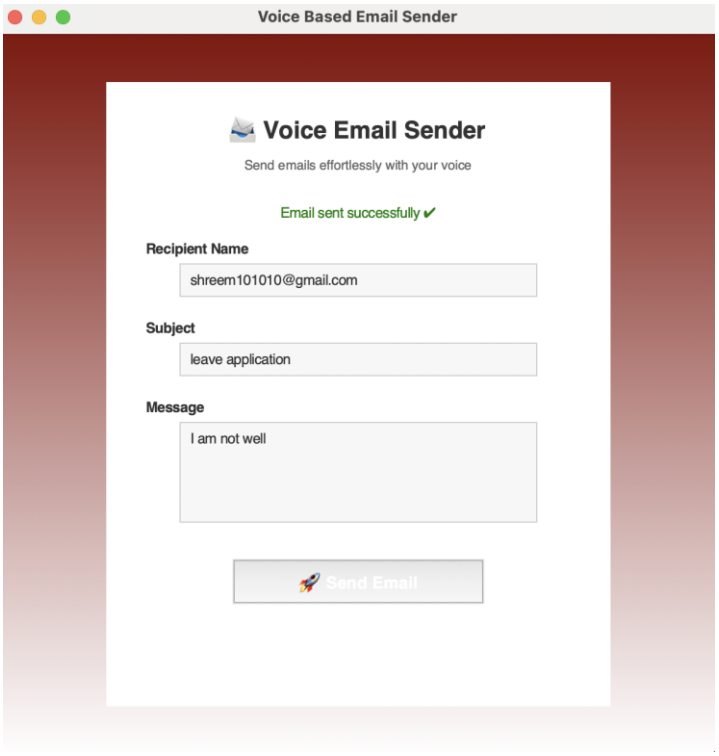

Fig .2 Web Interface of Voice Based Email

The recipient field contains the recognized email address, the subject field reflects the spoken subject ("leave application"), and the message body contains the dictated content ("I am not well"). This confirms that the system

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correctly interprets and maps voice input into structured email fields. The "Send Email" button completes the process without requiring keyboard or mouse interaction, thereby minimizing user dependency on visual interfaces.

Overall, the result validates that the proposed voice-based email system enables visually challenged users to independently compose and send emails efficiently. The successful output demonstrates improved accessibility, usability, and reliability of the system, making digital communication more inclusive for users with visual impairments.

VII. FUTURE ENHANCEMENT

Future enhancements of a voice-based email system for visually challenged users can focus on making the interaction more intelligent, personalized, and secure. Integrating advanced AI and natural language processing can enable the system to understand complex voice commands, prioritize important emails, and provide context-aware responses. Multilingual support with regional accents, emotion-aware text-to-speech, and personalized voice settings can further improve usability and listening comfort for diverse users.

Additionally, security and functionality can be enhanced through voice-based biometric authentication, ensuring safe and password-free access. Features such as offline support, smart error correction during email composition, and AI-assisted handling of attachments (such as describing images or reading documents aloud) can significantly improve independence. Integration with virtual assistants and cloud-based infrastructure will further enhance scalability, performance, and overall user experience.

VIII. CONCLUSION

The Voice- Based Email System successfully overcomes the accessibility challenges faced by visually impaired individuals by enabling complete email management through speech. With integrated STT, TTS, and IVR technologies, the system eliminates the need for screen navigation and manual typing, thereby offering independence and convenience. Future improvements include support for attachments, multilingual capabilities, enhanced noise filtering, and integration with mobile platforms.

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