



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(3): 574-579
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www.thepharmajournal.com
Received: 02-01-2019
Accepted: 04-02-2019

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Enabling email accessibility for individuals with visual impairments through voice-based communication

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DOI: <https://doi.org/10.22271/tpi.2019.v8.i3j.25395>

Abstract

Since it makes it so easy for people to access knowledge, information, and communication tools, the internet has emerged as a crucial component of contemporary living. Individuals with vision impairments, however, frequently need outside help and have significant difficulty accessing these features. With the aid of screen readers, audio-based environments, and other features that facilitate work place navigation, computers have created a world of possibilities for those who are visually impaired. Using the most recent technological developments, a voice-based email system has been developed that enables people with visual impairments to write and receive emails without the help of a third party. Speech recognition has become more crucial in a variety of applications, including those for home appliances, schooling, and medical procedures.

Keywords: Automated Speech recognition (ASR), Google Speech API, text-to-speech (TTS), Speech-to-text

Introduction

In today's world, the internet is essential for communication and is needed for various jobs. Even while email and electronic mail are essential parts of daily life, some people are unable to utilize the internet for a variety of reasons, such as being visually impaired or illiterate. Screen readers, Automatic Speech Recognition (ASR), Text-to-Speech (TTS), and Speech-to-Text (STT) are only a few of the technologies that are available, but they might not be effective for them. There are around 39 million people who are and 246 million people who are having low vision, making up a size able portion of the population who are visually impaired. Furthermore, 82% of blind people are 50 or older. Thus, it's imperative to give them access to internet resources ^[1].

A voice-based email system that is specifically designed for the visually impaired has been created by our team to meet this demand. The system we offer enables users to send and receive emails using voice instructions, making its impleto use for users of all ages. Our system aims to make the usage of email more accessible for the visually impaired and increase the sense of community in the world.

Email, which has evolved into a crucial instrument for communication in the modern digital world, is one area of particular concern. Blind people frequently require support from sighted people or from specialized assistive devices like screen readers and Braille displays in order to access and manage their emails on an autonomous basis ^[2]. However, with the stools, visually impaired may still find it difficult to use.

The email service effectively. For example, Braille displays may not be able to display complicated email formatting, or they may require sighted assistance to read and create emails. We suggest a voice-based email system created exclusively for visually impaired to address these issues. The goal of our system is to give blind people a usable and accessible email platform that they can use independently, without the aid of sighted people or specialized assistive devices.

With the help of our system, blind people can check and reply to their emails using voice commands, as well as enter their email addresses by pronouncing each letter aloud or using a Braille keyboard. No matter the user's accent or speaking habits, this function makes sure the system correctly recognizes each letter.

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Literature Survey

Voice Based Email for Blind

Mulla pudi Harsh asrietal. (July 2021) create system that uses four different types of technologies: Speech to text (STT), Text to speech (TTS), a chatbot for making the conversation smooth and more human like and a mail communication module for sending and receiving emails ^[3].

Voice based E-mail for the Visually Impaired

Aishwarya Belekar *et al.* (September 2020), created a desktop application that can be used by people with various visual imparities to access and send emails efficiently net and net platforms are used to convert speech to text. For emails, the SMTP protocol is used for sending mails and POP3 protocol is used to receive emails.

Voice based-mail System for Blinds

Pranjal Ingle *et al.* (2016), created a system that use similar technologies; Speech to text (STT), Text to speech (TTS) as well as Interactive voice response (IVR). IVR helps the user work with an email host system. IVR uses a pre-recorded message to assist user on how to proceed ^[4]

F Voice Based Mail System for Visually Impaired

M. R. Pradhicsha *et al.* (July 2022), created a system that uses Google speech-to-text to recognize voice commands from user and execute commands such as composing mails, reading unread mails, etc. They are using the Gmail module of python that support the SMTP protocol for sending and receiving mails ^[6]

Voice Based Email for the Visually Impaired

Jain. V. *et al.*, (2021), this study suggests a voice-based email system that visually impaired individuals can use to receive email with ease. This initiative uses technology to make it easier for blind people to transmit and receive voice mails. The improvement of text-to-voice email delivery for those who are blind or visually impaired is the main goal of this endeavor. This study develops a text-to-voice and voice-to-text email access technique for blind persons. This makes it possible for blind people to transmit mail using voice control rather than eypad ^[5].

Voice Based E-mail System for Visually Impaired: A Review

Parkhi Bhardwajetal., (2016), developed a programme using additional speech recognition technology in addition to all other converters and IVR. The suggested system offers more functions than the current GUI does. The primary programming tool used was Java. All kinds of handicapped individuals, including those who are illiterate, can use the application.

Voice Based Email for Blind

Amritha Suresh *et al.* (2016), in this paper, a voice-based email architecture is suggested that will make email more accessible to blind persons. Because it doesn't provide any audio feedback to read out material for the blind, the current system is not user-friendly for them ^[8]. The suggested method makes use of mouse click events, inter active voice response, and speech recognition. Voice recognition issued for user authentication as well, for added protection. Registration is the first element in this system. By asking the user to input the necessary information, this module will gather all of the user's

information. The system will prompt the user for their user's name and password in the second module, which is the login module. Voice instructions are used to accomplish this.

Proposed System

The proposed system is designed to provide visually impaired individuals with an accessible and user-friendly email application. By incorporating voice and Braille input options, the application addresses the unique challenges faced by visually impaired individuals ^[9]. The applications secure to rage mechanisms and support for multiple-user login ensure that user information is kept confidential and easily accessible. Overall, this system aims to empower visually impaired individuals to communicate more efficiently and effectively through email.

A. Features

- The application runs as a background process on the user's device, allowing them to use it simultaneously with other applications.
- The application provides users with the option to use either voice commands or a Braille keyboard to interact with the email interface.
- The application stores user credentials in an encrypted format using a key for easy access and login, ensuring him security of user information.
- The application supports multiple-user log in and credential storage, enabling g multiple users to use the application on the same device.

B. Functionality

- Upon launching the application, the user is prompted to login using their credentials. We are using python's pyttx3 module for broadcasting messages to the user, hence prompting user to enter their credentials ^[7].
- Once logged in, the user is presented with the email interface, which they can interact with using either voice commands. The user is presented with multiple voice commands for sending, receiving as well as managing users.
- The user can compose and send emails, read received emails, and manage their inbox using voice commands or a Braille keyboard.
- The application supports the use of standard email protocols such as POP3, and SMTP, allowing users to connect to their existing email accounts.

C. Implementation

- The application will be developed as a background running exe file using python that will be launched at the startup of a computer.
- If the user is already logged in, the user can directly start using voice commands to start interacting with the application otherwise the application will ask the user to enter their credentials.
- The application will support both voice and braille input when providing information to the application.
- The application will implement encryption mechanisms for storing sensitive information such as the credentials of the user.
- The application will be designed with a user-friendly interface, making it easy for visually impaired individuals to navigate and minimize the user of mouse clicks and

visual information.

System Architecture

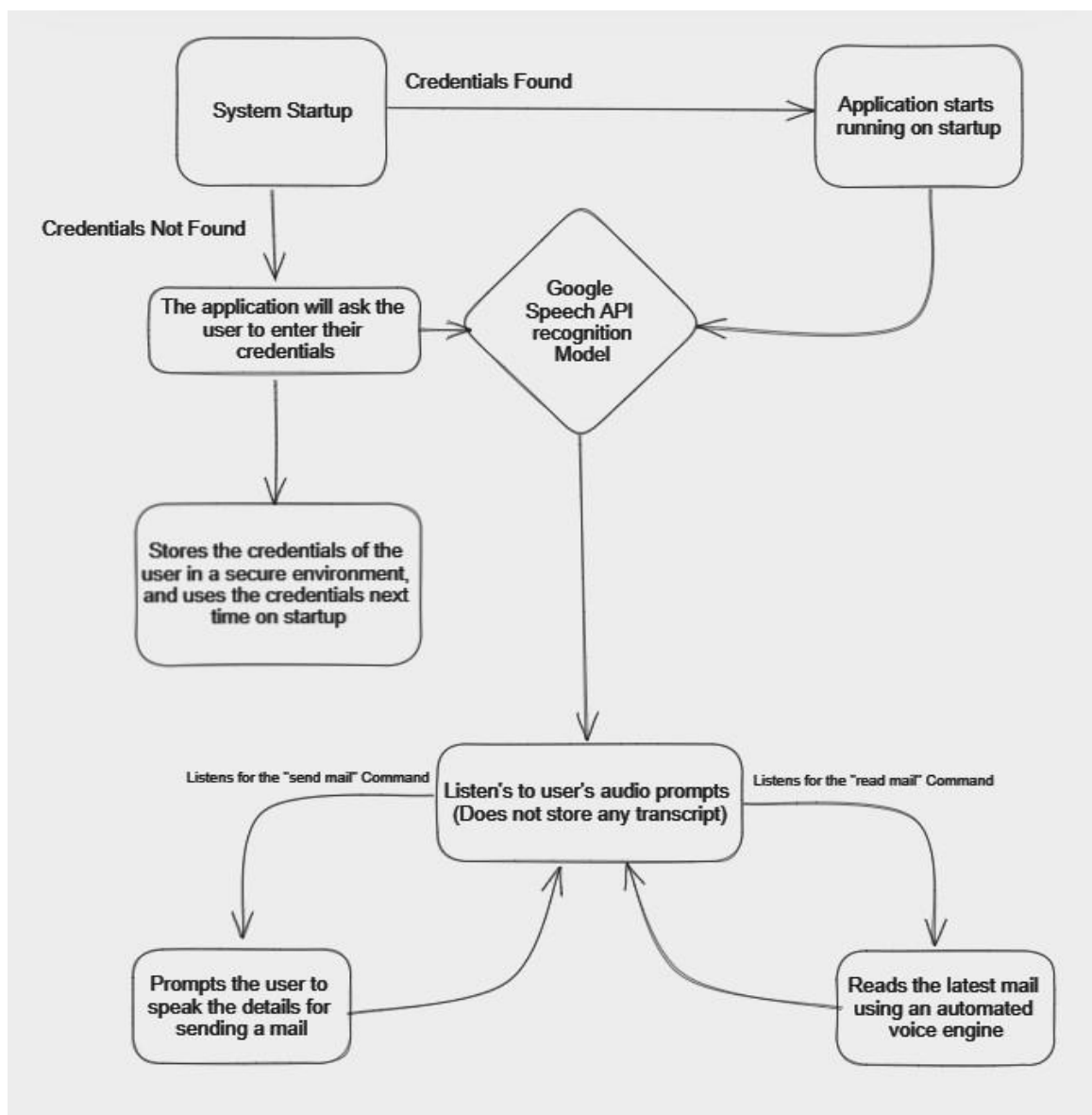
In terms of recognizing the needs of those who are blind, our approach is quite elegant. It keeps in mind, even the minor difficulties that a visually impaired person might face while operating our application. One such difficulty is browsing the system to find the desired application. Keeping this in mind, the proposed system automatically runs on system startup. That is, when a system is turned on, the application starts without the involvement of a user [10].

Once the application is up and running, the application checks for user credentials, that is, the user's email address and the password associated with it. These credentials are further used by the application for logging in and performing automation tasks such as sending mails and reading mails. The credentials are stored by the application in a virtual environment. On startup, the application check sif the credentials are present in the virtual environment. If the credentials are not found, the

application prompts the user to enter their credentials.

The process of entering credentials is a very crucial task, both for the application and the user. Keeping this in mind, we have designed the application so that it allows the user to enter the credentials using both speech and a keyboard. Still limiting the use of any visual information, the user can use a braille keyboard to enter their credentials. Moreover, if the user wishes to enter their credentials using speech, the application instructs the user to enter their credentials letter by letter instead of speaking it in a whole. Since credentials are usually related to personal information such as names, birth dates, etc. it can be difficult for the application to correctly understand what is spoken.

Once the credentials are entered, the application will ask the user to confirm their credentials and store it in a secure virtual environment. This process is only one time, until the user wishes to change their credentials again. The user can do so by speaking one command.



Once the credentials are stored within the application's memory, the application will continue to run as a background application whilst it listens to the audio input of the user. None of the audio input is stored anywhere in the application, and the application is further awakened by speaking any one

of the commands recognized by it.

The main commands that the application offers are:

A. Send Mail

As the name of the command suggests, this command is used

to send mails to a desired email address. The application asks the user to submit the following information when this command is used: "Receiver address," that is, the recipient's email address, Subject of the mail, and lastly the content of the mail. The application makes use of the stored credentials to log in to the user's email, and create a SMTP session to send a mail. The application then uses Transport Layer Security (TLS) that provides data security in transferring of mails. Once the application carries out the sending of the mail, it goes back to listening to user's audio input.

B. Read Mail

The application listens for this command to allow the user to read their latest mails. This command doesn't take any prompts from the user and it simply uses the stored credentials of the user to log in and read their mail over the IMAP protocol. The mail sent over the IMAP protocol isn't downloaded locally, and is sent in encoded bytes. The application then decodes the mail, and cleans the HTML format to filter out the clean body of the email. The application then makes use of an automated voice engine to read out the mail details which include the subject, body and the author of the mail. Once the mail is read out, the application goes back to listening to user's audio input.

Results and Discussions

A. Libraries implemented

The proposed system utilizes the pip command to install several libraries that are implemented in the application. Speech Recognition is a package from the Python library, that makes use of the google speech API to convert speech-to-text. To maintain security for the credentials entered by the user, the system utilizes the PyCryp to Dome package for secure encryption and decryption of email IDs and Passwords. The Py Audio package is used to record and play audio, while the pyttsx3 module handles the text-to-speech conversion. Python's client-side library called smtplib is also utilized to send emails over the SMTP protocol. This allows the system to send email messages effectively to any machine with an SMTP or ESMTP daemon listener. IMAP4 email access and reading can also be done with the help of the library in addition to smtplib.

B. Implementation of STT (Speech-to-Text)

Speech-to-text is the process of converting spoken utterances into written text. It is a technology that analyses and converts spoken language into written text using automated speech recognition (ASR), which can subsequently be shown on a screen or processed by a computer programme. Due to the rising demand for voice-controlled devices like virtual assistants and its potential to increase accessibility for people with hearing or speech impairments, speech-to-text technology has grown in popularity in recent years.

The proposed system makes use of the speech recognition package to carry out the purpose of converting speech-to-text. Speech input is taken using the Py Audio package that provides the system access to a microphone, internal or external. This allows our user to interact with the system using any microphone or attached micro even internal microphone.

The core translation of speech-to-text is done by the google speech API which is being inherited by the speech recognition package. The API provides state of the art accuracy in transcribing the user's speech to captions, which are further

processed by the system to carry out queries or functions as required. The system provides a wide variety of commands ranging from manipulation of user credentials to reading and sending mails for the user. All of these commands are carried out by voice and voice only. Hence, minimizing the usage of key board and mouse.

C. Implementation of TTS (Text-to-Speech)

Text-to-speech (TTS) refers to the technique of converting written text into spoken language. It is a technology that produces an audio version of the written content by reading the text aloud using synthesized voices. In recent years, TTS technology has grown significantly, resulting in more accurate and realistic-sounding voices. Applications for this technology include producing audio books, enabling voice-activated assistants to interact with users, and giving audio descriptions of visual content for people with visual impairments.

The proposed system makes use of the pyttsx3 module to convert text to audio. The system also utilized the Py Audio module to access the required hardware such as the headphones or speakers to play back the audio synthesized by the pyttsx3 module.

The system uses TTS (Text-to-Speech) to read out mails that are sent to the user as well as instruct the user on how to operate the system. It lets the user know what instruction is being carried out and what input it requires from the user. Such messages or announcements are made using the pyttsx3 package.

D. Manipulation of emails

The proposed system makes use of SMTP and IMAP4 protocols to send and read emails respectively.

An SMTP client session is defined by the built-in smtplib package in Python and used to send emails. Simple Mail Transfer Protocol, or SMTP, is a set of rules for communicating while sending emails over the internet. The smtplib client created by the smtplib library makes use of the user credentials to log in and then send mails. It also allows the user to attach and create HTML content.

The imaplib library is being used in the system to read mails being delivered to the user. The library makes use of the IMAP4 protocol and is a very effective retrieval method as it does not download the mails, instead, it just reads and displays them. IMAP stands for Internet Mail Access Protocol.

E. Application design

One of the elegant features of our proposed system is that it does not make use of any graphical user interface. Hence, it nulls the use of any visual information to be processed. All the commands provided by the system can be carried out through speech input.

Even with a gui-less interface, the system offers the user to make use of a braille keyboard if the user wishes to enter sensitive information or pieces of text that are difficult to recognize by speech. The system pops a terminal window that then takes the keyboard input from the user.

This hybrid design of our proposed system allows the flexibility of both speech input as well as keyboard input.

The application runs in the background, that constantly takes input from the user. When the system receives a command from the user, it further instructs the user to provide the required input using Text-to-Speech module.

F. Result and performance

The proposed system when compared to the already existing systems, presents a highly organized manner of putting together various technologies such as STT (Speech-to-text), TTS (Text-to-Speech), IMAP4, SMTP etc. One of the advantages of our system is in its architecture itself. The pre-existing systems make use of a graphical user interface that increases the use of interaction with a keyboard and mouse. Our system however eliminates the need of external hardware such as keyboard and mouse to navigate the application. The application runs in the background which can just be navigated through voice commands.

In addition to allowing the user to navigate via voice commands, it also gives them the option of using a keyboard and speech. Along with the beautiful architecture, the system also provides the functionality of a credential system that stores and manipulates existing credentials of a user.

Among the various advantages of our proposed system, there also exist a few disadvantages. One of them being, security of the credentials being entered. Currently our system makes use of basic encryption technology to secure the credentials, however, a stronger encryption method ensures the security of a user's sensitive information. The system is also slightly insensitive towards special characters and words that are difficult to pronounce or are spoken differently indifferent accents.

Overall, our system provides the user with a smooth and undisturbed environment to navigate and compose their mails.

Conclusion

We have created a tool that will facilitate successful email service use for those with visual impairments. To increase a sense of community among persons who are blind is the main objective of creating the kind of system described in the study. This strategy might help overcome a number of challenges that blind individuals have faced while attempting to access emails. The decision tree follows a particular path because each operation produces a distinct result. This significantly increases system compatibility.

The user will be given choices, and the system will be proceeding accordance with their choice. As a result, users of all ages find the system to be very simple to use. Our system is even compatible with those who are externally disabled as well thanks to speech to content and content to speech reader technologist hat has been used in our system.

Additionally, our proposed voice-based email system will offer users a choice in how they enter their details, allowing them to either use voice commands or a Braille keyboard. This feature addresses the needs of users who may prefer or be more comfortable with typing their messages using a Braille keyboard, as well as those who prefer using voice commands for hands-free operation.

We gave careful thought to the possibilities of user variations in pronunciation and accents when designing our voice-based email system. To address this issue, we have implemented a system where users will be required to speak their email address alphabet by alphabet, rather than as a whole word. This strategy guarantees that the algorithm correctly recognizes each individual letter, even if users pronounce the word differently overall. By separating the email address into its constituent letters, we can increase the system's accuracy and depend ability and lessen the chance of mistakes or misunderstandings.

The research has, however, also noted number of difficulties

and restrictions, including the necessity for precise voice recognition, privacy and security issues, and the possibility for user fatigue. When creating and implementing voice-based email systems for blind users, it is imperative to take these difficulties into mind.

Overall, the study emphasis the potential of voice-based email to increase blind people's independence and quality of life and makes a significant contribution to the field of assistive technology for the blind. To make voice-based email systems more accessible to blind users, additional research and development are required in this field.

Future Scope

In future, we attempt to improve up on several features of our proposed system. We can work on improving the security of the credentials being stored in the application's virtual environment. For this, an encryption system can be used to protect the credentials from being exposed.

Additionally, the current system is designed to work on laptops, and this can be further developed for mobile operating systems as well.

The prototype we have built currently manage single user, and this can be further improved to incorporate multiple users and provide multi-user functionality. Further, the application reads the latest email, which can be improved further to read a desired amount of latest mails or read all the unread mails.

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