BUILDING PYTHON APPLICATION FOR WEBMAIL INTERFACES NAVIGATION USING VOICE RECOGNITION TECHNOLOGY

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ABSTRACT

Voice Recognition Technology (VRT) has played a crucial role in technology development, finding extensive use in the development of humanitarian assistance applications, including assistance programs for individuals with disabilities to use smart vehicles and smart homes, as well as websites. This paper discusses implementing a Computer Application (PC-App) for humanitarian assistance written in Python to enable Arabic-speaking elderly and handicapped employees to access and navigate webmail accounts using Arabic Voice Commands (AVC). Furthermore, a survey was conducted for elderly and disabled employees to assess the effectiveness of the application, with participants evaluating that it was useful in addition to improving their interaction with their accounts in Webmail. Ultimately, this application promotes independence and functionality for Arabic-speaking individuals, regardless of their mobility disability levels, by allowing them to independently use the Webmail interface using AVC.

KEYWORDS

Voice Recognition Technology, Arabic Voice Commands, Webmail,Elderly Employees, Assistant Applications.

1. INTRODUCTION

Technology has become our means of communication and interaction in both our daily and work lives. One significant development in communication history has been the innovation of E-mail, which has become an indispensable tool in various fields [40-52]. Although everyone can utilize this technology completely, disabled individuals are having difficulty fully utilizing it due to physical impairments. Consequentially, developers should work on assistive technology (AT) in order to ensure equal access to and benefit from advanced technology for disabled individuals. To ensure equal access to Technological developments for disabled individuals, the focus must be on AT[11-15-48]. Webmail accounts can be conveniently created and accessed online through hosting websites and control panels (cPanel) [34]. Therefore, accessibility measures and benefits from technologies are particularly crucial for people with disabilities and older employees who may struggle to keep up with technological advances. Although technological advancements like speech recognition and eye-tracking have made it possible for those with severe disabilities to interact actively with the world, there remains a need for accessible online systems that provide support and assistance[26-43-45]. Accordingly, investing in accessibility measures can significantly improve the quality of life for everyone, including disabled and elderly individuals. Through the use of AT, employers can support these segments of the population in employment and reduce isolation and confinement to their homes [9-14-35]. Notably, it is vital to ensure that VRT is accessible and usable for handicapped individuals and older employees [54-57].

This study investigates the accessibility of Webmail interfaces at the control panel of hosting (cPanel) for individuals with disabilities, handicaps, and the elderly using VRT. The research emphasizes the significance of integrating this technology to enhance accessibility and ensure equal opportunities for all individuals. By adopting an inclusive approach, this study aims to enable active participation in society, irrespective of physical abilities or age.

1.1. Statistics

These statistics provide valuable insights into many important aspects. They reveal the rapid growth of the email market and how important to use it for communicating with job applicants. In addition to the rapid development in the use of voice recognition and the popularity of Python packages in computer science, all these factors have motivated the submission of this paper.

To begin with, it is noteworthy that in Denmark, a remarkable 93% of the population used email in 2016. This indicates that email is widely used and holds immense importance as a means of communication. Additionally, even individuals aged 65-74 showed a high email usage rate of 98% [1].

A research study conducted in the Netherlands found that 60% of job researchers used job vacancy websites to find work. Interestingly, most individuals who changed employers relied on personal networks. These findings underscore the significance of personal connections when transitioning jobs [46].

Next,into applicant preferences in the United States. In 2018, 76% of job applicants preferred to receive personalized email acknowledgement of their receipt[47]. This finding aligns with a survey conducted by The Balance Careers, indicating that 84% of respondents preferred receiving a personalized email acknowledging their application. These statistics emphasize the importance of personalized communication and the impact it can have on applicant satisfaction[49].

Shifting our attention to the sheer volume of emails sent globally, there is a study discovered that over 231 million emails were sent in just one minute in April 2022. Additionally, the daily email count in countries like the Netherlands, Japan, India, and Germany reached a staggering 8.3 billion. These numbers highlight the immense reliance on email as a primary mode of communication in today's digital age[19].

Furthermore, approximately $50 billion will be generated by voice recognition by 2029, up from $10 billion in 2020. Consequently, the compound annual growth rate will be 23.7% [51]. This growth underscores the increasing importance and integration of VRT in various aspects of our lives. In the United States alone, there were approximately 142 million users of voice assistants in 2022, with predictions indicating a rise to 157.1 million users by 2026[50].

Lastly, others examine the popularity of Python packages in the field of data science. Numpy and Pandas emerged as the most widely used Python frameworks, with respective market shares of 60% and 55% in 2021. These statistics highlight the dominance of Python packages in facilitating data analysis and manipulation[55].

2. STUDY BACKGROUND

AT has emerged as an indispensable tool for disabled individuals, facilitating their engagement in various tasks and enabling their full participation within society [4-24-31]. The sphere of AT encompasses a diverse array of solutions, ranging from rudimentary to sophisticated. For

individuals with physical impairments, AT offers opportunities to enhance their mobility and foster independence by employing a multitude of aids, including but not limited to crutches, electric wheelchairs, specialized vehicles, and supplementary devices specifically designed to provide bodily support [7-21].

The software aids are another facet of AT that greatly benefit those with sensory or mobility issues. These include computer software-aided mobile devices, screen readers, voice recognition tools, and screen enlargement applications [5-30-32-39]. By utilizing these technologies, individuals can overcome barriers associated with visual or movement impairments and access information or communicate effectively. Electrical or software-backed assistive devices are employed to provide support and enable better engagement in educational, medical, professional, and personal things. These developments vary depending on the work tool and disability type, which can greatly enhance the ability of disabled individuals to complete specific activities independently [36-41-58].

2.1. Voice Recognition Technology

The VRT, also known as Automatic Speech Recognition (ASR), revolutionizes the way users interact with modern systems by using spoken commands. By converting spoken human language into written text or translating it into specific actions. The ASR technology heavily relies on complex algorithms and machine learning (ML) methods to accurately decipher spoken words and interpret their intended meaning. With its ability to understand and respond to human speech, VRT opens up a world of possibilities for hands-free communication in several industries[17-23-42-44].

2.2. Arabic Speech Recognition

The development of accurate and efficient Arabic Speech Recognition (ASR) systems presents unique obstacles due to the intricate phonetic structure and grammar of the Arabic language. Recent advancements in technology have employed various techniques to address these challenges, including the combination of deep learning models and traditional acoustic models to enhance ASR capabilities. This approach has resulted in promising results in the accurate transcription of Arabic speech [2-6-8-12].

Moreover, ASR has already been integrated by applications and AT developers, enabling individuals to control wheelchairs and access computers using only AVC [10-28]. This advancement enhances accessibility and empowers Arabic-speaking individuals, especially those with disabilities, to perform everyday tasks independently. Despite the existing language variances and numerous dialects, researchers are continuously refining speech recognition algorithms and data sets to develop accurate and efficient ASR on technology [33-37].

2.3. Accessibility Using Voice Commands

The increasing use of voice commands in PC-App applications has become popular mainly due to the convenience and accessibility they offer. These applications allow for hands-free interaction and make tasks easy for disabled individuals, particularly those with physical impairments that limit their dexterity [18-24]. An example of such applications is the voice access applications developed by Google to enable users to navigate and operate smartphones solely using voice commands [29-53]. This feature makes it easier for users to access functions like texting, making calls, and opening applications through voice instructions. Furthermore, it supports a variety of human languages. The integration of voice recognition into various assistive technologies has proven to be beneficial for individuals with disabilities to access technology,

communicate, and interact with digital systems effectively. Thus, these applications promote inclusivity and independence for users with physical limitations [13-16-27-56].

3. THE DEVELOPED SYSTEM

This paper presents an integrated system that enables users to access Webmail accounts by using VRT, especially those who have difficulty using a mouse or keyboard.

3.1. System Components

The system architecture consists of a user, a personal computer PC, a microphone, a web browser, as well as a developed application. The user controls the developed system by speaking into the microphone.

3.2. The Developed Application

The developed application is responsible for processing the speech of the user and executing the corresponding commands on the PC. It is programmed by the Python language that supports multiple libraries and paradigms, such as "PyAudio", to receive and process the speech of the user, as well as to use the "Recognize Google API" to enhance the accuracy of the process of converting the voice. Additionally, utilize the "Pyautogui" library responsible for keys on the keyboard to control key events. Figures 1 and 2 illustrate a sample of the Python code that shows the essential functions of the developed application.

```
reg_speech = avr.Recognizer()
with avr.Microphone() as src:
    audio = reg_speech.listen(src)
    to_text = reg_speech.recognize_google(audio, language='ar-AR')
    print(to_text)
```

Figure 1. Python code written in the developed application

```
if to_text == "إنهاء إنهاء":
    os.system("shutdown /s /t 0")
    mm=' سيتم قفل الحاسوب'
    pub_ub_massage(mm)
if to_text == "التالي":
    pyautogui.hotkey('tab')
    mm='التالي'
    pub_ub_massage(mm)
```

Figure 2. Python code written in the developed application

3.3. System Description

The system operates as follows: the user says a voice command into the microphone. then received and converted into text by the voice libraries and the Google recognition API in real-

time without recording. The text is then matched with a set of predefined commands by the Python code. If a match is found, the application executes the corresponding action by either opening a link or simulating a key event in the web browser. For example, if the user says "الوارد", the application opens the inbox link in the web browser. If the user says "قفل", the application simulates the ALT+F4 key event to close an active window. The application waits for another voice command after completing any voice command action.

The application also integrates a GUI into the application through the executed voice commands visually to know what happened at the backend, making it easier for users to manipulate their Webmail accounts and navigate them without confusion in commands or delay in executing any procedure. This visual representation greatly improves the overall usability and ease of interaction with the developed application, as shown in Figure 3.

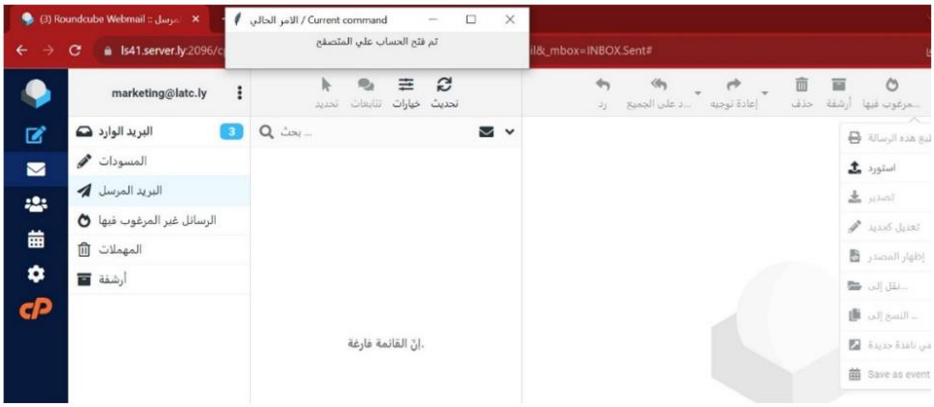

Figure 3. The pop-up message for the last executed voice command

3.4. System UML Diagram

The Unified Modeling Language (UML) diagram of the system provides a clear and concise overview of the system's structure and functionality, as Figure 4 shows, which depicts the main classes and methods of the application, as well as the relationships and interactions among them.

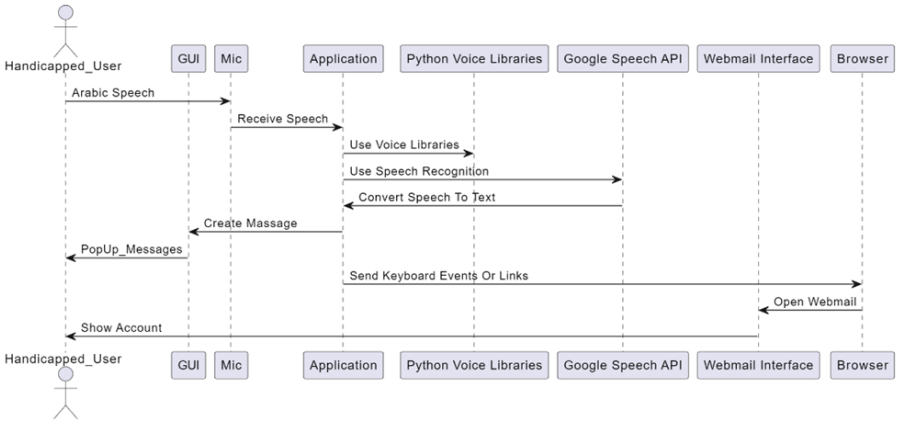

Figure 4. The UML diagram of the developed system

3.5. Voice Commands Flowchart

The integration of application commands with voice commands facilitated smooth execution main events. The user is able to effortlessly communicate their desired actions through Arabic spoken language, and the application would promptly execute them accordingly. This operational concept is visually depicted in flowchart as shown in figure 5.

Upon the user issuing the speech as a voice command, the application receives and converts it to a string variable represented by a word. Thereafter, if this word exists within the available options of the application, it is executed as key-events or open hyperlinks. then going back to receiving further voice commands. Conversely, if the word does not correspond to any of the pre-defined command words within the application, the application repeats its sound reception process. This loop continues until the application is finished.

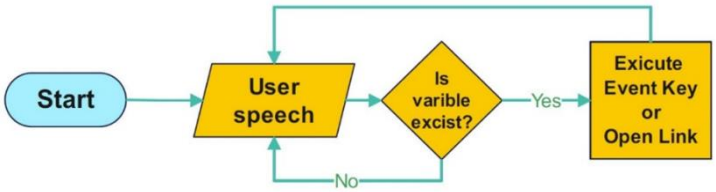

Figure 5. The user speech flowchart

3.6. Developed System Requirements

The core component of the system is a developed application called Application Assistance for Webmail (AAW). To develop and implement AAW, both hardware and software components had to be provided to facilitate the development and smooth implementation of the application within the system.

A Windows 10-compatible computer system was required, along with an external or built-in microphone for receiving speech input from the user. During the development phase, open-source software was preferred to minimize costs. As a result, the AAW incorporated numerous programs and libraries that are essential to its functioning. These include:

- Python 3.12:This particular version of the Python language was utilized for developing the application. Python is renowned for its simplicity in coding, versatility, and supportive community, making it an excellent choice for this project[38].
- Tkinter library:It works as the standard library in Python to allow developers to create applications with visually appealing and user-friendly interfaces through a GUI.
- Recognize_Google library:a specific library is designed for programming speech recognition applications using Google's services. Utilizing the API of speech recognition in Google's capabilities, it converts audio input from a microphone into text. Furthermore, multiple languages are supported.
- Pyautogui library: It is a Python library that provides platform support for automating tasks on a PC. Developers can use it to create scripts that automate this process as well as to simulate human-like interactions with the computer, such as opening links, pressing keys, clicking buttons, moving the mouse cursor, more even to even typing text. This makes it useful for testing user interfaces or performing actions that require human input [20-22].

3.7. System Launching

The system consists of two sections. the computer and the developed application. Initially, the user must operate the computer and subsequently launch the application from within it. Closing both components is also required.

3.7.1. Turn Computer On

For people who are disabled or elderly, using motion sensors or push buttons on PCs can be a useful way to operate them. These methods can be set up for the PC depending on the user's needs and disability.

- One method is to use a push button that is medium-sized and easy to press with the head or leg. It is placed in a suitable location for the user and connected to the PC as a replacement for the normal operating button.
- Another approach involves employing a motion sensor as an alternative mechanism for regulating the operation of PCs. This technique functions as a switch on/off by using a Passive InfraRed (PIR) [25]. The PC power supply powers the sensor's electronic circuitry after it has been configured. Additionally, it necessitates placement in proximity to the user while ensuring minimal interference from any extraneous movements.

3.7.2. Run The Application

The application AAW is installed on a PC following the provided installation instructions. Once installed, it is added to the list of programs that automatically run when Windows boots up. This ensures that the application starts up automatically and is ready to receive voice commands through the microphone. The first command to activate Webmail in the browser is "حسابي". And if there are any unknown voice commands, the application does not respond to them. Additionally, there are alert pop-up messages to guide users and allow them to repeat their commands if they are unclear.

The application immediately recognizes specific command words such as "التالي", "فوق", "إرسال", "إنشاء", as well as "قفل" It accurately identifies these words and takes appropriate action accordingly. Table No. 1 displays a portion of the speech commands and corresponding reactions used within the application. It should be noted that when writing a lengthy message in Arabic, the voice command "رسالة" is used. The AAW characterized by the command voice "الإنجليزية اللغة", is used to switch to receiving speech in English for writing letters and numbers or writing long messages solely in English. The command "Arabic language" can be used to go back to receiving AVC. Using this method, you can type the recipient's name, email address, subject, or any sentence using the appropriate language.

Table 1. Some of the AVCs with its reaction in the system

Arabic Voice Commands	Reaction
حسابي	To open the browser on the **Webmail** account
إنشاء	To open **Compose**in Webmail
قفل	To **Close** the currently active window
تحت	As if you were pressing the **Down** arrow key

التالي	As if you were pressing the **Tab** key
الخلف	As if you were pressing the **Backspace** key
اللغة الإنجليزية	Using to **Switch**to receiving speech English

3.7.3. Turn Computer Off

The developed system allows users to shut down their computers using voice commands. The process begins by repeating the "قفل" command until all active windows are closed. The user then issues the"إنهاء" command, which is responsible for permanently shutting down the computer.

4. EXPERIMENTS AND RESULTS

A small group of physically disabled and elderly employees of various ages were taught how to send and receive emails using the developed application AAW. They were interviewed after a week to learn more about their opinions of the application. According to Figure 6, the results were as follows:

- A majority of participants rated the application AAW as good, with 91% commenting positively.
- Some elderly participants had difficulty writing emails since they needed more practice.

The results suggest that the developed application AAWcan be an effective assistive tool for people with disabilities to use webmail accounts, but some may require additional training or practice to fully utilize the system.

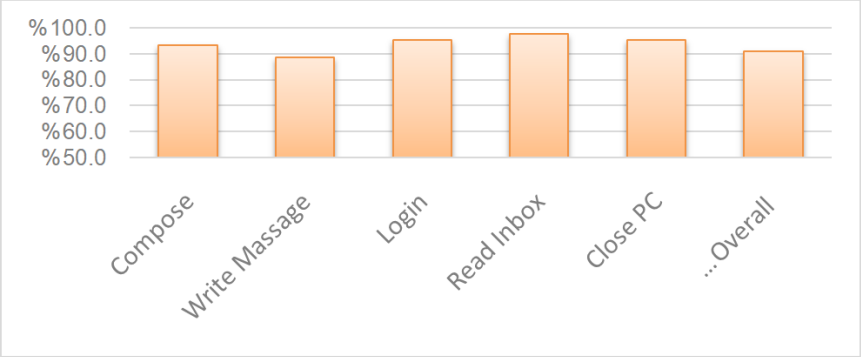

Figure 6. Users evaluate the developed system

5. LIMITATIONS OF THE SYSTEM

The study focused on developing a system tailored to Arabic-speaking individuals, specifically those who experience physical disabilities that hinder their hand function and ability to move other body parts. It is assumed that these individuals possess the ability to speak comfortably. From a technical perspective, the successful operation of the application hinges on a stable Internet connection for Webmail account navigation and the use of Google voice recognition capabilities Additionally, recommended to use the system in a private room or an office to achieve optimal performance. Where the background noise might degrade speech recognition

results, which can be a primary obstacle to efficiently using the developed system in outdoor areas and large public places.

6. CONCLUSION

This paper presents a specialized Windows application for Arabic speakers with disabilities or old age that has successfully addressed the challenges they face in using Webmail accounts. The application uses VRT to enable users to interact with their Webmail platform without relying on keyboards or mice, which can be difficult for them. Thus, it enables the users to effortlessly access all the features of the Webmail account, such as logging in and out, browsing their Webmail pages, and turning their PCs on and off. The system is cost-effective. Moreover, it can be easily used. Ultimately, the system improves the well-being and productivity of disabled or elderly workers who face challenges with traditional input methods.

7. FUTURE WORK

Even though the system has demonstrated promising results, future work is suggested to increase its development. One potential area of development is expanding the system's capability to include compatibility with other popular communication platforms, such as Gmail, WhatsApp, Facebook, and Outlook, all within the same application. By integrating artificial intelligence, the system could also learn multiple languages as voice commands directly from users, providing them with the flexibility to choose their preferred language. Moreover, making the system compatible with several operating systems would enhance its accessibility and appeal to a broader range of users.

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