Evaluates the Prognosis Of AI-Powered Voice-Guided System Aided for Individuals with Partial Disabilities Using Machine Learning.

Anil kumar[1], Ravi Arora[2], Gaurav Mitra[3], Apurva jain[4], Ruchi Sharma[5], Vijay Kumar[6*]

Abstract: Design of a new low-cost self-assistance system that facilitates the operation of household appliances and wheelchairs by using sophisticated voice commands from individuals with disabilities. With the modern advancements in technologies, each individual nowadays is moving over to an easier and more effective lifestyle. People are moving on with technology and finding solutions to problems faced in everyday life. Normal people are getting privileges of technology but sometimes the benefits could not reach the partially disabled ones. Partially disabled face a number of problems in day-to-day lives from navigation to communicating with others. The partially sighted people and hearing-impaired ones try to cope up with the normal ones but they do not get many opportunities. The study focuses on partially disabled people to provide them with some of the features to overcome few of the problems faced in the real world. This project demonstrates the aid for the partially visual and hearing impaired through communication via voice for the visually impaired and communication via text for the hearing impaired. The project is divided into two parts, initially consisting of text-to-speech and voice-to-speech capabilities, and object recognition for people with disabilities. This project includes a brief analysis of various models and algorithms such as interactive speech response (IVR), convolutional neural network (CNN), recurrent neural network (RNN), and Text-to-speech (TTS). Another part is the integration with Android applications. Here, the trained deep learning model serves as the source for the backend in object detection. Models are imported to predict outcomes, and text-to-speech helps people with disabilities access a variety of features such as voice-based email, object recognition, and virtual navigation.

Keywords: CNN, RNN, IVR, TTS, voice control, home automation, self-assistance, and disabled individuals

1. Introduction

Nowadays in today's era, the advancements in technology have helped the humanity largely. But sometimes, the extent gets restricted for the less privileged ones. Internet has been the easiest way to connect to people all over the globe. However, the visually impaired or the hearing- impaired people still face some problem in order to be connected to rest of the world [1]. So, in order to overcome this obstacle, the advancements were also made toward the impaired that would help in their everyday life and the advancements will go on in future too. The project demonstrates the aid for the visually and hearing-impaired people by communication via voice to visually impaired and communication via text to hearing impaired. The project is divided into two parts, first consisting of the feature of text to speech and speech to text along with object detection for the impaired ones. The project includes a brief analysis of different models and algorithms such as interactive voice response (IVR), convolutional neutral network (CNN), recurrent neural network (RNN), text-to-speech (TTS). The other part is integrating it with the android application where deep learning model trained will act as a source for the backend. The model will be imported to predict the result and text-to-speech will help in assisting partially disabled people to access different feature such as voice-based email, object detection, virtual navigation and many more. The problem is to make an application, which is capable of assisting partially disabled people to overcome the problems faced by their disability in day-to-day life. The recommended solution to this problem statement is by introducing a one-in-all deep learning and machine learning based features such as voice-based email, object detection, virtual navigation and many more. Upon implementing different libraries to form the frontend, the modulesobtained an accuracy of 97.714%. The objective of the project truly aims at making an end-to-end android application that will predict a system which assisting

[1] Associate Professor, Bharati Vidyapeeth's College of Engineering, New Delhi.
dranilchhikara@gmail.com

[2] Assistant Professor, Bharati Vidyapeeth's College of Engineering, New Delhi
ravi.arora@bharatividyapeeth.edu

[3] Assistant Professor, Bharati Vidyapeeth's College of Engineering, New Delhi.
gaurav.mitra@bharatividyapeeth.edu

[4] Assistant Professor, Dr Akhilesh Das Gupta Institute of Professional studies, New Delhi
apurva.jain@adgitmdelhi.ac.in

[5] Associate Professor, Bharati Vidyapeeth's College of Engineering, New Delhi.
ruchi.sharma@bharatividyapeeth.edu

[6*] Assistant Professor, Bharati Vidyapeeth's College of Engineering, New Delhi.
Vijay.kumar@bharatividyapeeth.edu

* Corresponding author email id – vjaikr@gmail.com

partially disabled people to access different feature such as voice-based email, object detection, virtual navigation and many more. It integrates deep learning concepts along with android app development to get an application as the product. Below listed are the key objectives of the project:

a) Reviewing existing research works conducted in the past 7 years.

b) Predicting text-to-speech and speech-to-text for implementation of various features.

c) Prediction of real-world objects to assist the visually impaired users for path detection considering the basic object labels dataset.

d) Comparison of the results obtained with the literature work.

e) To provide an interactive interface between the partially disabled user and the android application consisting of a variety of features.

f) To assist the partially disabled users by bridging the gap between growing technologies and their disabilities.

2. Literature Survey

In literature, many researchers and scholars have done a lot of research to make a predictive application, which can be used to help partially disable people in functioning of their day-to-day activities. In 2020, [2] presented a mobile application called ReCog which is used to capture and recognize images for the blind users. The application is an integrated software of android and deep learning network. In this, the authors have proposed a methodology where a human computer interaction (HCI) is made which enables blind users to directly interact with the application. The results acquired by deep learning model is efficient but still there seems a huge scope of enhancement as the paper uses the concept of augmented reality within the working applications. Therefore, the paper can be improved further by working on the parameters of the deep learning model.

In the same year, [3] came up with their study for the partially disable people. The study uses the concept of machine leaning to provide mobility aid to the visually impaired person. The study basically shows an integrated hardware system with a machine learning and deep learning models embedded in it to help the visually impaired people navigate roads, destinations etc. The deep learning and CNN model used in this study help in the object detection where a camera will be

Switched on. Then, by the means of ultrasonic sensors objects in the way can be detected which can be further

predicted by the CNN model that what is the exact location and how to navigate further. The results obtained by the CNN model have a comparatively low accuracy than the other researches. Therefore, the results can be improved and the prototype constructed can be converted into a wearable device by using advanced techniques i.e., smart phones, tabs, laptops etc. to make it easily accessible.

Based on the above study, in 2020 [4] also came up with their study on virtual navigation technique for blind people which can be useful in transferring route knowledge in the real world. The study helps the blind people to access a virtual navigation system to encounter short routes for travelling from one destination to another. The study proposes a method of using finger gestures as a means of navigations. It also shows results by analyzing 14 visually impaired people, directly different routes and destinations for different purposes. And upon acquiring the results the author's concluded that the system shows an accuracy of above 85% and can be used in future for real-time scenarios. Not only navigation systems, but also many other features can also be considered to assist the partially disabled people.

Therefore, [5] came up with a new concept of voice-based email system for the visually impaired people. The study proposes various techniques to build a system that can be used to generate the content of email using the voice of the person. The system can both read and write mails for the visually disabled people. Therefore, it includes the concept of speech recognition using machine learning and deep learning models. It also proposes an interaction voice response (IVR) which can be used to read and understand the mails as well as generate the mail content for the user. Thus, the paper concludes by showing a complete analysis of different techniques and models such as machine learning model, deep learning model, Voice enabled interface, computer sound detection, speech recognition etc. can be used to generate and read e-mails for the visually impaired people.

Keeping on the same aim in mind, in the same year [6] came up with a unique methodology to propose a voice based emailing system for the blind. The study proposes a user interface, which can be used to generate speech from text or text from speech using deep learning neural network model. The application takes speech/text as an input and predicts the corresponding text/speech as an output which can be used to send and read emails. Though the application can be helping the visually impaired individuals to access email facilities. Bu the interface still lacks some of the key features which can be further eliminated for the ease of the visually impaired people and thus can be made more user friendly to interact with.

In 2019, [7] proposed a study in which the authors used Microsoft speech recognition and Microsoft speech SDK to implement the concept of voice-based email system for visually challenged people. The study uses Microsoft speech recognition model directly to enable the speech to text conversion and acquired an accuracy of above 80%. The proposed study uses persons Microsoft email id along which can be improved further by associating a voice-based

nickname system to make the system blind-user friendly. So, that instead of searching individual email id, the person can directly call out the unique nickname. In the same year, [8] also came up with a similar study on the voice-based mail system for visually challenged people. The study proposes a machine learning model integrated with an application to create the voice-based mail system. The system takes speech as an input, implementing viterbi algorithm and getting text as an output as the form of email content. Thus, the algorithm acquires and accuracy of approximately 89%. The study shows the complete system for the voice-based commands of the user to email text conversion which can be worked upon even for normal people as a voice assistant.

To create a user-friendly system for the blind people which is compatible to every electronic system such as desktop, mobile device etc. [9] in 2018, came up with their research on the same by using Microsoft speech SDK for real simple syndication and create a system which can be enabled to assist visually impaired people generate a voice-based email, SMS or text for communication. The system works on the mouse clicks as well as voice commands, which are used as a keyword to perform the desired operation like, compose mail, cancel mail, NOP, send mail, and select next mail and many more. Thus, the system acquired a perfection of 60% of the total blind population all over India, which is efficient enough to prove its working.

[10] Also came with a hand gesture recognition technique, which can be used to create a voice- based email system for the visually impaired people. Some of the techniques includes speech recognition model, machine-learning models, deep learning models, text to speech and speech to text convertors and many more. Thereby, obtaining and accuracy of above 90%, the research concludes that any model used for the purpose of voice detection and conversion. It is personal system dependent, its compatibilities etc. plays a vital role in the selection of the model and computing its accuracy. Thus, it also suggests that the study can be improved further by making the model compatible for different languages such as Hindi, English, French, Dutch and many more.

In the year 2017, [11] came with their approach for the

visually impaired people by proposed a model which can be used for object detection and distance measurement. They proposed a system, which included sona switch, monolithic converter and a serial post for the formation of the machine that used to detect objects in front of the blind user and compute the distance correspondingly. The machine takes input as a voice command operational system to ease the user for operating the machine.

In a similar vein, [12] presented their concept for a voice-activated email system for the blind and visually impaired in 2015. creating an email system that will enable anyone who is blind or visually impaired to use the services for communication even in the absence of prior training. The user will only be able to operate the mouse and convert speech to text; they will not be able to use the keyboard. Furthermore, any average person, such as someone who cannot use the suggested system, should be able to read. Because interactive voice response is the system's sole foundation, using it will be simple and effective. Apart from this, many researchers also proposed different methodologies and techniques to assist the visually impaired people to face daily challenges they come across. [13] used morse code visualizations to implement an integrated system for blind and deaf people to enable them the access to communicate and share their views and messages via such application. The proposed technique acquired an accuracy above 80%, which is significant for the usage. [14] Also proposed a methodology, which was to create web-based applications that can be used by people of all kind. Web applications that are flawlessly designed, developed, and edited allow for reciprocal licensing of information functionality among users of all stripes without compromising usability. Checking emails is a fundamental and crucial requirement for utilizing the internet. A small amount of applied micro systematic research has been conducted on the accessibility of emails for visually impaired users. Thus, [15] also showed their analysis and technique that can be used for the visually impaired people as an aid. The proposed methodology receives voice through microphone as input; accuracy of the voice recognition can be improved by training the computer. As much the user trains computer the recognition is accurate, removal of noise from the speech also improves accuracy level. The speech input is converted to text representation using a voice recognition engine. The interpreted text displayed on search box. The relevant links will be retrieved from server database, displayed on the home page of the proposed search engine. The links displayed readout by the speech synthesis. Basic limitations of speech synthesis can be overcome by high quality of coder.Thus, a lot of research and predictions are made by various authors using different analysis schemes and techniques for predicting various system for the visually impaired people to provide them an aid for their day-to-day challenges. Next, section-

3 discusses the research project material followed by methodology to assist the visually impaired people for detection and recognition of text etc.

3. Material

3.1 Deep learning

Deep learning is a special type of machine learning and artificial intelligence [16]. It is used to imitate the way in which human thing, gain, learn about new things. As we know machine learning algorithms is capable of performing simple predictions by learning from the existing or non- existing trends. Similarly, deep learning also predicts the future but in a different way [17]. It uses stacked algorithms which are constructed in a hierarchy of increasing complexity and abstraction. Some of the most common examples of deep learning are automated cars, virtual assistants, face recognition, emotion prediction.

3.1.1 Convolutional neural network (CNN)

Convolutional neural network [18] is one of the most powerful tools of deep learning. It was developed in around 1980s. It is very useful in recognizing handwritten patters, image processing and many other networking skills. It basically works on a large amount of dataset which is used for training and building the neural networks.

The convolutional neural network comprises of various networking layers such as the max-pooling layer, input layer, hidden layer and output layer. The dataset is set to train all the layers of the neural network that are defined by the coder. For training and constructing a neural network it uses a special technique known as Convolution. Convolution is a mathematical operation on which two functions are provided which produces a third function which can be used to express or can say predict the shape of the one modification layer to another.

3.1.2 Recurrent neural network (RNN)

Recurrent neural network is another type of deep learning neural networks [19]. It uses sequential data and time series data for prediction, training and testing. Like convolutional neural network, the recurrent neural network is also constructed by the formation of different layers such as the input, output and hidden layers. There are different types of recurrent neural networks such as one- to-one, one-to-many, many-to-one and many-to-many.

3.2 Android

Developed primarily for smartphones and tablets, Android [20] is a touchscreen mobile operating system built on an altered version of the Linux kernel and other open-source applications. Android is developed by the Open Handset Alliance, a consortium of developers, and is commercially sponsored by Google. The HTC Dream, the first Android smartphone sold commercially, was unveiled in November 2007 and released in September of that same year. With source code from the Android Open-Source Project (AOSP), which is mostly licensed under the Apache License2, it is free and open-source software. But most Android smartphones also have extra proprietary apps pre-installed. The most well-known of them is Google Mobile Services (GMS), which includes essential apps like Google Chrome, the online store Google Play, and the related Google Play Services development platform

3.2.1 Android studio

The official integrated development environment (IDE) for Android platform development is called Android Studio [22]. Under the terms of the Apache license, Android Studio is freely available. The purpose of Android Studio is to facilitate Android development exclusively.

You can begin developing Android applications on any of the following operating systems:

- Windows Vista, Windows 8/7, Windows 2003 (32- or 64-bit).
- Mac OS X (10.8–11.9.5) or later (Mavericks).
- The KDE or GNOME desktop.

We may download all of the open source tools needed to create Android applications from the internet. The list of applications that must be installed before beginning to program Android applications is provided below.
• Version JDK5 or higher for Java

https://www.android.com/intl/en_in/

1 https://en.wikipedia.org/wiki/Android_(operating_system)

Java Runtime Environment (JRE) 6

Android Studio

The next section – 4 discusses about the proposed methodology of the project "A deep-learning based android application for partially disabled people".

4. Methodology used

This section focuses on the proposed methodology of the project. After performing research over the problem statement (ref. to section – 2) following is the methodology adopted in this project:

a) Implementing the various libraries

The second part of the project includes the application of various libraries such as speech-to-text or text-to-speech which will further be used in various features of the applications such as mailing, sending SMS, chatting etc. Whereas, OpenCV library and implementation of various models/algorithms will be used for the object detection, color prediction, navigation and many more for the future work.

b) Interface for displaying the results

The interface will be based on android app development which will use HTTP protocols for the interlinking of the results obtained from the neural network with the user interface.

Thus, the proposed methodology is used for the comparison of the existing work accomplished by various researchers and scholars to obtains results for predicting a system that can be used as a virtual assistance to the partially disabled people. Further, the coming sub-sections discuss a brief description of the implementation, working and proposed methodology.

4.1 Proposed Methodology

This section of the report describes the overall methodology proposed including all the essential steps, procedure and diagrams for a better understanding of the proposed architecture for implementing a deep-learning based android application for partially disabled people. Thus, in order to understand the complete proposed methodology, this section is divided into the two parts: backend implementation and frontend implementation.

4.1.1 Backend implementation

In order to develop the backend part of the project "A deep-learning based android application for partially disabled people" various models/algorithms were built to make predictions on the given input. The first system constructed was the deployment of a speech-to-text and text-to-speed conversion system. This system will allow the user to operate the messaging functionality of the mobile application.

Figure - One shows the complete requirement to build the email system from hardware component to software components. It also shows different modules of the email system made. Following is the description of each module of the email system.
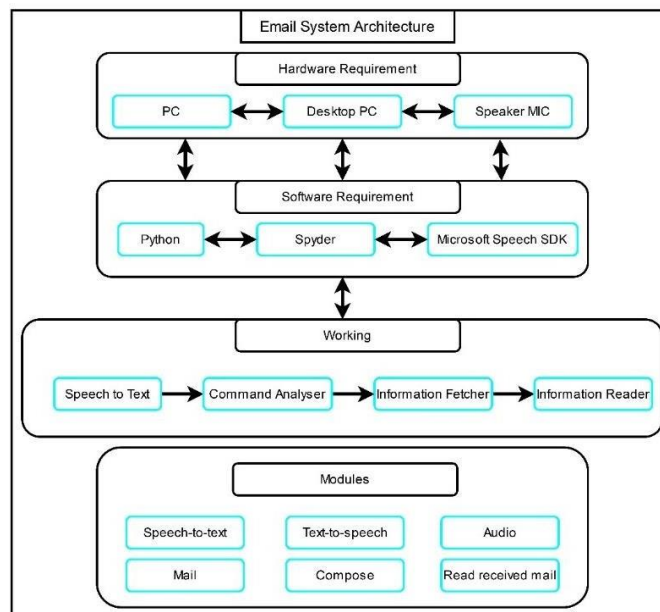

Fig. 1: Email system architecture

a) Speech-to-text

Speech-to-text modules allows user to provide an input in the form of speech which is further converted into text or it can also help users to obtain a speech output from the written text they have received. In order to

implement speech-to-text module the library used in this report project was "Speech_recognition". Speech recognition system basically converts the speech into text. It converts the spoken words in different language into text. Figure – 2 shows the algorithm of the speech recognition used to convert speech to text.
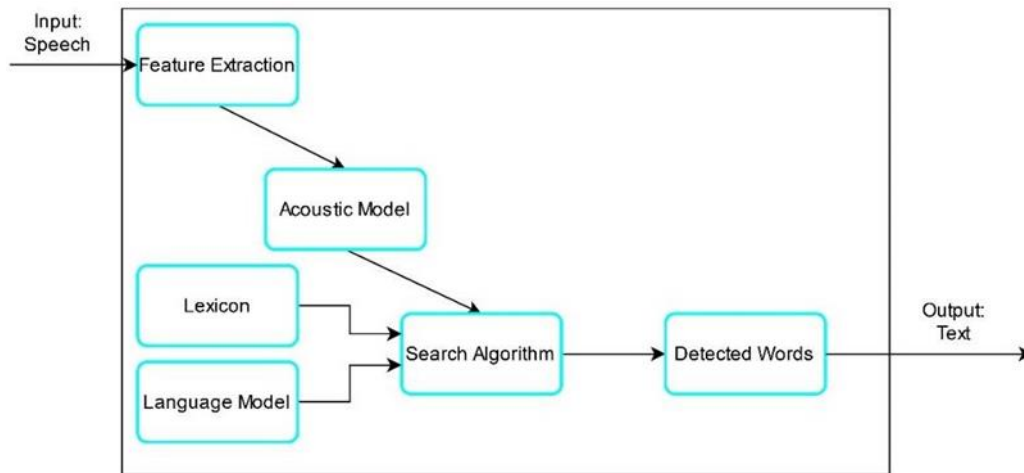
Fig. 2: Algorithm of speech recognition

b) Text-to-speech

This module will enable users to convert the text to speech. It will help the users to enable the content received be heard instead of reading. For this python has an inbuilt library known as the "Google Text-to-Speech" library. This library helps to convert the textual content into speech by providing a voice to the textual words. This library uses the working of natural language processing and digital signal processing to complete its task. Figure – 3 shows the flow of converting text to speech using google text-to-speech (gTTS).
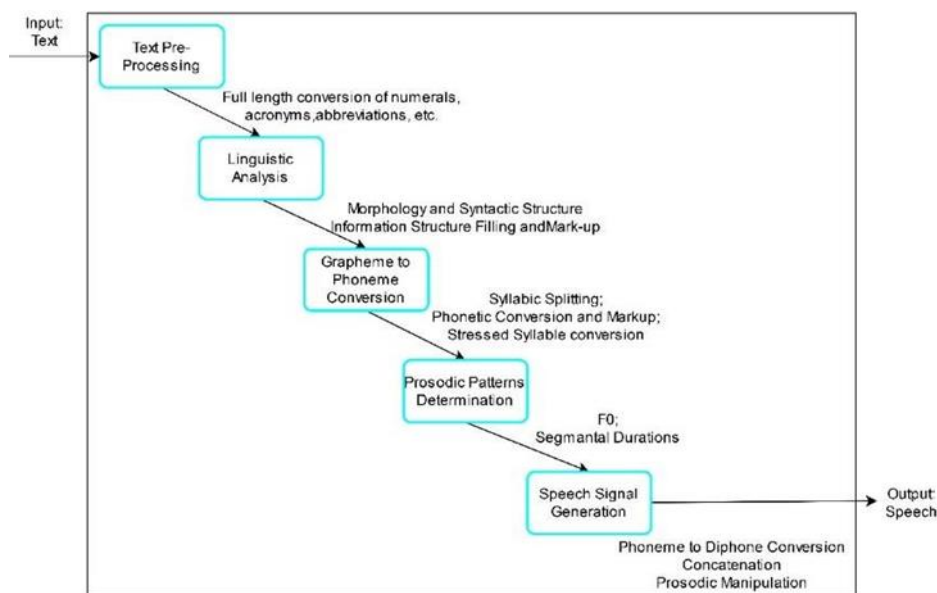

Fig. 3: Algorithm of gTTS

c) Audio

Audio modules refers to the module which is used to convert or store any audio related recordings. It is used to capture the audio spoken by the user. For this python has a library known as the "pyglet" library which helps the system to store or record the audio captured through the microphone of the mobile phone. "Hashlib" library is also used in this project to store any temporary audio file while working of the application.

d) Mail

Mail modules refers to sending any mail to another user. "Imaplib" library is used to send, receive and compose any email. Basically, imaplib library helps the system to build a connectivity between the system and the mailing server. In this project, G-mail server has been connected with the system through Imaplib library.

e) Compose

The compose modules is used to compose an email to be delivered to another user through either speech-to-text or text-to-speech modules. It also uses imaplib library for its proper functionality.

f) Read received mails

This module consists of reading the received mails via text-to-speech process. To perform and set up this modules imaplib library was used to establish the

connectivity between the module and the mailing server.

Thus, figure – 4 shows the overall functionality of the email sending and receiving system that can be used by the user:
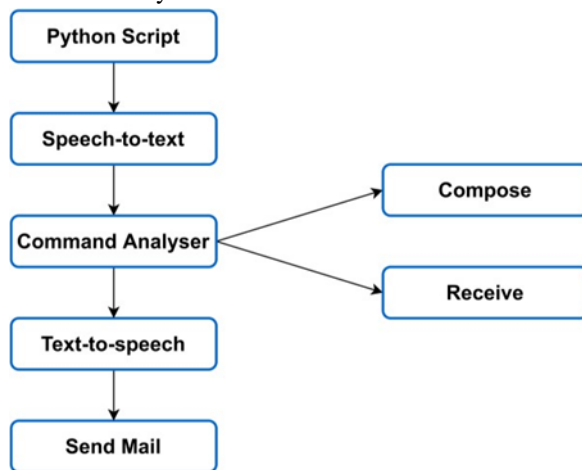

Fig. 4: Overall working of the email system

4.1.2 Frontend implementation

In the previous section, we discussed about the overall proposed methodology of the backend development. This section focuses on the frontend development i.e., providing an interface for the end users for proper functioning of the system. Now, in order to provide an interface for the end users usage android application was the most suitable approach. Following figure – 5 shows the overall working of the android application used to provide a frontend.
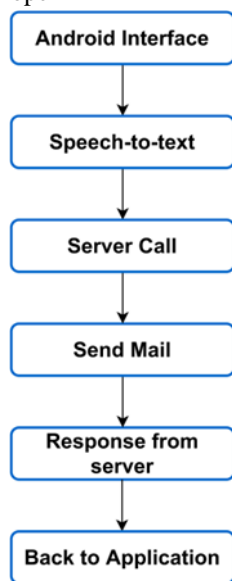

Fig. 5: Proposed working of the android application

Figure – 5 shows the proposed working of the android application which will be used to provide an interface to the end users. Till now in this project the basic application with the features has been implemented (ref. to section – 3). For future, the application with be integrated with the backend to provide a fully functional application with all the features included. The next section describes the step-by-step procedure followed for the formation of the deep-learning based android application for partially disabled people.

4.2 Procedure followed

This section of the report will discuss about the systematic procedure followed for implementing a deep-learning based android application for partially disabled people. Thus, following is the step- by-step procedure followed for implementing the system:

Step 1: Different python libraries such as GTTS, speech recognition, IMAPLib, pyglet and many more were used to implement speech-to-text and text-to-speech modules.

Step 2: Implementation of different modules such as compose mail, read mail, send mail, inbox setting etc. were done with the help of the inbuilt python libraries.

Step 3: Once the implementation phase was completed,

the system was tested by manually taking inputting from different users from diverse areas. Different inputs showed different results. Upon which accuracy and error scores were obtained for the built system.

Step 4: The backend implementation, further led to the implementation of the frontend which consist of the android structure and formation of an interface that will be further integrated with the backend system.

Step 5: Thus, the frontend was implemented using android, android studio, taking voice as an input and performing the desired functionalities.

5. Conclusion

Technology has widened its domain in the past few years. Every technology has come up with a huge change, which has made everything digital making it difficult for the physically challenged people to cope up with this rising innovation. Therefore, in order to provide an aid to the partially disabled people, this project aims at creating a deep-learning based android application that will enable the partially disabled user to perform all the functionalities present in their android application by either speaking the desired commands or writing the commands for the mobile application to execute. The application is capable to fulfill all the requirements of the targeted users making it a user-friendly interface. Unlike siri, google voice assistant it provides some special features such as email sending, receiving, reading the text messages, detecting objects, providing speech navigation, color detection and many more. This application is a one-in-all combination of the android application, which will serve as a huge, assert to the partially disabled people providing them the capability to introduce themselves to the challenging world. For implementing this application various python libraries such as speech recognition, GTTS, STT, TTS, pyglet etc. were used. Similarly, for the frontend application java, xml and android studio tool kit was used. Upon implementing the frontend and backend of the system, unit testing was performed for the implemented modules. The accuracy therefore obtained was 97.714% which is the highest among all the exiting models and techniques used for voice recognition emailing system.

Thus, the modules obtained the desired accuracy and concluded that the unit testing of both the sections is successful. For future, the modules can be further integrated by adding some more features such as object detection, color prediction, navigation, calling system and many more. Thus, the frontend can also be further deployed with the backend to obtain a complete simple android application for the partially disabled people.

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