Final Report

A Real Time Communication System Powered By AI For Specially Abled

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REAL TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

1.INTRODUCTION

1.1 PROJECT OVERVIEW

People with disabilities exist in our society. Although technology is constantly evolving, little is being done to improve the lives of these people. It has always been difficult to communicate with someone who is deaf and mute. It is quite challenging for silent people to communicate with non-mute people. because hand-sign language is not taught to the general public. It might be quite challenging for them to communicate at times of crisis. In circumstances where other modes of communication, like speech, are not possible, the human hand has remained a common alternative for information transmission. To have proper communication between a normal person and a handicapped person in any language, a voice conversion system with hand gesture recognition and translation will be very helpful.

1.2 PURPOSE

The project intends to create a system that can translate speech into acceptable sign language for the deaf and dumb, as well as translate sign language into a human voice in the desired language to communicate a message to normal people. A convolutional neural network is being used to build a model that is trained on various hand motions. On the basis of this model, an app is created. With the help of this app, people who are deaf or dumb can communicate using signs that are translated into speech and human-understandable words.

2. LITERATURE SURVEY

2.1 Existing Problem

There are handicapped people in our society. Although technology is constantly evolving, little is being done to improve the lives of these people. It has always been difficult to communicate with someone who is deaf-mute. It is challenging for mute persons to communicate with hearing people. because hand sign language is not taught to the general public. It might be quite challenging for them to communicate at times of crisis. In circumstances where other forms of communication, like speech, are not possible, the human hand has remained a common choice for information transmission. To have a proper conversation between a normal person and an impaired person in any language, a Voice Conversion System with Hand Gesture Recognition and Translation will come in handy.

2.2 References

Design of Communication Interpreter for Deaf and Dumb Person was published by Pallavi Verma (Electrical and Electronics Department, Amity University, Greater Noida, Uttar Pradesh, India), Shimi S. L (Assistant Professor, NITTTR, Chandigarh, India), Richa Priyadarshani (Electrical and Electronics Department, Amity University, Greater Noida, Uttar Pradesh, India).

International Journal of Science and Research (IJSR) · Jan 2013

Development of full duplex intelligent communication system for deaf and dumb people was published in the year January 2017

DOI:10.1109/CONFLUENCE.2017.7943247

At 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence (Confluence) by Surbhi Rathi Department of Information Technology, Yeshwantrao Chavan College of Engineering Nagpur, India and Ujwalla Gawande, Department of Information Technology Yeshwantrao Chavan College of Engineering Nagpur, India.

A Review Paper on Sign Language Recognition for The Deaf and Dumb published by R Rumana(B.E Graduate(IV year), Department of Computer Science and Engineering, SCSVMV, Kanchipuram) , Reddygari Sandhya Rani(B.E Graduate(IV year), Department of Computer Science and Engineering, SCSVMV, Kanchipuram) , Mrs. R. Prema(Assistant Professor, Department of Computer Science and Engineering, SCSVMV, Kanchipuram).

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2.3 PROBLEM STATEMENT DEFINITION

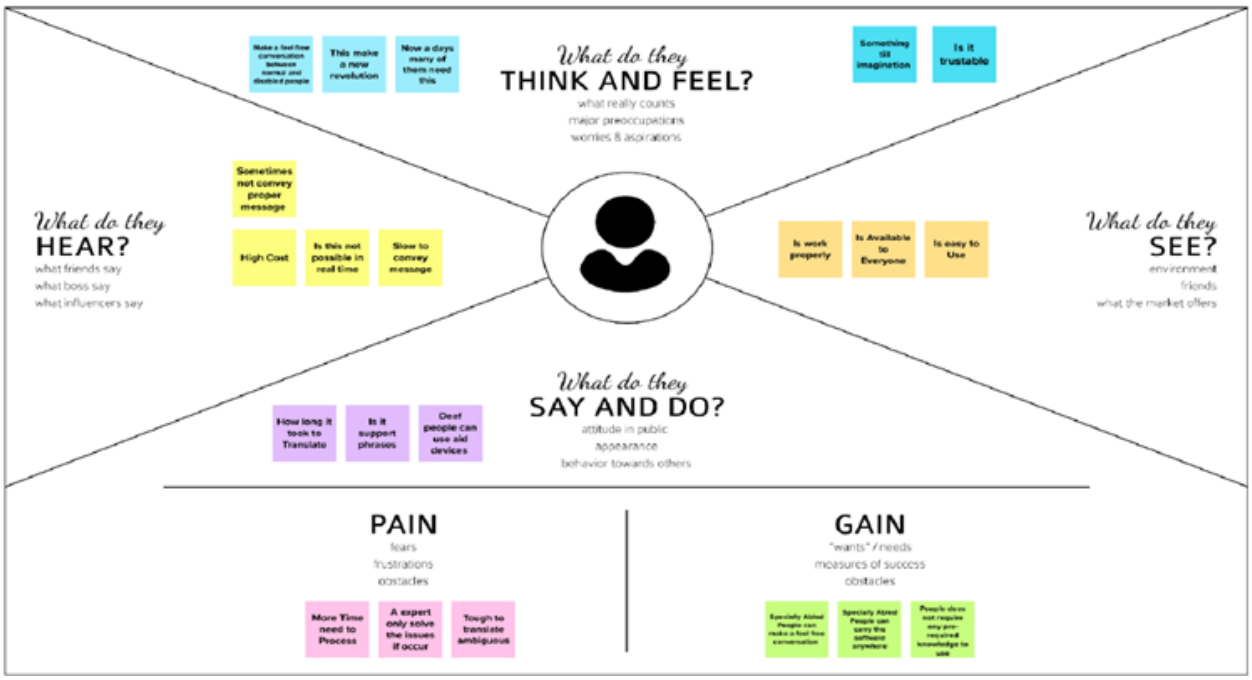
This venture is to plan and actualise a framework that can make an interpretation of finger spelling to discourse and the other way around by utilizing acknowledgement and combination methods for every methodology. Such a framework will empower correspondence with the consultation impeded when no other methodology is accessible. Albeit gesture based communication is the fundamental correspondence mode of the consultation weekend, as far as programmed acknowledgment, finger spelling has the benefit of utilizing predetermined number of finder signs, comparing to the letters/sounds in the letters in order.

I AM	I'M TRYING TO	BUT	BECAUSE	WHICH MAKES ME FEEL
DEAF	communicating with others	unable to recognize normal people speech	its hard for me to understand other people's lip sync	frustrated and regretful
MUTE	express my thoughts	I can't c ɔnvey my feelings	normal people don't understand what im trying to say	more depressed
A PARENT OF PARTIAL DEAF - MUTE CHILD	teach sign language to my child	he doesnt listen to me.	it not interesting to him to learn	downhearted and discouraged
A CHILD OF DEAF MUTE PARENTS	understand what they are trying to say	sometimes im unable to understand them.	their signed action are unknown for me	sad

3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

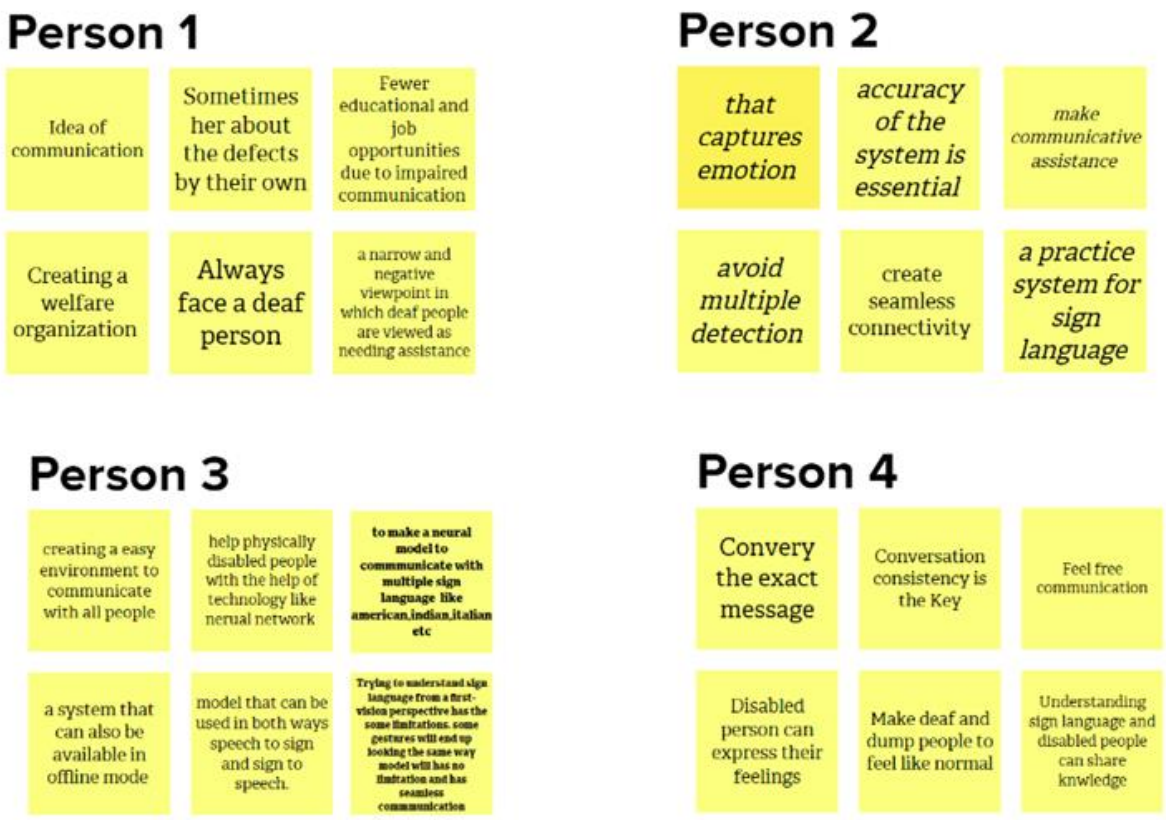
An empathy map is a simple, easy-to-digest visuals that captures knowledge about an user's behaviour and attitude. It is an useful tool to help team build a better understanding for their users. Creating an effective solution requires understanding the true problem he person who is experiencing it.



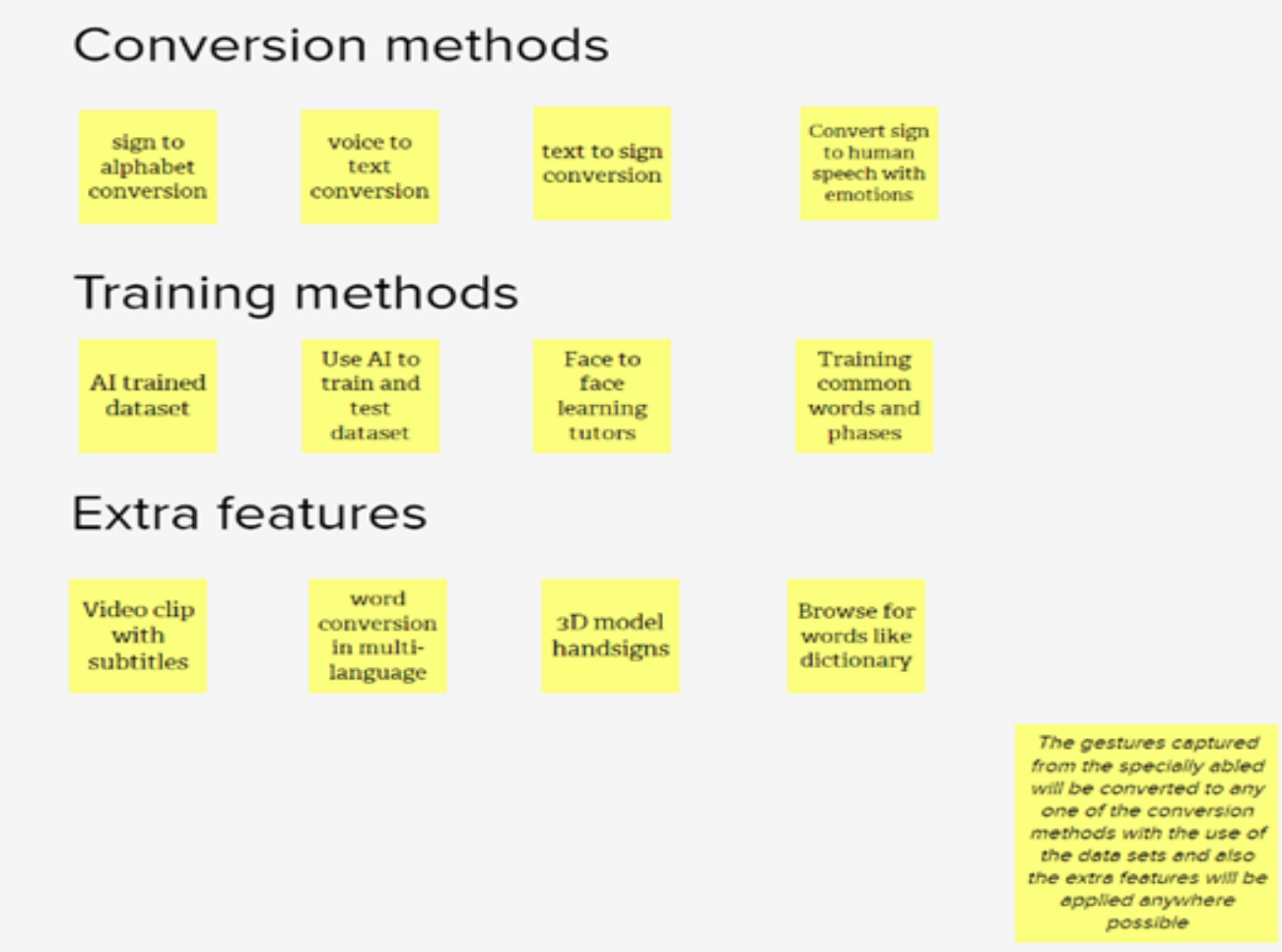
3.2 IDEATION AND BRAINSTORMING

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

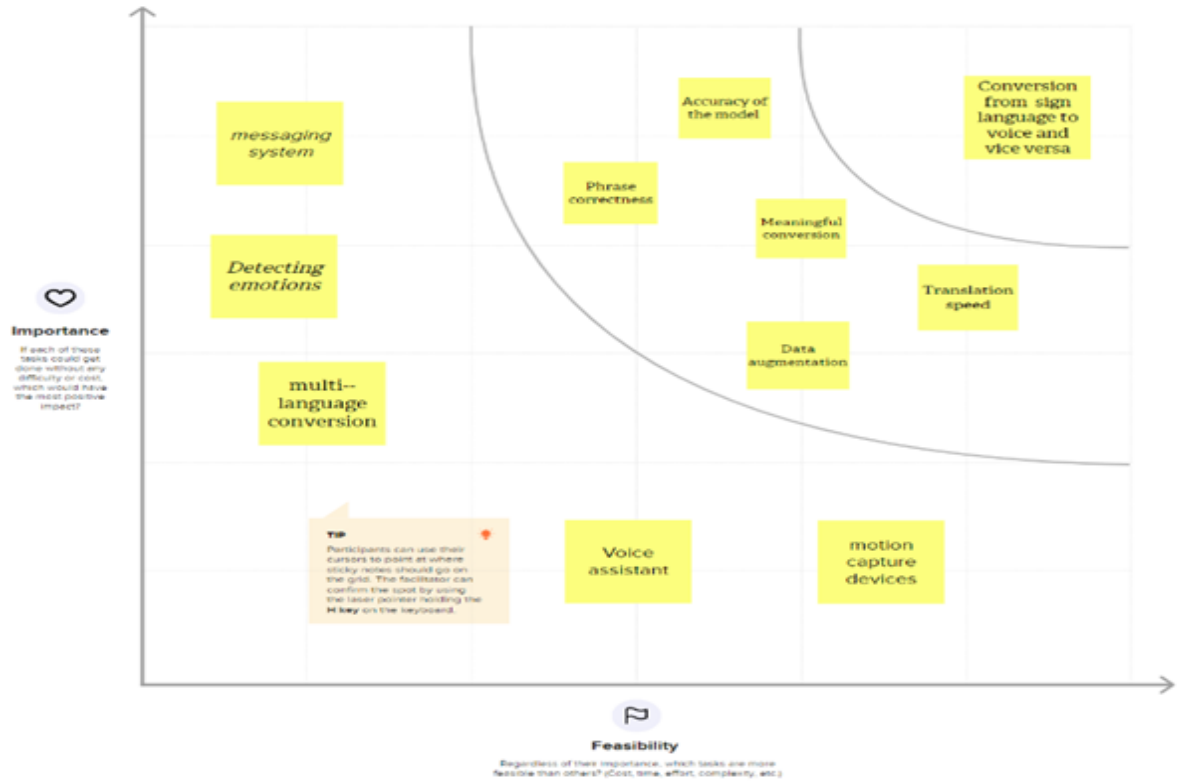
3.2.1 BRAINSTORM



3.2.2 GROUP IDEAS



3.2.3 PRIORITIZATION



3.3 PROPOSED SOLUTION

Problem Statement (Problem to be solved):

This programme can facilitate communication between those who have special needs and those who do not, as well as the other way around.

Idea / Solution description:

By employing AI technology to import the relevant libraries into the Python code, these problems can be fixed. This research presents a prototype assistive system for Deaf-mute people to bridge the communication gap with hearing people. With the help of this tool, a person can communicate through hand gestures to recognise a variety of gesture-based signs. The controller for this assistive system was developed to analyse gesture images using a range of image processing methods and deep learning models to recognise the sign. This sign is converted into voice in real time using a text-to-speech module.

Novelty / Uniqueness:

This project was developed to address the need to translate a variety of modalities, such as images into Natural Language (NL) text, into a language that deaf and blind people can understand and communicate in. The prototype created as a result of this research includes cameras attached to dark-coloured spectacles, along with a travel-sized computer, speaker, and microphone. However, all of the technologies we looked into up until this point were only focused on one parameter or degree of disability among the three: blindness, deafness, and dumbness. We have since discovered a variety of technologies that can help people with disabilities communicate more easily among themselves and with the rest of society. There is currently no technology that is sufficiently developed to act as a general solution to any of these three constraints. Therefore, in order to accomplish this, we propose a generic strategy that anyone with a combination of these three disabilities might use to picture oneself as a part of this magnificent setting.

Social Impact / Customer Satisfaction:

Due to society's poor command of ASL and lack of awareness of the Deaf community, Deaf individuals face challenges in many facets of everyday life, including employment, higher education, healthcare, mental health services, emergency preparedness, technology, and government benefits. The development of expressive and receptive communication skills (speech and language) is hampered. Academic achievement is lowered by language-related learning difficulties. Communication issues usually lead to social isolation and a poor self image.

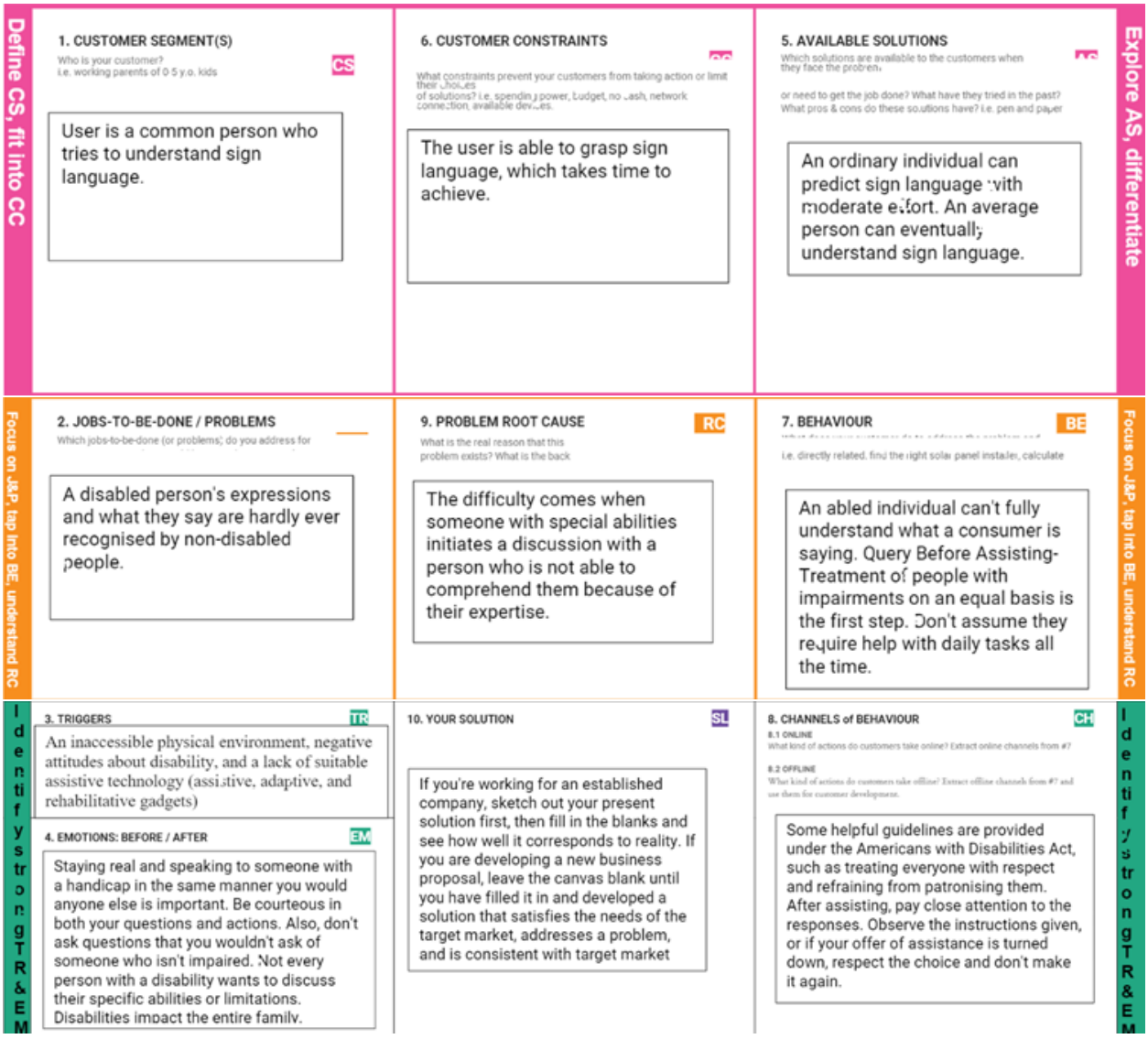
Business Model (Revenue Model):

A business must continuously keep its clients in mind in an environment where the pace is accelerating if it wants to keep their satisfaction and, consequently, their loyalty. Offering ICT based services to people with intellectual disabilities is the case company's main focus. The case firm has concluded that in order to maintain and grow its revenue, it is essential to improve the customer experience because it has already greatly increased its market share and expanded its operations in its primary client categories. The challenge the company is now facing is to develop a business plan and continue offering customers satisfactory service in order to maintain and boost the company's returns.

Scalability of the Solution:

This is typically accepted in the Deaf community, but hearing people might not comprehend it. Directness in communication is regarded to be one aspect of the Deaf culture. Two more indications for communication are touch and physical proximity.

3.4 PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registrationthrough Gmail
FR-2	User Confirmation	Confirmation via Email Confirmationvia OTP.
FR-3	Create connection	Create a connection between users
FR-4	Access the input	Get the user input through webcam/camera/voice
FR-5	Conversion	Convert the input to voice and voice to sign language

4.2 NON-FUNCTIONAL REQUIREMENTS:

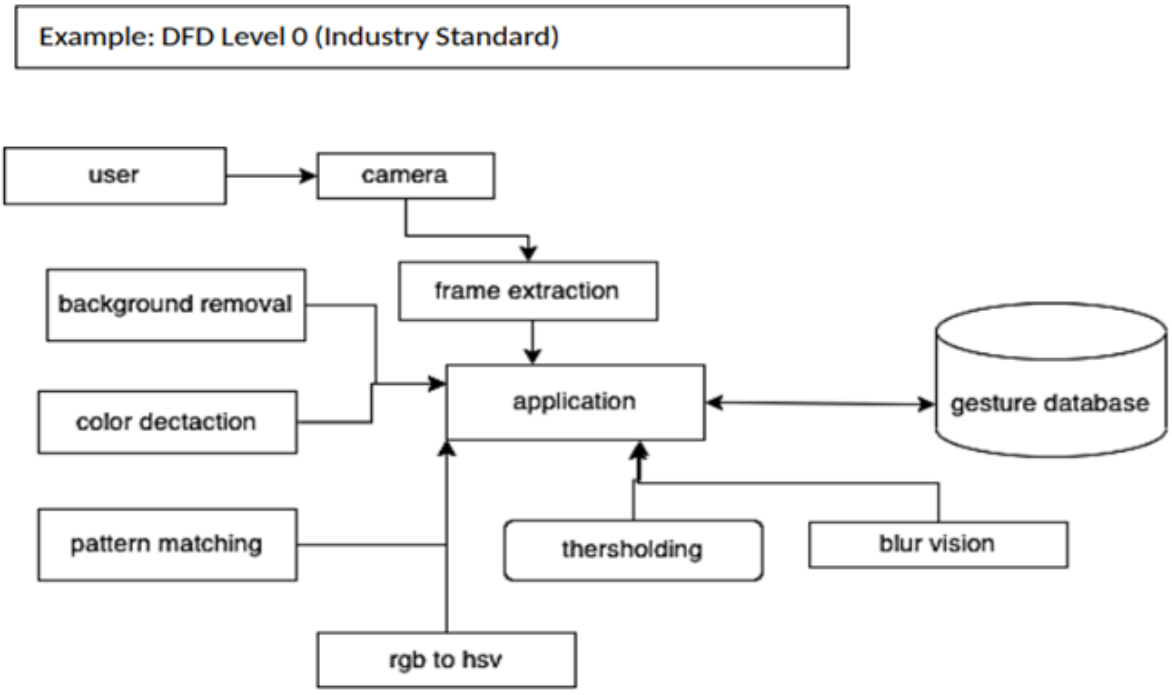
Following are the non-functional requirements of the proposed solution.

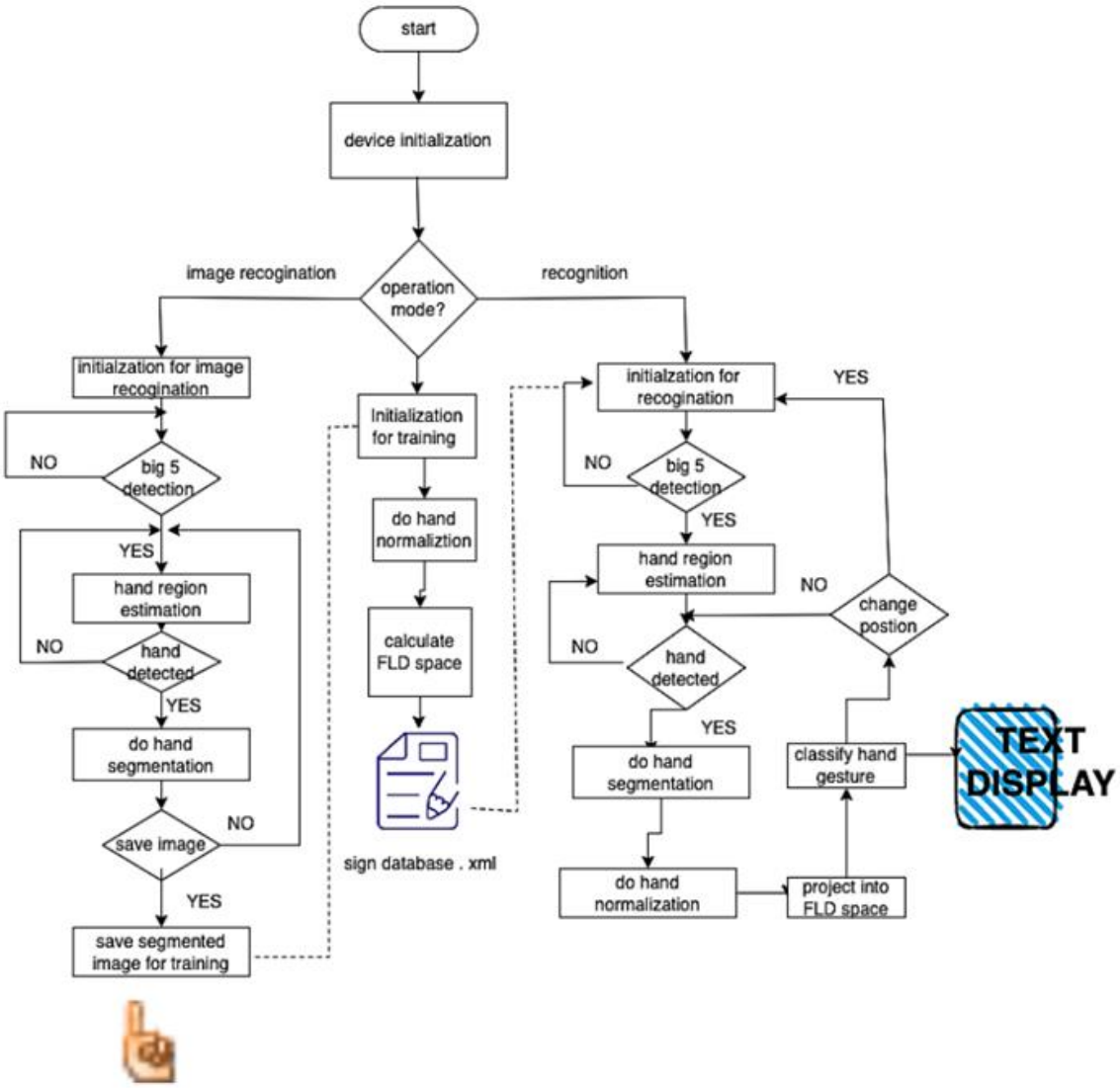
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Making a UI user-friendly creates an easy approach to comprehend it.
NFR-2	**Security**	Making the connection between the users without any interference from the external user.
NFR-3	**Reliability**	The application must run smoothly and without errors.
NFR-4	**Performance**	The speed at which a website's pages load and appear in a web browser is referred to as website performance.
NFR-5	**Availability**	The ability of users to access and use a website or web service is referred to as website availability (also known as website uptime). Usually, a website's availability is expressed as a percentage for a specific period of time.

5. PROJECT DESIGN

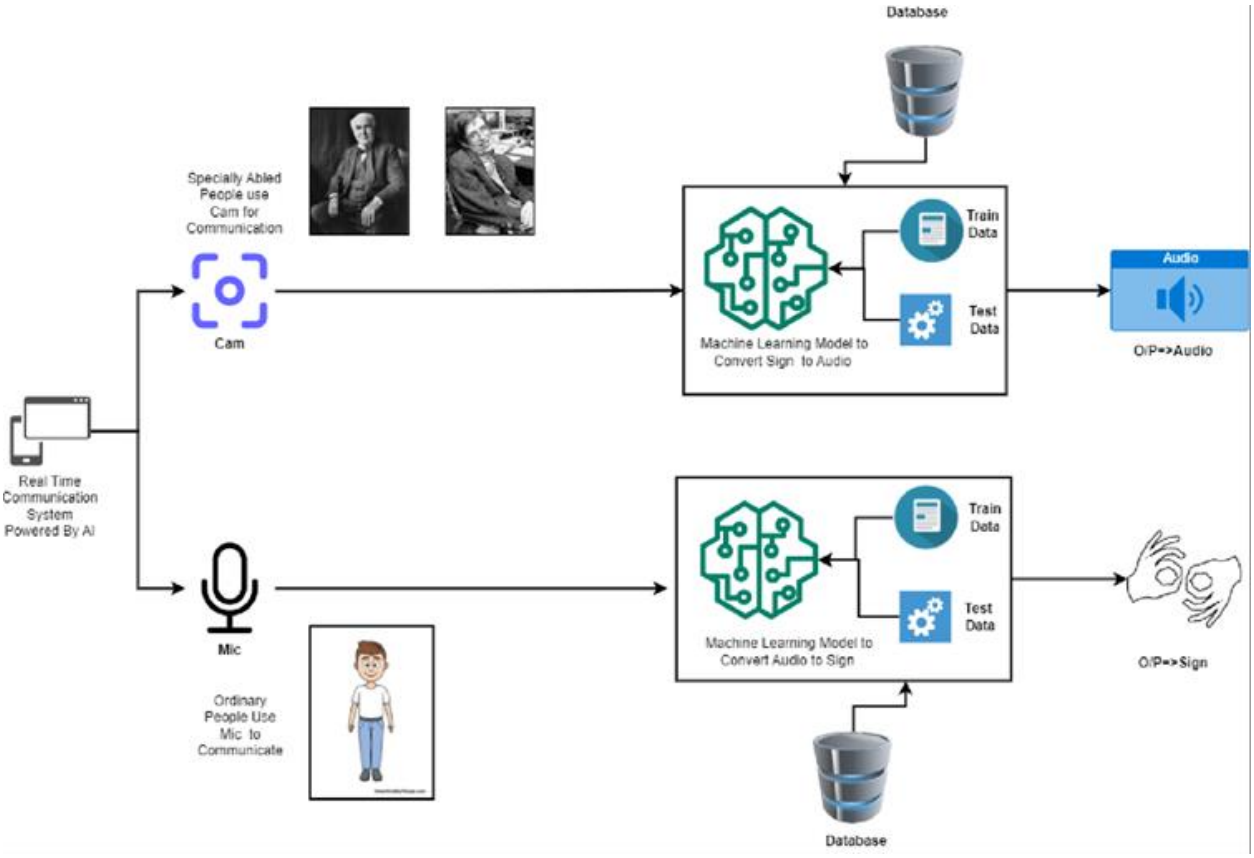
5.1 DATA FLOW DIAGRAM

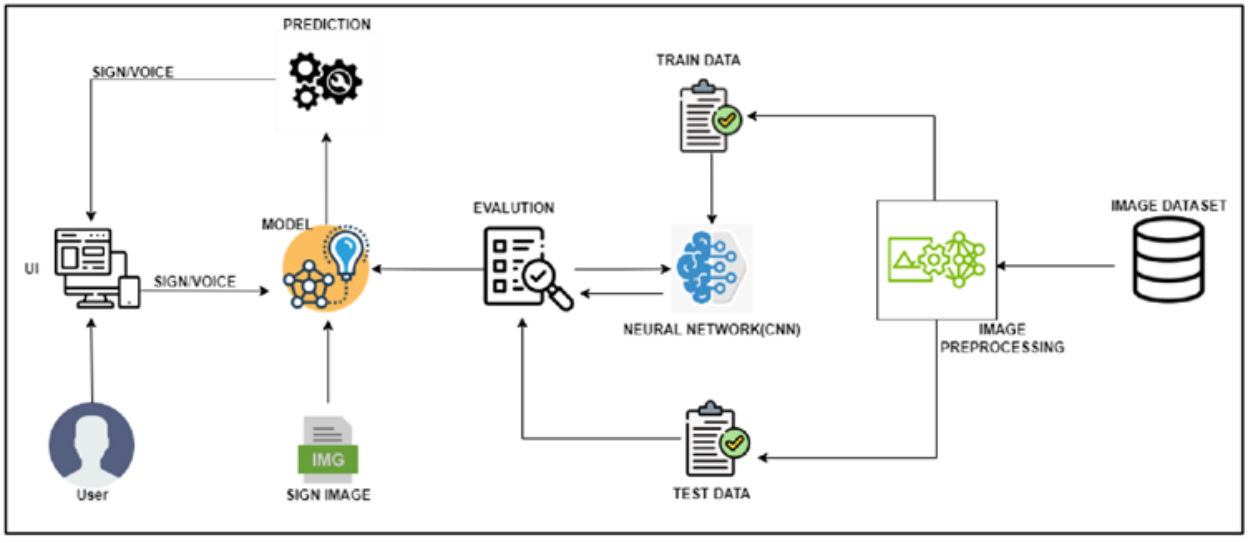
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.




start
device initialization
operation mode?
image recogination
recognition
initialzation for image recogination
big 5 detection
NO
YES
hand region estimation
hand detected
NO
YES
do hand segmentation
save image
NO
YES
save segmented image for training
Initialization for training
do hand normaliztion
calculate FLD space
sign database . xml
initialzation for recogination
YES
big 5 detection
NO
YES
hand region estimation
change postion
NO
hand detected
NO
YES
do hand segmentation
do hand normalization
project into FLD space
classify hand gesture
TEXT DISPLAY

5.2 SOLUTION AND TECHNICAL ARCHITECTURE





5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer *(Desktop user)*	Registration	USN-1	**Not Required**	The user may access my dashboard or account.	High	Sprint-1
	Login	USN-2	**Not Required**		High	Sprint-1
	Dashboard	USN-3	**Not Required**			
Customer *(Desktop user)*	**Main page**	USN-4	Once user click, user can enter the website as a user and get the instructions for using the software.	After clicking, the user may access the website.	Medium	Sprint-1
Customer (Desktop user)	**Guidelines**	USN-5	The user can read the instructions to learn how the application works.	The user can review the instructions.	Medium	Sprint-1
Customer *(Desktop user)*	**Convert Sign**	USN-6	A user can access the Main screen by clicking the Convert sign button.	When a user clicks the Convert button, I am sent to the main screen.	Medium	Sprint-2
Customer *(Desktop user)*	**Camera(Hand movement detection)**	USN-7	A user can enter text by waving my hand gestures in front of the camera.	My hand signal may be correctly displayed to the camera by the user.	High	Sprint-2
Customer *(Desktop user)*	**Voice mode**	USN-8	Once the text has been received, the user can select the voice option to hear the text spoken.	The voice mode, which presents the text as speech, can be selected by the user.	High	Sprint-2
Customer Care Executive	**Provide the necessary functionalities required to use the app.**		Users may submit the necessary camera specifications and other details as executives, ensuring the software runs well.	The necessary camera specifications and other information can be provided by the user.	Low	Sprint-1
Customer Care Executive	**Check the performance of the app**		A user can review the use and enquiries received from end users in their capacity as an executive.	The use and questions received from the end users are viewable by the user.	Medium	Sprint-1
Administrator	**Receive queries based on the usage**		In order to help the users of the app utilise it successfully, an administrator may take the questions from the customer service and repeat the testing step while loading the other indicators in the dataset.	The user can ask the customer service representative questions and repeat the necessary steps.	High	Sprint-2

6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

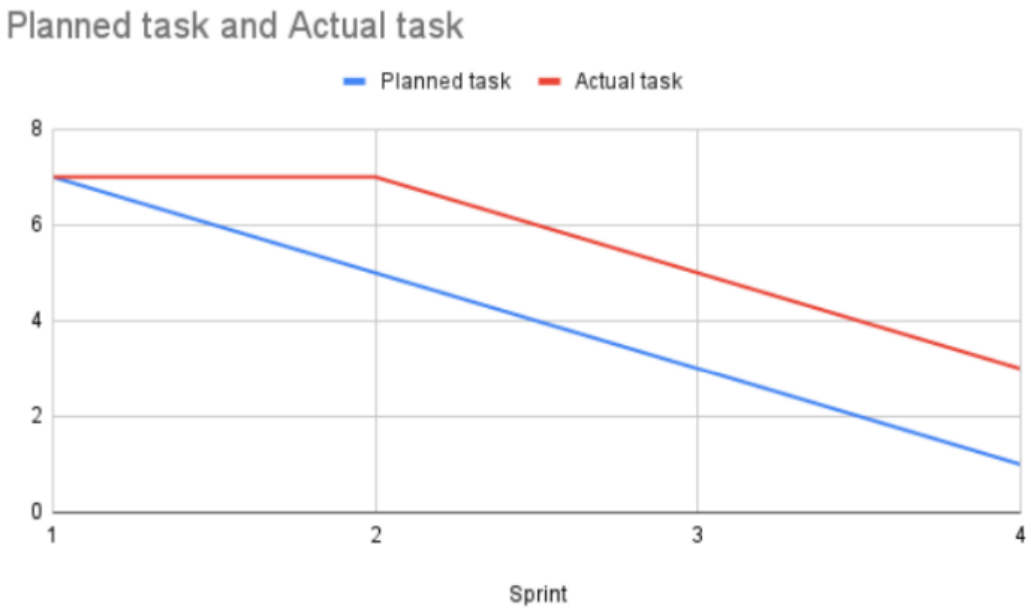
Sprint	Functional Requirement (Epic)	User story number	User story/Task	Story Points	Priority	Team members
Sprint-1	Pre requistes	USN-1	As a user, I can install the pre requistes libraries	3	High	Srinivasan
Sprint-1	Project Structure	USN-2	As a user, I will design a project structure comfortable for project deployment.	2	Medium	Richard
Sprint-1	Data collection	USN-3	As a user, I will download the dataset and extract it.	1	Low	Rahul Fernandez
Sprint-1	Image Preprocessing	USN-4	As a user, I will run the image processing model.	2	High	Srinivasan
Sprint-2	Model Building	USN-5	As a user, I will processing The images by building model.	3	High	IndiraKumar
Sprint-2	Test The Model	USN-6	As a user, I must evaluate the model with external data and detect accuracy.	2	High	IndiraKumar
Sprint-3	Build The HTML Page	USN-7	As a user, I must need a web UI for performing tasks.	1	Low	Richard
Sprint-3	Build a Flask Applicaion	USN-8	As a user, I can access the site using mobile/ desktop in specific port with tasks.	3	High	Rahul Fernandez
Sprint-4	IBM Cloud Registration	USN-9	As a user, I need a cloud place for deploy the Application.	2	Medium	Srinivasan
Sprint-4	Train Image Classification Model	USN-10	As a user, I must train a model to convert sign to audio and audio to sign.	3	High	IndiraKumar

6.2 SPRINT DELIVERY SCHEDULE

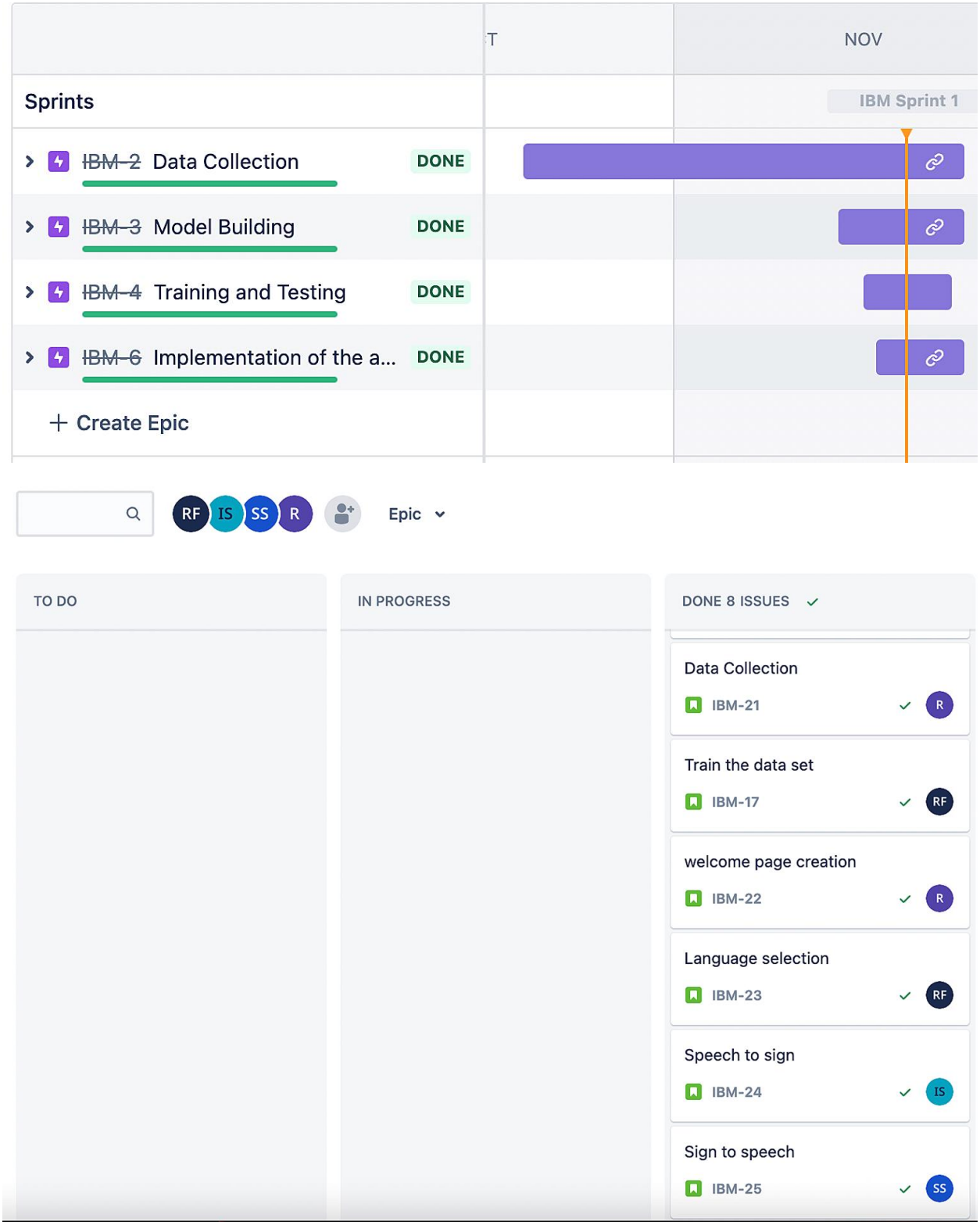
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date(Planned)	Story Points Completed(As on planned end date)	Sprint Release Date(Actual)
Sprint-1	8	6 Days	24 October, 2022	29 October, 2022	8	29 October, 2022
Sprint-2	5	6 Days	31 October, 2022	05 November, 2022	5	05 November, 2022
Sprint-3	4	6 Days	07 November, 2022	12 November, 2022	7	12 November, 2022
Sprint-4	5	6 Days	14 November, 2022	19 November, 2022	5	19 November, 2022

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



6.3 REPORT FROM JIRA



7. Coding and Solutioning

7.1 Libraries to be installed

- ✓ **pip install flask**
- ✓ **pip install opencv-python**
- ✓ **pip install numpy**
- ✓ **pip install keras**
- ✓ **pip install tensorflow**
- ✓ **pip install SpeechRecognition**
- ✓ **pip install moviepy**
- ✓ **pip install scikit-image**
- ✓ **pip install gTTS**
- ✓ **pip install Pillow**
- ✓ **pip install scikit-image**
- ✓ **pip install imutils**
- ✓ **pip install playsound**

7.2 Real time sign to speech

People who are unable to talk typically use sign language to communicate. The majority of people find it extremely challenging to communicate with silent persons since they are unable to grasp Universal Sign Language (unless they have studied it). The core of this project is a tool that allows silent people and others communicate with one another. Our technology makes use of a CNN-built model that can recognise sign languages in real time. It quickly recognises the sign and provides feel-free cover for those with special needs.

```
img = cv2.imread('static/image.jpg') # read a image

img=resize(img,(64,64,1)) # resize a image

img=image.img_to_array(img) # Convert image into array values

img=np.expand_dims(img,axis=0)

if(np.max(img)>1):

        img=img/255.0

prediction=model.predict(img)# predict the vaule using trained model
```

```
prediction=np.argmax(prediction, axis=1)

pred=vals[prediction[0]] # return predicted letter
```

7.3 Real time speech to sign

We can use JavaScript to recognise voice thanks to the Web Speech API. JavaScript makes it very simple to recognise speech in a browser and then extract the text from the speech for use as user input. The voice is translated into text using the Speech Recognition object, which is subsequently shown on the screen as signs. This can be accomplished by our technology in real time. Any language that the user is trying to speak in can be recognised by it. But only the Chrome browser is supported for this API. The live example below will function if you are viewing this example in another browser.

```
r=sr.Recognizer() #listen a auido

file=sr.AudioFile("Speech/audio.mp3")

   with file as source:

      audio_data = r.record(source)#record a source audio

   text = r.recognize_google(audio_data, language='en-IN', show_all=True)

   text=text['alternative']

   text=text[0]

   text=text['transcript']# predict a text using source audio
```

7.3 ASL Learning module and Reference

This is module consist of basic learning resources to understand American sign language. The page will navigate to the particular resources so that users can easily get started with the sign language.

8.Testing

8.1 Test Cases

• Verify if user can see the options when user clicks the URL

• Verify if the UI elements are getting displayed properly

• Verify if the user is getting redirected to the sign to speech page

• Verify if the application can convert the sign to speech

Verify if the user can exit the sign to speech page

• Verify if the user is getting redirected to the speech to sign page

• Verify if the UI elements are being displayed

• Verify if the application can convert speech to text on clicking voice to text button.

• Verify if the user can exit the speech to sign page.

8.2 User Acceptance Testing

				Date	17 Nov 22							
				Team ID	PNT2022TMID27182							
				Project Name	Project - Real-Time Communication System P							
				Maximum Marks	4 marks							
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
HomePage_TC_OO1	UI	Home Page	check all the elements are loading proper.	OS,Browser,Internet Connection	1.Enter URL and click go 2.It gets user to website page	URL For Website	Home page should display with UI elements	Working as expected	Pass	NA	N	NA	Richard, Rahul Fernandez
HomePage_TC_OO2	UI	Home Page	Verify the Navigations are working proper	OS,Browser,Internet Connection	1.Enter URL and click go 2.Home Page is display 3.Navigationa are provides a.Sign to Speech b.Speech to SIgn c.Learn Sign language d.ASL Alphabet	URL For Website	Navigations should redirect correct webpage	Working as expected	Pass	NA	N	NA	Indirakumar, Rahul Fernandez
SigntoSpeechPage_TC_OO1	Functional	Sign to Speech page	Verify user webcam is properly stream frames	OS,Browser,Internet Connection,Webcam	1.Go to the Home Page 2.Click on Sign to Speech button 3.Redirect to Sign to Speech Page 4.Webcam will Turn on 5.User's Video will display on the page	Give access for webcam	User's webcam should turn on and capture the frames	Working as expected	Pass	NA	N	NA	Indirakumar, Srinivasan
SpeechtoSignPage_TC_OO1	Functional	Speech to Sign page	Verify user voice is properly transmit and predict correctly to audio	OS,Browser,Internet Connection,Desktop Mic and Specker	1.Enter URL and click go 2.Click on Speech to Sign Button 3.The Page redirect to Speech to Sign page 4.Click Start button and Speak 5.Click Stop button after complete the sentence	Speak Something	System should record user voice and predict correctly	Working as expected	Pass	NA	N	NA	Indirakumar, Rahul Fernandez
SignStreamPage_TC_OO1	Functional	Sign Stream page	Verify user's audio is present and convert audio into sign	OS,Browser,Internet Connection	1.After Audio prediction from Speech to Sign Page 2.Click on Stream button 3.Redirect to Stream Page 4.Audio will Display in Sign language 5.Click Back Button for return to Speech to Sign Page	Provide Predicted word	Detect Predicted word and Convert it into Sign Language Letters	Working as expected	Pass	NA	N	NA	Indirakumar, Srinivasan
SigntoSpeechPage_TC_OO2	Functional	Sign to Speech page	Verify Hand SIgn Predicting	OS,Browser,Internet Connection, Webcam	1.Enter URL and click go 2.Click on Sign to Speech button 3.Webcam Live will display 4.Show Hand inside the green rectangle box 5.Sign Letter will predicted and Display in middle of the webcam screen	Show Hand Sign inside the recctangle box	Detect the Hand sign Letter present inside the rectangle box	Working as expected	Pass	NA	N	NA	Indirakumar, Richard
SigntoSpeechPage_TC_OO2	Functional	Sign to Speech page	Verify Predicted sign is translated in voice	OS,Browser,Internet Connection, Webcam,Speaker	1.In Sign to Speech Page 2.Webcam Live will display 3.Sign Letter will predicted and Display in middle of the webcam screen. 4.Click on Play & Clear button, Predicted word is say in voice and displaying word is cleared	Provide Predicted Hand Signs	Detect Predicted sign and Convert into voice	Working as expected	Pass	NA	N	NA	Indirakumar, Srinivasan

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

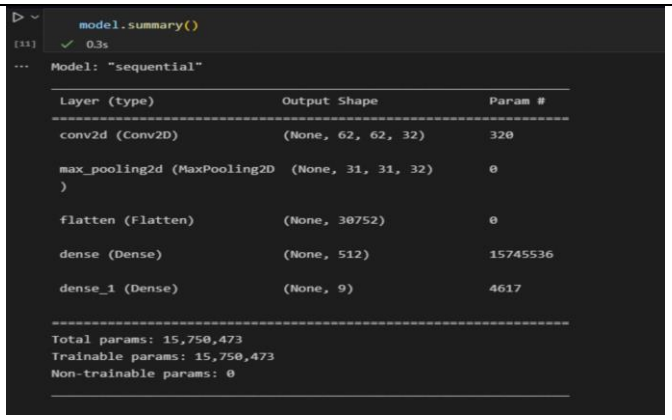
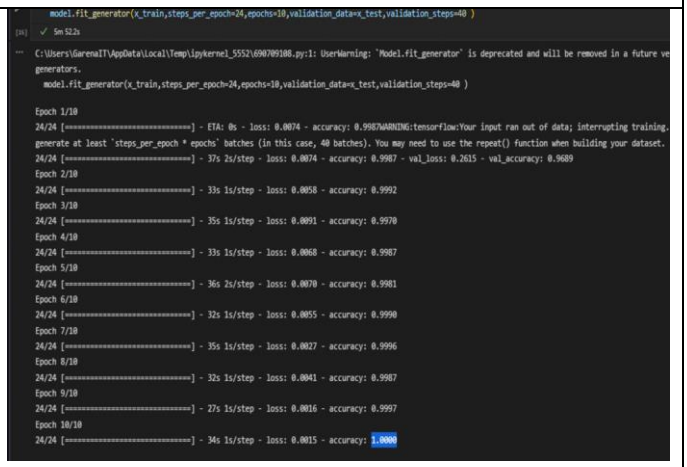
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	8	4	2	3	17
Duplicate	2	0	3	0	5
External	3	3	0	1	7
Fixed	5	2	4	12	23
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	0	0
Totals	18	9	11	17	55

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	10	0	0	10
Security	3	0	0	3

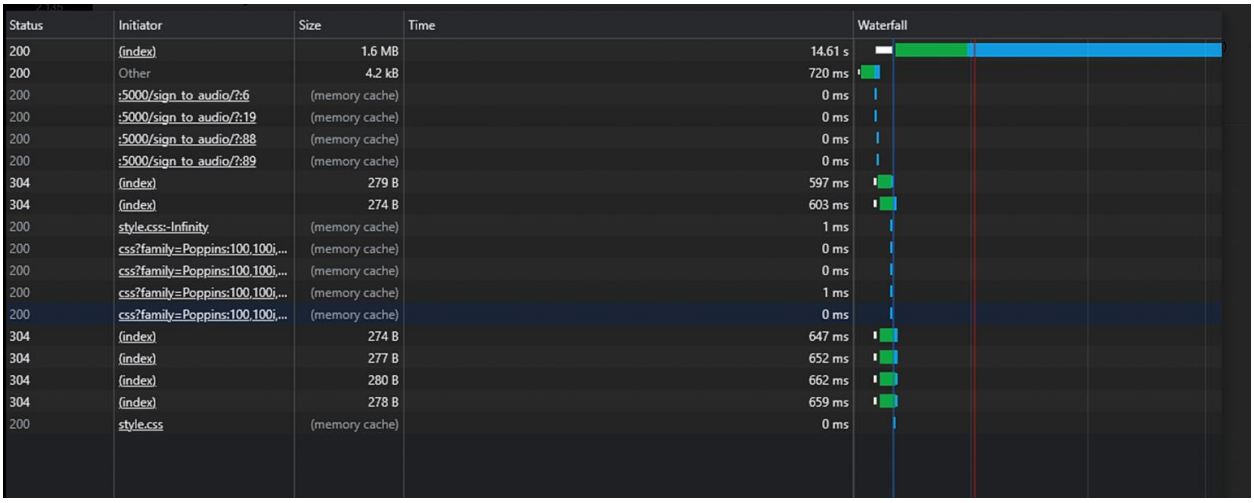
8.3 Performance Testing

S.No	Parameter	Values	Screenshot
1	Model Summary	Total params: 15,750,473 Trainable params: 15,750,473 Non-trainable params: 0	
2	Accuracy	Training Accuracy - 1.0000 Validation Accuracy - 0.9689	

9.Results

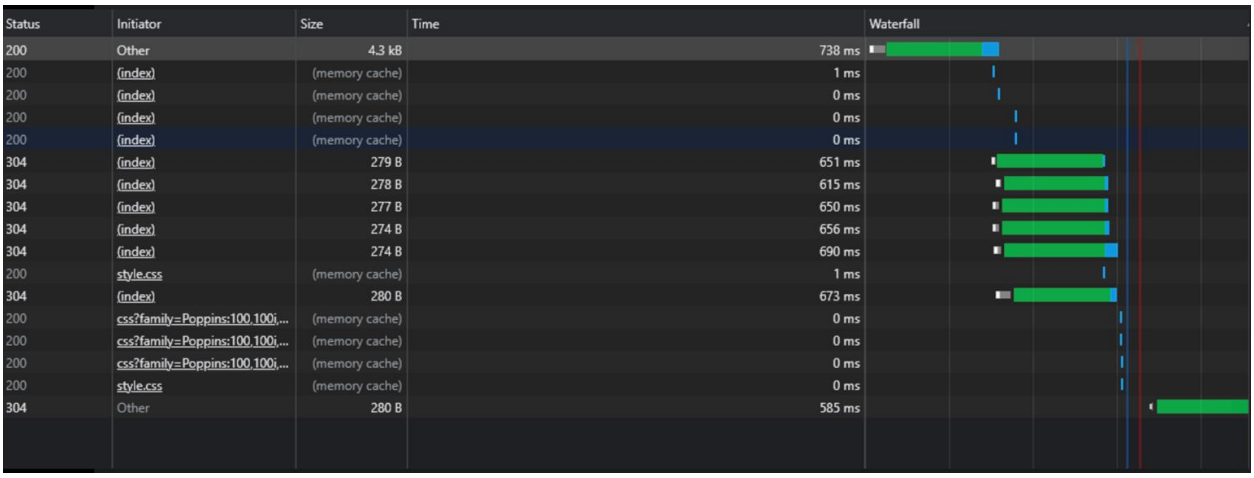
Performance Metrics

For Sign to speech



Status	Initiator	Size	Time	Waterfall
200	(index)	1.6 MB	14.61 s	
200	Other	4.2 kB	720 ms	
200	:5000/sign_to_audio/?:6	(memory cache)	0 ms	
200	:5000/sign_to_audio/?:19	(memory cache)	0 ms	
200	:5000/sign_to_audio/?:88	(memory cache)	0 ms	
200	:5000/sign_to_audio/?:89	(memory cache)	0 ms	
304	(index)	279 B	597 ms	
304	(index)	274 B	603 ms	
200	style.css:-Infinity	(memory cache)	1 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	1 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
304	(index)	274 B	647 ms	
304	(index)	277 B	652 ms	
304	(index)	280 B	662 ms	
304	(index)	278 B	659 ms	
200	style.css	(memory cache)	0 ms	

For Speech to sign



Status	Initiator	Size	Time	Waterfall
200	Other	4.3 kB	738 ms	
200	(index)	(memory cache)	1 ms	
200	(index)	(memory cache)	0 ms	
200	(index)	(memory cache)	0 ms	
200	(index)	(memory cache)	0 ms	
304	(index)	279 B	651 ms	
304	(index)	278 B	615 ms	
304	(index)	277 B	650 ms	
304	(index)	274 B	656 ms	
304	(index)	274 B	690 ms	
200	style.css	(memory cache)	1 ms	
304	(index)	280 B	673 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
200	css?family=Poppins:100,100i,...	(memory cache)	0 ms	
200	style.css	(memory cache)	0 ms	
304	Other	280 B	585 ms	

10. ADVANTAGES AND DISADVANTAGES

Advantages:

1. Real time sign to speech detection.
2. Model provides good accuracy.
3. Real time facial emotion detection.
4. Language Customization.
5. Real time speech to text conversion.
6. Friendly UI
7. Data privacy

Disadvantages:

1. At times the website may lag.
2. Model is not tested on a wide set of data set, having all the signs.
3. Sign language customization feature is not available.
4. User cannot take notes while using the app.
5. User cannot make calls using the app.
6. Speech recognition works only on google chrome.

11. CONCLUSION

The ability to express oneself requires communication. Additionally, it satisfies one's needs. Career advancement requires effective communication. By promoting mutual understanding, good communication skills can simplify your daily life and enhance your connections with others. As part of our effort, a system that converts speech into suitable sign language for the deaf and dumb has been created. In order to converse with regular people, it also transforms sign language into a human voice. A model that has been trained on several hand motions has been created using a convolutional neural network. An app is produced using this idea. This software makes it simple for deaf and dumb people to communicate by using signs that can be translated into speech and human-understandable English.

12. FUTURE SCOPE

The following are the features that can be added in our application:

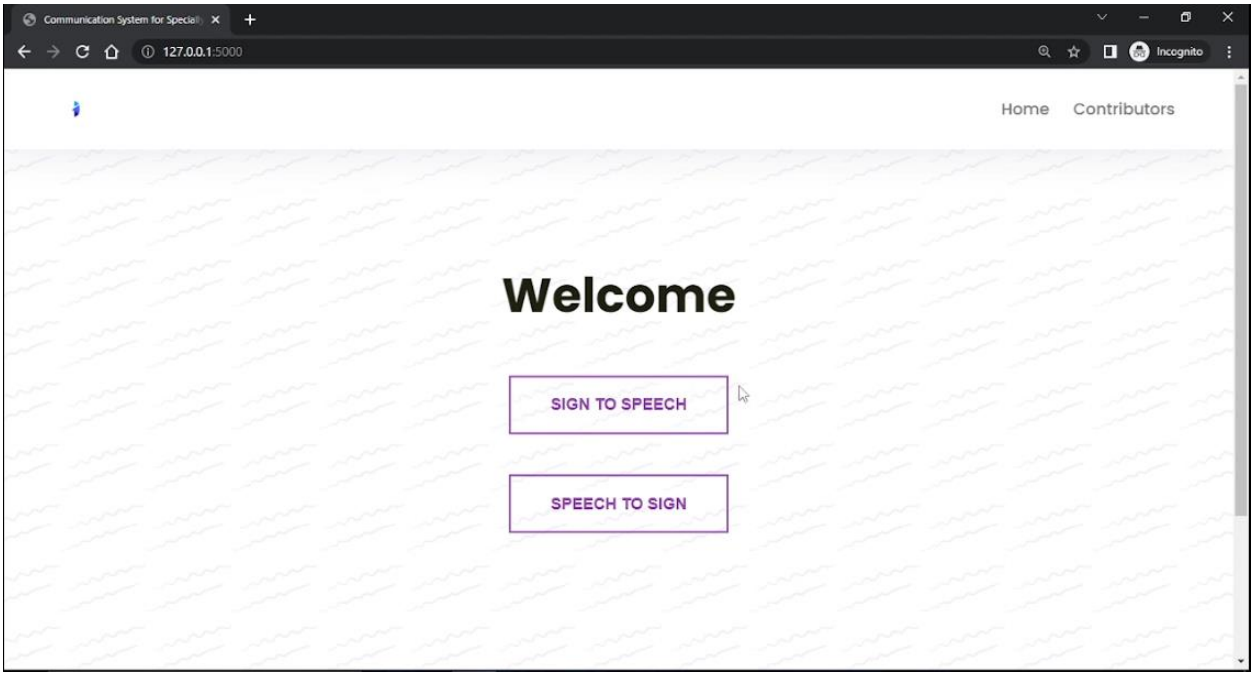
- A communication app can be built with the same set of features. The user can choose the appropriate mode (speech to sign or sign to speech) and accordingly the real time detection would take place on both the end users' application.
- The accuracy of the model shall be increased.
- Customization of languages shall be added.
- Users shall be allowed to write notes while on call.
- Customization of signs can also be added as a feature.

13.Appendix

Source Code

Index.html

```
<div class="section full-height" >
      <div class="absolute-center">
         <div class="section">
            <div class="container">
               <div class="row">
                  <div class="col-12">

<h1><span>W</span><span>e</span><span>l</span><span>c</span><span>o</span><span>
m</span><span>e</span></h1>
               <br>

               <form action="/sign_to_audio/"><button class="btn fifth">Sign To
Speech</button></form>
               <form action="/audio_to_sign/"><button class="btn fifth">Speech to
Sign</button></form>

                </div>
               </div>
            </div>
         </div>

      </div>
```



app.py

```
from flask import Flask, render_template,redirect,url_for,request,Response
from moviepy.editor import VideoFileClip
import cv2
import speech_recognition as sr
from PIL import Image
import numpy as np
from skimage.transform import resize
from gtts import gTTS
import playsound
from keras.utils import image_utils as image
from keras.models import load_model

app=Flask(__name__)

vals=['A','B','C','D','E','F','G','H','I']
model=load_model('IBM.h5')

app.secret_key = "secret key"
arr = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l',
        'm', 'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z','.']

@app.route('/')
def index():
    return render_template("index.html")


@app.route('/audio_to_sign/')
def audio_to_sign():
    return render_template('SpeechtoSign.html')

@app.route('/audio', methods=['POST'])
def audio():
    r = sr.Recognizer()
    frameSize = (281, 363)
    out =
cv2.VideoWriter('./static/uploads/output_video.mp4',cv2.VideoWriter_fourcc(*'DIVX'), 1,
frameSize)
    with open('Speech/audio.mp3', 'wb') as f:
        f.write(request.data)
    with sr.AudioFile('Speech/audio.mp3') as source:
        audio_data = r.record(source)
        text = r.recognize_google(audio_data, language='en-IN', show_all=True)
```

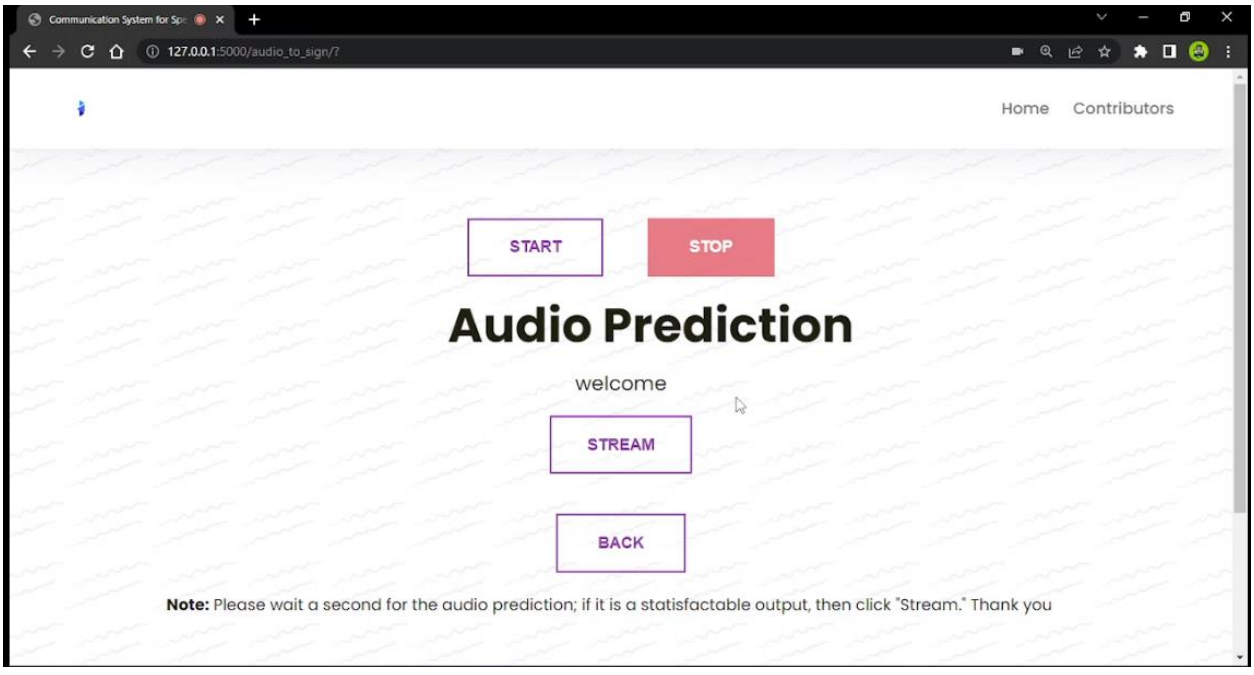
```
        print(text)
        try:
            for num, texts in enumerate(text['alternative']):
                transcript = texts['transcript'].lower()
                print(transcript)
                break
        except:
            transcript = " Sorry!!!! Voice not Detected "

    for i in range(len(transcript)):
        if transcript[i] in arr:
            ImageAddress = 'L/'+transcript[i]+'.png'
            ImageItself = Image.open(ImageAddress)
            ImageNumpyFormat = np.asarray(ImageItself)
            img = cv2.imread(ImageAddress)
            out.write(img)
    out.release()
    videoFileClip=VideoFileClip("./static/uploads/output_video.mp4")
    videoFileClip.write_gif("./static/uploads/output_video.gif")
    videoFileClip.write_gif("./static/uploads/output_video1.gif")
    return str(transcript)

@app.route('/scrn', methods=['POST'])
def upload_video():
    r=sr.Recognizer()
    file=sr.AudioFile("Speech/audio.mp3")
    with file as source:
        audio_data = r.record(source)
    text = r.recognize_google(audio_data, language='en-IN', show_all=True)
    text=text['alternative']
    text=text[0]
    text=text['transcript']
    return render_template('stream.html', filename='output_video.gif',text=text)

@app.route('/display/<filename>')
def display_video(filename):

        return redirect(url_for('static', filename='uploads/' + filename), code=301)

@app.route('/sign_to_audio/')
def sign_to_audio():
    return render_template('SigntoSpeech.html')

def gen():
```

```
    string = " "
    count = 0
    video = cv2.VideoCapture(0)
    while (video.isOpened()):
        ret, frame = video.read()
        gray=cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)
        gray = cv2.threshold(gray, 0, 255,cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]
        color_dict=(0,255,0)
        cv2.rectangle(frame,(24,24),(250 , 250),color_dict,2)
        copy=gray.copy()
        copy = copy[24:250,24:250]
        count = count + 1
        cv2.imwrite('static/image.jpg',copy)
        img = cv2.imread('static/image.jpg')
        img=resize(img,(64,64,1))
        img=image.img_to_array(img)
        img=np.expand_dims(img,axis=0)
        if(np.max(img)>1):
            img=img/255.0
        prediction=model.predict(img)
        prediction=np.argmax(prediction, axis=1)
        pred=vals[prediction[0]]
        print(pred)
        if(count == 200):
            count = 99
            prev= vals[prediction[0]]
            if(len(prev) == 0):
                string = string + "_"
                myobj = gTTS(text=string, lang="en", slow=False)
                myobj.save("./Speech/sign.mp3")
            else:
                string = string + prev
                myobj = gTTS(text=string, lang="en", slow=False)
                myobj.save("./Speech/sign.mp3")

        cv2.putText(frame, pred, (24,
14),cv2.FONT_HERSHEY_SIMPLEX,0.8,(255,255,255),2)
        cv2.putText(frame, string, (275,
50),cv2.FONT_HERSHEY_SIMPLEX,0.8,(200,200,200),2)
        if not ret:
            break
        else:
            ret,buffer=cv2.imencode('.jpg',frame)
            frame=buffer.tobytes()
```

```
        yield (b'--frame\r\n'
                b'Content-Type: image/jpeg\r\n\r\n' + frame + b'\r\n\r\n')

@app.route('/video_feed')
def video_feed():
    return Response(gen(),
                mimetype='multipart/x-mixed-replace; boundary=frame')

@app.route('/redirect')
def delet():
   video = cv2.VideoCapture(0)
   video.release()
   return render_template("index.html")

@app.route('/play')
def play():
   playsound.playsound("./Speech/sign.mp3", True)
   return render_template("SigntoSpeech.html")

@app.route('/alp')
def alp():
   return render_template("Alphabet.html")

if __name__ == "__main__":
   app.run(debug=True)
```

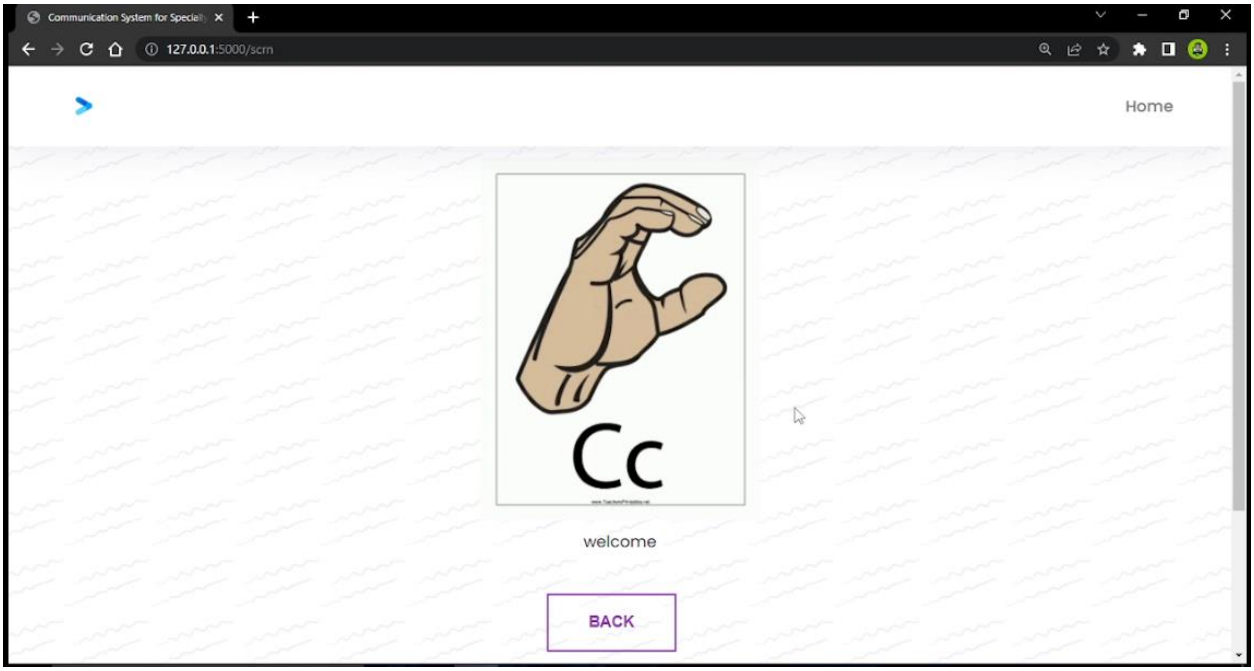
Speech to Sign.html

```
<div class="row">
  <div class="col-12">
    <button id="start" class="btn btn-success" onclick="startRecording()"
disabled>Start</button>
    <button id="stop" class="btn btn-danger" onclick="stopRecording()"
disabled>Stop</button>
  </div>
  <div class="column2">
    <h1 style="padding-left: 60px;">
      <span>Audio Prediction</span>
    </h1>
    <p class="glow" id="output" style="font-size: 20px;"></p>
    <form action="/scrn" method="post" enctype="multipart/form-data">
      <input type="submit" id="stream" value="Stream" class="btn btn-info stream"
disabled>
    </form>
    <a href="/">
      <button class="btn btn-danger btn-lg">Back</button>
    </a>
  </div>
  <div class="note">
    <b>Note:</b> Please wait a second for the audio prediction; if it is a statisfactable
output, then click "Stream." Thank you
  </div>
</div>
```



STREAM.HTML

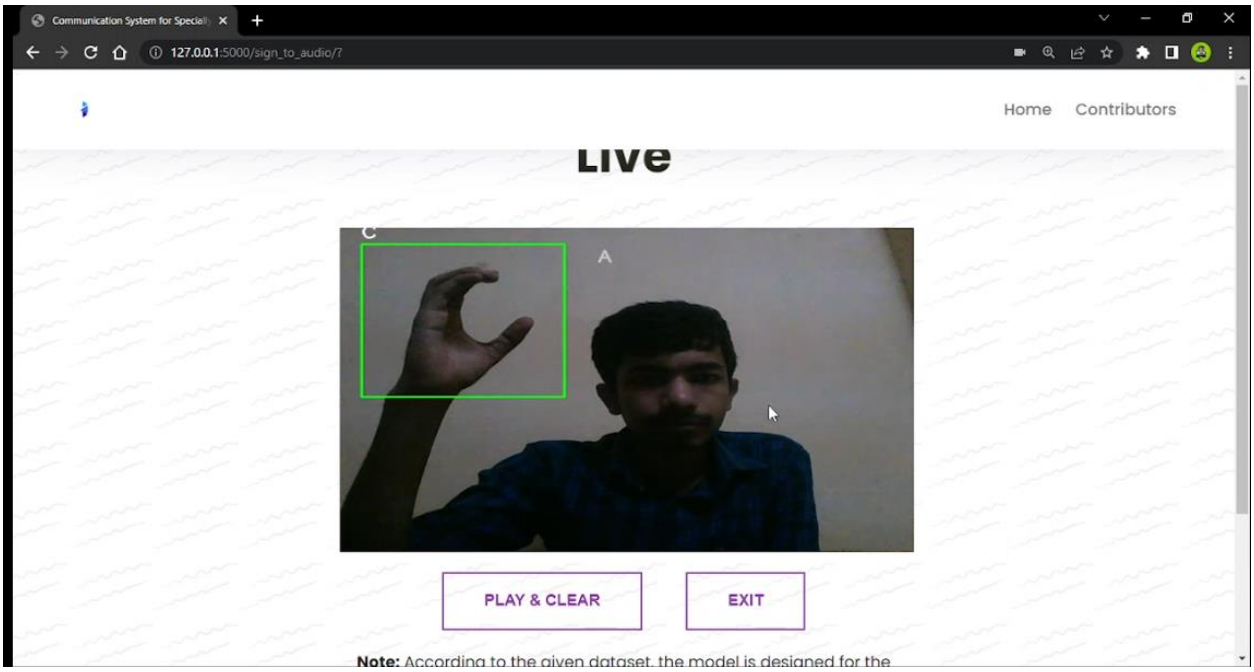
```
<div class="section">
  <div class="container">
    <div class="row">
      <div class="col-12">
        <img src="{{ url_for('display_video', filename=filename) }}">
        <p>{{text}}</p>
      </div>
      <form action="/audio_to_sign/">
        <button class="btn fifth back">Back</button>
      </form>
    </div>
  </div>

</div>
```



SigntoSpeech.html

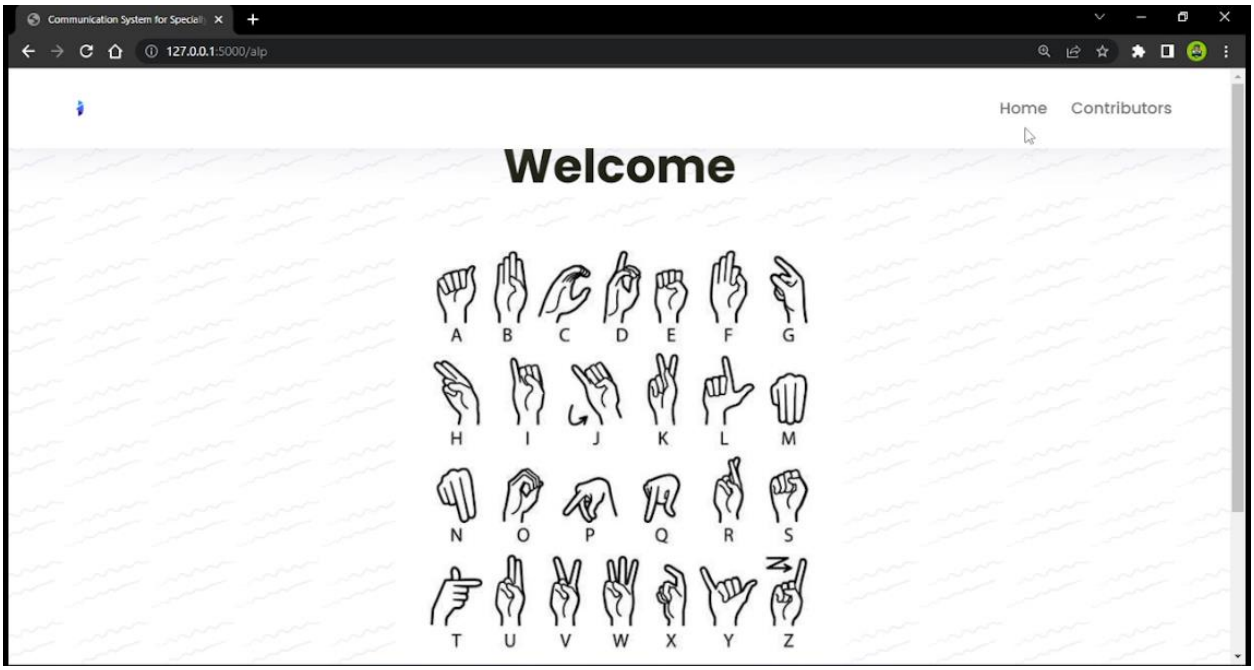
```
<div class="column2">
  <h1 style="margin-top: 10%;">Live </h1>
  <br>
  <div class="stream-video">
```

```
    <img src="{{ url_for('video_feed') }}" width="576px" height="324px" />
    <br>
    <a href="/play">
      <button class="btn btn-info btn-lg" id="play">Play & Clear</button>
    </a>
    <a href="/redirect">
      <button class="btn btn-danger btn-lg">Exit</button>
    </a>
  </div>
  <div>
    <b>Note:</b> According to the given dataset, the model is designed for the alphabet A–I, so it predicts only limited alphabets And press the "Play & Clear" button after the predicted letter displays on the right side of the green rectangle. Thank you
  </div>
</div>
<script>
document.getElementById("play").disabled = true;
setTimeout(function(){document.getElementById("play").disabled = false;},10000);
</script>
```



Alphabet.html

```
<div class="container">
        <div class="row">
        <div class="col-12">

        <h1><span>W</span><span>e</span><span>l</span><span>c</span><span>o</span><span>m</span><span>e</span></h1>
                                        <br>
                                <img
src="https://i.pinimg.com/564x/98/2c/d1/982cd1fb0bac83d6b12c9a6acdff0879.jpg" style="text-align: left;">
                                </div>
                                </div>
 </div>
```



13.2 GitHub and Demo Link:

GitHub: https://github.com/IBM-EPBL/IBM-Project-1189-1658377511

Demo: https://youtu.be/49vbEE03iFI