Real-Time Communication System Powered by AI for Specially Abled

IBM PROJECT REPORT

SUBMITTED BY

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in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

AMRITA COLLEGE OF ENGINEERING AND TECHNOLOGY

ERACHAKULAM, NAGERCOIL.

ANNA UNIVERSITY::CHENNAI 600 025

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CERTIFICATE OF EVALUATION

COLLEGE NAME: AMRITA COLLEGE OF ENGINEERING AND TECHNOLOGY

BRANCH : COMPUTER SCIENCE AND ENGINEERING

SEMESTER : VII

TITLE : Real-Time Communication System Powered by AI for Specially Abled

TEAM ID : PNT2022TMID51928

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The report of this project is submitted by the above students in partial fulfillment for the award of Bachelor of Engineering Degree, in Computer Science and Engineering of Anna University are evaluated and confirmed to the reports of the work done by the above students.

MENTOR **EVALUATOR**

ACKNOWLEDGEMENT

First and foremost we would like to express our sincere gratitude to our respected Founder Amma,Mata Amritanandamayi Devi and Chairman Mr. K S Ramasubban IAS(Retd) for their blessings and grace in making our project great success.

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We would like to express our sincere thanks to our beloved Head of the Department Dr. P M Siva Raja and Project Coordinator Mrs. S L Jothi Lakshmi, for creating a supportive and a model environment for us to work and build up our innovative skills. We also thank our project Mentor Dr.T S Sasikala for the kind encouragement and moral support, who has been a constant source of inspiration to us.

We wish to express our sincere sense of gratitude to Dr. P M Siva Raja, Head, Department of Computer Science and Engineering and to our Project Guide who enabled us to complete our project successfully.

1.INTRODUCTION

1.1 Project Overview Objective: -

The main objective of the Real-Time Communication System Powered by AI for Specially Abled is to build an AI model that will be able to detect the signs posed by the humans and convert them into text.The model will be able to bridge the gap between the normal and the specially abled people.

Abstract:-

Sign language is the most preferred means of communication among the deaf and the hearing impaired people. Recognition of sign language can have a varying degree of success when used in computer vision or any other methods. Sign language is said to have a structured set of gestures in which each gesture has a specific meaning.The motive of this project is to design a real time sign language detection system that can be accessed from anywhere by anyone who needs to learn and communicate via sign language. This project helps us to understand the usage of Artificial Intelligence in solving the real world problems. The sign language detection system is a Convolutional Neural Network model that can detect the signs posed by the human and convert them into text in real time on the click of the camera.

1.2Purpose: -

To develop a real-time sign language detection model using AI which can be used to accurately detect the signs posed by the user and convert the hand gestures of alphabets into text in real time.

This helps the user to understand and learn the sign language .It can also act as an interface for the users to communicate with the hearing impaired people and understand them .It can also be used by the hearing hearing impaired people to communicate their thoughts to others.

2.LITERATURE SURVEY

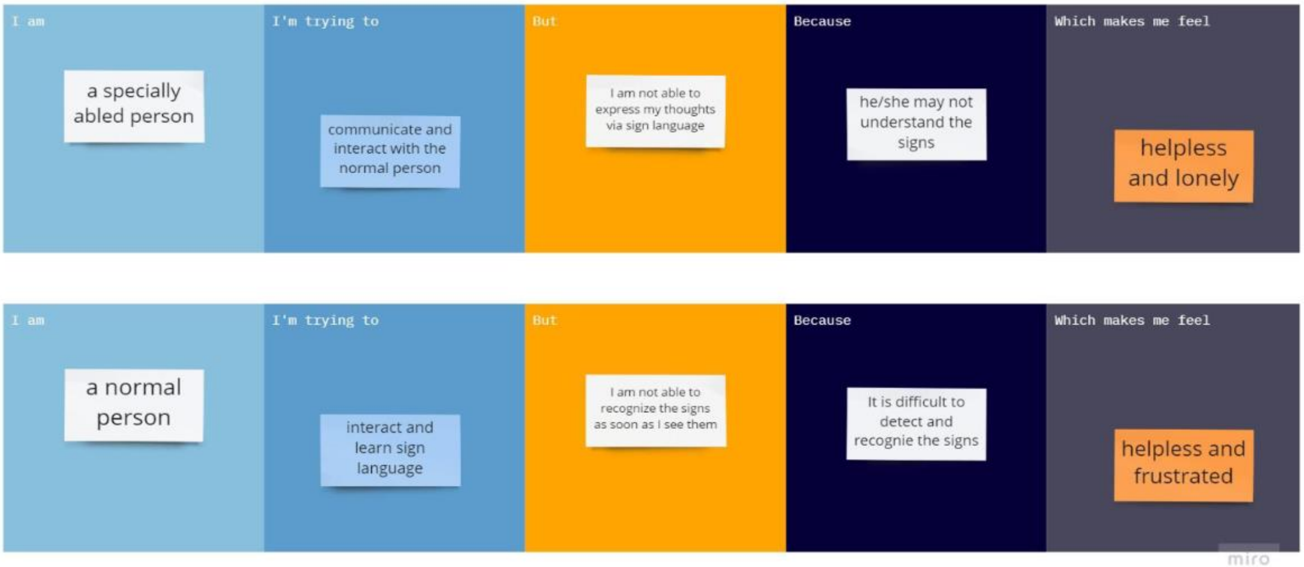
2.1 Existing problem:-

Imprecision and false interpretations. Speech recognition software isn't always able to interpret spoken words correctly. This is due to computers not being on par with humans in understanding the contextual relation of words and sentences, causing misinterpretations of what the speaker meant to say or achieve.

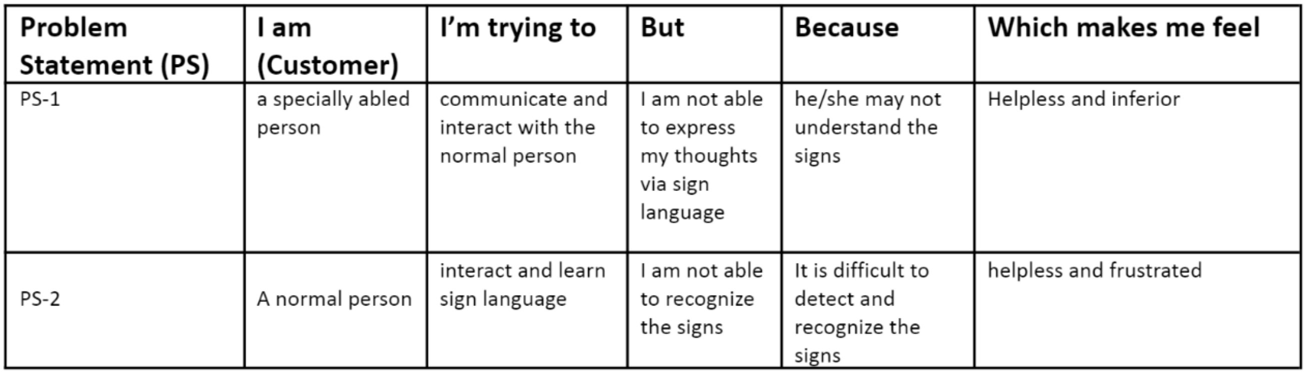
2.2 References:-

- https://www.researchgate.net/publication/344151211_D-Talk_Sign_Language_Recognition_System_for_People_with_Disability_using_Machine_Learning_and_Image_Processing

2.3 Problem Statement Definition:-



I am	I'm trying to	But	Because	Which makes me feel
a specially abled person	communicate and interact with the normal person	I am not able to express my thoughts via sign language	he/she may not understand the signs	helpless and lonely
a normal person	interact and learn sign language	I am not able to recognize the signs as soon as I see them	It is difficult to detect and recognie the signs	helpless and frustrated

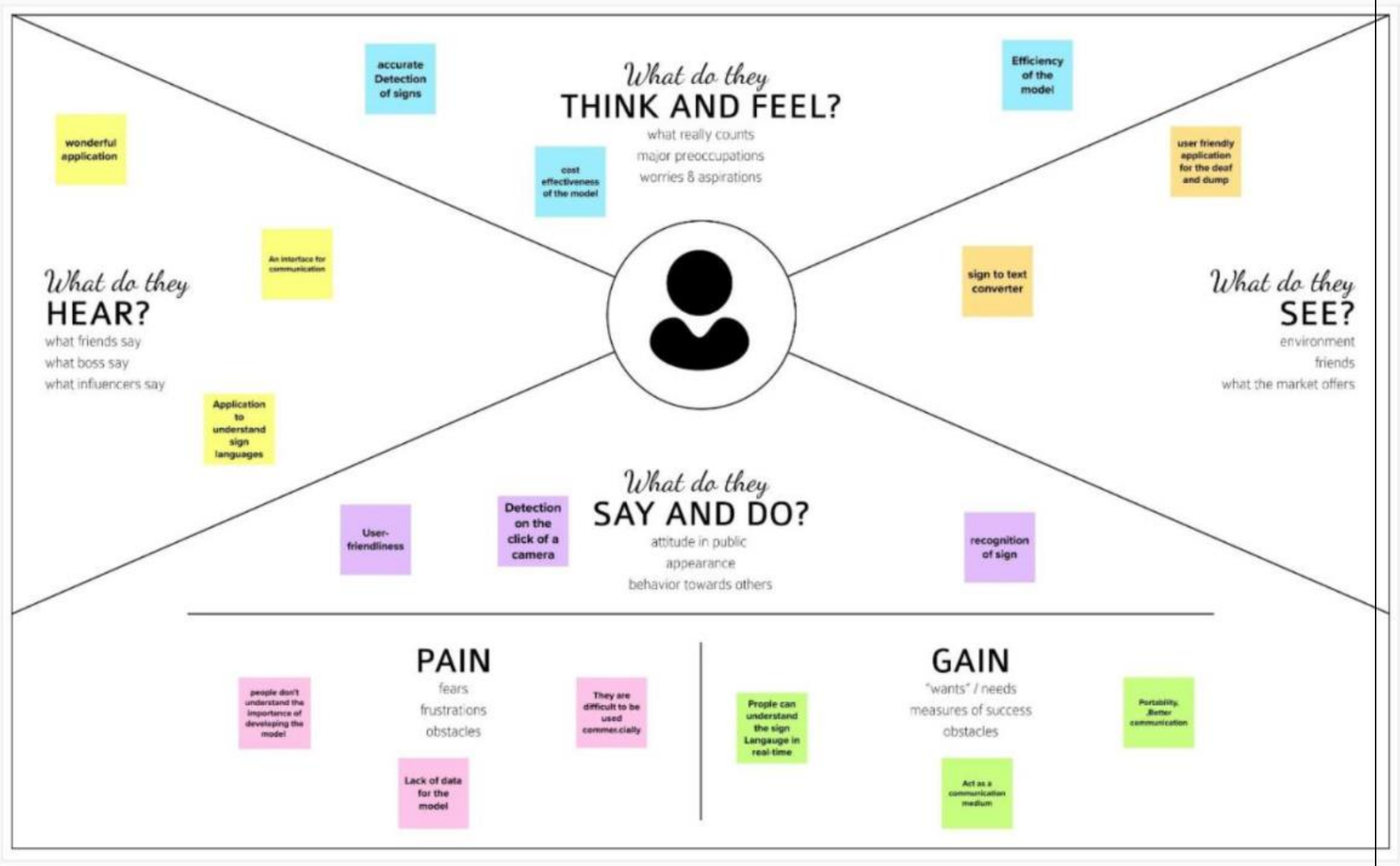


Problem Statement (PS)	I am (Customer)	I’m trying to	But	Because	Which makes me feel
PS-1	a specially abled person	communicate and interact with the normal person	I am not able to express my thoughts via sign language	he/she may not understand the signs	Helpless and inferior
PS-2	A normal person	interact and learn sign language	I am not able to recognize the signs	It is difficult to detect and recognize the signs	helpless and frustrated

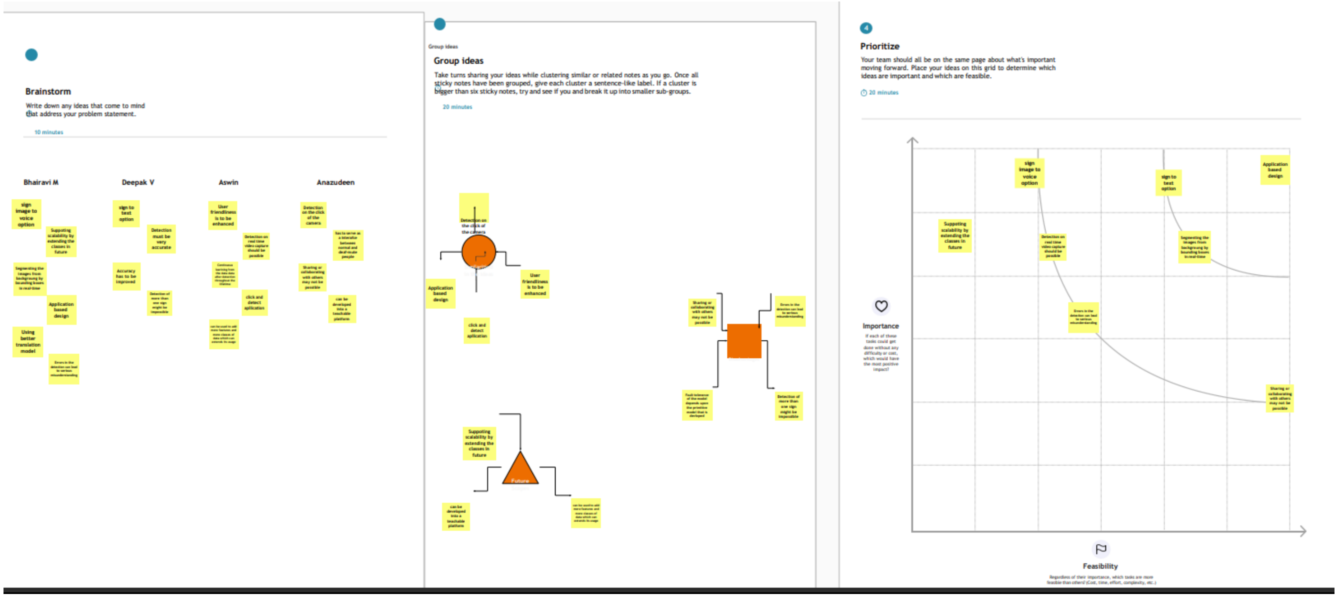
3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:-

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviour and attitudes. It is a useful tool to helps teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming:-



Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

Group ideas

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

Bhairavi M
sign image to voice option
Supporting scalability by extending the classes in future
Segmenting the images from background by bounding boxes in real-time
Application based design
Using better translation model
Errors in the detection can lead to serious misunderstanding
Deepak V
sign to text option
Detection must be very accurate
Accuracy has to be improved
Detection of more than one sign might be impossible
Aswin
User friendliness is to be enhanced
Detection on real time video capture should be possible
Continuous learning from the data data after detection throughout the lifetime
click and detect aplication
can be used to add more features and more classes of data which can extends its usage
Anazudeen
Detection on the click of the camera
has to serve as a interative between normal and deaf-mute people
Sharing or collaborating with others may not be possible
can be developed into a teachable platform
Detection on the click of the camera
User friendliness is to be enhanced
Application based design
click and detect aplication
Sharing or collaborating with others may not be possible
Errors in the detection can lead to serious misunderstanding
Fault tolerance of the model depends upon the primitive model that is devloped
Detection of more than one sign might be impossible
Supporting scalability by extending the classes in future
Future
can be developed into a teachable platform
can be used to add more features and more classes of data which can extends its usage
4
sign image to voice option
sign to text option
Application based design
Supporting scalability by extending the classes in future
Detection on real time video capture should be possible
Segmenting the images from background by bounding boxes in real-time
Errors in the detection can lead to serious misunderstanding
Sharing or collaborating with others may not be possible
Importance
If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?
Feasibility
Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

3.3 Proposed Solution:-

Ideas/Solution description:

The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb. We are making use of a convolution neural network to create a model that is trained on different hand gestures. An app is built which uses this model. This app enables deaf and dumb people to convey their information using signs which get converted to human understandable language and speech is given as output.

Novelty/uniqueness:

The characteristic feature of the model is the ability of the model to be able to convert the sign to text as well as voice that could help both the deaf and the normal people to choose between the options.

It can detect the image in the real-time By drawing a bounding box and focusing on the sign to be detected and gives a clear picture of what is being recognized. This can aid in detecting multiple signs at a particular time.

.

Social Impact /Customer satisfaction:

The application will serve as a sign to text and voice converter which will reduce the dependency of the customer searching for the sign or the translator. This can reduce the time and energy of the customer. The use- friendly interface makes it easier for any age person to access it with ease.

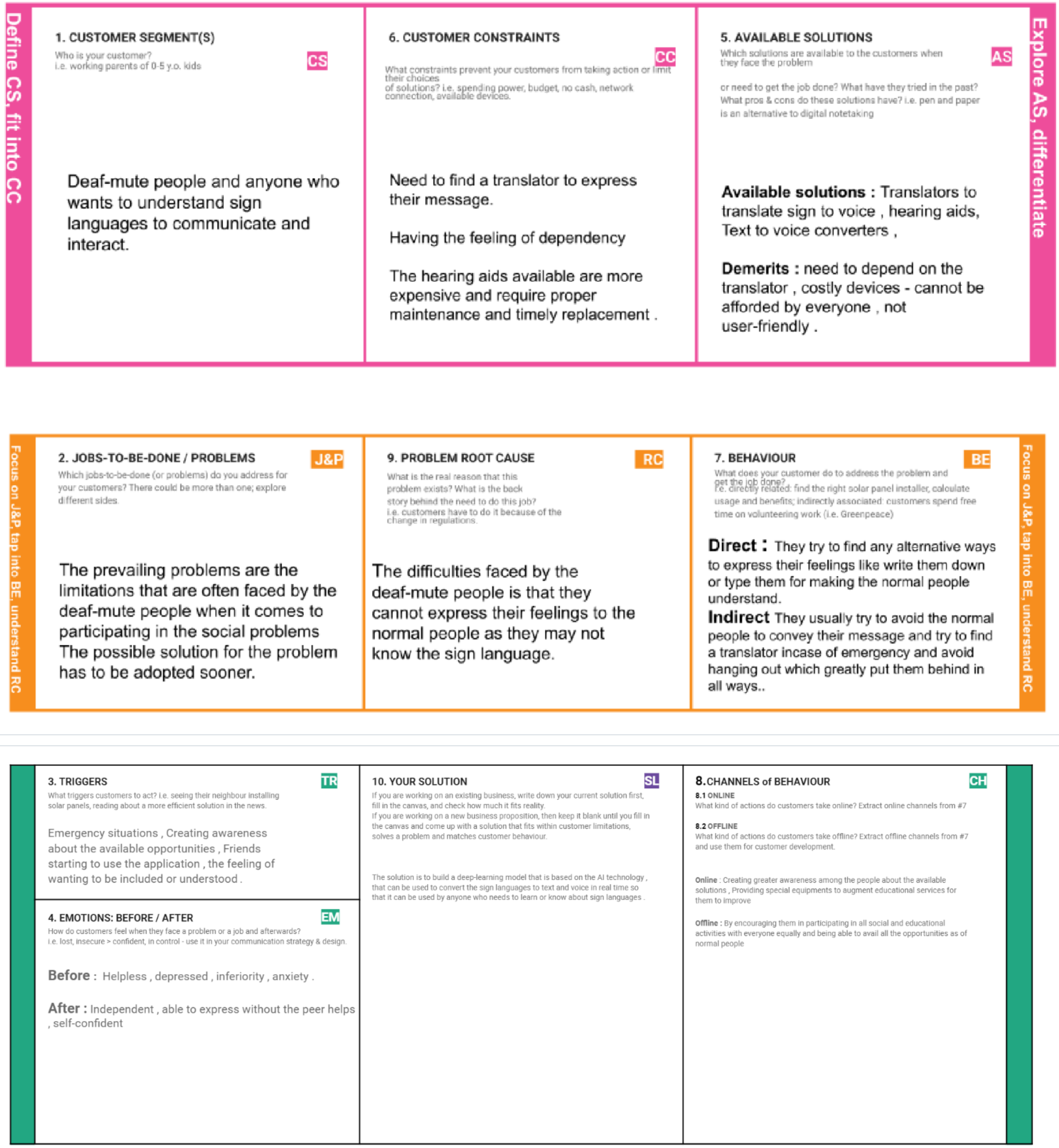
Business model:

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. Inorder to improve the model and production the company need to have a clear idea about the customers, their concerns, their expectations and their requirements and focus on developing the model to satisfy the requirements and subside the constraints.This will help in improving the profits and the usage of the model and improve the feedback for the model creating a good awareness about the application, resulting in a better revenue model.

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 statement fit:-


Define CS, fit into CC
Explore AS, differentiate
Focus on J&P, tap into BE, understand RC
Focus on J&P, tap into BE, understand RC
CS
CC
AS
J&P
RC
BE
TR
EM
SL
CH

1. CUSTOMER SEGMENT(S)

Who is your customer?
i.e. working parents of 0-5 y.o. kids

Deaf-mute people and anyone who wants to understand sign languages to communicate and interact.

6. CUSTOMER CONSTRAINTS

What constraints prevent your customers from taking action or limit their choices
of solutions? i.e. spending power, budget, no cash, network connection, available devices.

Need to find a translator to express their message.

Having the feeling of dependency

The hearing aids available are more expensive and require proper maintenance and timely replacement .

5. AVAILABLE SOLUTIONS

Which solutions are available to the customers when they face the problem

or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking

Available solutions : Translators to translate sign to voice , hearing aids, Text to voice converters ,

Demerits : need to depend on the translator , costly devices - cannot be afforded by everyone , not user-friendly .

2. JOBS-TO-BE-DONE / PROBLEMS

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

The prevailing problems are the limitations that are often faced by the deaf-mute people when it comes to participating in the social problems The possible solution for the problem has to be adopted sooner.

9. PROBLEM ROOT CAUSE

What is the real reason that this problem exists? What is the back story behind the need to do this job?
i.e. customers have to do it because of the change in regulations.

The difficulties faced by the deaf-mute people is that they cannot express their feelings to the normal people as they may not know the sign language.

7. BEHAVIOUR

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

Direct : They try to find any alternative ways to express their feelings like write them down or type them for making the normal people understand.

Indirect They usually try to avoid the normal people to convey their message and try to find a translator incase of emergency and avoid hanging out which greatly put them behind in all ways..

3. TRIGGERS

What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.

Emergency situations , Creating awareness about the available opportunities , Friends starting to use the application , the feeling of wanting to be included or understood .

4. EMOTIONS: BEFORE / AFTER

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

Before : Helpless , depressed , inferiority , anxiety .

After : Independent , able to express without the peer helps , self-confident

10. YOUR SOLUTION

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

The solution is to build a deep-learning model that is based on the AI technology , that can be used to convert the sign languages to text and voice in real time so that it can be used by anyone who needs to learn or know about sign languages .

8. CHANNELS of BEHAVIOUR

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

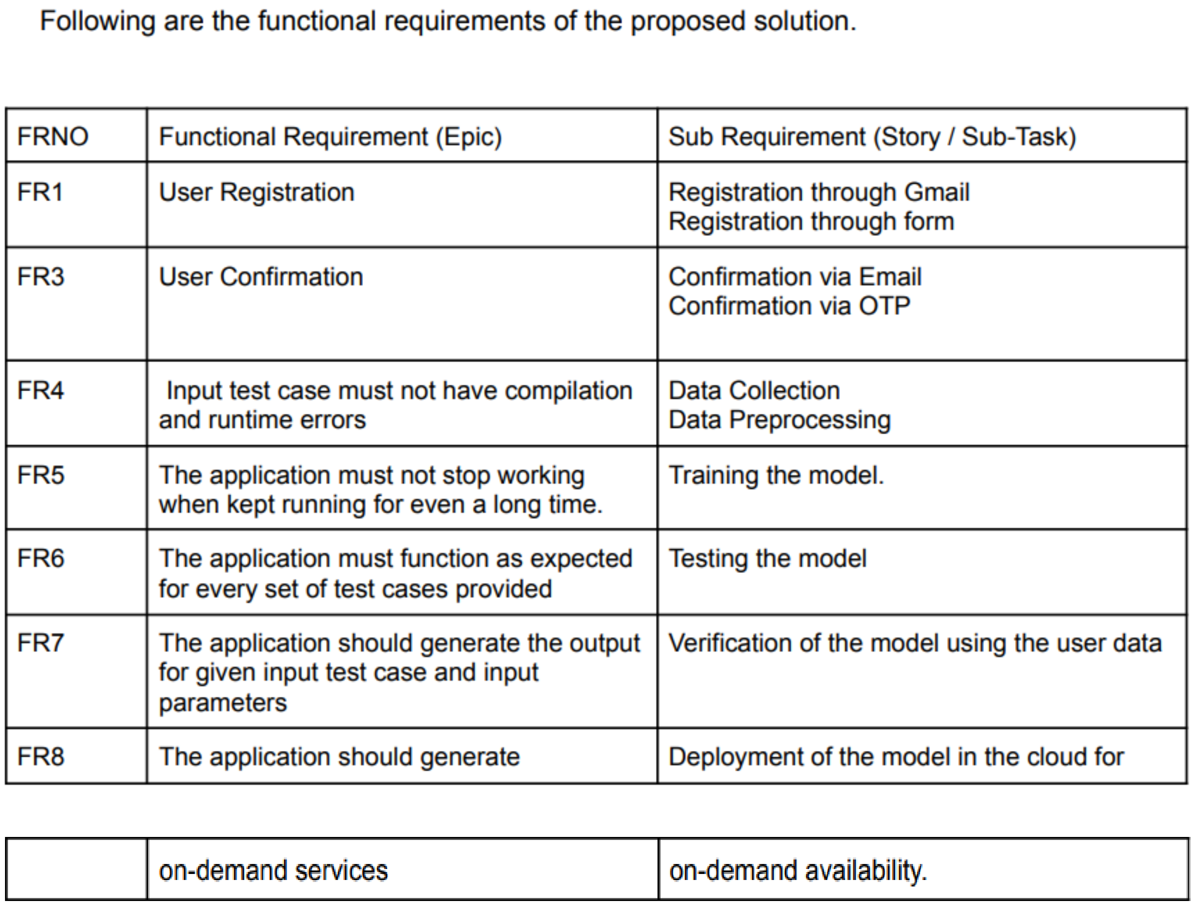
8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

Online : Creating greater awareness among the people about the available solutions , Providing special equipments to augment educational services for them to improve

Offline : By encouraging them in participating in all social and educational activities with everyone equally and being able to avail all the opportunities as of normal people

4.REQUIREMENT ANALYSIS

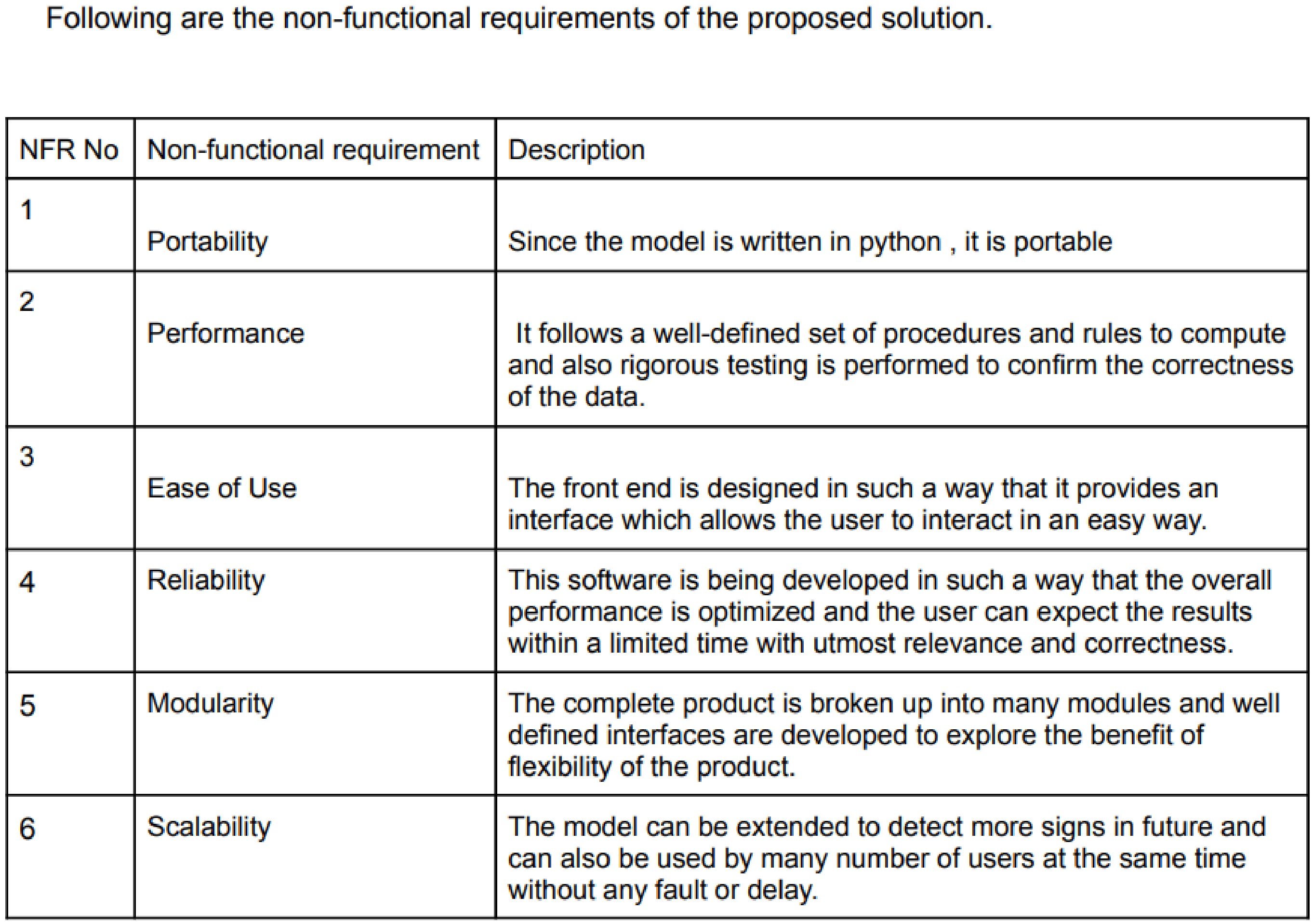
4.1 Functional requirement:-



Following are the functional requirements of the proposed solution.

FRNO	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR1	User Registration	Registration through Gmail Registration through form
FR3	User Confirmation	Confirmation via Email Confirmation via OTP
FR4	Input test case must not have compilation and runtime errors	Data Collection Data Preprocessing
FR5	The application must not stop working when kept running for even a long time.	Training the model.
FR6	The application must function as expected for every set of test cases provided	Testing the model
FR7	The application should generate the output for given input test case and input parameters	Verification of the model using the user data
FR8	The application should generate on-demand services	Deployment of the model in the cloud for on-demand availability.

4.2 Non-Functional requirements:-



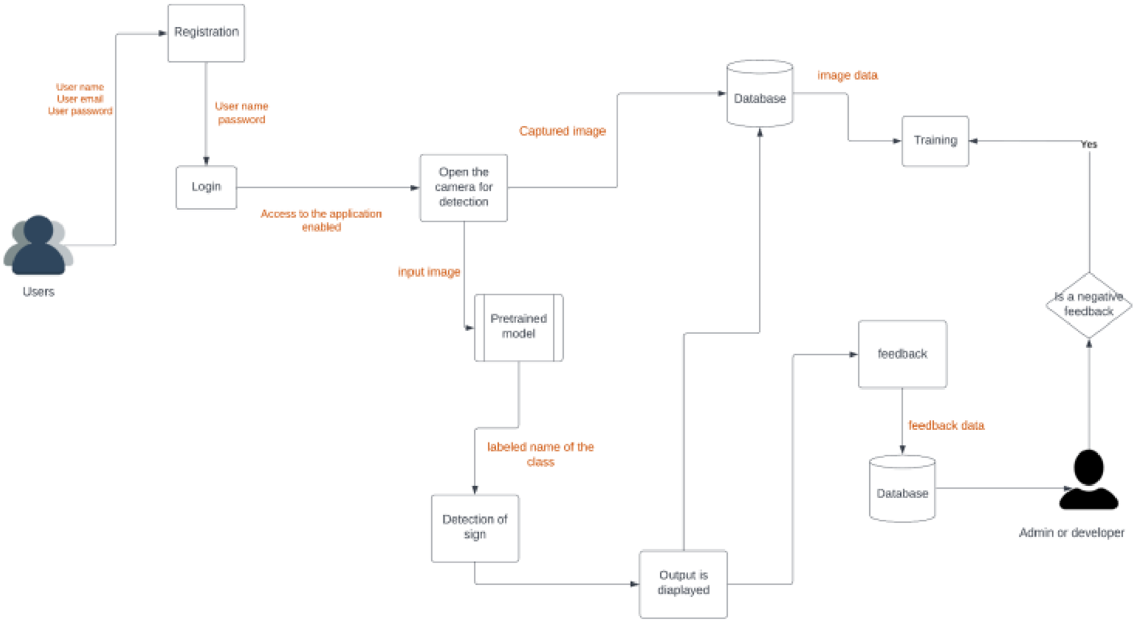
Following are the non-functional requirements of the proposed solution.

NFR No	Non-functional requirement	Description
1	Portability	Since the model is written in python , it is portable
2	Performance	It follows a well-defined set of procedures and rules to compute and also rigorous testing is performed to confirm the correctness of the data.
3	Ease of Use	The front end is designed in such a way that it provides an interface which allows the user to interact in an easy way.
4	Reliability	This software is being developed in such a way that the overall performance is optimized and the user can expect the results within a limited time with utmost relevance and correctness.
5	Modularity	The complete product is broken up into many modules and well defined interfaces are developed to explore the benefit of flexibility of the product.
6	Scalability	The model can be extended to detect more signs in future and can also be used by many number of users at the same time without any fault or delay.

5.PROJECT DESIGN

5.1 Data Flow Diagrams:-

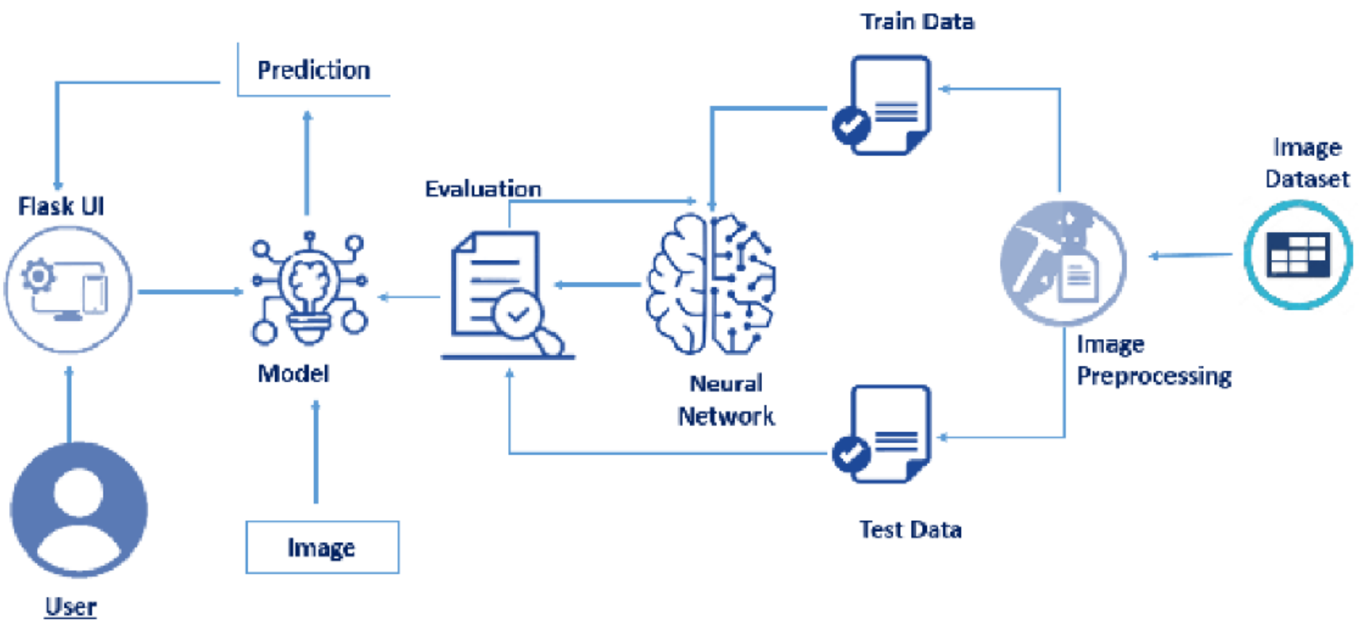
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



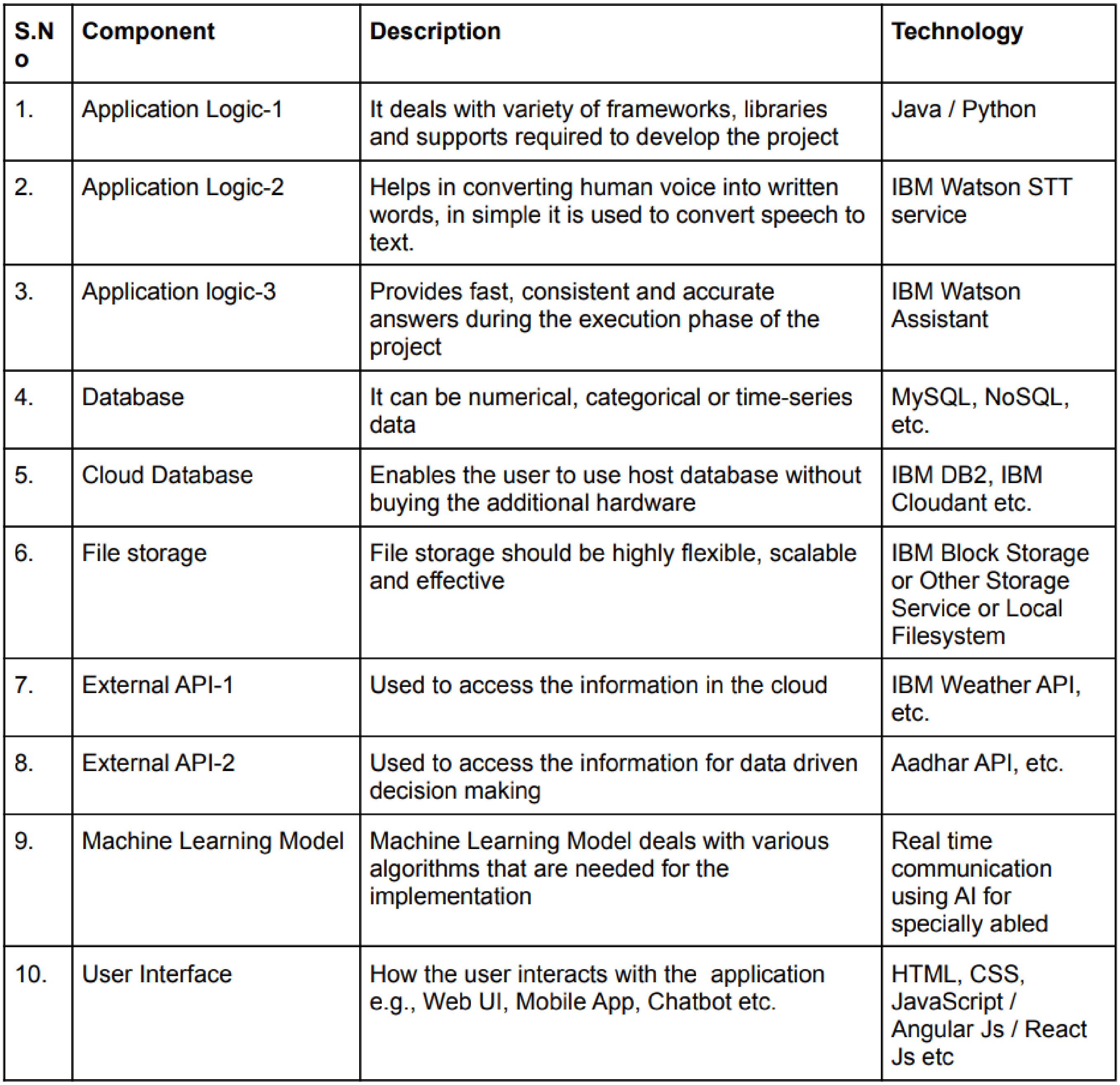
5.2 Solution & Technical Architecture:-

Solution Architecture:

Real-Time Communication System powered by AI for Specially abled

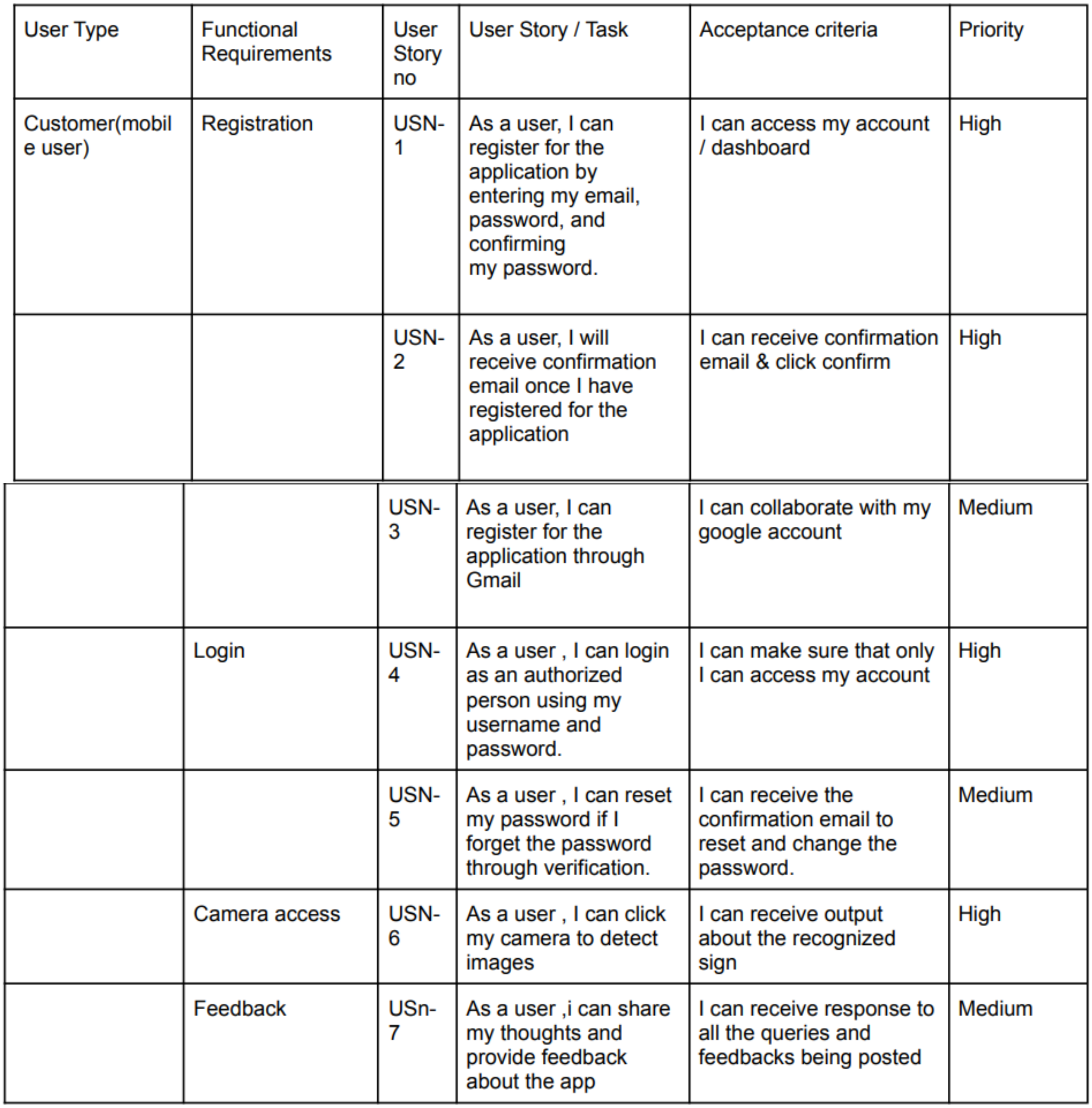


Technical Architecture :-



S.No	Component	Description	Technology
1.	Application Logic-1	It deals with variety of frameworks, libraries and supports required to develop the project	Java / Python
2.	Application Logic-2	Helps in converting human voice into written words, in simple it is used to convert speech to text.	IBM Watson STT service
3.	Application logic-3	Provides fast, consistent and accurate answers during the execution phase of the project	IBM Watson Assistant
4.	Database	It can be numerical, categorical or time-series data	MySQL, NoSQL, etc.
5.	Cloud Database	Enables the user to use host database without buying the additional hardware	IBM DB2, IBM Cloudant etc.
6.	File storage	File storage should be highly flexible, scalable and effective	IBM Block Storage or Other Storage Service or Local Filesystem
7.	External API-1	Used to access the information in the cloud	IBM Weather API, etc.
8.	External API-2	Used to access the information for data driven decision making	Aadhar API, etc.
9.	Machine Learning Model	Machine Learning Model deals with various algorithms that are needed for the implementation	Real time communication using AI for specially abled
10.	User Interface	How the user interacts with the application e.g., Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc

User Stories :

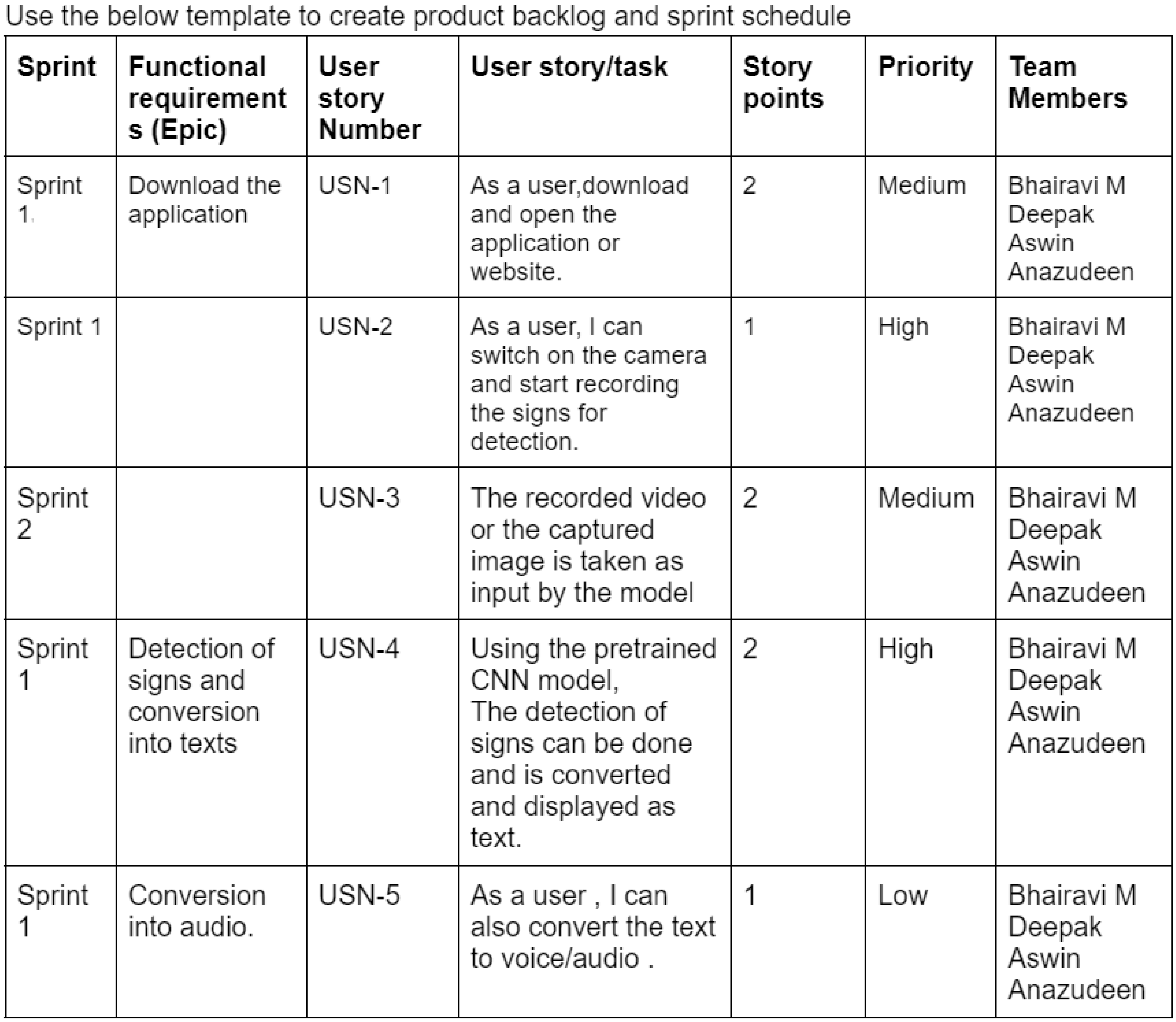


User Type	Functional Requirements	User Story no	User Story / Task	Acceptance criteria	Priority
Customer(mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High
		USN-3	As a user, I can register for the application through Gmail	I can collaborate with my google account	Medium
	Login	USN-4	As a user , I can login as an authorized person using my username and password.	I can make sure that only I can access my account	High
		USN-5	As a user , I can reset my password if I forget the password through verification.	I can receive the confirmation email to reset and change the password.	Medium
	Camera access	USN-6	As a user , I can click my camera to detect images	I can receive output about the recognized sign	High
	Feedback	USn-7	As a user ,i can share my thoughts and provide feedback about the app	I can receive response to all the queries and feedbacks being posted	Medium

6.PROJECT PLANNING & SCHEDULING

6.1 Product Backlog, Sprint Schedule, and Estimation :

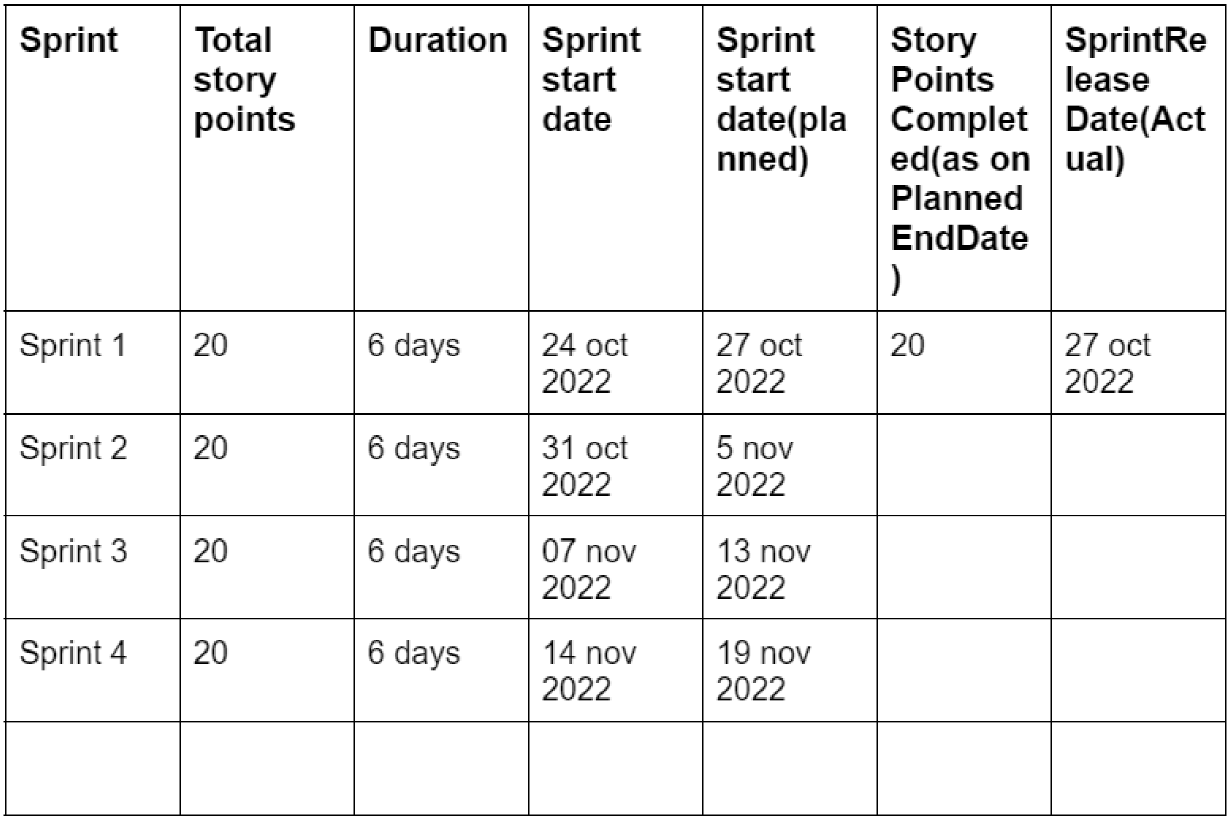
Sprint Planning & Estimation:



Use the below template to create product backlog and sprint schedule

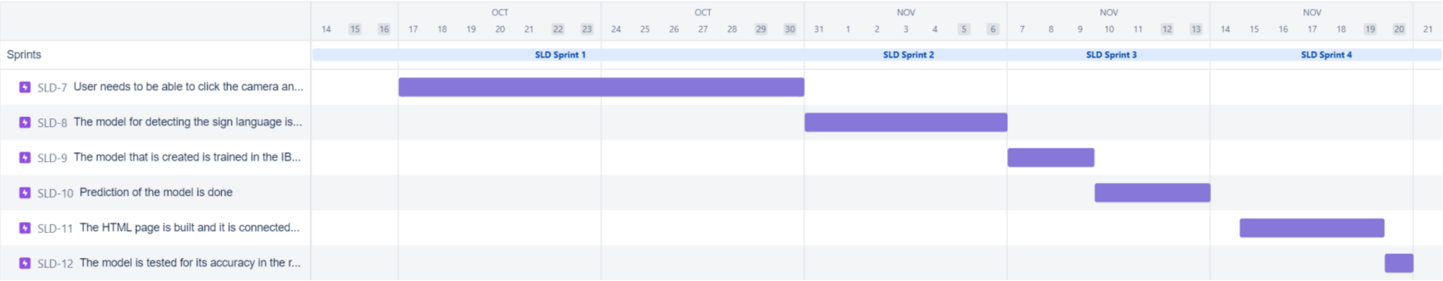
Sprint	Functional requirements (Epic)	User story Number	User story/task	Story points	Priority	Team Members
Sprint 1	Download the application	USN-1	As a user,download and open the application or website.	2	Medium	Bhairavi M Deepak Aswin Anazudeen
Sprint 1		USN-2	As a user, I can switch on the camera and start recording the signs for detection.	1	High	Bhairavi M Deepak Aswin Anazudeen
Sprint 2		USN-3	The recorded video or the captured image is taken as input by the model	2	Medium	Bhairavi M Deepak Aswin Anazudeen
Sprint 1	Detection of signs and conversion into texts	USN-4	Using the pretrained CNN model, The detection of signs can be done and is converted and displayed as text.	2	High	Bhairavi M Deepak Aswin Anazudeen
Sprint 1	Conversion into audio.	USN-5	As a user , I can also convert the text to voice/audio .	1	Low	Bhairavi M Deepak Aswin Anazudeen

6.2 Sprint Delivery Schedule:



Sprint	Total story points	Duration	Sprint start date	Sprint start date(planned)	Story Points Completed(as on Planned EndDate)	SprintRelease Date(Actual)
Sprint 1	20	6 days	24 oct 2022	27 oct 2022	20	27 oct 2022
Sprint 2	20	6 days	31 oct 2022	5 nov 2022		
Sprint 3	20	6 days	07 nov 2022	13 nov 2022		
Sprint 4	20	6 days	14 nov 2022	19 nov 2022		

6.3 Reports from JIRA



Sprints

SLD-7 User needs to be able to click the camera an...

SLD-8 The model for detecting the sign language is...

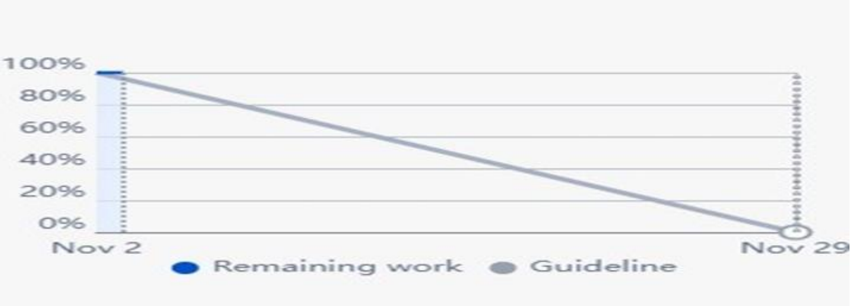
SLD-9 The model that is created is trained in the IB...

SLD-10 Prediction of the model is done

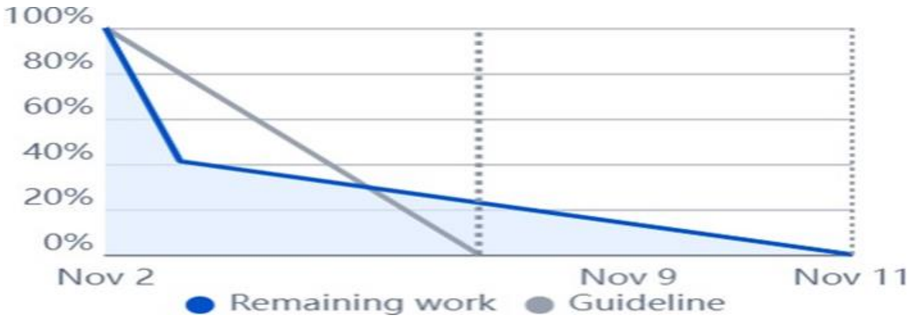
SLD-11 The HTML page is built and it is connected...

SLD-12 The model is tested for its accuracy in the r...

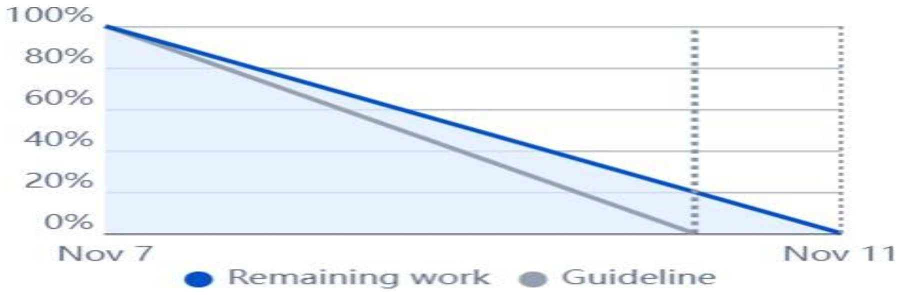
Sprint-1



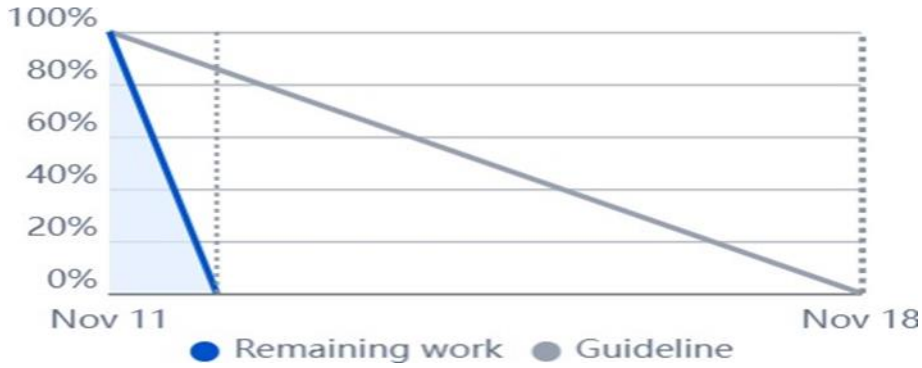
Sprint-2



Sprint-3



Sprint-4



This are the final reports that is been generated from the software. Initially with the help of the software we have made a plan for the sprint delivery. By using it so we are getting the four phase sprint report with roadmap. By using this we can assign and complete the work in the desired period. This will help to complete the work in time.

7.CODING & SOLUTIONING

In order to design website that coverts sign language into English alphabets we need to develop the website. For developing the website, primarily we need a platform that is useful for developing the code. Coding is nothing that which are the applications developed by the developers in a certain computer language. Here we are using Python language for developing the website.

7.1 Feature1:-

```
# importing the necessary libraries

import tensorflow as tf
from keras.preprocessing.image import ImageDataGenerator


#Augmenting the input training images

train_datagen = ImageDataGenerator(
        rescale=1./255,
        shear_range=0.2,
        zoom_range=0.2,
        horizontal_flip=True)


# Considering the training dataset folder it is converted into grayscale

training_set = train_datagen.flow_from_directory(
        r'Dataset/Train_set',
        target_size=(64, 64),
        batch_size=32,
        class_mode='categorical',
        color_mode = "grayscale")


#Preprocessing the test data

test_datagen = ImageDataGenerator(
        rescale=1./255)

# Considering the testing datset folder it is converted into grayscale

test_data = test_datagen.flow_from_directory(
        r'dataset/Test_set',
        target_size=(64, 64),
        batch_size=32,
        class_mode='categorical',
        color_mode = "grayscale")

#Building the model

cnn = tf.keras.models.Sequential()

#Adding convolution layer

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu",input_shape =[64,64,1]))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu"))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu"))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))


# Adding dropout (optimization technique)

cnn.add(tf.keras.layers.Dropout(0.5))

# Flattening the layers

cnn.add(tf.keras.layers.Flatten())

# Adding dense layers(Hidden Layers)

cnn.add(tf.keras.layers.Dense(units=512 ,activation ="relu"))

cnn.add(tf.keras.layers.Dense(units=512 ,activation ="relu"))

#Adding the output dense layer and the units 9 denote the number of classes in it

cnn.add(tf.keras.layers.Dense(units=9,activation="softmax"))

#compilation of the neural network model

cnn.compile(optimizer="rmsprop",loss="categorical_crossentropy" ,metrics =["accuracy"])

#Fitting the neural network model and training it

cnn.fit(training_set , validation_data =test_data , epochs = 30 )
cnn.fit(training_set , validation_data =test_data , epochs = 30 )

#summary of the model

cnn.summary()

#saving the model

cnn.save("aslpng.h5")

#load the model


import cv2
import numpy as np

cnn = tf.keras.models.load_model("aslpng.h5")

#preprocess the test image

# Loading the image to be tested
img_rgb = cv2.imread('prediction/ff.jpg')

# Preprocessing - converting the rgb image into grayscale
img_gray = cv2.cvtColor(img_rgb, cv2.COLOR_BGR2GRAY)


 # saving it as new img in the specified location
cv2.imwrite("prediction/result.jpg",img_gray)


#prediction if the model using the test image

image =
tf.keras.preprocessing.image.load_img("prediction/result.jpg",color_mode="grayscale",target_size=(64,64))
input_arr = tf.keras.preprocessing.image.img_to_array(image)
input_arr = np.expand_dims(input_arr,axis=0)

#print(input_arr)
result = cnn.predict(input_arr)


# The output representation of the various classes are represented

Training_set.class_indices
```

```
# The result of the prediction is depicted

print(result)
```

7.2 Feature 2:-

```
  # importing the required libraries

from flask import Flask,render_template,request
import cv2
import numpy as np
from keras.models import load_model

app = Flask(__name__, static_url_path='/static')

@app.route('/',methods=['POST','GET'])

def hello_world():
    if(request.method=='POST'):
        model = load_model('Hello.h5')

        # CAMERA can be 0 or 1 based on default camera of your computer.
        camera = cv2.VideoCapture(0)

        # Grab the labels from the labels.txt file.
        labels = open('labels.txt', 'r').readlines()

        while True:

            # Grab the webcameras image.
            ret, image = camera.read()

            # Resize the raw image into (224-height,224-width) pixels.
            image = cv2.resize(image, (224, 224), interpolation=cv2.INTER_AREA)

            # Show the image in a window
            orig_img = image


            # Convert the image into a numpy array and reshape it to the models input shape.
            image = np.asarray(image, dtype=np.float32).reshape(1, 224, 224, 3)

            # Normalize the image array
            image = (image / 127.5) - 1
            #Predict the image using the model
            probabilities = model.predict(image)

            # Print what the highest value probabilities label
            print(labels[np.argmax(probabilities)])



            font                   = cv2.FONT_HERSHEY_SIMPLEX
            bottomLeftCornerOfText = (30,50)
            fontScale              = 1
            fontColor              = (255,0,0)
            thickness              = 3
            lineType               = 2

            cv2.putText(orig_img,labels[np.argmax(probabilities)],
            bottomLeftCornerOfText,
            font,
            fontScale,
            fontColor,lineType)


            cv2.imshow('Webcam Image', orig_img)



            # Listen to the keyboard for presses.
            keyboard_input = cv2.waitKey(1)
            # 27 is the ASCII for the esc key on your keyboard.
            if keyboard_input == 27:
                break

        camera.release()
        cv2.destroyAllWindows()
        return("Opening Camera...")
    else:
         return render_template('index.html')

# main driver function
if __name__ == '__main__':

    app.run(debug=True)
```

8.Testing

After designing the website we need to test it whether it working finely. And it is mandatory to create a test report based on the testing. A test report is an organized summary of testing objectives, activities, and results. Test Report is a document which contains a summary of all test activities and final test results of a design. Test report is an assessment of how well the Testing is performed. Based on the test report, we can better understand the designs quality and its performance.

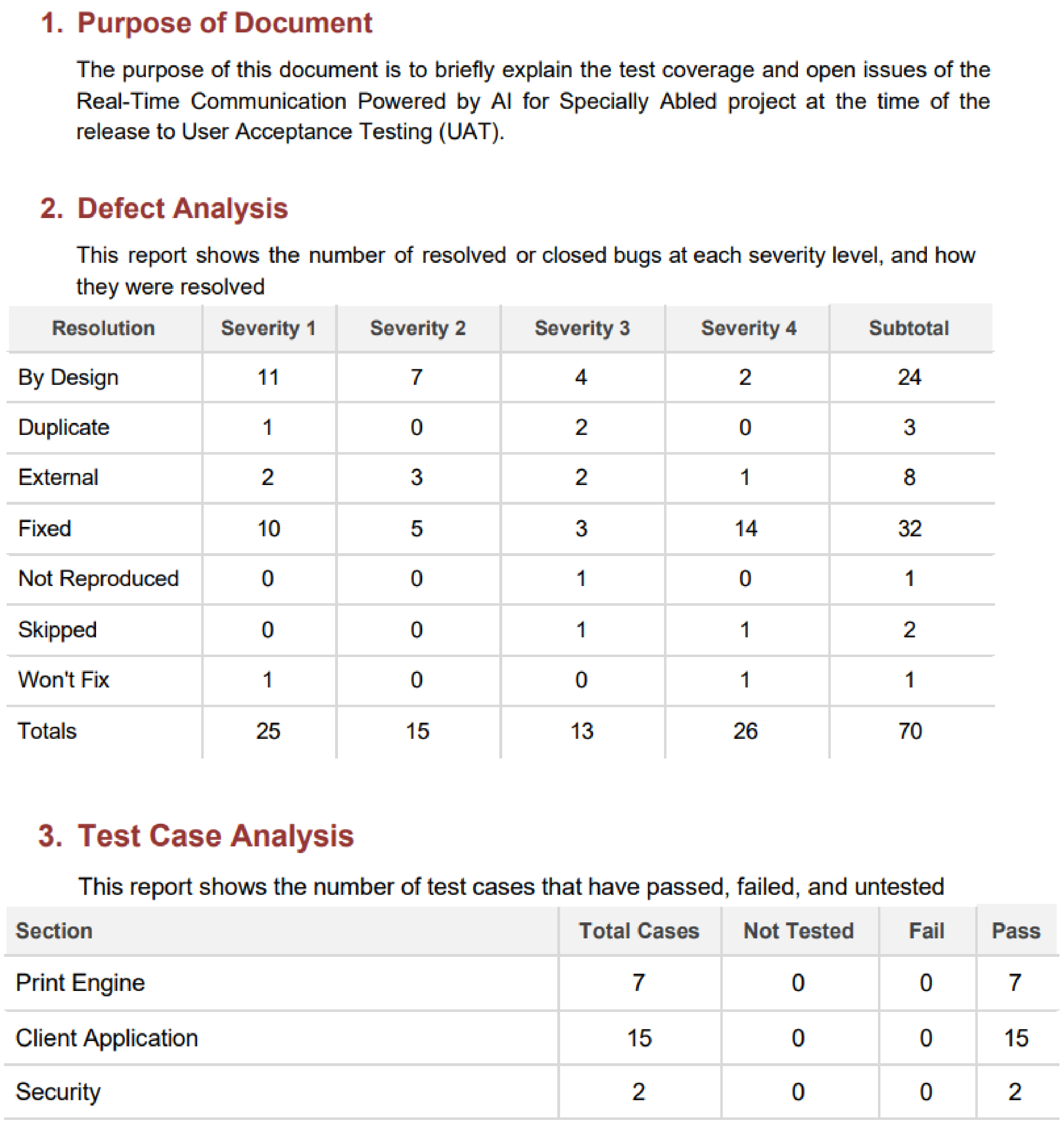
8.1 Test cases:-

A test case is nothing but a series of step executed on a design, using a predefined set of input data, expected to produce a pre-defined set of outputs, in a given environment.It describes "how" to implement those test cases. Test case specifications are useful as it enlists the specification details of the design, the following are the some of the specifications of test cases.

- Test case ID and objective with pre-requisite
- Input data
- Expected result
- Actual result
- Final result

8.2 User Acceptance Testing:-

User acceptance testing (UAT), also called application testing or end-user testing, is a phase of software development in which the software is tested in the real world by its intended audience. UAT is often the last phase of the software designing process and is performed before the tested software is released to its intended market.



1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Real-Time Communication Powered by AI for Specially Abled project at the time of the release to User Acceptance Testing (UAT).

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	11	7	4	2	24
Duplicate	1	0	2	0	3
External	2	3	2	1	8
Fixed	10	5	3	14	32
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	1	0	0	1	1
Totals	25	15	13	26	70

3. Test Case Analysis

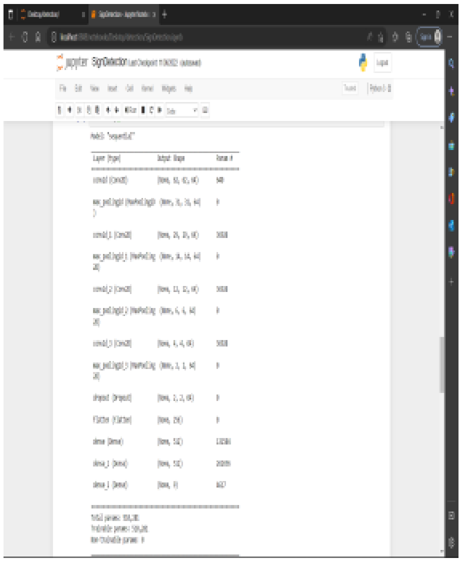
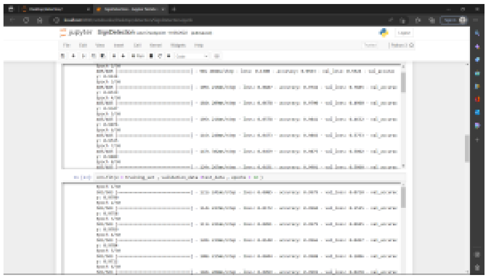
This report shows the number of test cases that have passed, failed, and untested

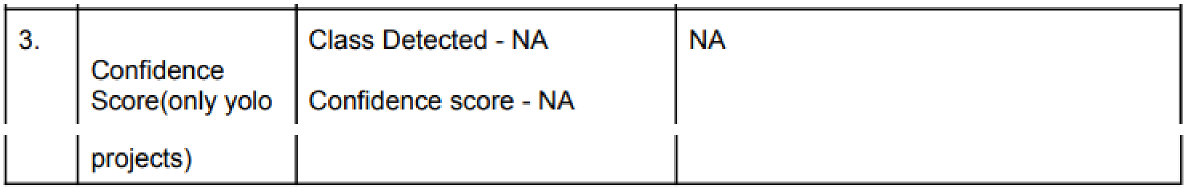
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	15	0	0	15
Security	2	0	0	2

Outsource Shipping	2	0	0	2
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9.RESULTS

9.1 Performance Metrics:-

Sn o	Parameter	Values	Screenshot
1.	Model summary	Cnn - sequential model Layers, Convo2D-,(None, 62, 62, 64) dropout (Dropout (None, 2, 2, 64) 0 flatten (Flatten) (None, 256) 0 dense (Dense) (None, 512) 131584 dense_2 (Dense) (None, 9) 4617 Total params: 510,281 Trainable params: 510,281 Non-trainable params: 0 ________________________________	
2.	Accuracy	Training accuracy : 0.9991 Validation Accuracy :0.9914	



3.	Confidence Score(only yolo projects)	Class Detected - NA Confidence score - NA	NA

10.ADVANTAGES & DISADVANTAGES

ADVANTAGES:-

1. It is possible to create a mobile application to bridge the communication gap between deaf and dumb persons and the general public.

2. As different sign language standards exist, their dataset can be added, and the user can choose which sign language to read.

DISADVANTAGES:-

1.The current model only works from alphabets A to I.

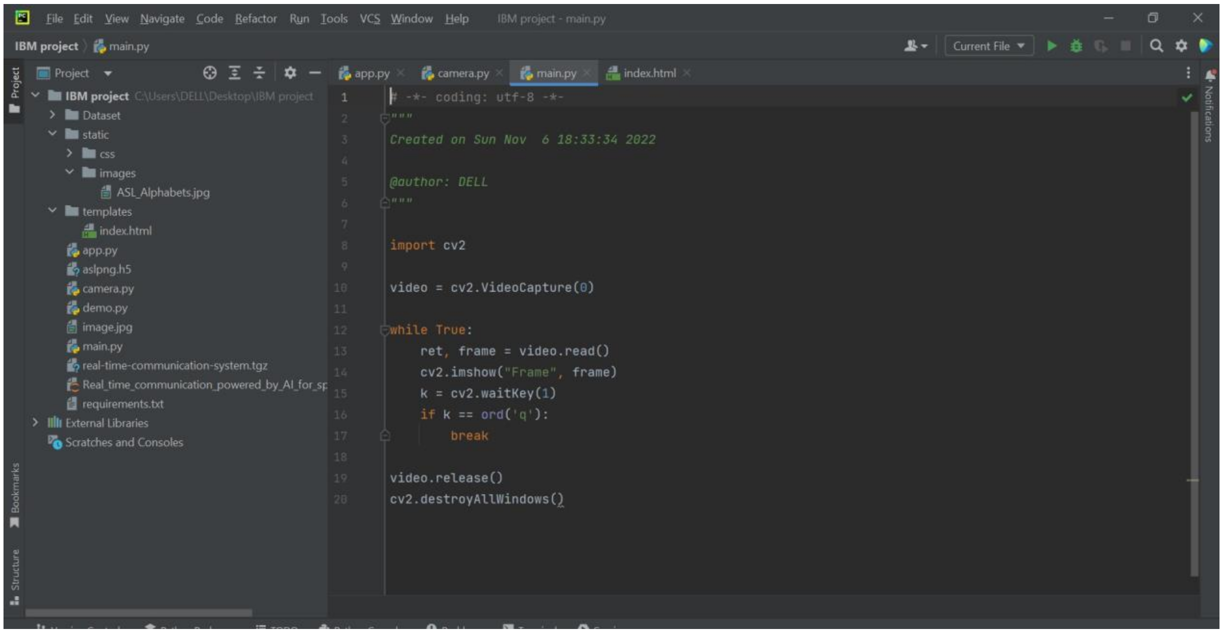
2.In absence of gesture recognition, alphabets from J cannot be identified as they require some kind of gesture input from the user.

3.As the quantity/quality of images in the dataset is low, the accuracy is not great, but that can easily be improved by change in dataset.

11.CONCLUSION

Sign language is a useful tool for facilitating communication between deaf and hearing people. Because it allows for two-way communication, the system aims to bridge the communication gap between deaf people and the rest of society.

The proposed methodology translates language into English alphabets that are understandable to humans. This system sends hand gestures to the model, who recognises them and displays the equivalent Alphabet on the screen. Deaf-mute people can use their hands to perform sign language, which will then be converted into alphabets, thanks to this project.



```python
# -*- coding: utf-8 -*-
"""
Created on Sun Nov  6 18:33:34 2022

@author: DELL
"""

import cv2

video = cv2.VideoCapture(0)

while True:
    ret, frame = video.read()
    cv2.imshow("Frame", frame)
    k = cv2.waitKey(1)
    if k == ord('q'):
        break

video.release()
cv2.destroyAllWindows()
```

12.FUTURE SCOPE

Having a technology that can translate hand sign language to its corresponding alphabet is a game changer in the field of communication and AI for the specially abled people such as deaf and dumb. With introduction of gesture recognition, the web app can easily be expanded to recognize letters beyond 'I', digits and other symbols plus gesture recognition can also allow controlling of software/hardware interfaces.

We can develop a model for ISL word and sentence level recognition. This will require asystem that can detect changes with respect to the temporal space. We can alsodevelop a complete product that will help the speech and hearing impaired people, and thereby reduce the communication gap.

13.APPENDIX

Source code:-

SignDetection.pynb

```
# importing the necessary libraries

import tensorflow as tf
from keras.preprocessing.image import ImageDataGenerator


#Augmenting the input training images

train_datagen = ImageDataGenerator(
        rescale=1./255,
        shear_range=0.2,
        zoom_range=0.2,
        horizontal_flip=True)


# Considering the training dataset folder it is converted into grayscale

training_set = train_datagen.flow_from_directory(
        r'Dataset/Train_set',
        target_size=(64, 64),
        batch_size=32,
        class_mode='categorical',
        color_mode = "grayscale")


#Preprocessing the test data

test_datagen = ImageDataGenerator(
        rescale=1./255)

# Considering the testing datset folder it is converted into grayscale

test_data = test_datagen.flow_from_directory(
        r'dataset/Test_set',
        target_size=(64, 64),
        batch_size=32,
        class_mode='categorical',
        color_mode = "grayscale")

#Building the model

cnn = tf.keras.models.Sequential()

#Adding convolution layer

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu",input_shape =[64,64,1]))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu"))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))

cnn.add(tf.keras.layers.Conv2D(filters=64,kernel_size=3,activation ="relu"))

cnn.add(tf.keras.layers.MaxPool2D(pool_size = 2,strides=2))


# Adding dropout (optimization technique)

cnn.add(tf.keras.layers.Dropout(0.5))

# Flattening the layers

cnn.add(tf.keras.layers.Flatten())

# Adding dense layers(Hidden Layers)
```

```
cnn.add(tf.keras.layers.Dense(units=512 ,activation ="relu"))

cnn.add(tf.keras.layers.Dense(units=512 ,activation ="relu"))

#Adding the output dense layer and the units 9 denote the number of classes in it

cnn.add(tf.keras.layers.Dense(units=9,activation="softmax"))

#compilation of the neural network model

cnn.compile(optimizer="rmsprop",loss="categorical_crossentropy" ,metrics =["accuracy"])

#Fitting the neural network model and training it

cnn.fit(training_set , validation_data =test_data , epochs = 30 )

cnn.fit(training_set , validation_data =test_data , epochs = 30 )

#summary of the model

cnn.summary()

#saving the model

cnn.save("aslpng.h5")

#load the model


import cv2
import numpy as np

cnn = tf.keras.models.load_model("aslpng.h5")

#preprocess the test image

# Loading the image to be tested
img_rgb = cv2.imread('prediction/ff.jpg')

# Preprocessing - converting the rgb image into grayscale
img_gray = cv2.cvtColor(img_rgb, cv2.COLOR_BGR2GRAY)


 # saving it as new img in the specified location
cv2.imwrite("prediction/result.jpg",img_gray)
```

```
#prediction if the model using the test image

image =
tf.keras.preprocessing.image.load_img("prediction/result.jpg",color_mode="grayscale",target_size=(64,64))
input_arr = tf.keras.preprocessing.image.img_to_array(image)
input_arr = np.expand_dims(input_arr,axis=0)

#print(input_arr)
result = cnn.predict(input_arr)


# The output representation of the various classes are represented

Training_set.class_indices

# The result of the prediction is depicted

print(result)
```

index.py

```
# importing the required libraries

from flask import Flask,render_template,request
import cv2
import numpy as np
from keras.models import load_model

app = Flask(__name__, static_url_path='/static')

@app.route('/',methods=['POST','GET'])

def hello_world():
    if(request.method=='POST'):
        model = load_model('Hello.h5')

        # CAMERA can be 0 or 1 based on default camera of your computer.
        camera = cv2.VideoCapture(0)

        # Grab the labels from the labels.txt file.
        labels = open('labels.txt', 'r').readlines()

        while True:

            # Grab the webcameras image.
```

```
ret, image = camera.read()

# Resize the raw image into (224-height,224-width) pixels.
image = cv2.resize(image, (224, 224), interpolation=cv2.INTER_AREA)

# Show the image in a window
orig_img = image


# Convert the image into a numpy array and reshape it to the models input shape.
image = np.asarray(image, dtype=np.float32).reshape(1, 224, 224, 3)

# Normalize the image array
image = (image / 127.5) - 1



#Predict the image using the model
probabilities = model.predict(image)

# Print what the highest value probabilities label
print(labels[np.argmax(probabilities)])



font                   = cv2.FONT_HERSHEY_SIMPLEX
bottomLeftCornerOfText = (30,50)
fontScale              = 1
fontColor              = (255,0,0)
thickness              = 3
lineType               = 2

cv2.putText(orig_img,labels[np.argmax(probabilities)],
bottomLeftCornerOfText,
font,
fontScale,
fontColor,lineType)


cv2.imshow('Webcam Image', orig_img)



# Listen to the keyboard for presses.
keyboard_input = cv2.waitKey(1)
# 27 is the ASCII for the esc key on your keyboard.
if keyboard_input == 27:
```

```
            break

        camera.release()
        cv2.destroyAllWindows()
        return("Opening Camera...")
    else:
         return render_template('index.html')

# main driver function
if __name__ == '__main__':

     app.run(debug=True)
```

index.html

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">

    <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css" rel="stylesheet"
integrity="sha384-Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy9Bv1WTRi"
crossorigin="anonymous">


    <title>Document</title>

    <style>

.displayed {
    display: block;
    margin-top:28%;
    margin-left: auto;
    margin-right: auto }
    h1{
        margin-top:3%;
        text-align: center;
        color: rgb(45, 166, 241);
    }

    </style>


</head>
<body background="{{ url_for('static', filename='images/bh.jpg') }}">

    <header class="intro-header">

        <h1>Real time communication system for the specially-abled</h1>

    </header>

    <!-- <input type="submit" value="Predict"> -->


    <form action="http://localhost:5000" method="post">
        <input type ="submit" value="click to predict signs" class ="btn btn-outline-primary displayed">  </input>
    </form>
</body> </html>
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-39157-1660398237/tree/main/Final%20Deliverables/Source%20Code

Project Demo Link:

https://youtu.be/Z-TzRXlGHn4