NALAIYA THIRAN - IBM PROJECT REPORT

Professional Readiness for Innovation, Employability and Entrepreneurship

ON

Real-Time Communication System Powered by AI for Specially Abled

Submitted by

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1. INTRODUCTION

1.1 Project Overview

In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communication between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained in hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language.

1.2 Purpose

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

2. LITERATURE SURVEY

2.1 Existing Problem And Approach

S.No	Authors	Approach	Description	Pros	Cons
1.	D.Deora and N. Bajaj	Following steps are used to find finger tips. Step 1: Thinning using Distance Transform Step 2: Finding perimeter pixels of the image Step 3: Finding Corner points Step 4: Eliminating Corner Points Clustering Algorithm i. Calculating distance of each point from every other point and putting these distances into a matrix. If all the cells have zero value but still we have points, it means there is only one cluster i.e. only one finger tip is there. There are some areas in the image that are still satisfying the criteria for the fingertip which are not correct. To fix this problem we have proposed an algorithm. For this we find the orientation of the binary image. Using	Principal Component Analysis is one of the most popular tools for high dimensional data analysis where dimensional reduction is necessary to reduce the number of input variables in order to simplify the problems. Commonly, in PCA, one tries to find out a set of projections that maximize the variance of given data, or equivalently, that minimize the residuals of the projections. PCA is obtained by calculating the Eigenvectors of the covariance matrix of the current frame; the Eigenvectors are stored according to their corresponding Eigenvalues in decreasing order called as the feature vector	The development of a natural input device for creating sign language documents would make such documents more readable for deaf people. Moreover hearing people have difficulties in learning sign language and likewise the majority of those people who were born deaf or who became deaf early in life, have only a limited vocabulary of accordant spoken language of the community in which they live. Hence a system of translating sign language to spoken language would be of great help for deaf as well as for hearing people. A second aspect is that sign language recognition serves as a good basis for the development of gestural human-machine interface.	Unlike Other Sign Languages(AmericanSignLanguage, GermanSignlanguage)IndianSignlanguageusesbothhandstomakesigns.Somesignsinvolve overlapping of both the hands. Thisoverlapping of hands poses difficulty in Segmentation recognition which is explained in steps later. Recognition for static signs is easy to implement but some signs involve motion in them due to which their recognition becomes more difficult. For example–signs h, j, v,andyhavemotioninthem

		the orientation and the centroid of the hand, a line is drawn, which passes through this centroid at an angle that is given by orientation			
2.	Stephan Liwicki and Mark Everingham	They investigated the problem of recognizing words from video, finger spelled using the British Sign Language (BSL) finger spelling alphabet. This is a challenging task since the BSL alphabet involves both hands occluding each other, and contains signs which are ambiguous from the observer's viewpoint. The main contributions of our work include: (i) recognition based on hand shape alone, not requiring motion cues; (ii) robust visual features for hand shape recognition; (iii) scalability to large lexicon recognition with no re-training. We report results on a data-set of 1,000 low quality webcam videos of 100 words. The	They approach these challenges in the following way: (i) we avoid attempts to explicitly track the individual hands, extracting a single appearance descriptor for the pair of hands; (ii) the method bases recognition on single image features alone. This prevents the classifier exploiting co-articulation features which vary across letter pairs, and means that we require only a small training set; (iii) variation in hand pose is overcome by the use of robust descriptors invariant to local deformation, and by training on short continuously signed sequences; (iv) implicitly ambiguous signs are disambiguate by using a lexicon of words, while not	They have demonstrated that combining a state-of-the-art appearance descriptor with a simple HMM-based lexicon model can give highly accurate finger-spelling recognition on a large lexicon. The proposed method has an advantage over previous work in not requiring word-level training, making it scalable, and we showed that pan grams are a useful source of natural training signs. In improving the method, our results suggest that work should focus on letters level recognition rather than prior language models. It seems promising to investigate extracting cues from multiple frames full gesture modeling which compromises	Limitationsof their workare that ourdatasetcurrentlycontainsonlyasingleinexperiencedsigner, and that the imaging conditions are only moderately challenging, compared to. They hope that expanding the training data with other signers will remove the needforsigner-specific training, and aim to investigate front end methods robust enough to deal with arbitrary and dynamic imaging conditions.

		proposed method achieves a word recognition accuracy of 98.9%	requiring re-training to expand the lexicon.	scalability	
3.	Dewinta Aryanie, Yaya Heryadi	Finger-spelling is a term that refers to a finger gesture system where each alphabet of a particular sign language is represented by a unique and discrete finger pose. Fingerspelling is a very interesting research problem in computer vision with many potential applications in various domains. In sign language, for example, finger-spelling is used to explain a concept which lacks a specific sign, proper nouns, signs borrowed from other languages, finger spelled compounds, and a sign is ambiguous. Therefore, finger spelling is a complementary rather than substitute of sign language to enhance or emphasize the qualities of hand signs. The finger-spelling recognition system in this research can be	User's hand is captured using a Microsoft Kinect sensor. Although, Kinect sensor produces two types of images namely color and depth images, for computation simplicity, only color images provided by the Kinect are used as training dataset. In order to address the curse of dimensionality, Principal Component Analysis (PCA) is applied to reduce data dimensions by converting a set of extracted features into a set of values of linearly uncorrelated variables called principal components (PC) using an orthogonal transformation. The principal components are then selected based on its Eigenvalues that reflect its contribution to explain variability of the original	This study finds that the performance of k-NNclassifier is better for finger-spelling recognition when the finger pattern is represented using full dimensional features rather than using reduced-dimensional features. Reducing feature dimension to only principal components that explain 98%of data variation decreases the k- NN performance significantly. Normalized color histogram is appropriate to represent finger pattern. However, this feature is sensitive to lighting. Therefore, performance investigation of other features involving texture and salient points will be the focus of future research.	The limitation of the k-NN classifier is its computation work load for recognition especially when the training dataset size is large. Ontheother hand, in order to implement this method intomany potential applications of intelligent mobile electronic devices, efficient classifierfortrain ingandrecogniti ondancegestures isverycrucial.Th erefore, performance investigation of other machine learning classifiers will become the focus of future research. It is also recommended that the result of this study is validated using a larger number

		characterized as follows: (1) Finger pose feature is a vector of normalized color histogram, and (2) Finger- spelling recognizer is k-Nearest Neighbors	dataset. In this research, the Eigenvectors that are kept are those that explain 98 % of the total variance. Therefore, the number of principal components is less than or equal to the number of original dimensions.		of fingerspelling examples and a variety of image features.

2.2 References:

D. Deora and N. Bajaj, "Indian sign language recognition," 2012 1st International Conference on Emerging Technology Trends in Electronics, Communication & Networking, 2012, pp. 1-5, doi: 10.1109/ET2ECN.2012.6470093.

S. Liwicki and M. Everingham, "Automatic recognition of finger spelled words inBritish Sign Language," 2009 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, 2009, pp. 50-57, doi: 10.1109/CVPRW.2009.5204291.

D. Aryanie and Y. Heryadi, "American sign language-based finger-spelling recognition using k-Nearest Neighbors classifier," 2015 3rd International Conference on Information and Communication Technology (ICoICT), 2015, pp. 533-536, doi: 10.1109/ICoICT.2015.7231481.

2.3 Problem statement definition:

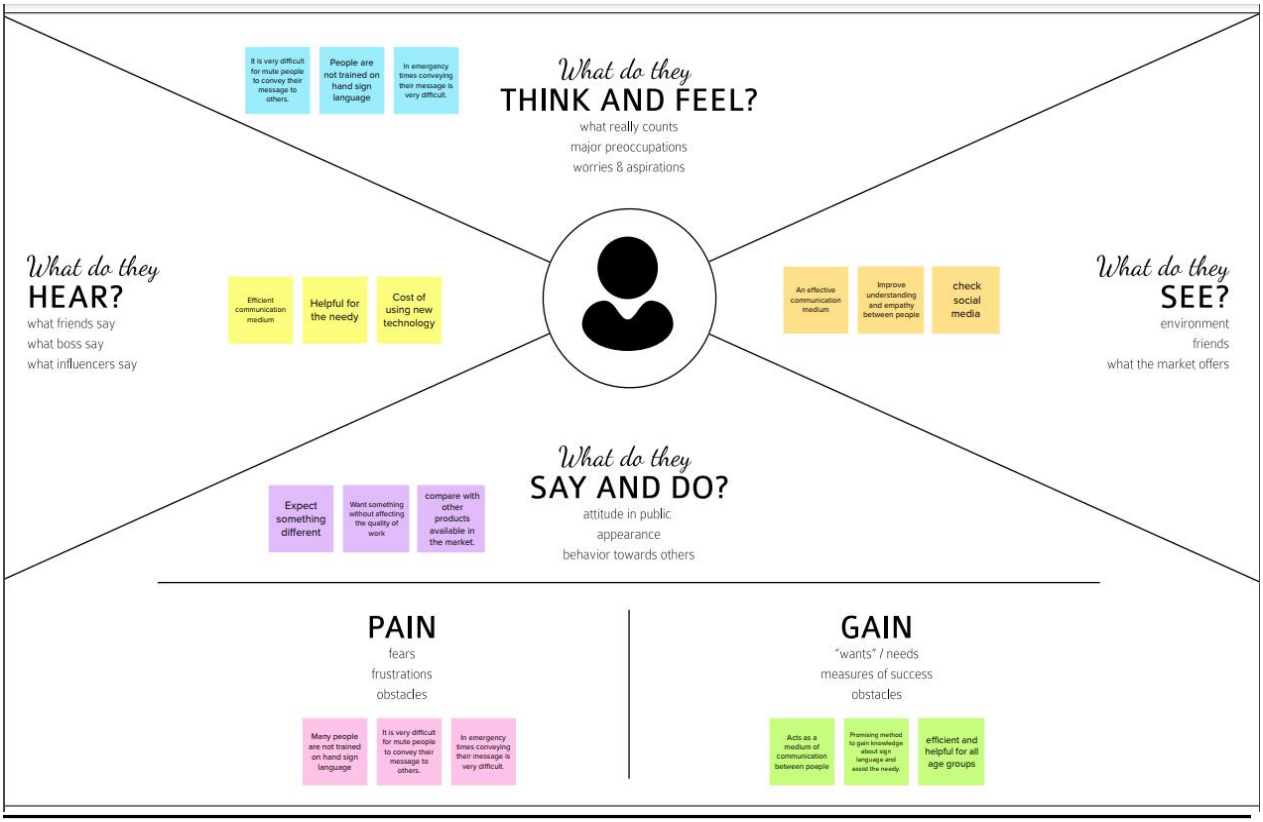
In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language.

Differently abled people need better forms of communication with the help of new technology so that they can significantly improve their ability to get around and participate in daily activities. Differently abled need a form of communication that is easy and helps them to

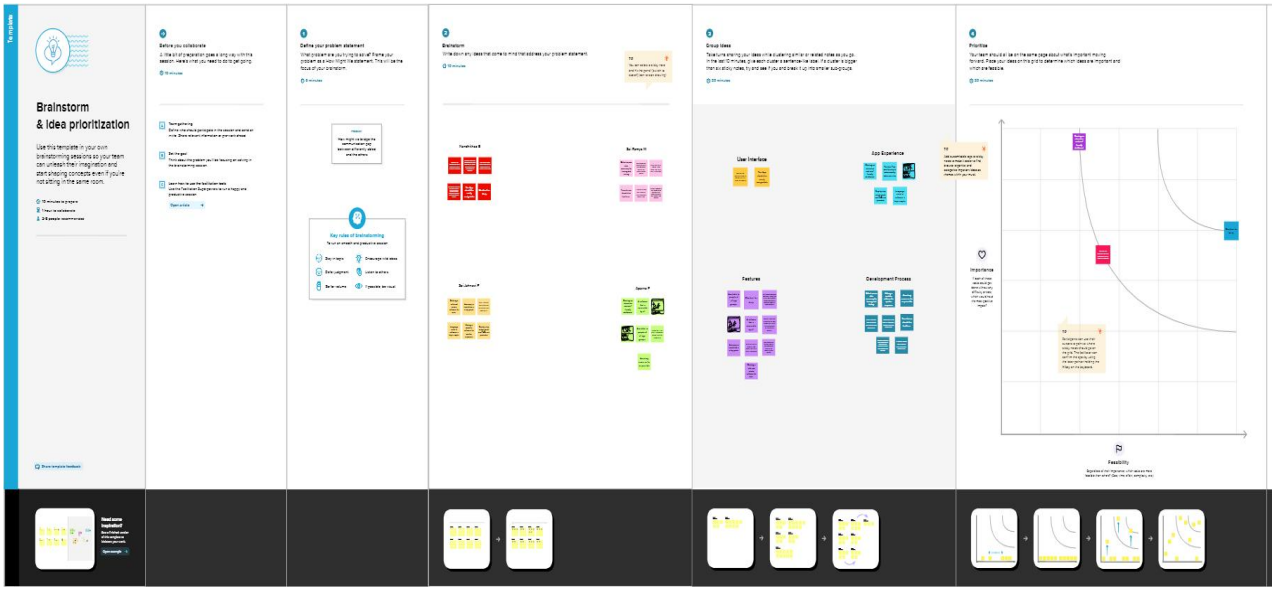
cope up with the hurdles in day-to-day life. People need better access mechanisms to communicate with the differently abled and thus understand their needs and concerns and to have a proper communication medium. People need sensitization of technology to be inclusive of sign language which will help everyone.

3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy map canvas



3.2 Ideation & Brainstorming



3.3 Proposed solution

SNo	Parameter	Description
1.	Problem Statement (Problem to be solved)	In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communication between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained in hand sign language. In emergency times conveying their message is very difficult. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language
2.	Idea / 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.
3.	Novelty / Uniqueness	● Creating an interactive and user friendly dashboard ● Available to people of all age groups ● Images taken and processed by web camera will avoid the background disturbance & Objects ● An alarm button can be setup for any emergency uses for the specially abled person ● Collect various data necessary for training and testing Fault tolerant and handling the exceptions efficiently. ● Making a modular software for quicker response. ● A global community chat forum can be created so that people can share their thoughts and opinions
4.	Social Impact / Customer Satisfaction	Through examples of artificial intelligence technology solutions, discover how accessibility for people with disabilities can be enhanced!
5.	Business Model (Revenue Model)	The business model is based on accurate translation of the sign language and get the user an effective communication with a specially abled person without even knowing the sign language and collecting data on images related to sign language and storing in image database for even more vast usability of data to users.The target audience of the app are the users who wanted to communicate without any hitch. As communication is the means of living our app provides the best experience to all the users which is the major business model of our project.
6.	Scalability of the Solution	The Results brought by the application will have accurate results.

3.4 Problem solution fit

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-4	Camera Orientation	The camera must be placed in such a way that the entire hand gesture is visible Should be placed in the opposite direction of light to ensure proper functioning Background color must be different the the skin color for the camera to fully detect the hand gesture.
FR-5	Pre-requisites	A minimal amount of knowledge on how to use the system is must.
FR-6	Webcam	The webcam should work continuously to capture the frames correctly. The position of the user should be in such a way that the camera is able to capture their hand gestures fully and correctly.

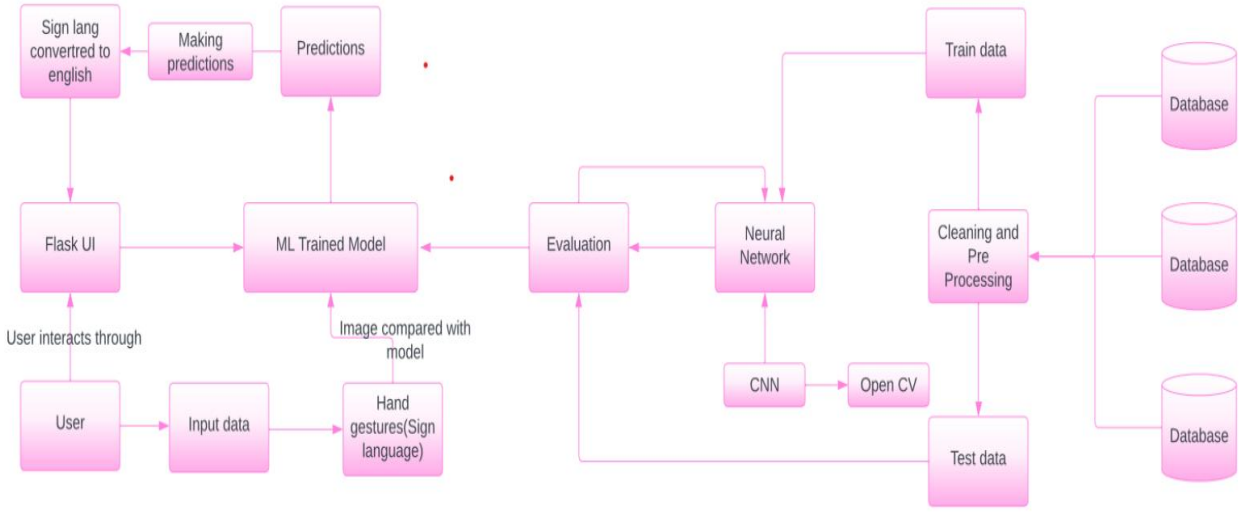
4.2 Non-Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	It can be used by people of all age groups with considerable knowledge on systemusage.
NFR-2	Security	Authentication is set up and only they can access it
NFR-3	Reliability	The model is built after training thousands of images and uses AI, hence it is reliable.

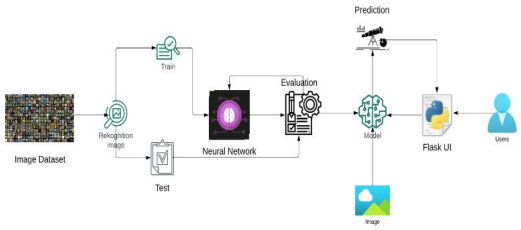
NFR-4	Performance	It detects sign language with high accuracy and sensitivity and gives a faster response
NFR-5	Availability	Provides automatic recovery and User access.
NFR-6	Scalability	Standard network condition the device should convert information within seconds.

5. PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture



Guidelines:

- Include all the processes (As an application logic / Technology Block)
- Provide infrastructural demarcation (Local / Cloud)
- Indicate external interfaces (third party API's etc.)
- Indicate Data Storage components / services
- Indicate interface to machine learning models (if applicable)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology

1.	User Interface	How user interacts with application- Chatbot	HTML, CSS, Python
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service and TTS service
4.	Cloud Database	Database Service on Cloud	IBM Cloudant
5.	File Storage	File storage requirements	Local Filesystem
6.	Machine Learning Model	Neural Networks -CNN model, ANN model	Object Recognition- CNN model
7.	Infrastructure (Server / Cloud)	Application Deployment on Local System	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Numpy, Pandas, Keras, Tensorflow	Python framework
2.	Security Implementations	Security access controls, use of firewalls	SHA-256
3.	Scalable Architecture	Scalable AI	SEI Digital library
4.	Availability	Use of cloud, Virtual assistant	IBM Cloud IBM Watson Assistant
5.	Performance	Image pre-processing and CNN	Python

5.3 User stories

User Type	Functional	User	User Story / Task	Acceptance	Priority	Release

	Requirement (Epic)	**Story Number**		**criteria**		
Customer (Mobile user)	Registration	USN-1	As a user, I can register with Gmail, password and other required information needed with a confirmed password.	I can access my account and dashboard	High	Sprint-1
		USN-2	As a user, I will get a confirmation mail once I have registered for the application.	I can receive confirmation mail with code so it can be used to enter in the application	High	Sprint-1
		USN-3	As a user, I can register for the application through Google	I can register & access the dashboard with Google Login	Medium	Sprint-2
		USN-4	As a user, I can register for the application through Facebook		Low	Sprint-3
	Login	USN-5	As a user, I can log into the application by entering email & password	I can access the application account and other features.	High	Sprint-1
	Dashboard	USN-6 I	As a user, After login to the application I can see the dashboard where I get all required information from	I can receive the information from dashboard of application	High	Sprint-2

			the application.			
Customer (Web user)	Image	USN-7	As a user, I can access my webcam for image capturing.	I can get accurate translation of sign to normal language	High	Sprint-2
		USN-8	As a user,I want to invite my friends , so we can enjoy this application together	I can communicate in sign language as well as normal one.	low	Sprint-4
Customer Care Executive Helpline	Helpline	USN-9	As a customer care executive, I need to provide support to users for understanding and use the application to the fullest.	I can get to access the guidelines and help from application	Medium	Sprint-3
	FAQs	USN-10	As a customer care executive, I would have to answer queries in using the application while accessing it.	I can answer questions and access other FAQs as well.	Medium	Sprint-4
Administrator	Data access	USN-11	As an administrator, I would like to access history of the reference in user communication	I can provide a detailed answer for the user needs from application	High	Sprint-4
		USN-12	As an admin, I need to provide users with a good description of the application.	I can add directions for each step of the user.	Medium	Sprint -3

6.PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning and Estimation

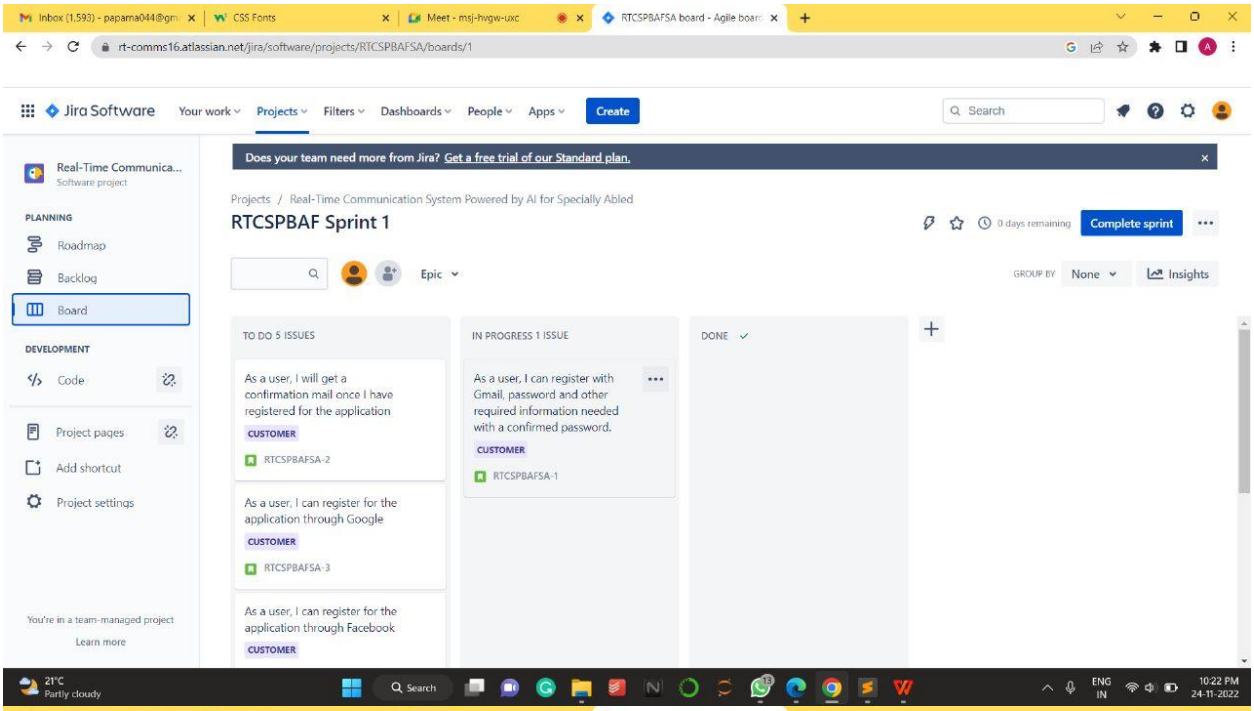
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register with Gmail, password and other required information needed with a confirmed password.	5	High	Aparna P
Sprint-1		USN-2	As a user, I will get a confirmation mail once I have registered for the application.	10	High	Nandhithaa B
Sprint-2		USN-3	As a user, I can register for the application through Google	5	Medium	Aparna P
Sprint-3		USN-4	As a user, I can register for the application through Facebook	10	Low	Sai Jahnavi
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	5	High	Aparna P
Sprint-2	Dashboard	USN-6	As a user, After login to the application I can see the dashboard where I get all	5	High	Nandhithaa

			required information from the application.			
Sprint-2	Image	USN-7	As a user, I can access my webcam for image capturing.	10	High	Sai Ramya
Sprint-4		USN-8	As a user,I want to invite my friends , so we can enjoy this application together	5	low	Sai Jahnavi
Sprint-3	Helpline	USN-9	As a customer care executive, I need to provide support to users for understanding and use the application to the fullest.	10	Medium	Aparna P
Sprint-4	FAQs	USN-10	As a customer care executive, I would have to answer queries in using the application while accessing it.	5	Medium	Sai Jahnavi
Sprint-4	Data access	USN-11	As an administrator, I would like to access history of the reference in user communication	5	High	Nandhithaa
Sprint -3		USN-12	As an admin, I need to provide users with a good description of the application.	5	Medium	Aparna P

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	20	10 Days	24 Oct 2022	08 Nov 2022	20	08 Nov 2022
Sprint-2	20	10 Days	09 Nov 2022	19 Nov 2022	20	19 Nov 2022
Sprint-3	20	10 Days	20 Nov 2022	30 Nov 2022	20	30 Nov 2022
Sprint-4	20	10 Days	1 Dec 2022	10 Dec 2022	20	10 Dec 2022

6.3 Reports from Jira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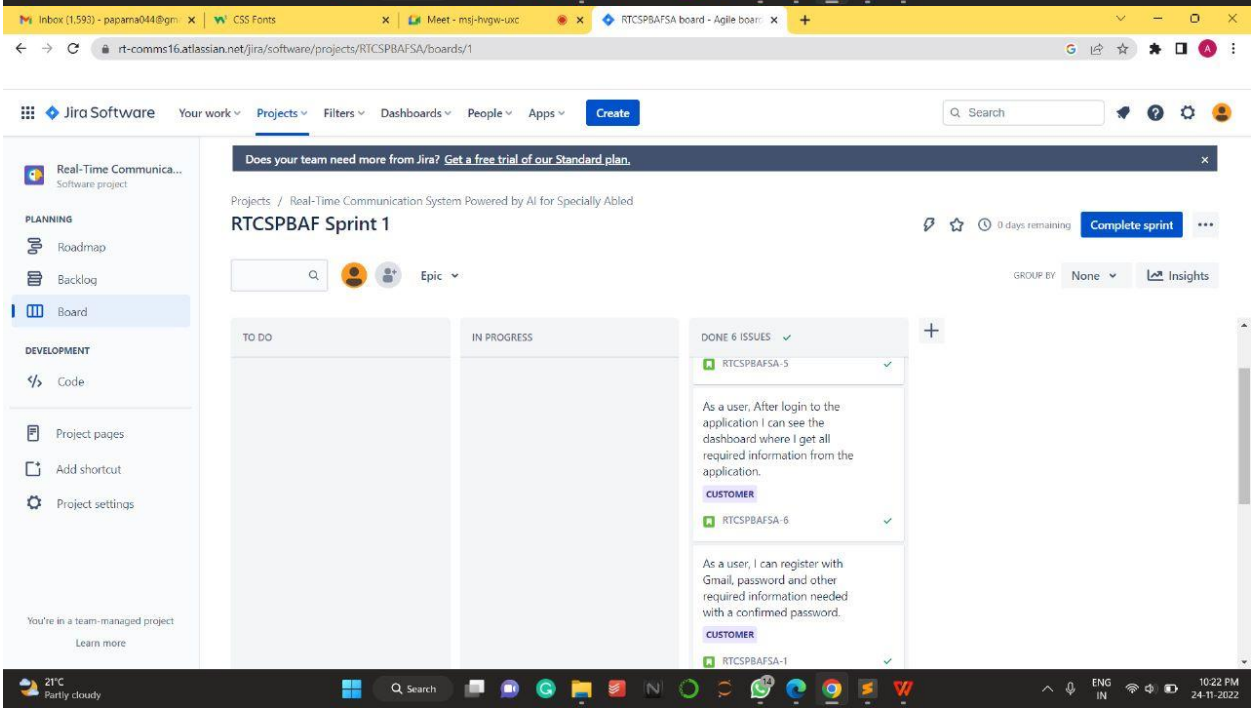
RTCSPBAF Sprint 1
0 days remaining
Complete sprint
Epic
GROUP BY
None
Insights
TO DO 5 ISSUES
As a user, I will get a confirmation mail once I have registered for the application
CUSTOMER
RTCSPBAFSA-2
As a user, I can register for the application through Google
CUSTOMER
RTCSPBAFSA-3
As a user, I can register for the application through Facebook
CUSTOMER
IN PROGRESS 1 ISSUE
As a user, I can register with Gmail, password and other required information needed with a confirmed password.
CUSTOMER
RTCSPBAFSA-1
DONE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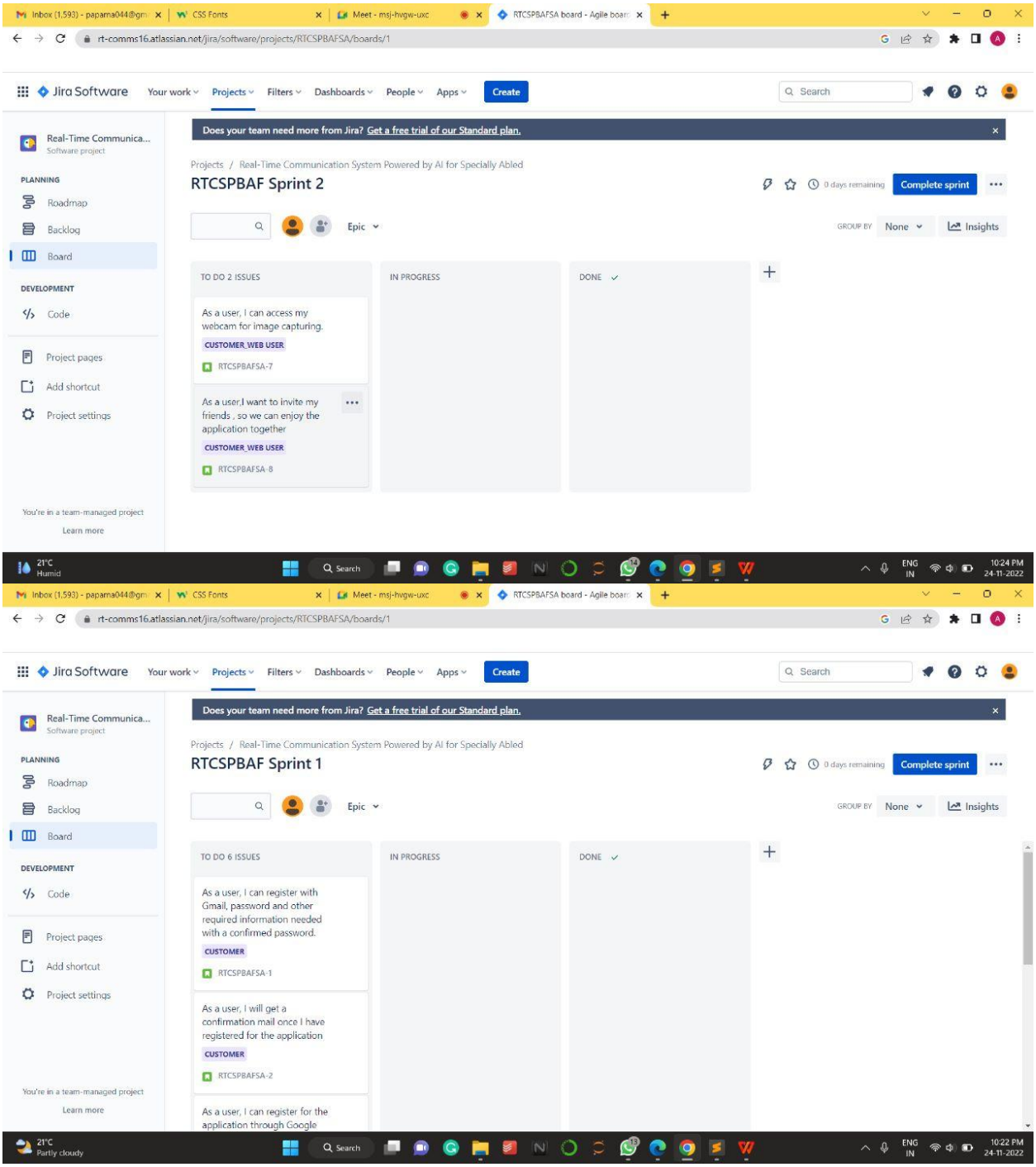
RTCSPBAF Sprint 1
0 days remaining
Complete sprint
Epic
GROUP BY
None
Insights
TO DO
IN PROGRESS
DONE 6 ISSUES
RTCSPBAFSA-5
As a user, After login to the application I can see the dashboard where I get all required information from the application.
CUSTOMER
RTCSPBAFSA-6
As a user, I can register with Gmail, password and other required information needed with a confirmed password.
CUSTOMER
RTCSPBAFSA-1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RTCSPBAF Sprint 2
0 days remaining
Complete sprint
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CUSTOMER_WEB USER
RTCSPBAFSA-7
As a user,I want to invite my friends , so we can enjoy the application together
CUSTOMER_WEB USER
RTCSPBAFSA-8
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RTCSPBAFSA-2
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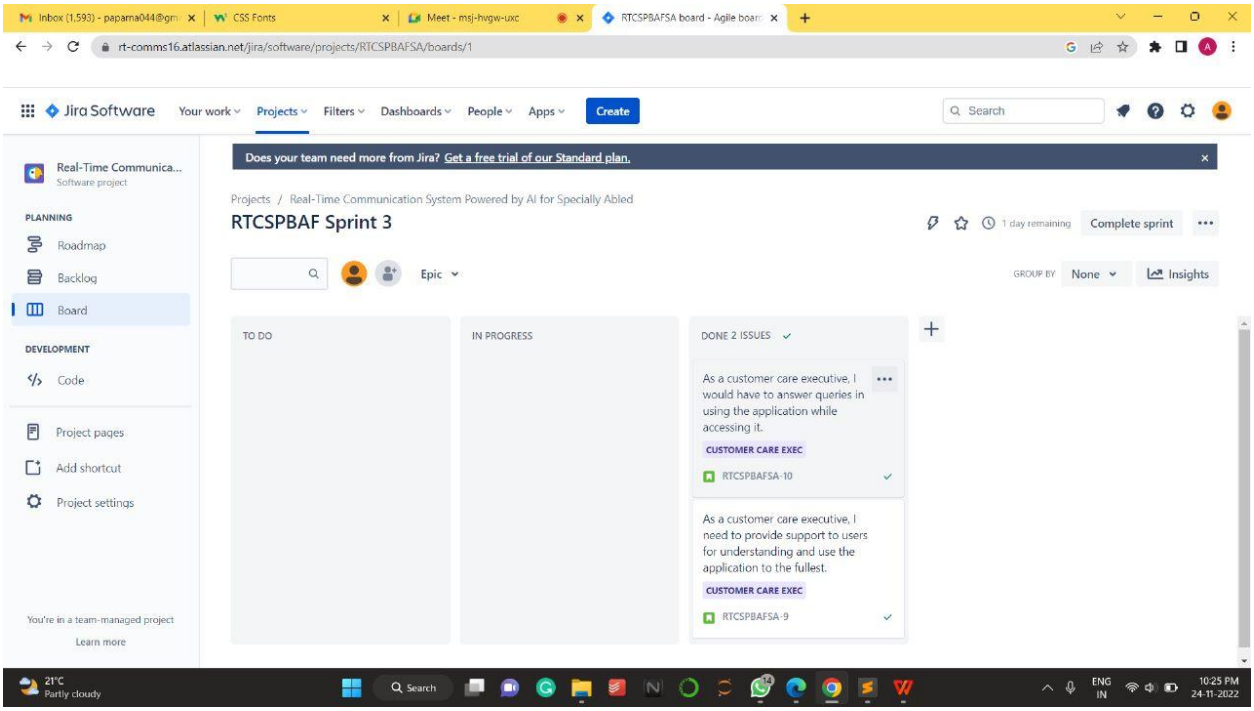
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RTCSPBAF Sprint 3
1 day remaining
Complete sprint
Epic
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CUSTOMER CARE EXEC
RTCSPBAFSA-10
As a customer care executive, I need to provide support to users for understanding and use the application to the fullest.
CUSTOMER CARE EXEC
RTCSPBAFSA-9
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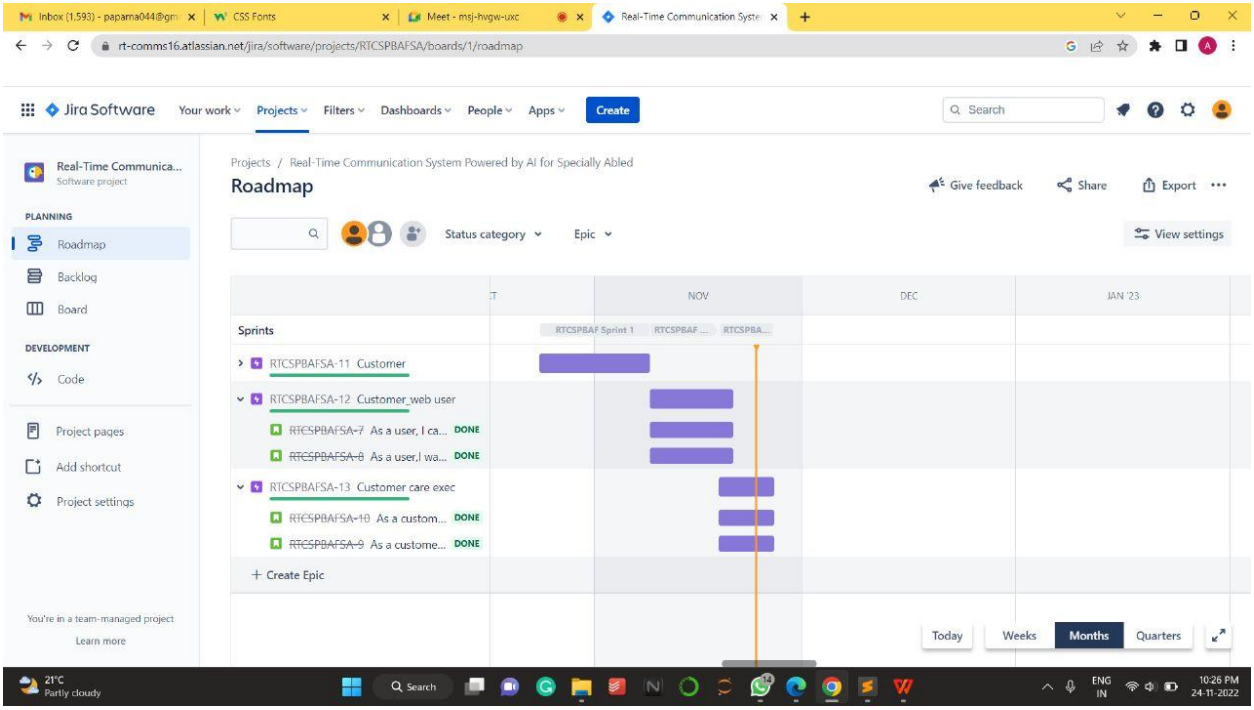
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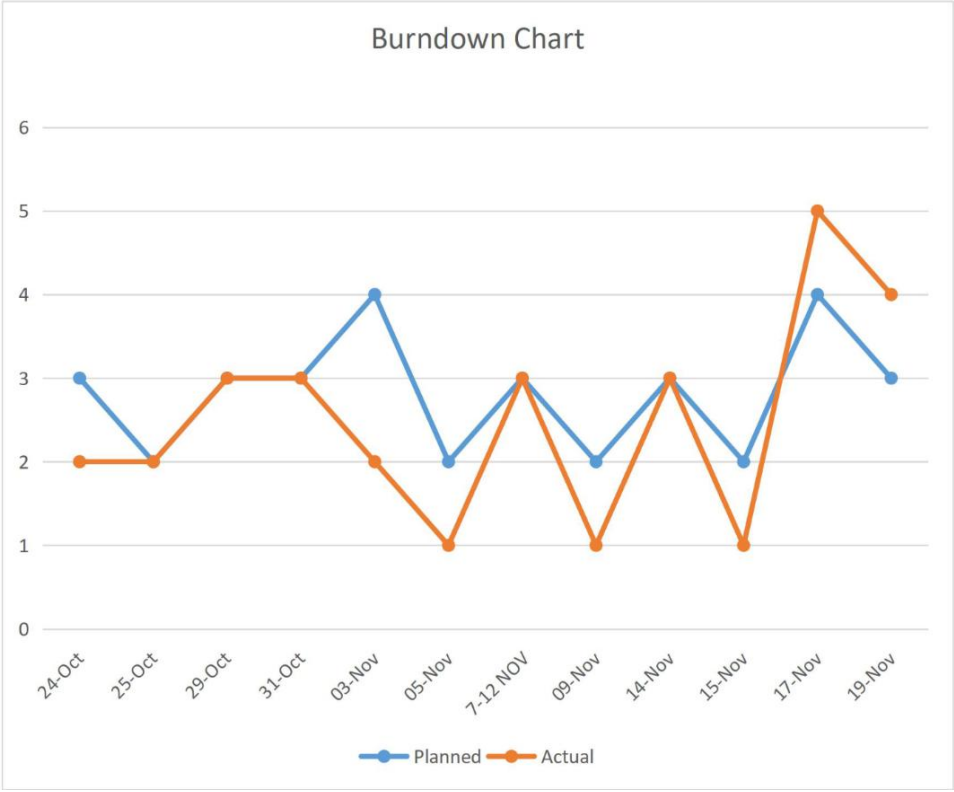
Roadmap
Give feedback
Share
Export
Status category
Epic
View settings
NOV
DEC
JAN '23
Sprints
RTCSPBAFSA-11 Customer
RTCSPBAFSA-12 Customer_web user
RTCSPBAFSA-7 As a user, I ca... DONE
RTCSPBAFSA-8 As a user,I wa... DONE
RTCSPBAFSA-13 Customer care exec
RTCSPBAFSA-10 As a custom... DONE
RTCSPBAFSA-9 As a custome... DONE
Create Epic
Today
Weeks
Months
Quarters
21°C
Partly cloudy
Search
ENG
IN
10:26 PM
24-11-2022

Burndown chart:



6.CODING AND SOLUTIONING

7.1 Feature 1

In [3]:
```
#PNT2022TMID23360

#Project: Real-Time Communication system powered by AI for specially abled

#Image Preprocessing
```

In [4]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

In [5]:
```
# Training Datagen
train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
# Testing Datagen
test_datagen = ImageDataGenerator(rescale=1/255)
```

In [6]:
```
import tensorflow as tf
import os
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Conv2D, Flatten, Dropout, MaxPooling2D
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import numpy as np
import matplotlib.pyplot as plt
import IPython.display as display
from PIL import Image
import pathlib
```

In [7]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

In [8]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

In [9]:
```
!unzip '/content/drive/MyDrive/Dataset/Dataset.zip'
```

```
Streaming output truncated to the last 5000 lines.
  extracting: Dataset/training_set/G/1225.png
  extracting: Dataset/training_set/G/1226.png
  extracting: Dataset/training_set/G/1227.png
```

In [9]:
```
!unzip '/content/drive/MyDrive/Dataset/Dataset.zip'
```

```
Streaming output truncated to the last 5000 lines.
  extracting: Dataset/training_set/G/1225.png
  extracting: Dataset/training_set/G/1226.png
  extracting: Dataset/training_set/G/1227.png
  extracting: Dataset/training_set/G/1228.png
  extracting: Dataset/training_set/G/1229.png
   inflating: Dataset/training_set/G/123.png
  extracting: Dataset/training_set/G/1230.png
  extracting: Dataset/training_set/G/1231.png
  extracting: Dataset/training_set/G/1232.png
   inflating: Dataset/training_set/G/1233.png
   inflating: Dataset/training_set/G/1234.png
   inflating: Dataset/training_set/G/1235.png
   inflating: Dataset/training_set/G/1236.png
   inflating: Dataset/training_set/G/1237.png
   inflating: Dataset/training_set/G/1238.png
   inflating: Dataset/training_set/G/1239.png
   inflating: Dataset/training_set/G/124.png
   inflating: Dataset/training_set/G/1240.png
   inflating: Dataset/training_set/G/1241.png
   inflating: Dataset/training_set/G/1242.png
   inflating: Dataset/training_set/G/1243.png
   inflating: Dataset/training_set/G/1244.png
   inflating: Dataset/training_set/G/1245.png
  extracting: Dataset/training_set/G/1246.png
   inflating: Dataset/training_set/G/1247.png
   inflating: Dataset/training_set/G/1248.png
   inflating: Dataset/training_set/G/1249.png
   inflating: Dataset/training_set/G/125.png
   inflating: Dataset/training_set/G/1250.png
   inflating: Dataset/training_set/G/1251.png
   inflating: Dataset/training_set/G/1252.png
   inflating: Dataset/training_set/G/1253.png
   inflating: Dataset/training_set/G/1254.png
   inflating: Dataset/training_set/G/1255.png
   inflating: Dataset/training_set/G/1256.png
   inflating: Dataset/training_set/G/1257.png
   inflating: Dataset/training_set/G/1258.png
   inflating: Dataset/training_set/G/1259.png
   inflating: Dataset/training_set/G/126.png
   inflating: Dataset/training_set/G/1260.png
   inflating: Dataset/training_set/G/1261.png
  extracting: Dataset/training_set/G/1262.png
```

```
   inflating: Dataset/training_set/I/988.png
   inflating: Dataset/training_set/I/989.png
   inflating: Dataset/training_set/I/99.png
   inflating: Dataset/training_set/I/990.png
   inflating: Dataset/training_set/I/991.png
   inflating: Dataset/training_set/I/992.png
  extracting: Dataset/training_set/I/993.png
   inflating: Dataset/training_set/I/994.png
   inflating: Dataset/training_set/I/995.png
  extracting: Dataset/training_set/I/996.png
   inflating: Dataset/training_set/I/997.png
   inflating: Dataset/training_set/I/998.png
   inflating: Dataset/training_set/I/999.png
```

In [10]:
```
train_datagen = ImageDataGenerator(rescale=1./255,zoom_range=0.2,horizontal_flip=True, vertical_flip=False)
test_datagen= ImageDataGenerator(rescale=1./255)
```

In [11]:
```
x_train = train_datagen.flow_from_directory('/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), batch_size=300,
                                            class_mode='categorical', color_mode = "grayscale")
```

```
Found 15790 images belonging to 1 classes.
```

In [12]:
```
x_train.class_indices
```

Out[12]:
```
{'training_set': 0}
```

In [14]:
```
from sklearn.model_selection import train_test_split
```

7.2 Feature 2

```
In [1]: from tensorflow.keras.preprocessing.image import ImageDataGenerator

In [2]: # Training Datagen
        train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
        # Testing Datagen
        test_datagen = ImageDataGenerator(rescale=1/255)

In [4]: # Training Dataset
        x_train=train_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/test data',target_size=(64,64), class_mode='categorical',batch_size
        # Testing Dataset
        x_test=test_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), class_mode='categorical',batch_si

        Found 2260 images belonging to 1 classes.
        Found 15790 images belonging to 1 classes.

In [5]: from google.colab import drive
        drive.mount('/content/drive')

        Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).

In [6]: print("Len x-train : ", len(x_train))
        print("Len x-test : ", len(x_test))

        Len x-train :  3
        Len x-test :  18

In [7]: # The Class Indices in Training Dataset
        x_train.class_indices

Out[7]: {'test_set': 0}

In [8]: # Importing Libraries
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense

In [9]: # Creating Model
        model=Sequential()
```

```
In [6]: print("Len x-train : ", len(x_train))
        print("Len x-test : ", len(x_test))

        Len x-train :  3
        Len x-test :  18

In [7]: # The Class Indices in Training Dataset
        x_train.class_indices

Out[7]: {'test_set': 0}

In [8]: # Importing Libraries
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense

In [9]: # Creating Model
        model=Sequential()

In [10]: # Adding Layers
         model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))

In [11]: model.add(MaxPooling2D(pool_size=(2,2)))

In [12]: model.add(Flatten())

In [13]: # Adding Dense Layers
         model.add(Dense(300,activation='relu'))
         model.add(Dense(150,activation='relu'))
         model.add(Dense(9,activation='softmax'))

In [14]: # Compiling the Model
         model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

```
         #import imagedatagenerator
         from keras.preprocessing.image import ImageDataGenerator

In [2]: # Training Datagen
        train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
        # Testing Datagen
        test_datagen = ImageDataGenerator(rescale=1/255)

In [5]: # Training Dataset
        x_train=train_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/test data',target_size=(64,64), class_mode='categorical',batch_size
        # Testing Dataset
        x_test=test_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), class_mode='categorical',batch_si

        Found 2260 images belonging to 1 classes.
        Found 15790 images belonging to 1 classes.

In [6]: print("Len x-train : ", len(x_train))
        print("Len x-test : ", len(x_test))

        Len x-train :  3
        Len x-test :  18

In [7]: # The Class Indices in Training Dataset
        x_train.class_indices

Out[7]: {'test_set': 0}

In [8]: # Importing Libraries
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense

In [9]: # Creating Model
        model=Sequential()

In [10]: # Adding Layers
         model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
```

In [1]:
```
#import imagedatagenerator
from keras.preprocessing.image import ImageDataGenerator
```

In [2]:
```
# Training Datagen
train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
# Testing Datagen
test_datagen = ImageDataGenerator(rescale=1/255)
```

In [3]:
```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/test data',target_size=(64,64), class_mode='categorical',batch_size
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), class_mode='categorical',batch_si
```

```
Found 2260 images belonging to 1 classes.
Found 15790 images belonging to 1 classes.
```

In [4]:
```
print("Len x-train : ", len(x_train))
print("Len x-test : ", len(x_test))
```

```
Len x-train :  3
Len x-test :  18
```

In [5]:
```
# The Class Indices in Training Dataset
x_train.class_indices
```

Out[5]:
```
{'test_set': 0}
```

In [6]:
```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

In [7]:
```
# Creating Model
model=Sequential()
```

In [8]:
```
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
```

In [ ]:
```
#PNT2022TMID23360

#Project: Real-Time Communication system powered by AI for specially abled

#Image Preprocessing
```

In [ ]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

In [ ]:
```
!unzip '/content/drive/MyDrive/Dataset/Dataset.zip'
```

```
Streaming output truncated to the last 5000 lines.
 extracting: Dataset/training_set/G/1225.png
 extracting: Dataset/training_set/G/1226.png
  inflating: Dataset/training_set/I/997.png
  inflating: Dataset/training_set/I/998.png
  inflating: Dataset/training_set/I/999.png
```

In [ ]:
```
from keras.preprocessing.image import ImageDataGenerator
train_datagen=ImageDataGenerator(rescale = 1./255, shear_range=0.2, zoom_range=0.2,horizontal_flip=True)
test_datagen = ImageDataGenerator(rescale=1./255)
```

In [ ]:
```
x_train = train_datagen.flow_from_directory("/content/Dataset/training_set", target_size=(64,64),batch_size=300,
                                            class_mode='categorical', color_mode ="grayscale")
```

```
Found 15750 images belonging to 9 classes.
```

In [ ]:
```
x_test = test_datagen.flow_from_directory("/content/Dataset/test_set", target_size=(64,64),batch_size=300,
                                          class_mode='categorical', color_mode ="grayscale")
```

```
Found 2250 images belonging to 9 classes.
```

In [ ]:
```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Convolution2D
from tensorflow.keras.layers import Conv2D, MaxPooling2D
from keras.layers import Dropout
from keras.layers import Flatten
```

In [ ]:
```
model=Sequential()
```

In [ ]:
```
model.add(Convolution2D(32,(3,3), input_shape=(64,64,1), activation = 'relu'))
```

In [ ]:
```
model.add(MaxPooling2D(pool_size=(2,2)))
```

In [ ]:
```
model.add(Flatten())
```

In [ ]:
```
model.add(Dense( units=512, activation='relu'))
```

```
#import imagedatagenerator
from keras.preprocessing.image import ImageDataGenerator
```

```
# Training Datagen
train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
# Testing Datagen
test_datagen = ImageDataGenerator(rescale=1/255)
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/test data',target_size=(64,64), class_mode='categorical',batch_size
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), class_mode='categorical',batch_si
```

```
Found 2260 images belonging to 1 classes.
Found 15790 images belonging to 1 classes.
```

```
print("Len x-train : ", len(x_train))
print("Len x-test : ", len(x_test))
```

```
Len x-train :  3
Len x-test :  18
```

```
# The Class Indices in Training Dataset
x_train.class_indices
```

```
{'test_set': 0}
```

```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```


```
# Training Datagen
train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
# Testing Datagen
test_datagen = ImageDataGenerator(rescale=1/255)
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/test data',target_size=(64,64), class_mode='categorical',batch_size
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'/content/drive/MyDrive/content/dataset/training data',target_size=(64,64), class_mode='categorical',batch_si
```

```
Found 2260 images belonging to 1 classes.
Found 15790 images belonging to 1 classes.
```

```
print("Len x-train : ", len(x_train))
print("Len x-test : ", len(x_test))
```

```
Len x-train :  3
Len x-test :  18
```

```
# The Class Indices in Training Dataset
x_train.class_indices
```

```
{'test_set': 0}
```

```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```


```
# Creating Model
model=Sequential()
```

```
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
```

FINAL TESTING:

```
[ ]  #replace the credentials that you got from Watson Machine Learning service
     from ibm_watson_machine_learning import APIClient
     wml_credentials = {
                        "url": "https://us-south.ml.cloud.ibm.com",
                        "apikey": "3ls6KARqw4K7Icbfhp-X36q5Q5UtIjkPBVHg67294jVf"
                       }
     client = APIClient(wml_credentials)

[ ]  client = APIClient(wml_credentials)

     def guid_from_space_name(client, space_name):
         space = client.spaces.get_details()
         #print(space)
         return(next(item for item in space['resources']if item['entity']["name"] == space_name)['metadata']['id'])

[ ]  space_uid = guid_from_space_name(client, 'imageclassification')
     print("Space UID = " + space_uid)

     Space UID = 34eea79c-4e6f-446b-8079-3cbc5fe1e0fb

[ ]  client.set.default_space(space_uid)

     'SUCCESS'
```

```
client.software_specifications.list()
```

```
------------------------------  ------------------------------------  ----
NAME                            ASSET_ID                              TYPE
default_py3.6                   0062b8c9-8b7d-44a0-a9b9-46c416adcbd9  base
kernel-spark3.2-scala2.12       020d69ce-7ac1-5e68-ac1a-31189867356a  base
pytorch-onnx_1.3-py3.7-edt      069ea134-3346-5748-b513-49120e15d288  base
scikit-learn_0.20-py3.6         09c5a1d0-9c1e-4473-a344-eb7b665ff687  base
spark-mllib_3.0-scala_2.12      09f4cff0-90a7-5899-b9ed-1ef348aebdee  base
pytorch-onnx_rt22.1-py3.9       0b848dd4-e681-5599-be41-b5f6fccc6471  base
ai-function_0.1-py3.6           0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda  base
shiny-r3.6                      0e6e79df-875e-4f24-8ae9-62dcc2148306  base
tensorflow_2.4-py3.7-horovod    1092590a-307d-563d-9b62-4eb7d64b3f22  base
pytorch_1.1-py3.6               10ac12d6-6b30-4ccd-8392-3e922c096a92  base
tensorflow_1.15-py3.6-ddl       111e41b3-de2d-5422-a4d6-bf776828c4b7  base
autoai-kb_rt22.2-py3.10         125b6d9a-5b1f-5e8d-972a-b251688ccf40  base
runtime-22.1-py3.9              12b83a17-24d8-5082-900f-0ab31fbfd3cb  base
scikit-learn_0.22-py3.6         154010fa-5b3b-4ac1-82af-4d5ee5abbc85  base
default_r3.6                    1b70aec3-ab34-4b87-8aa0-a4a3c8296a36  base
pytorch-onnx_1.3-py3.6          1bc6029a-cc97-56da-b8e0-39c3880dbbe7  base
kernel-spark3.3-r3.6            1c9e5454-f216-59dd-a20e-474a5cdf5988  base
pytorch-onnx_rt22.1-py3.9-edt   1d362186-7ad5-5b59-8b6c-9d0880bde37f  base
tensorflow_2.1-py3.6            1eb25b84-d6ed-5dde-b6a5-3fbdf1665666  base
spark-mllib_3.2                 20047f72-0a98-58c7-9ff5-a77b012eb8f5  base
tensorflow_2.4-py3.8-horovod    217c16f6-178f-56bf-824a-b19f20564c49  base
runtime-22.1-py3.9-cuda         26215f05-08c3-5a41-a1b0-da66306ce658  base
do_py3.8                        295addb5-9ef9-547e-9bf4-92ae3563e720  base
autoai-ts_3.8-py3.8             2aa0c932-798f-5ae9-abd6-15e0c2402fb5  base
tensorflow_1.15-py3.6           2b73a275-7cbf-420b-a912-eae7f436e0bc  base
kernel-spark3.3-py3.9           2b7961e2-e3b1-5a8c-a491-482c8368839a  base
pytorch_1.2-py3.6               2c8ef57d-2687-4b7d-acce-01f94976dac1  base
```

```
[ ] software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
    software_spec_uid
```

```
'acd9c798-6974-5d2f-a657-ce06e986df4d'
```

```
[ ] model_details = client.repository.store_model(model= "image-classification-model_new.tgz",meta_props={
     client.repository.ModelMetaNames.NAME:"CNN",
     client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
     client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_spec_uid}
                                                )
    model_id = client.repository.get_model_id(model_details)
```

```
model_id
```

```
'bc85e23c-eb45-48f5-aa3f-e9548648e0e3'
```

```
[ ] client.repository.download(model_id, 'my_model.tar.gz')
```

```
Successfully saved model content to file: 'my_model.tar.gz'
'/home/wsuser/work/my_model.tar.gz'
```

```
[ ] from keras.models import load_model
    import numpy as np
    import cv2
```

```
[ ]  model=load_model("aslpng.h5")
    img = image.load_img('/home/wsuser/work/Dataset/training_set/D/15.png',target_size=(64,64))
    img
```

```
x = image.img_to_array(img)
x
```

```
array([[[0., 0., 0.],
        [0., 0., 0.],
        [0., 0., 0.],
        ...,
        [0., 0., 0.],
        [0., 0., 0.],
        [0., 0., 0.]],

       [[0., 0., 0.],
        [0., 0., 0.],
        [0., 0., 0.],
        ...,
        [0., 0., 0.],
        [0., 0., 0.],
        [0., 0., 0.]],

       [[0., 0., 0.],
```

```
(64, 64, 3)
```

```
[ ] x = np.expand_dims(x,axis=0)
    x.shape
```

```
(1, 64, 64, 3)
```

```
[ ] pred = model.predict(x)
```

```
pred
```

```
array([[0., 0., 0., 1., 0., 0., 0., 0., 0.]], dtype=float32)
```

```
[ ] class_name=["A","B","C","D","E","F","G","H","I"]
    pred_id = pred.argmax(axis=1)[0]
    pred_id
```

```
3
```

```
[ ] print("the alphabet is ",str(class_name[pred_id]))
```

```
the alphabet is  D
```

8. TESTING

8.1 TEST CASES

				Date	17-Nov-22								
				Team ID	PNT2022TMID23360								
				Project Name	Project - Real time communicati								
				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
Home Page_TC_OO2	UI	Home Page	Checkif the UI elements are displayed properly in differentscreen sizes		1) Open the page in a specific device 2) Checkif all the UI elements are displayed properly 3) Repeat the above steps with differentdevice	Screen Sizes1440 x 970102	The Home page must be displayed properly in all sizes	Working as expected	Pass	NIL	N	N/A	Aparna P
Home page_TC_OO3	Functional	Home page	Checkif the page redirects to the resultpage once the input is given		1) Open the page 2) Click on select button 3) Click on web camera 4) Check if the page redirects	Camera feed	The page should redirect to the results page	Working as expect	Pass	NIL	N	N/A	Nandhithaa B
BE_TC_OO4	Functional	Backend	Check if all the routes are working properly		1) Go to Home Page 2) Click on web camera 3) Check the results page	Camera feed	All the routes should properly work	Working as expected	Pass	NIL	N	N/A	Nandhithaa B
M_TC_001	Functional	Model	Check if the model can handle variousimage	Flask	1) Open the page in a specific device 2) Click on Web Camera 3) Repeat the above steps with	Camera feed	Themodel should rescale the image and predict the results	Working as expected	Pass	NIL	N	N/A	Sai Jahnavi P
M_TC_002	Functional	Model	Check if the model predicts the disaster	opencv-python	1) Open the page 2) Click on Web Camera 3) Check the results	Camera feed	The model should predict the disaster	Working as expected	Pass	NIL	N	N/A	Sai Jahnavi P
M_TC_003	Functional	Model	Check if the model can handle complex input		1) Open the page 2) Click on Web Camera 3) Check the results	Complex camera feed	The model should predict the disaster in thecomplex camera feed	Working as expected	Pass	NIL	N	N/A	Aparna P
RP_TC_001	UI	Result page	Verify UI elements in the Result Page		1) Open the page 2) Click on Web Camera 3) Check if all the UI elements are displayed properly	Camera feed	The Result page must be displayed properly	Working as expected	Pass	NIL	N	N/A	Sai Ramya M
RP_TC_002	UI	Result page	Check if the result is displayed properly		1) Open the page 2) Click on Web Camera 3) Check if the result is	Camera feed	The result should be displayed pr	Working as expect	Pass	NIL	N	N/A	Sai Jahnavi P
RP_TC_003	UI	Result page	Check if the other predictions are displayed properly		1) Open the page 2) Click on Web Camera 3) Checkif all the other predictions are displayed	Camera feed	The other predictions should be d	Working as expecte	Pass	NIL	N	N/A	Sai Ramya M

8.2 USER ACCEPTANCE TESTING

8.2.1 DEFECT ANALYSIS

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	2	0	1	1	4
Duplicate	1	0	1	0	2
External	0	0	0	0	0
Fixed	2	0	1	0	3
Not Reproduced	0	1	0	1	2
Skipped	1	0	0	0	1
Won't Fix	0	1	0	0	1
Totals	6	2	3	2	13

8.2.2 TEST CASE

ANALYSIS

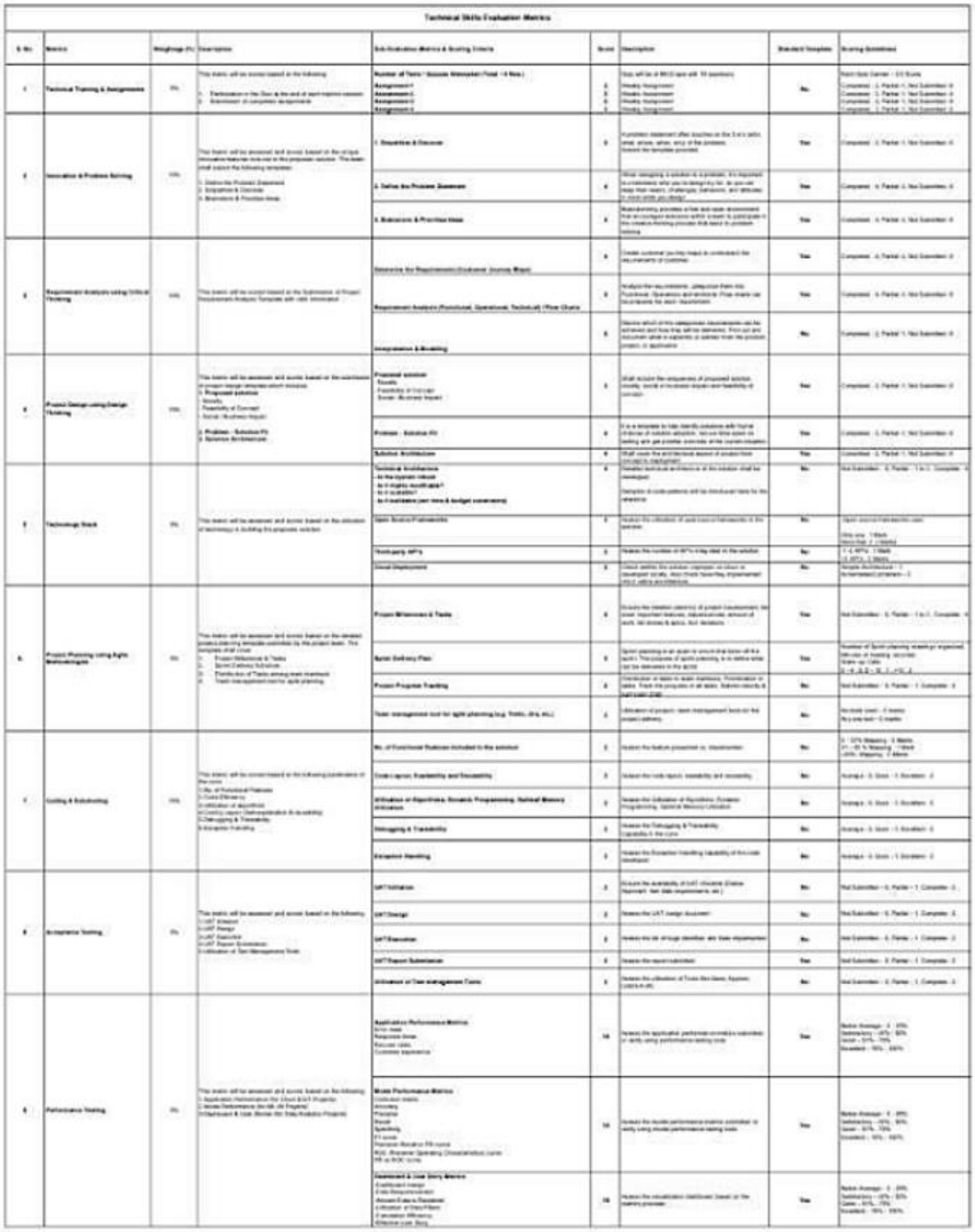
3. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Client Application	16	0	0	16
Security	5	0	0	5
Exception Reporting	3	0	0	3
Final Report Output	3	0	0	3
Version Control	1	0	0	1

9. RESULTS

9.1 Performance Metrics



Technical Skills Evaluation Metrics								
S. No	Metrics	Weightage (%)	Description	Sub-Evaluation Metrics & Scoring Criteria	Score	Description	Standard Template	Scoring Guidelines
1	Technical Training & Assignments	5%	This metric will be scored based on the following: 1. Participation in the Quiz at the end of each training session 2. Submission of completed assignments	Number of Tests / Quizzes Attempted (Total - 4 Nos.)		Quiz will be of MCQ type with 10 questions	No.	Each Quiz Carried - 2.5 Score
				Assignment-1 Assignment-2 Assignment-3 Assignment-4	2 2 2 2	Weekly Assignment Weekly Assignment Weekly Assignment Weekly Assignment		Completed - 2, Partial-1, Not Submitted-0 Completed - 2, Partial-1, Not Submitted-0 Completed - 2, Partial-1, Not Submitted-0 Completed - 2, Partial-1, Not Submitted-0
2	Innovation & Problem Solving	15%	This metric will be assessed and scored based on the unique innovative features and solution provided by the participant. The team shall submit the following templates: 1. Define the Problem Statement 2. Empathize & Ideate 3. Brainstorm & Prioritize Ideas	1. Empathize & Discover	5	A problem statement after empathize on the 5 w's (who, what, where, when, why) of the problem. Submit the template provided	Yes	Completed - 2, Partial-1, Not Submitted-0
				2. Define the Problem Statement	5	While designing a solution is a problem, it's important to understand what you're designing for. So you can keep their needs, challenges, behaviors, and attitudes in mind while you design	Yes	Completed - 5, Partial-2, Not Submitted-0
				3. Brainstorm & Prioritize Ideas	5	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	Yes	Completed - 5, Partial-2, Not Submitted-0
3	Requirement Analysis using Critical Thinking	10%	This metric will be scored based on the Submission of Project Requirement Analysis Template with valid information	Scenarios for Requirements Exploration Journey Maps	5	Create customer journey maps to understand the requirements of customer	Yes	Completed - 5, Partial-2, Not Submitted-0
				Requirement Analysis (Functional, Operational, Technical) / Flow Charts	5	Analyze the key components, play a role them into Functional / Operational and technical. Flow charts can be a template for each requirement.	Yes	Completed - 5, Partial-2, Not Submitted-0
				Interpretation & Modelling	5	Discuss which of the categorized requirements can be achieved and how they will be delivered. Find out and document what is supported, or cannot meet the product project, or application	No	Completed - 2, Partial-1, Not Submitted-0
4	Product Design using Design Thinking	10%	This metric will be assessed and scored based on the submission of project design deliverables which includes: 1. Proposed solution - Novelty - Feasibility of Concept - Social / Business Impact 2. Problem - Solution Fit 3. Solution Architecture	Proposed solution Novelty Feasibility of Concept Social / Business Impact	5	Shall include the uniqueness of proposed solution, novelty, social or business impact and feasibility of concept	Yes	Completed - 5, Partial-1, Not Submitted-0
				Problem - Solution Fit	5	It is a template to help identify solutions with higher chances of solution adoption. Iterate over time based on testing and get possible overview of the market adoption	Yes	Completed - 5, Partial-1, Not Submitted-0
				Solution Architecture	5	Shall cover the architectural aspect of product from concept to deployment	Yes	Completed - 5, Partial-1, Not Submitted-0
5	Technology Stack	5%	This metric will be assessed and scored based on the relevance of technology & building the proposed solution	Technical Architecture - Is the system robust - Is it highly Available? - Is it scalable? - Is it compliance (per time & budget constraints)	5	Detailed technical architecture of the solution shall be developed. Samples of code patterns will be introduced here for the reference	No	Not Submitted - 0, Partial - 1 to 3, Complete - 5
				Open Source Frameworks	5	Assess the utilization of open source frameworks in the solution	No	Open source frameworks used: Only one - 1 Mark More than 2 - 2 Marks
				Third-party API's	5	Assess the number of API's in key role in the solution	No	1-2 API's - 3 Mark 3 API's - 5 Mark
				Cloud Deployment	5	Check whether the solution deployed, or close to deployed on any Azure Cloud Now/Key implemented (Yes-5 / Not-0 and Architecture)	No	Deployed - 5 Simple Architecture - 2 Architecture(Complex) - 3
6	Project Planning Using Agile Methodologies	5%	This metric will be assessed and scored based on the detailed project planning deliverable submitted by the project team. The template shall cover: 1. Project Milestones & Tasks 2. Sprint Delivery Activities 3. Distribution of Tasks among team members 4. Team management tool for agile planning	Project Milestones & Tasks	5	Ensure the timeline planning of project (development, test cases, important features, requirements, amount of work, risk factors & gaps), and iterations	Yes	Not Submitted - 0, Partial - 1 to 3, Complete - 5
				Sprint Delivery Plan	5	Sprint planning is an event to ensure that team will be ready to The outcome of sprint planning is to define what can be delivered in the sprint	Yes	Number of Sprint planning meetings organized, Minutes of meeting recorded Meeting Count 0 - 0, 0.5 - 2, 1 - >2 - 5
				Project Progress Tracking	5	Conclusion or basis to scope maintains, Prioritization of tasks, Track the progress of all tasks, Submit reports at each sprint end	No	Not Submitted - 0, Partial - 1, Complete - 5
				Tools/ management tool for agile planning (e.g. Trello, Jira, etc.)	5	Utilization of project / team management tools for the project delivery	No	No tools used - 0 marks Any one tool - 5 marks
7	Coding & Refactoring	15%	This metric will be scored based on the following combination of the score: 1.No. of Functional Features 2.Code Efficiency 3.Utilization of Algorithms 4.Coding Layers Distinguishable & re-usability 5.Debugging & Traceability 6.Exception Handling	No. of Functional Features included in the solution	5	Assess the feature presented vs. requirements	No	0 - 33% Missing - 0 Marks 34 - 66 % Missing - 1 Mark >34% Missing - 2 Marks
				Code Layout, Explainity and Reusability	5	Assess the code layout, readability and reusability	No	Average 0 - 2, Good - 3, Excellent - 5
				Utilization of Algorithms, Dynamic Programming, Optimal Memory Utilization	5	Assess the Utilization of Algorithms, Dynamic Programming, Optimal Memory Utilization	No	Average 0 - 2, Good - 3, Excellent - 5
				Debugging & Traceability	5	Assess the Debugging & Traceability Capability in the core	No	Average 0 - 2, Good - 3, Excellent - 5
				Exception Handling	5	Assess the Exception Handling capability of the code developed	No	Average 0 - 2, Good - 3, Excellent - 5
8	Acceptance Testing	5%	This metric will be assessed and scored based on the following: 1.UAT Initiation 2.UAT Design 3.UAT Execution 4.UAT Report Submission 5.Utilization of Test Management Tools	UAT Initiation	5	Ensure the scalability of UAT. Involve (Define Approach, test data requirements, etc.)	No	Not Submitted - 0, Partial - 1, Complete - 5
				UAT Design	5	Assess the UAT design document	No	Not Submitted - 0, Partial - 1, Complete - 5
				UAT Execution	5	Assess the bit of bugs identified and fixes implemented	No	Not Submitted - 0, Partial - 1, Complete - 5
				UAT Report Submission	5	Assess the report submitted	Yes	Not Submitted - 0, Partial - 1, Complete - 5
				Utilization of Test management Tools	5	Assess the utilization of Tools like Qtest, Xpoint, Listed in JD	No	Not Submitted - 0, Partial - 1, Complete - 5
9	Performance Testing	5%	This metric will be assessed and scored based on the following: 1.Application Performance (for Cloud &IoT Projects) 2.Model Performance (for ML or Projects) 3.Dashboard & User Stories (for Data Analytics Projects)	Application Performance Metrics Error rates Response times Request rates Customer experience	10	Assess the application performance metrics submitted or verify using performance testing tools	Yes	Below Average - 0 - 4% Satisfactory - 4% - 6% Good - 51% - 75% Excellent - 76% - 100%
				Model Performance Metrics Confusion matrix Accuracy Precision Recall Specificity F1 score Precision-Recall or PR curve ROC (Receiver Operating Characteristic) curve PR vs ROC curve	10	Assess the models performance metrics submitted or verify using model performance testing tools	Yes	Below Average - 0 - 4% Satisfactory - 4% - 6% Good - 51% - 75% Excellent - 76% - 100%
				Dashboard & User Story Metrics Dashboard design Data Responsiveness Actual Data is Rendered Utilization of Story Points Calculation Efficiency Effective User Story	10	Assess the visualization dashboard based on the metrics provided	Yes	Below Average - 0 - 4% Satisfactory - 4% - 6% Good - 51% - 75% Excellent - 76% - 100%

10. ADVANTAGES AND DISADVANTAGES

10.1 Advantages

- It is a cost-effective way of getting several people from different locations to attend meetings and conferences.
- The ability to meet with individuals remotely cuts down the amount of time you'll need to spend in larger, full-team meetings.
- It enables employees from across the world to communicate with each other 24×7 and share ideas or solve problems quickly.

10.2 Disadvantages

- Also accuracy depends upon distance between camera and object.
- It requires high-performance hardware and is expensive. It adds an overload of data in case of system failure.
- It takes a lot of time to listen, speak, read, or write to someone and it always depends on the accuracy.

11. CONCLUSION

The proposed communication system between specially abled and ordinary people is aiming to bridge the communication gap between two societies. It provides complete two - sided communication in an efficient manner between the specially abled and the normal one.

For communication to occur effectively without hitch, a mediator is required to translate the sign language. But a mediator is required to know the sign language used by specially abled. But this is not always possible since there are multiple sign languages for multiple languages.

As in our society, we have people with disabilities. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a

normal person and an impaired person in any language.So to understand all sign languages, Hand gestures of deaf people by normal people, this system is proposed.

12. FUTURE SCOPE

- The speech-to-text and text-to-speech technologies helped those people who had difficulties in communicating or expressing their feelings to the normal people.
- This reduces the communication gap between the normal people and the specially abled people.
- Using image pre-processing and Artificial Intelligence it is easy to understand the context of objects and clearly explains it to the people who use it for communication.
- We can update this by making the application support the Indian sign language which is using two hands.
- We can even add the emotions and greetings with the sign language too to make it even more efficient.
- This application can be one of the majorly used applications as it is the bridge between normal and the specially abled one.

APPENDIX

SOURCE CODE - GITHUB LINK:

IBM-EPBL/IBM-Project-22038-1659801788: Real-Time Communication System Powered by AI for Specially Abled (github.com)

PROJECT DEMO:

https://youtu.be/dHZohKJTlz4