

**REAL - TIME COMMUNICATION SYSTEM  
POWERED BY AI FOR  
SPECIALLY ABLED**

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# **INDEX**

## **1. INTRODUCTION**

1.1 Project Overview

1.2 Purpose

## **2. LITERATURE SURVEY**

2.1 Existing problem

2.2 References

2.3 Problem Statement Definition

## **3. IDEATION & PROPOSED SOLUTION**

3.1 Empathy Map Canvas

3.2 Ideation & Brainstorming

3.3 Proposed Solution

3.4 Problem Solution fit

## **4. REQUIREMENT ANALYSIS**

4.1 Functional requirement

4.2 Non-Functional requirements

## **5. PROJECT DESIGN**

5.1 Data Flow Diagrams

5.2 Solution & Technical Architecture

5.2.3 User Stories

## **6. PROJECT PLANNING & SCHEDULING**

6.1 Sprint Planning & Estimation

6.2 Sprint Delivery Schedule

6.3 Reports from JIRA

## **7. CODING & SOLUTIONING**

7.1 Feature 1

7.2 Feature 2

## **8. TESTING**

8.1 Test Cases

8.2 Use Acceptance Testing

## **9. RESULTS**

9.1 Performance Metrics

## **10. ADVANTAGES AND DISADVANTAGES**

## **11. CONCLUSION**

## **12. FUTURE SCOPE**

## **13. APPENDIX**

Source Code

Github & Demo Link

# CHAPTER 1

# **1.INTRODUCTION**

## **1.1 PROJECT OVERVIEW**

Real-time communications (RTC) is any mode of telecommunications in which all users can exchange information instantly or with negligible latency or transmission delays. IN RTC, there is always a direct path between the source and the destination. Although the link might contain several intermediate nodes, the data goes from source to destination without being stored in between them. In contrast, asynchronous or time shifting communications, such as email and voicemail, always involve some form of data storage between the source and the destination. In these cases, there is an anticipated delay between the transmission and receipt of the information.

## **1.2 PURPOSE**

Real-time communication (RTC) refers to any communication that happens between two (or more) Individuals in real-time – with minimal latency and without transmission delays. Some examples of Real-time communication include landline phones, mobile calls, instant messaging, VoIP, and video Conferencing. This enables deaf and dumb people to convey their information using sign language and text is given as output.

The main purpose of sign language recognition is to provide an efficient and accurate sign language into text or voice has aids for the hearing impaired for example or enabling very young children to interact with computers.

# CHAPTER 2

## **2. LITERATURE SURVEY**

### **2.1 EXISTING PROBLEM**

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 on 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.

### **2.2 REFERENCES**

1. Koufos, K., EL Haloui, K., Dianati, M., Higgins, M., Elmirghani, J., Imran, M. A., & Tafazolli, R. (2021). Trends in Intelligent Communication Systems: Review of Standards, Major Research Projects, and Identification of Research Gaps. *Journal of Sensor and Actuator Networks*, 10(4), 60.
2. Panda, G., Upadhyay, A. K., & Khandelwal, K. (2019). Artificial intelligence: A strategic disruption in public relations. *Journal of Creative Communications*, 14(3), 196-213
3. Xu, G., Mu, Y., & Liu, J. (2017). Inclusion of artificial intelligence in communication networks and services. *ITU J. ICT Discov. Spec*, 1, 1-6.

## 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.
- ❖ Communications 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 on 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 very useful to have a proper conversation between a normal person and an impaired person in any language.
- ❖ 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 website is built which uses this model.
- ❖ This website enables deaf and dumb people to convey their information using signs which get converted to human understandable language and text is given as output.



<b>I am</b>	Deaf and dumb person who face lots of difficulty in day to day life.
<b>I am trying to</b>	Speak like others and feel happy by forgetting my inabilities.
<b>But</b>	I feel frustrated by thinking my inability.
<b>Because</b>	I can't deliver my thoughts.
<b>Which makes me feel happy</b>	I am feel very happy when the society recognised me and feel extremely happy when I communicate easily with others.

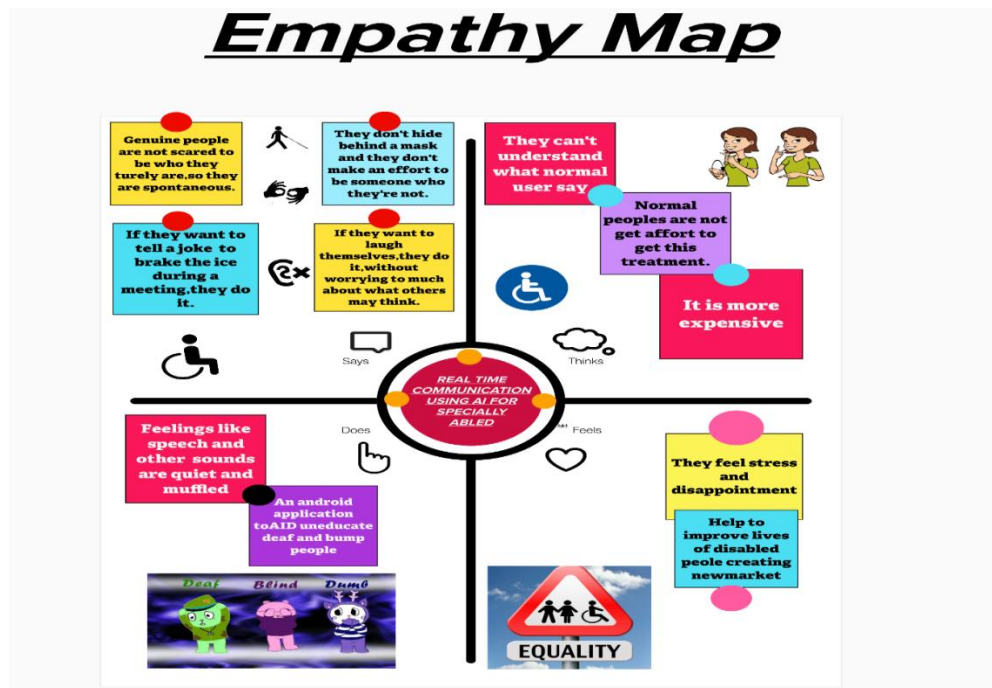
# CHAPTER 3



## 3. IDEATION AND PROPOSED SOLUTION

### 3.1 EMPATHY MAP CANVAS

- ❖ An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours
- ❖ It is a useful tool to help 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.



Reference:

<https://app.mural.co/invitation/mural/ibm74132/1663148891949?sender=u335aaeca59037e8272905605&key=cbca06e6-bc9b-4cb3-8711-16ebcc3637f>

#### Who are we empathizing with?

- 1) We want to understand the specially abled person
- 2) They are in a situation who finds it hard to communicate with other people on their own
- 3) Their role is about communication.

### What do they need to do?

- Get familiar with new technologies
- Get familiar with sign language.

### What do they see?

- App gets many downloads if it is a success
- Many people with disabilities get to communicate well

### What do they say?

- Reviews and thoughts on improving the app

## 3.2 IDEATION AND BRAINSTORMING

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

### Reference:

<https://app.mural.co/invitation/mural/ibm74132/1663851454750?sender=u335aaeca59037e8272905605&key=398b7a69-aa20-4f1f-91cc-bd5a20e6836d>

### Step-1: Team Gathering, Collaboration and Select the Problem Statement

**Brainstorm & idea prioritization**

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare  
1 hour to collaborate  
2-6 people recommended

**Before you collaborate**  
A little bit of preparation goes a long way with this session. Here's what you need to do to get going.  
10 minutes

- 1. **Team gathering**  
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- 2. **Set the goal**  
Think about the problem you'll be focusing on solving in the brainstorming session.
- 3. **Learn how to use the facilitation tools**  
Use the Facilitation Superpowers to run a happy and productive session.  
[Open article](#)

**Define your problem statement**  
What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.  
5 minutes

To help the specially able person by using AI technology and to barriers the disabilities with this technology

**Key rules of brainstorming**  
To run an smooth and productive session

- Stay in topic.
- Defer judgment.
- Go for volume.
- Encourage wild ideas.
- Listen to others.
- If possible, be visual.

[Share template feedback](#)

## Step-2: Brainstorm, Idea Listing and Grouping

**Brainstorm**  
Write down any ideas that come to mind that address your problem statement.  
30 minutes

**REAL TIME COMMUNICATION USING AI FOR SPECIALLY ABLED PERSON**

**Group ideas**  
Take time grouping your ideas, adding clarifying notes or related ideas on paper.  
15 minutes

## Step-3: Idea Prioritization

**Prioritize**  
Your team should sit on this page about what's important, moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.  
30 minutes

**After you collaborate**  
You can export the results as an image or PDF to share with members of your company who might find it helpful.

**Quick add-ons**

- Share this result
- Export the result

**Keep moving forward**

- Strategy blueprint
- Customer experience journey map
- Strategic, operational, organizational & financial

**Share template feedback**

# 3.3 PROPOSED SOLUTION

## 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. Communications 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 on 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.

## **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. 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.

## **3. Novelty / Uniqueness**

Building mobile tools with data isn't as easy as importing an XML feed of your latest headlines. But if you're going to spend thousands of dollars developing a mobile app anyway, you might as well spend a little more to build a real application that helps solve problems and makes advertisers take notice.

## **4. Social Impact / Customer Satisfaction**

These apps are using only for solve the problems. There are many different types of disabilities, and there are also many different ways in which people may use AI. The use of artificial intelligence is a boon for specially abled people. Technology had opened up new opportunities and created jobs where none had existed before, such as speech to text software that helped one woman find her voice after she was paralysed in an accident. Artificial Intelligence can help those with disabilities accomplish tasks they never thought possible; here are just a few ways we've seen AI technology impact lives: Facial recognition and predictive texting tools.

## **5. Business Model (Revenue Model)**

Building mobile tools with data isn't as easy as importing an XML feed of your latest headlines. But if you're going to spend thousands of dollars developing a mobile app anyway, you might as well spend a little more to build a real application that helps solve problems and makes advertisers take notice.

## **6. Scalability of the Solution**

With the help of machine tasks that usually requires human intelligence, such as voice and speech synthesis, visual perception, predictive text functionality, judgement, and a variety of other tasks, AI can assist individuals with disabilities by making a significant distinction in their ability.

### 3.4 PROBLEM SOLUTION FIT:

Project Title: Real time communication using AI for specially abled person

Project Design Phase-I - Solution Fit Template

Team ID: PNT002764048007

Define CS, PS into CC	<b>1.CUSTOMER SEGMENTS</b> <span>CC</span> <div>Specially abled person</div>	<b>2.CUSTOMER CONSTRAINTS</b> <span>CC</span> <ul style="list-style-type: none"> <li>Spending time</li> <li>Budget</li> <li>Health condition</li> <li>Limit negative thoughts</li> </ul>	<b>3.AVAILABLE SOLUTION</b> <span>CC</span> <ul style="list-style-type: none"> <li>They can connect with family and doctors if they have Wi-Fi during emergency</li> <li>CERT BOT to get them back from mental stress</li> <li>They can get job notification by using AI</li> </ul>	Explain why, how, what, where, when						
	<b>4. JOBS - TO - BE DONE/PROBLEMS</b> <span>CC</span> <ul style="list-style-type: none"> <li>Customers have to adapt to the disadvantages based on their disability</li> <li>Disability disability percentage may differ according to their disability</li> <li>Give customer to improve their mental strength</li> </ul>	<b>5.BEHAVIOUR ROOT CAUSE</b> <span>CC</span> <ul style="list-style-type: none"> <li>Nuclear accidents</li> <li>Bleeds</li> <li>By birth</li> <li>Accidents</li> <li>Disruptive work conditions</li> </ul> <p>The specially abled person should build confidence and bounce back to do great things.</p>	<b>6.BEHAVIOUR</b> <span>CC</span> <p><b>Directly related</b></p> <p>By giving customer to them we can make change</p> <p><b>Indirectly related</b></p> <p>Use of Wi-Fi button to get help from others during emergency situations.</p>							
Identify existing PS & CS	<b>7.STRIGGLES</b> <span>CC</span> <ul style="list-style-type: none"> <li>My customers are triggered by the inferiority complexes.</li> <li>They feel themselves as useless and they think that they can't do anything what is done by normal person.</li> </ul>	<b>8.OTHER SOLUTIONS</b> <span>CC</span> <ul style="list-style-type: none"> <li>They will be a platform, where the specially abled person to be live alone in that time if they have some emergency they can easily connect with the police through Wi-Fi.</li> <li>Since they are inability to do the work like others when make them to get job alerts according to their disability percentage.</li> <li>Create chat bot to be consulting with them.</li> </ul>	<b>9.CHAIN OF RELATION</b> <span>CC</span> <p>→ <b>action</b></p> <p>They can use website by assistive technology</p> <p>→ <b>action</b></p> <p>They can use Wi-Fi in mobile phone while they are in emergency.</p>	What will Success Appear as						
	<b>10.LEARNING BEFORE/AFTER</b> <span>CC</span> <table> <tr> <td><b>BEFORE</b></td> <td><b>AFTER</b></td> </tr> <tr> <td>Inferiority complex</td> <td>Feel confidence</td> </tr> <tr> <td>Lack of confidence</td> <td>Feeling happy</td> </tr> <tr> <td>Feeling insecure</td> <td>Mental strength</td> </tr> </table>	<b>BEFORE</b>	<b>AFTER</b>		Inferiority complex	Feel confidence	Lack of confidence	Feeling happy	Feeling insecure	Mental strength
<b>BEFORE</b>	<b>AFTER</b>									
Inferiority complex	Feel confidence									
Lack of confidence	Feeling happy									
Feeling insecure	Mental strength									

# CHAPTER 4

## **4.REQUIREMENT ANALYSIS**

### **4.1 FUNCTIONAL REQUIREMENT**

#### **FR-1 DATA COLLECTION**

Collecting data for building our project. Creating two folders one for training and the other for testing. Images present in the training folder will be used for building the model and the testing images will be used for validating our model.

#### **FR-2 MODEL BUILDING**

- ❖ Initializing the model
- ❖ Adding Convolution layers
- ❖ Adding Pooling layers
- ❖ Flatten layer
- ❖ Full connection layers which include hidden layers
- ❖ Compile the model with layers we added to complete the neural network structure.

#### **FR-3 TEST THE MODEL**

- ❖ Test the model by passing an image to get predictions.
- ❖ While test the model we should make sure that the test image should meet the target size of the model,
- ❖ dimensions need to meet, and should undergo rescaling before giving it to the model.

#### **FR-4 APPLICATION BUILDING**

- ❖ Building a flask application that is used for building our app which in backend can be interfaced to the model to get predictions.
- ❖ Flask application requires an html page for frontend and a python file for the backend which takes care of the interface with the model.

#### **FR-5 TRAIN CNN MODEL**

- ❖ Train model
- ❖ Store y Model
- ❖ Download the Stored model to the Local system

#### **FR-6 REGISTRATION**

Register for IBM cloud

#### **FR-7 TRAIN IMAGE CLASSIFICATION MODEL**

- ❖ locally Train the model on IBM
- ❖ Store your Model
- ❖ Download model to local system Test model

## **4.2 NON-FUNCTIONAL REQUIREMENTS**

Following are the non-functional requirements of the proposed solution

### **NFR-1 Usability**

- ❖ Non-functional requirements are the constraints or the requirements imposed on the system.
- ❖ They specify the quality attribute of the software.
- ❖ Non-functional requirements deal with issues like scalability, maintainability.
- ❖ Performance, portability, security, reliability, and many more.

### **NFR-2 Security**

It provides cyber security systems with up-to-date and relevant knowledge of Industry specific and global threats, which help teams make critical decisions about priorities based on what attack strategies may be used against a company

### **NFR-3 Reliability**

- ❖ AI technology can empower people living with limited physical mobility.
- ❖ Microsoft's AI for Accessibility program uses the potential of Artificial Intelligence to develop solutions to many physical and cognitive challenges disabled individuals face at work and in daily life to promote social inclusion for them.

### **NFR-4 Performance**

- ❖ AI enables people with disabilities to step into a world where their difficulties are understood and taken into account.
- ❖ Technology adapts and helps transform the world into an inclusive place with artificial intelligence accessibility.

### **NFR-5 Availability**

- ❖ Using driverless cars enables disabled people to leave the house, get around their communities, interact with people and even find jobs.
- ❖ Once autonomous vehicles are fully integrated into society, they could ease independent mobility, and increase accessibility adapted to each user's abilities and needs.

### **NFR-6 Scalability**

Scalability is a non-functional property of a system that describes the ability to appropriately handle increasing workloads.

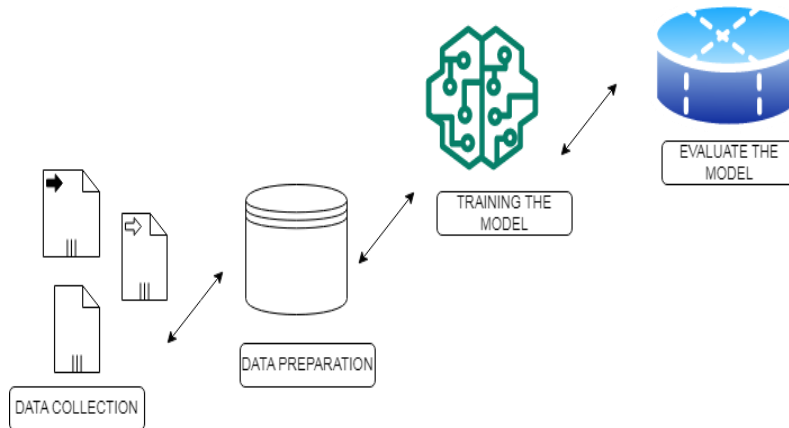


# CHAPTER 5

## **5. PROJECT DESIGN**

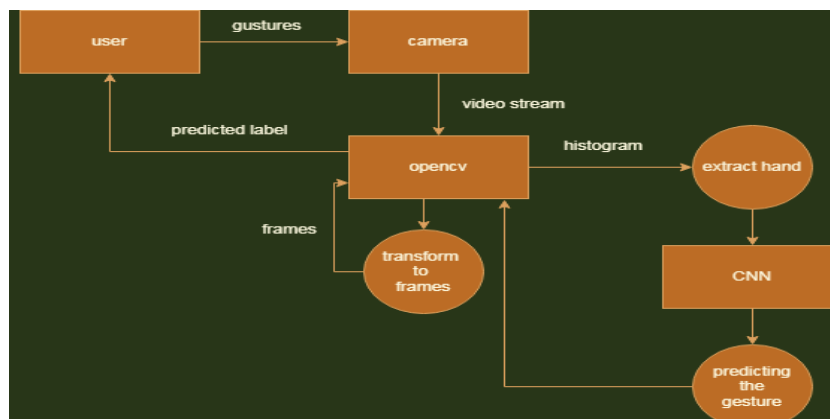
### **5.1 DATA FLOW DIAGRAMS**

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.



### **5.2 SOLUTION AND TECHNICAL ARCHITECTURE**

- ❖ Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:
- ❖ Find the best tech solution to solve existing business problems.
- ❖ Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.
- ❖ Define features, development phases, and solution requirements.
- ❖ Provide specifications according to which the solution is defined, managed, and delivered.



## 5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (web user)	Data collection and data augmentation	USN-1	To collect the dataset it was asked to four users to wear the vision system and perform every gesture for 10 seconds while both cameras were recording in a 640x480 pixel resolution.	Artificial Neural Network	High	Sprint-1
	Data augmentation	USN-2	To improve the generalization capability of the model it was artificially added more images with different backgrounds replacing the green Backgrounds. This way it is obtained more data without investing too much time.	Convolution neural network	High	Sprint-1
	Creating data set	USN-3	To improve the generalization capability of the model it was artificially added more images with different backgrounds replacing the green backgrounds. This way it is obtained more Data without investing too much time.	Using computer Vision OpenCv	Low	Sprint-1
	Threshold value	USN-4	Calculate the threshold value for every frame and determine the contours.	Using openCV	Medium	Sprint-2
	Training CNN	USN-5	Load the data using Image Data Generator of keras through which we can use the flow_from_directory function to load the train and test set data, and each of the names of the number folders will be the class names for The images loaded.	Using keras	High	Sprint-2
	Plot image function		Plotting images of data loaded.	Using Python and openCv	Low	Sprint-2
	Testing the model	USN-6	Train the model through various epochs.	It can be get through the computer vision (openCV) based on the deep learning concept	High	Sprint -3
	Visualizing the model.	USN-7	Check if everything is working as we expect it to while detecting on the live cam feed.	Understanding the concept of ANN	Medium	Sprint-3
	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
	Predict the Gestures	USN-8	Check if everything is working as we expect it to while detecting on the live cam feed.	Learning the concept of deep learning	Medium	Sprint-3
	Calculate weight average	USN-9	Caution of average weight of preloaded data.	Learning the concepts of opencv	High	Sprint-4
	Segmenting the hands	USN-10	Getting the max contours and the threshold image of the hand detected.	Learning the concept of deep learning	High	Sprint-4
	Detection of hand	USN-11	Running the CNN model.	Learning the concept of CNN and open cv concepts	High	Sprint-4

# CHAPTER 6

## 6. PROJECT PLANNING AND SCHEDULING

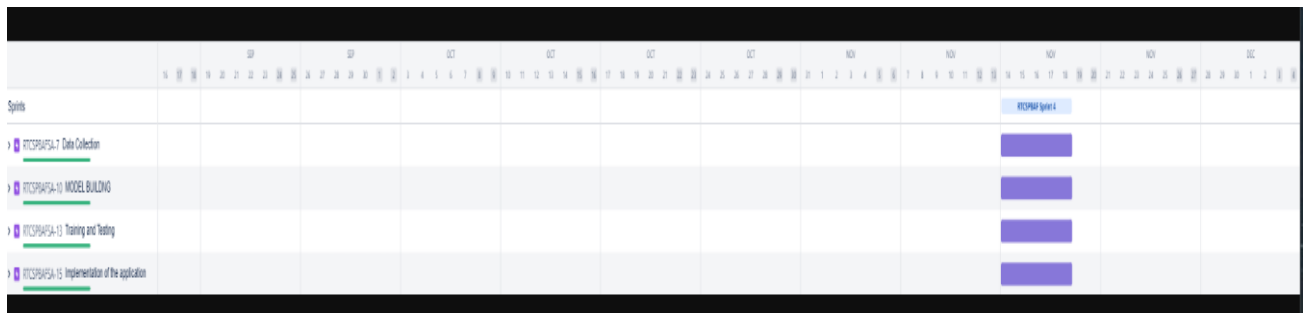
### 6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint- 1	Local system	USN-1	I have to collect the data for building our project.	2	High	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 1	Local system	USN-2	Create train and test data folder	1	High	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 1	Python IDE – keras package	USN-3	We have to do image preprocessing, shearing, rescale, zooming, etc. to make the model robust with different types of images.  We will be loading all the images of the train and test using the flow from directory method.	2	Low	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 2	Neural Networks	USN-5	Model building	1	High	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 2	openCV	USN-5	Load The Test Image, Pre-Process It And Predict	1	High	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 3	Python Flask	USN-6	Integrate the code with python flask. Build the HTML page. Open the navigator and run the localhost.	2	high	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI
Sprint- 4	IBM cloud	USN-7	Train the model on IBMStore Model Download model to local system Deployment of the project.	4	high	J SAFRIN NIHAR K KARPAGAVALLI L BHUVANESHWARI P PODHUMANI

### 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	6 Days	29 Oct 2022	02 Oct 2022	20	02 Oct 2022
Sprint-2	20	6 Days	03 Oct 2022	07 Nov 2022	20	07 Nov 2022
Sprint-3	20	6 Days	08 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

### 6.3 REPORTS FROM JIRA



# CHAPTER 7

# 7. CODING AND SOLUTIONING

## 7.1 FEATURE 1

import libraries

```
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
from tensorflow import keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Conv2D, MaxPool2D, Flatten, Dropout, BatchNormalization
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, confusion_matrix
from tensorflow.keras.callbacks import ReduceLROnPlateau
```

▼ To accelerate GPU growth run the below cell

```
from tensorflow.compat.v1 import ConfigProto
from tensorflow.compat.v1 import InteractiveSession

config = ConfigProto()
config.gpu_options.allow_growth = True
session = InteractiveSession(config=config)
```

/home/admin/anaconda3/envs/gpu/lib/python3.8/site-packages/tensorflow/python/client/session.py:1761: UserWarning: An interactive session is already active. This can

▼ Loading the ASL dataset

```
[ ] train_df = pd.read_csv("Dataset/sign_mnist_train.csv")
test_df = pd.read_csv("Dataset/sign_mnist_test.csv")
```

```
test = pd.read_csv("Dataset/sign_mnist_test.csv")
y = test['label']
```

```
[ ] train_df.head()
```

	label	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel775	pixel776	pixel777	pixel778
0	3	107	118	127	134	139	143	146	150	153	...	207	207	207	207

```
[ ] train_df.head()
```

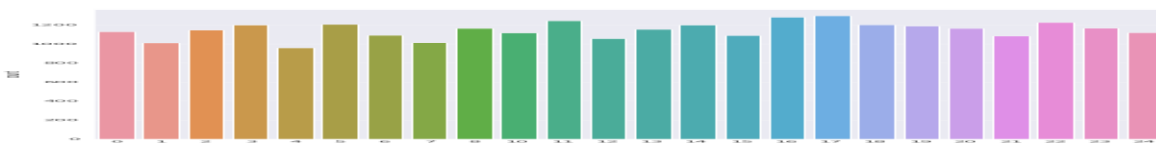
	label	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel775	pixel776	pixel777	pixel778
0	3	107	118	127	134	139	143	146	150	153	...	207	207	207	207
1	6	155	157	156	156	156	157	156	158	158	...	69	149	128	87
2	2	187	188	188	187	187	186	187	188	187	...	202	201	200	199
3	2	211	211	212	212	211	210	211	210	210	...	235	234	233	231
4	13	164	167	170	172	176	179	180	184	185	...	92	105	105	108

5 rows × 785 columns

▼ Data Visualization and Preprocessing

```
plt.figure(figsize = (10,10)) # Label Count
sns.set_style("darkgrid")
sns.countplot(train_df['label'])
```

/home/admin/anaconda3/envs/gpu/lib/python3.8/site-packages/seaborn/\_decorators.py:36: FutureWarning: Pass the following variab  
warnings.warn(  
<AxesSubplot:xlabel='label', ylabel='count'>



The dataset seems balanced as for each training label, enough training examples exist

```
y_train = train_df['label']
y_test = test_df['label']
del train_df['label']
del test_df['label']
```

+ Code

+ Text

```
[ ] from sklearn.preprocessing import LabelBinarizer
label_binarizer = LabelBinarizer()
y_train = label_binarizer.fit_transform(y_train)
y_test = label_binarizer.fit_transform(y_test)
```

```
[ ] x_train = train_df.values
x_test = test_df.values
```

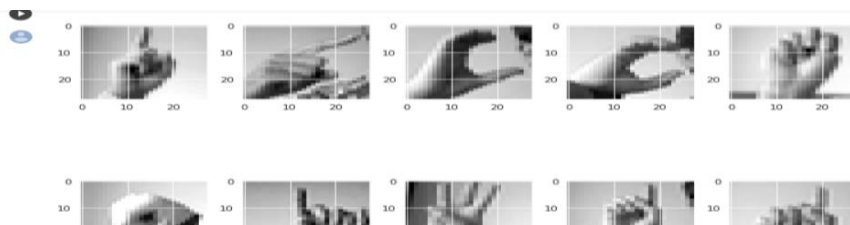
We perform a grayscale normalization to reduce the effect of illumination's differences. Moreover the CNN converges faster on [0..1] data than on [0..255].

```
[ ] # Normalize the data
x_train = x_train / 255
x_test = x_test / 255
```

```
[ ] # Reshaping the data from 1-D to 3-D as required through input by CNN's
x_train = x_train.reshape(-1,28,28,1)
x_test = x_test.reshape(-1,28,28,1)
```

Preview of first 10 images

```
▶ f, ax = plt.subplots(2,5)
f.set_size_inches(10, 10)
k = 0
for i in range(2):
    for j in range(5):
        ax[i,j].imshow(x_train[k].reshape(28, 28) , cmap = "gray")
        k += 1
plt.tight_layout()
```



## 7.2 FEATURE 2

### Data Augmentation

In order to avoid over fitting problem, we need to expand artificially our dataset. We can make your existing dataset even larger. The idea is to alter the training data with small transformations to reproduce the variation.

Approaches that alter the training data in ways that change the array representation while keeping the label the same are known as data augmentation techniques. Some popular augmentations people use are grayscale, horizontal flips, vertical flips, random crops, colour jitters, translations, rotations, and much more.

By applying just a couple of these transformations to our training data, we can easily double or triple the number of training examples and create a very robust model.

```
# With data augmentation to prevent overfitting
```

```
datagen = ImageDataGenerator(
    featurewise_center=False, # set input mean to 0 over the dataset
    samplewise_center=False, # set each sample mean to 0
    featurewise_std_normalization=False, # divide inputs by std of the dataset
    samplewise_std_normalization=False, # divide each input by its std
    zca_whitening=False, # apply ZCA whitening
    rotation_range=10, # randomly rotate images in the range (degrees, 0 to 180)
    zoom_range = 0.1, # Randomly zoom image
    width_shift_range=0.1, # randomly shift images horizontally (fraction of total width)
    height_shift_range=0.1, # randomly shift images vertically (fraction of total height)
    horizontal_flip=False, # randomly flip images
    vertical_flip=False) # randomly flip images
```

```
datagen.fit(x_train)
```



For the data augmentation, I chose to :

- Randomly rotate some training images by 10 degrees
- Randomly Zoom by 10% some training images
- Randomly shift images horizontally by 10% of the width
- Randomly shift images vertically by 10% of the height
- I did not apply a vertical flip nor horizontal flip since it could have lead to misclassify.
- Once our model is ready, we fit the training dataset .

## CONVOLUTIONAL NEURAL NETWORKS TO THE RESCUE

### Training The Model

```
learning_rate_reduction = ReduceLROnPlateau(monitor='val_accuracy', patience = 2, verbose=1, factor=0.5, min_lr=0.00001)

[ ] model = Sequential()
model.add(Conv2D(75, (3,3), strides = 1, padding = 'same', activation = 'relu', input_shape = (28,28,1)))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2), strides = 2, padding = 'same'))
model.add(Conv2D(50, (3,3), strides = 1, padding = 'same', activation = 'relu'))

model = Sequential()
model.add(Conv2D(75, (3,3), strides = 1, padding = 'same', activation = 'relu', input_shape = (28,28,1)))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2), strides = 2, padding = 'same'))
model.add(Conv2D(50, (3,3), strides = 1, padding = 'same', activation = 'relu'))
model.add(Dropout(0.2))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2), strides = 2, padding = 'same'))
model.add(Conv2D(25, (3,3), strides = 1, padding = 'same', activation = 'relu'))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2), strides = 2, padding = 'same'))
model.add(Flatten())
model.add(Dense(units = 512, activation = 'relu'))
model.add(Dropout(0.3))
model.add(Dense(units = 24, activation = 'softmax'))
model.compile(optimizer = 'adam', loss = 'categorical_crossentropy', metrics = ['accuracy'])

plot_model(model, show_shapes=True, show_layer_names=True, to_file='model.png')
from IPython.display import Image
Image(retina=True, filename='model.png')

graph TD
    conv2d_input[conv2d_input: InputLayer] --> conv2d[conv2d: Conv2D]
    conv2d --> batch_normalization[batch_normalization: BatchNormalization]
    batch_normalization --> max_pooling2d[max_pooling2d: MaxPooling2D]
```

### Save the model as CNNmodel.h5

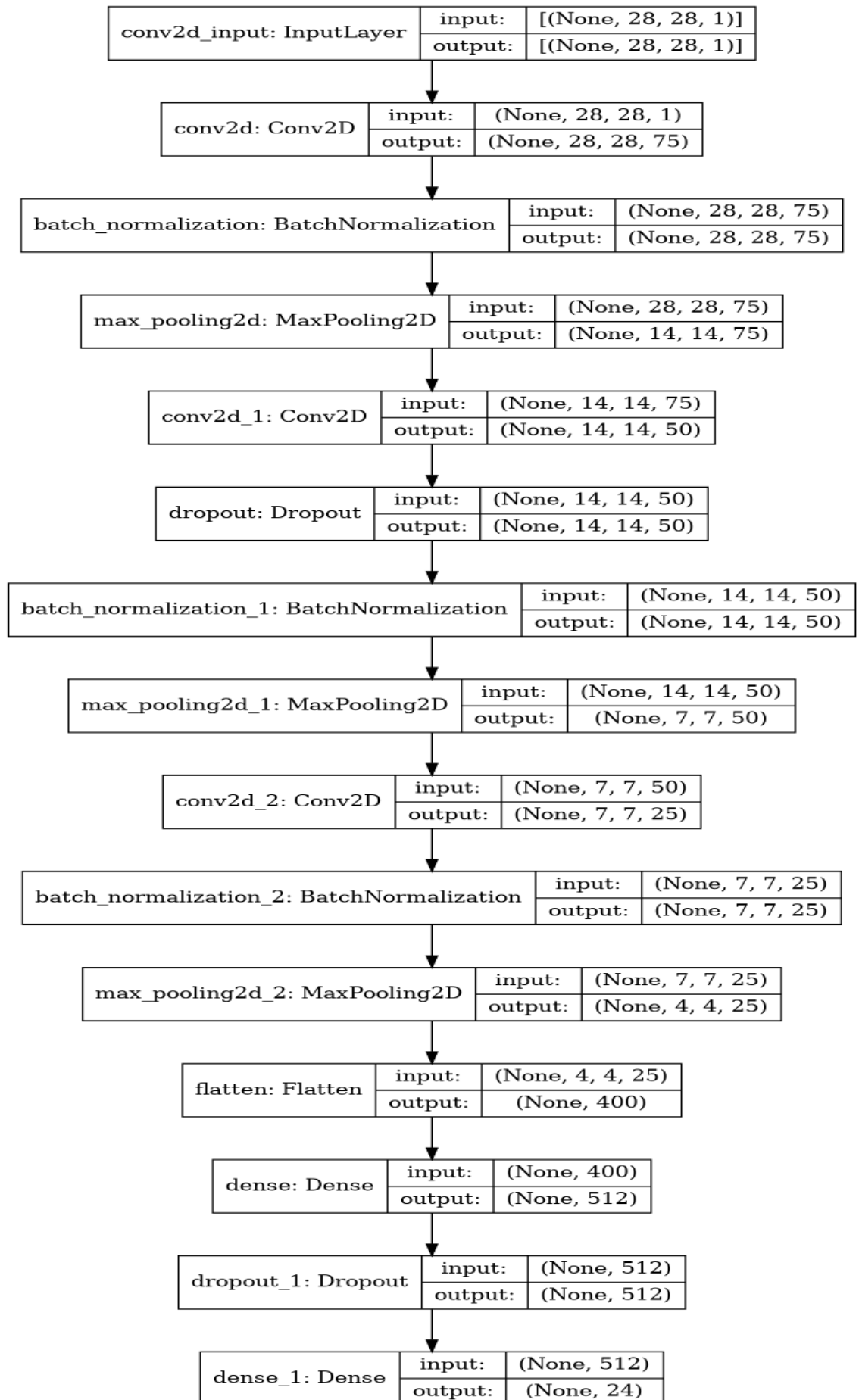
```
[ ] model.save('CNNmodel.h5')
```

### Analysis after Model Training

```
epochs = [i for i in range(20)]
fig, ax = plt.subplots(1,2)
train_acc = history.history['accuracy']
train_loss = history.history['loss']
val_acc = history.history['val_accuracy']
val_loss = history.history['val_loss']
fig.set_size_inches(16,9)

ax[0].set_title('Training & Validation Accuracy')
ax[0].legend()
ax[0].set_xlabel("Epochs")
ax[0].set_ylabel("Accuracy")

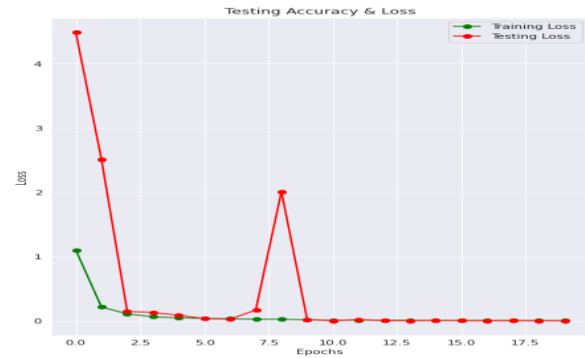
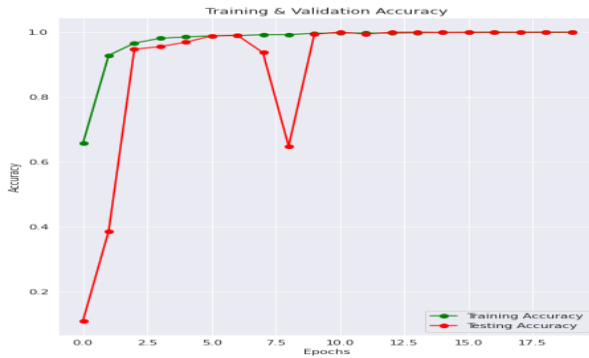
ax[1].plot(epochs, train_loss, 'g-o', label = 'Training Loss')
ax[1].plot(epochs, val_loss, 'r-o', label = 'Testing Loss')
ax[1].set_title('Testing Accuracy & Loss')
ax[1].legend()
ax[1].set_xlabel("Epochs")
ax[1].set_ylabel("Loss")
plt.show()
```



# CHAPTER 8

## 8. TESTING

### 8.1 TEST CASES



```
[ ] predictions = model.predict_classes(x_test)
for i in range(len(predictions)):
    if(predictions[i] >= 9):
        predictions[i] += 1
predictions[:5]

/home/admin/anaconda3/envs/gpu/lib/python3.8/site-packages/tensorflow/python/keras/engine/sequential.py:450: UserWarning: `model.predict_classes()` is deprecated and
array([ 6,  5, 10,  0,  3])
```

```
classes = ["Class " + str(i) for i in range(25) if i != 9]
print(classification_report(y, predictions, target_names = classes))
```

### 8.2 USER ACCEPTANCE TESTING

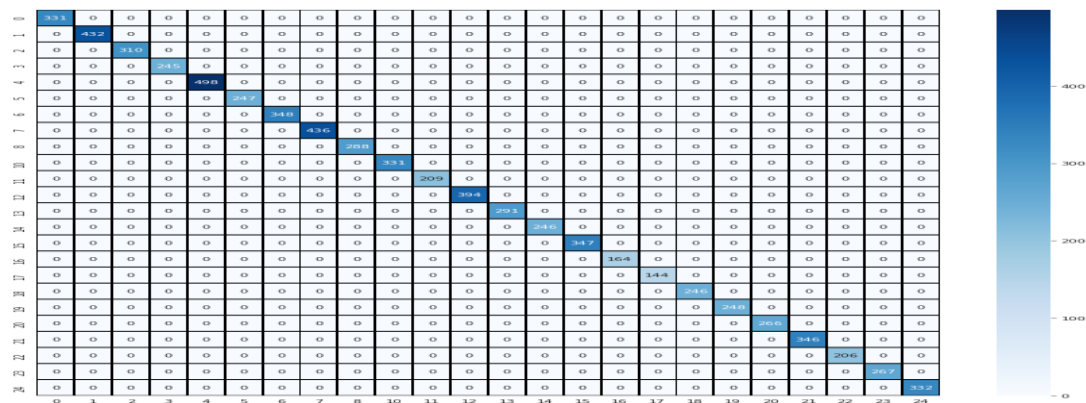
```
classes = ["Class " + str(i) for i in range(25) if i != 9]
print(classification_report(y, predictions, target_names = classes))
```

	precision	recall	f1-score	support
Class 0	1.00	1.00	1.00	331
Class 1	1.00	1.00	1.00	432
Class 2	1.00	1.00	1.00	310
Class 3	1.00	1.00	1.00	245
Class 4	1.00	1.00	1.00	498
Class 5	1.00	1.00	1.00	247
Class 6	1.00	1.00	1.00	348
Class 7	1.00	1.00	1.00	436
Class 8	1.00	1.00	1.00	288
Class 10	1.00	1.00	1.00	331
Class 11	1.00	1.00	1.00	209
Class 12	1.00	1.00	1.00	394
Class 13	1.00	1.00	1.00	291
Class 14	1.00	1.00	1.00	246
Class 15	1.00	1.00	1.00	347

```
[ ] cm = confusion_matrix(y,predictions)
```

```
[ ] cm = pd.DataFrame(cm , index = [i for i in range(25) if i != 9] , columns = [i for i in range(25) if i != 9])
```

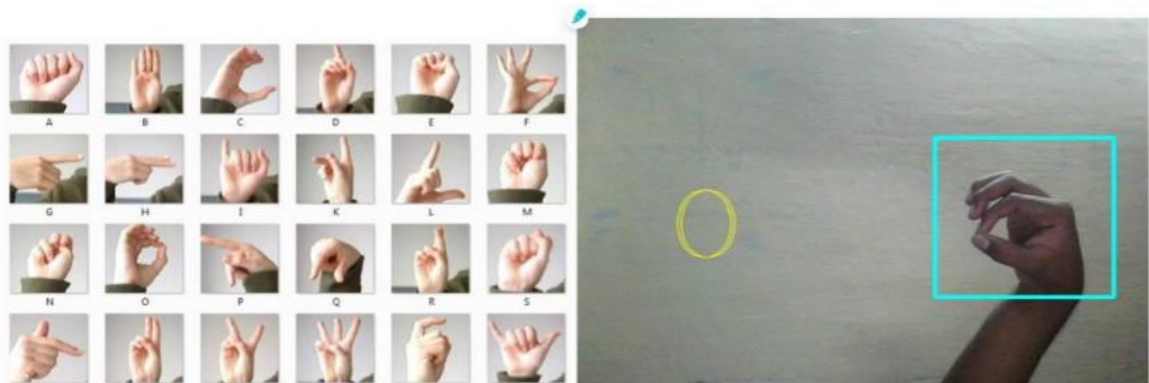
```
plt.figure(figsize = (15,15))
sns.heatmap(cm, cmap= "Blues", linecolor = 'black' , linewidth = 1 , annot = True, fmt='')
```



# CHAPTER 9

## 9.RESULT

We are running the output in the website which shows the letters of sign language in web camera



# CHAPTER 10

# **10. ADVANTAGES AND DISADVANTAGES**

## **ADVANTAGES**

- ❖ Enables deaf and dumb to communicate effectively
- ❖ Decrease frustration
- ❖ Improves child – parent communication if they are disabled
- ❖ Helps child remember words
- ❖ Increase self esteem
- ❖ Provides an insight into child's world
- ❖ Builds communication easily

## **DISADVANTAGES**

- ❖ The biggest disadvantage of communication is that it takes a lot of time to listen, speak, read, or write to someone.
- ❖ While trying to do one thing you can accidentally hurt another person's feelings by not listening or paying attention.
- ❖ Causes damage to the relationship when they not any attention.
- ❖ They are costly and difficult to be used commercially classification method are also varying from researchers.
- ❖ Problem for people who do not have full use of their hands properly.
- ❖ The normal person should feel difficulties in showing the full hand position.



# CHAPTER 11

## **11.CONCLUSION**

Real-time communication (RTC) workloads can be deployed on IBM cloud to attain scalability, elasticity, and high availability while meeting the key requirements.

Today, several customers are using cloud, its partners, and open source solutions to run RTC workloads with reduced cost and faster agility as well as a reduced global footprint.

The reference architectures and best practices provided in this white paper can help customers successfully set up RTC workloads on IBM CLOUD and optimize the solutions to meet end user requirements while optimizing for the cloud.

In this project we finally conclude with the text as the output. The CNN model is running in backend and we get the output in local system after that we created frontend with HTML and CSS and then by using flask and by registrations through IBM we deploy the model in IBM cloud

# CHAPTER 12

## **12. FUTURE SCOPE**

- ❖ Through image recognition technology, AI understands the context objects in photos and describes photos to people.
- ❖ The speech-to-text and text-to-speech technologies helped those people who had speech impediments.
- ❖ We can develop a model for ISI word and sentence level recognition.
- ❖ This will require a system that detect changes with respect to the temporal space.
- ❖ We can develop a complete product that will help the speech and hearing impaired people and thereby reduce the communication gap.
- ❖ Through image recognition technology, AI understands the context of objects in photos and describes photos to people.
- ❖ The product in AI that narrates the entire world around them visually impaired by reading texts, describing whereabouts and the looks of the nearby people by identifying and recognizing faces and emotions.
- ❖ Autonomous vehicles are in trend and their success is due to AI technology. These vehicles can be beneficial to people living with limited physical mobility

# CHAPTER 13

## **13.APPENDIX**

### **SOURCE CODE**

FINAL CODE- APP.PY

<https://github.com/IBM-EPBL/IBM-Project-2817-1658483653/blob/main/Project%20Development%20Phase/SPRINT%203/app.py>

HTML PAGE

<https://github.com/IBM-EPBL/IBM-Project-2817-1658483653/blob/main/Project%20Development%20Phase/SPRINT%203/index.html>

FULL PROJECT CODE

[https://github.com/IBM-EPBL/IBM-Project-2817-1658483653/tree/main/Project%20Development%20Phase/Sprint%202/Test\\_The\\_Model](https://github.com/IBM-EPBL/IBM-Project-2817-1658483653/tree/main/Project%20Development%20Phase/Sprint%202/Test_The_Model)

**GIT HUB LINK**

<https://github.com/IBM-EPBL/IBM-Project-2817-1658483653>

**PROJECT DEMO LINK**

[https://drive.google.com/file/d/167B6I9Pzi-HECABrQP2UdhXr7O2DtrAH/view?usp=share\\_link](https://drive.google.com/file/d/167B6I9Pzi-HECABrQP2UdhXr7O2DtrAH/view?usp=share_link)