

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

## **Team Details:**

**Team Id - PNT2022TMID12266**

### **Team Members :**

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## **Project Report Format**

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# **CHAPTER-1**

## **INTRODUCTION**

## **1.1 Project Overview**

The goal of this project was to build a neural network able to classify which letter of the American Sign Language(ASL) alphabet is being signed, given an image of a signing hand. This project is a first step towards building a possible sign language translator, which can take communications in sign language and translate them into written and oral language. Such a translator would greatly lower the barrier for many deaf and mute individuals to be able to better communicate with others in day to day interactions.

This goal is further motivated by the isolation that is felt within the deaf community. Loneliness and depression exists in higher rates among the deaf population, especially when they are immersed in a hearing world . Large barriers that profoundly affect life quality stem from the communication disconnect between the deaf and the hearing. Some examples are information deprivation, limitation of social connections, and difficulty integrating in society.

Most research implementations for this task have used depth maps generated by depth camera and high resolution images. The objective of this project was to see if neural networks are able to classify signed ASL letters using simple images of hands taken with a personal device such as a laptop webcam. This is in alignment with the motivation as this would make a future implementation of a real time ASL-to-oral/written language translator practical in an everyday situation.

## **1.2 Purpose**

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.

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.

CHAPTER-2

**LITERATURE SURVEY**



## Literature survey:

A literature survey or a literature review in a project report is that section which shows the various analyses and research made in the field of your interest and the results already published, taking into account the various parameters of the project and the extent of the project. It is the most important part of your report as it gives you a direction in the area of your research. It helps you set a goal for your analysis - thus giving you your problem statement.

### 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. 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.

### 2.2 References

TITLE: Innovative study of an AI voice based smart device to assist deaf people

AUTHOR: Dhaya Sindhu Battina

YEAR: 2021

Assistive technology consists of a wide range of hardware and software tools that enable a person to receive information in the format that suits their needs best. These Various technology may be available to the deaf.many items, including cochlear implants, loop systems,accessibility,FM technology and assistive listening devices,visual warning systems, videophones, and much more . Recognizing the worth and boundaries of different assistive devices can be advantageous for both.Artificial intelligence (AI) enables computers to learn from existing experiences, adapt to new information, and perform tasks that are similar to those carried out by humans . The vast majority of artificial intelligence applications that users know of today – ranging from chess playing robots to self-driving vehicles – are primarily reliant on deep learning and computational linguistics.Computers may be taught to do particular jobs by processing huge quantities of data and detecting trends in the data. This is accomplished via the use of various technologies.

TITLE:Communication system for deaf and dumb people

AUTHOR: Shraddha R. Ghorpade, Prof. Surendra K. Waghmare2

YEAR: 2019

People with disabilities are having a difficult time keeping up with the rapidly evolving technology, which is one of the major issues that our society is dealing with. For those with disabilities, having access to communication tools has become crucial. Typically deaf and stupid people use sign language to communicate, but they struggle to do so with non-sign language users. Information is the main topic of communication between normal and deaf individuals using sign language, which is expressive and natural. So that we can converse with them and comprehend what they're saying, we need a translation. A language translation technology converts common sign language into voice, enabling regular people to communicate with one another. When it comes to communicating with other people, sign language (SL) is the primary method of communication for hearing-impaired individuals and other groups. It is conveyed via both manual (body and hand movements) and non-manual (face expressions) characteristics. All of these characteristics are combined to create utterances that communicate the meaning of words or statements.

TITLE: Educational Status of Differently Abled Persons and Developed Policies in India

AUTHOR: Chiranjit Majumder

YEAR: 2019 April

One of the socially created phenomenon is basically Disability. The fact is that many children and adults suffered from disabilities excluded from mainstream education benefits. Disabled persons are segregated from education system because of social negligence and absence of support system in the home and inadequacy of sufficient facilities in schools particularly. However, education is the most important medium for social, economic and political transformation. Socialization of children with disabilities (CWD) through education receives an unremarkably important roles in societies such as India where social exclusion of Physically Challenged Persons (PCPs) is significant. Indisputably, the literacy level of Physically Challenged Persons (PCPs) is very low in India. Very poor educational outcomes for children with disabilities remain in developing countries specially. Most of disabled persons do not get the full benefits of education. However, some policies in India has started to display some concern for Physically Challenged students. Education is utmost significant to lift up the socioeconomic status of PCPs. But education of disabled persons has not received adequate intentness and resources that it requires. Physically Challenged Persons (PCPs), few who are enrolled in schools are not given equal opportunity for middle secondary and higher education levels. Many Disabled persons are educated but they do not get any work for earning in our society.

### 2.3 Problem Statement Definition

Communication is the only medium by which we can share our thoughts or convey the message but communications between deafmute and a normal person has always ben 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 lack of proper communication facilities to convey a wide variety of messages between a specially abled and a normal person who doesn't know sign language. The issue can happen wherever a specially abled person has an access but lacks services to assist them.

#### **Why is it important that we fix the problem?**

According to a number of study reports, it has been witnessed that the numbers of depressed specially abled persons are quite increasing due to the difficulties they face during their communication with normal people. With the advent of current technological facilities, it is possible to stop the continuation of this trend

CHAPTER-3

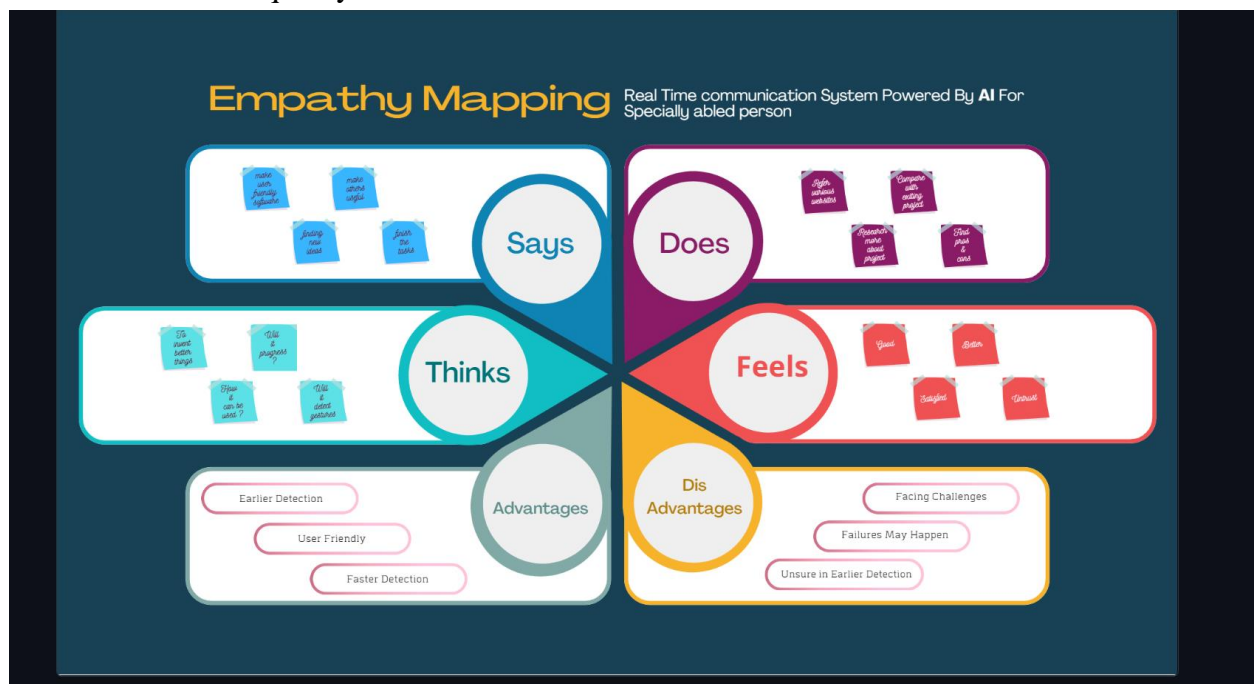
**IDEATION AND PROPOSED  
SOLUTION**

### 3.1 Empathy Map Canvas

#### Definition:

An empathy map canvas is a more in-depth version of the original empathy map, which helps identify and describe the user's needs and pain points. And this is valuable information for improving the user experience.

An empathy map canvas helps brands provide a better experience for users by helping teams understand the perspectives and mindset of their customers. Using a template to create an empathy map canvas reduces the preparation time and standardizes the process so you create empathy map canvases of similar quality.



### 3.2 Ideation & Brainstorming

Definition:

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 number of creative solutions.



### 3.3 proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Deaf and dumb people couldn't able to communicate with the normal people easily.
2.	Idea/Solution description	A real time ML based system is built for the real time sign language detection with a Tensor Flow object detection
3.	Novelty/Uniqueness	This model using SSD ML algorithm recognizing the signs as words instead of old traditional translators, that are very slow and take too much since every alphabet as to be recognized to form the whole statement in old methods.
4.	Social Impact/Customer satisfaction	It drastically reduce communication difference gap between normal people and specially abled people with the help of AI. So they can live their life independently.
5.	Business Model (Revenue Model)	We use freemium business revenue model for making revenue. In our device, we give most of the basic features for free of charge but they have to pay if they need more advanced features.
6.	Scalability of the Solution	The model which is TensorFlow model that has been used can be replaced with another model as well. The same system can be implemented for different sign languages by substituting the dataset.

## 3.4 Problem Solution Fit

### Definition:

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.

Solution fit		
<b>1. CUSTOMER SEGMENT(S)</b> Specially abled people are the customers who are not able to easily communicate with others. <b>CS</b>	<b>6. CUSTOMER CONSTRAINTS</b> While communicating, they can only able to communicate with the people those who know sign language. <b>CC</b>	<b>5. AVAILABLE SOLUTIONS</b> The available solutions are not so accuracy in image processing and the output was not so efficient. <b>AS</b>
<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> Only sign language known people can communicate so we introduced a new system to communicate all specially abled people. <b>J&amp;P</b>	<b>9. PROBLEM ROOT CAUSE</b> Due to the inability to communicate with others by the specially abled people's <b>RC</b>	<b>7. BEHAVIOUR</b> Finding the right signs and converting into correct communication between the people's <b>BE</b>
<b>3. TRIGGERS</b> Some of the triggers are introducing in all hospitals, medical trusts and also in advertisements. <b>TR</b>	<b>10. YOUR SOLUTION</b> Created an application using AI, that will able to convert the sign language by image processing of the specially abled people. <b>SL</b>	<b>8. CHANNELS of BEHAVIOUR</b> <b>8.1 ONLINE</b> We can update our application and use it in a very efficient way. <b>CH</b>
<b>4. EMOTIONS: BEFORE / AFTER</b> specially abled people hesitate to communicate with others but know using this system they can easily communicate with others. <b>EM</b>		<b>8.2 OFFLINE</b> In offline mode we use it but not so efficient we can use it with a recently updated application.

Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 license Created by Daria Nepriakhina / Amaltema.com



## CHAPTER- 4

# **REQUIREMENT ANALYSIS**

## 4.1 Functional Requirements

FR No.	Functional Requirement	Sub Requirements
FR-1	User Registration	Registration throughForm Registration through Gmail.
FR-2	User confirmation	Confirmation via Email Confirmation via OTP
FR-3	System	Desktop with high resolution camera
FR-4	Authorization Levels	There are two levelsof authorization namelystandard access level and advanced accesslevel.
FR-5	External interface	Ethernet, Wi-Fi,USB to provideinternet facility to access the resources with real timecommunication.
FR-6	Reporting	If anyissues found in the application, automatically it will be notified to the developer.

## 4.2 Non-Functional Requirements

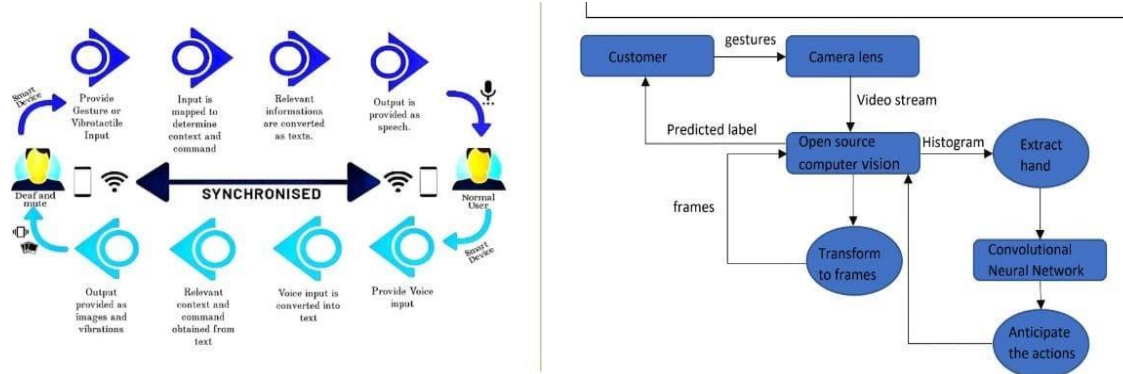
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	To convey a message to normal people, as well as convert speechinto understandable sign language for the deaf and dumb people.
NFR-2	Security	Converted information using signs intospeech is accessed only by the user.
NFR-3	Reliability	Provides insight into potential issues for desktop applications on managed devices.
NFR-4	Performance	The timefor converting signsinto speech shouldbe faster for the real time communication.
NFR-5	Availability	Provides automatic recovery as muchas possible.
NFR-6	Scalability	This app enables deaf and dumb people to convey their information using signs which get converted to human-understandable language and speechis given as output.

## CHAPTER-5

# **PROJECT DESIGN**

## 5.1 Data Flow Diagram

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

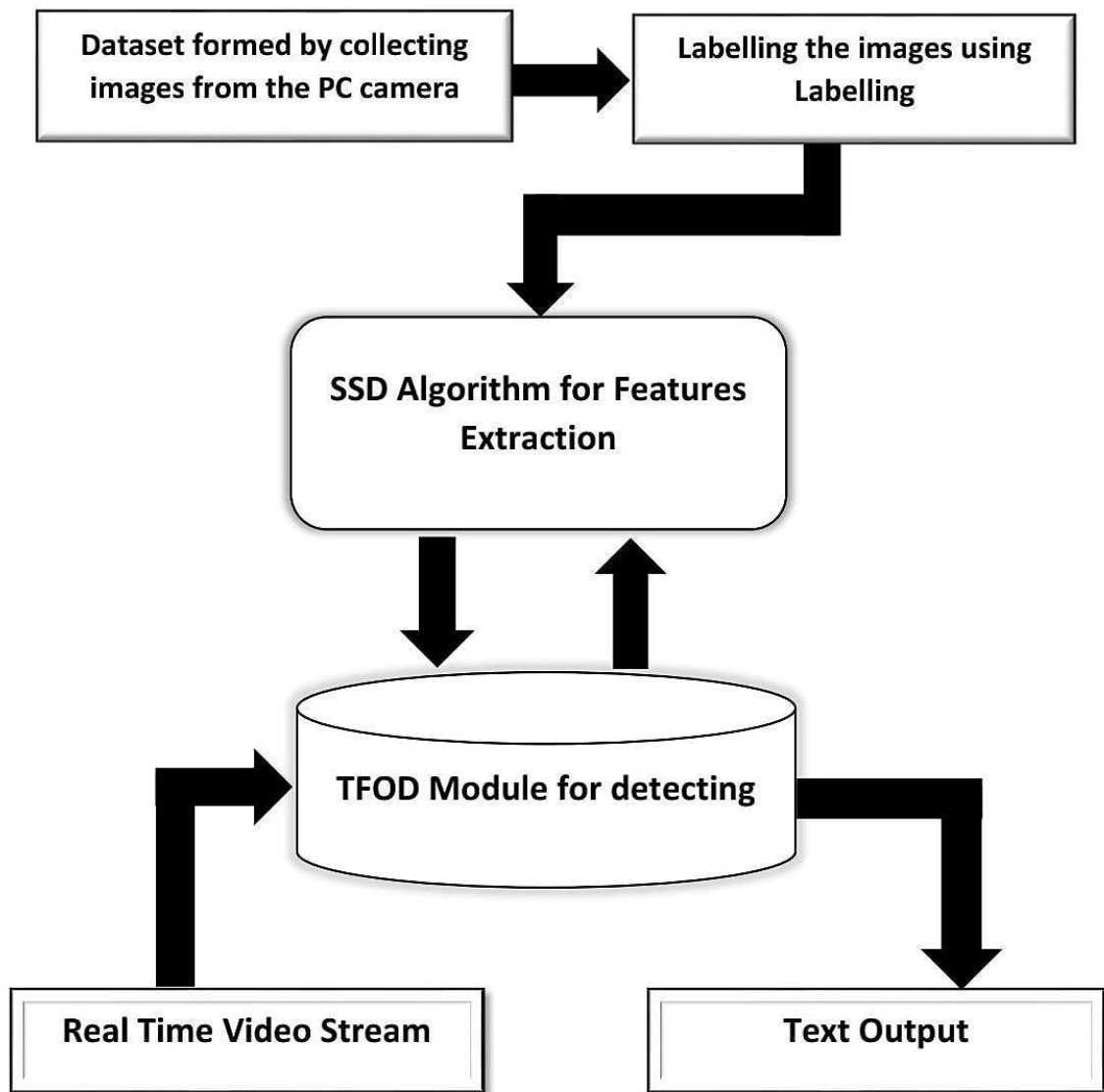


## 5.2 Solution & Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

1. Find the best tech solution to solve existing business problems.
2. Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.
3. Define features, development phases, and solution requirements.
4. Provide specifications according to which the solution is defined, managed, and delivered.

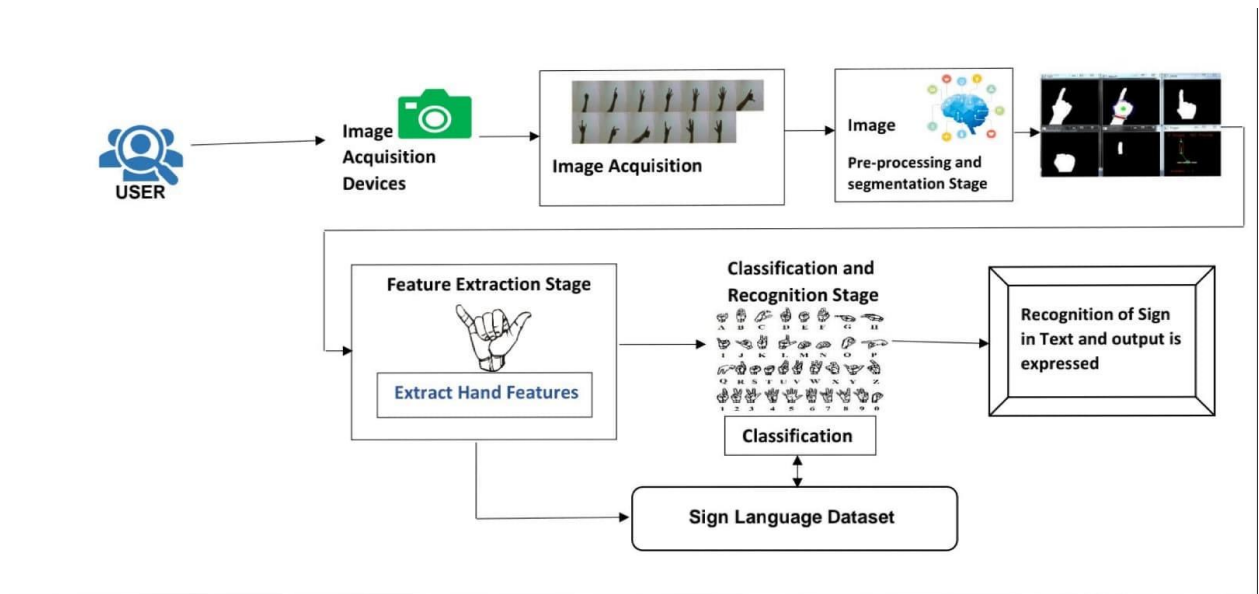
### **Solution Architecture Diagram :**



### **SYSTEM ARCHITECTURE**

## Technology Stack (Architecture & Stack):

### Technical Architecture:



**Table-1 Components and Technologies:**

S.NO	Component	Description	Technology
1.	User Interface	Customer have to login through their respective website or phone number. Then interaction will happen with the User interface.	javascript, CSS,HTML
2.	Application Logic-1	It requires various types libraries, frameworks to develop the project	Java / Python
3.	Application Logic-2	Helps to converting the human gestures/actions into written words.	Machine learning
4.	Application Logic-3	Provides helpful,feasible answers after recognising the human gestures.	ANN,CNN
5.	Database	Data could be numbers or words.	MySQL, Rational database
6.	Cloud Database	Providing customer to use host database without buying additional hardware..	Deep learning and neural networks
7.	File Storage	File storage could be fast, reliable and flexible..	Local filesystem
8.	External API-1	Used to access the information in the cloud	Weather API
9.	External API-2	Used to access the information for data driven decision making...	Aadhar API
10.	Machine Learning Model	Machine learning interact with various algorithms that are required for implementation.	Image acquisition
11.	Infrastructure (Server / Cloud)	Application deployment on local system / local cloud server configuration. Install the windows version and execute the installer..	Local, Cloud Foundry, Kubernetes, etc.

**Table-2: Application Characteristics:**

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	The framework which are used.	Tensor flow, Theano, RNN, PyTorch
2.	Security Implementations	Security controls which can implemented by using firewall..	Firewall and some security related softwares..
3.	Scalable Architecture	The architecture will be scalable (Micro services).	Data, models, speedand consistency..
4.	Availability	The availablity of application ( use of load balancers, distributed servers etc)	Image recognition, sign/gestures recognition, text recognition & real time captioning..
5.	Performance	Design aspects for the performance of application ( number of requests per second, use of cacheetc..,	Using Convolutional neural network, maching learning for conversation and improve the sensivity of the performance..



### 5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As customer, I couldable to register for the app by entering my E-mail and proper password.	I could able to access my registered account.	High	Sprint 1
		USN-2	As a user, I'll get the acknowledgement verification emailonce after my registration hasbeen done for theapp	I can get verification email and clickok to confirm it..	High	Sprint 1
		USN-3	As a customer, I could able to register for application via their official websites and social media.	I could able to register and access my account by using theirwebsite & socialmedia.	Medim	Sprint 2
		USN-4	As a customer, I could able to register for application through Gmail	via some thirdparties link	Low	Sprint 2
	Login	USN-5	As a customer, I could able to login into application by entering alreadyregistered email and password	I can type manually and also can used saved login credentials	High	Sprint 1

	Dashboard	USN6	As a customer,I can get all services andhelp in dashboard	I can access my dashboard and change profile	Medium	Sprint 2
Customer (Webuser)	Registration	USN7	As a customer, I could able to login throughregistered phone numberby using otp instead of Gmail	I could able to register & login via phone numberto access my account	High	Sprint 2
Customer Care Executive	Service	USN8	Can avail the service by calling customer care or reaching through E-mail.	Can avail the service by calling customer care or reaching throughE-mail.	Medium	Sprint 1
Administrator		USN9	Respective personin the companyshould take care all of this.	All the requirements arethere.	High	Sprint 2
	Sign up	USN-10	Customer have to sign-up to use these things andall	Have to enter validcredentials.	High	Sprint 2

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
	Wish list	USN-11	Customer's desired choices to availthese services.	As a customer can review and choose theirservices as he want/preferred.	Medium	Sprint 1
	Enrollment	USN-12	Now, customer can avail all services oncehe/she enrolled.	As a customer, it'squite enchanting	Medium	Sprint 2

**CHAPTER-6**

**PROJECT PLANNING &  
SCHEDULING**

## 6.1 Sprint Planning & Estimation

### Product Backlog, Sprint Schedule, and Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect Dataset.	9	High	PAVAN KUMAR M, YUVARAJ R
Sprint-1		USN-2	Image preprocessing	8	Medium	PAVAN KUMAR M, YUVARAJ R
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model	10	High	BALACHANDHAR V, HARIPRASAD J
Sprint-2		USN-4	Training the image classification model using CNN	7	Medium	BALACHANDHAR V, HARIPRASAD J
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	PAVAN KUMAR M, BALACHANDHAR V.
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	8	Medium	YUVARAJ R, HARIPRASAD J.

## 6.2 Sprint Delivery Schedule

**Project Tracker, Velocity & Burndown Chart:**

<b>Sprint</b>	<b>Total Story Points</b>	<b>Duration</b>	<b>Sprint Start Date</b>	<b>Sprint End Date (Planned)</b>	<b>Story Points Completed (as on Planned End Date)</b>	<b>Sprint Release Date(Actual)</b>
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	04 Nov 2022	5	04 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	11 Nov 2022	7	11 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	18 Nov 2022	5	18 Nov 2022

**Velocity:**

$$AV = 6/10 = 0.6$$

### Burndown chart:

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



## 6.3 Reports from JIRA

### Reports from JIRA:

Jira helps teams plan, assign, track, report, and manage work and brings teams together for everything from agile software development and customer support to start-ups and enterprises. Software teams build better with Jira Software, the #1 tool for agile teams. As a Jira administrator, you can create project categories so your team can view work across related projects in one place. Your team can use categories in advanced search, filters, reports, and more.



## **CHAPTER-7**

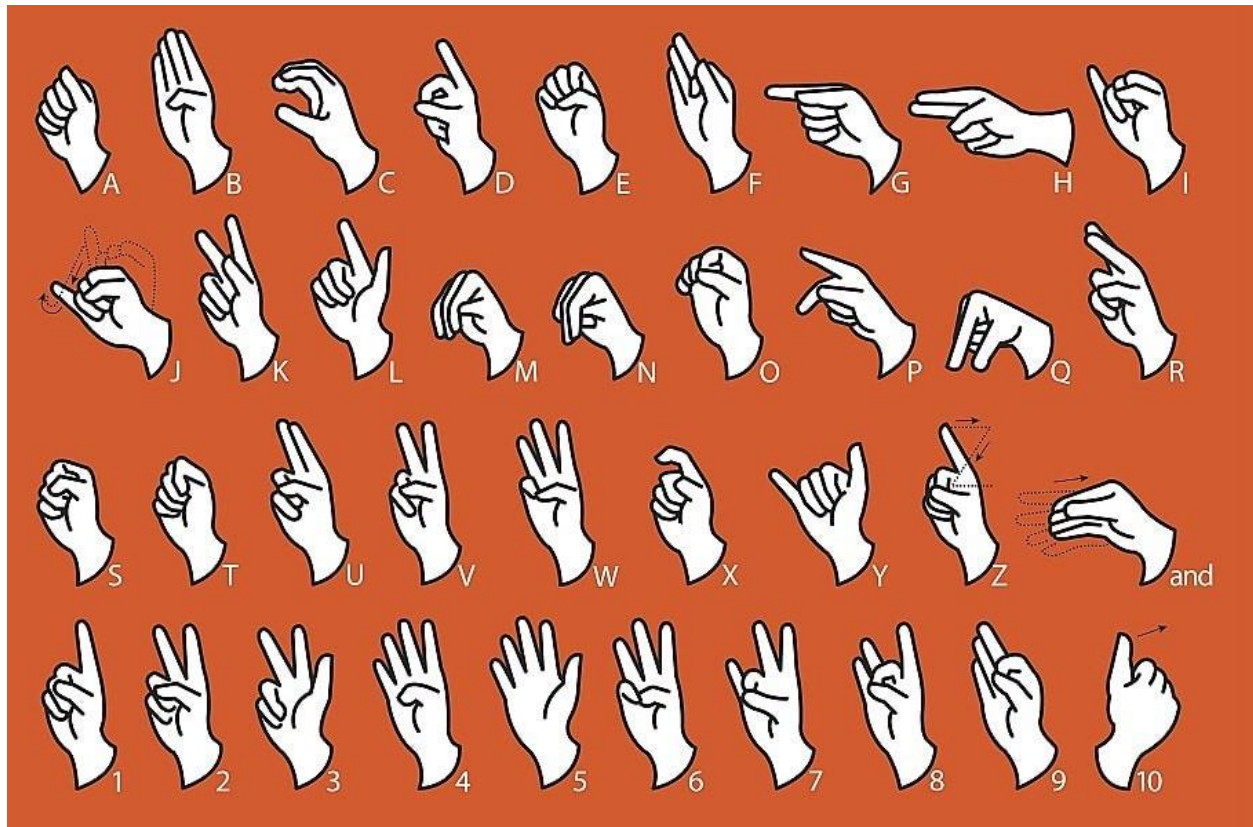
### **CODING & SOLUTIONING**

**(Explain the features added in the project  
along with code)**



## 7.1 Feature 1

The user can choose which sign language to read based on the different sign language standards that exist.



### MODEL BUILDING

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

In [101]:

```
#Creating the model
model=Sequential()
#Adding the layers
model.add(Convolution2D(32,(3,3), input_shape=(64,64,1), activation = 'relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())
```

*#adding hidden layers*

```
model.add(Dense(400, activation='relu'))
```

```
model.add(Dense(200, activation='relu'))
```

```
model.add(Dense(100, activation='relu'))
```

*#Adding the output layer*

```
model.add(Dense(9,  
activation='softmax'))
```

In [102]:

```
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

In [157]:

```
model.fit_generator(x_train, steps_per_epoch=30, epochs=10,  
validation_data=x_test, validation_steps=50)
```

Epoch 1/10

/usr/local/lib/python3.7/dist-packages/ipykernel\_launcher.py:1: UserWarning:

`Model.fit\_generator` is deprecated and will be removed in a future version. Please use  
`Model.fit`, which supports generators.

"""Entry point for launching an IPython kernel.

30/30 [=====] - ETA: 0s - loss: 0.0083 - accuracy: 0.9957

WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your  
dataset or generator can generate at least `steps\_per\_epoch \* epochs` batches (in this case, 50  
batches). You may need to use the repeat() function when building your dataset.

30/30 [=====] - 18s 587ms/step - loss: 0.0083 - accuracy:  
0.9957 - val\_loss: 0.2910 - val\_accuracy: 0.9693

Epoch 2/10

30/30 [=====] - 12s 402ms/step - loss: 0.0081 - accuracy:  
0.9980

Epoch 3/10

30/30 [=====] - 12s 400ms/step - loss: 0.0102 - accuracy:  
0.9963

Epoch 4/10

30/30 [=====] - 12s 402ms/step - loss: 0.0049 - accuracy:  
0.9993

Epoch 5/10

30/30 [=====] - 12s 402ms/step - loss: 0.0030 - accuracy:  
0.9997

Epoch 6/10

30/30 [=====] - 12s 394ms/step - loss: 0.0019 - accuracy:  
0.9997

Epoch 7/10

30/30 [=====] - 12s 401ms/step - loss: 0.0081 - accuracy: 0.9973

Epoch 8/10

30/30 [=====] - 12s 402ms/step - loss: 0.0124 - accuracy: 0.9960

Epoch 9/10

30/30 [=====] - 12s 401ms/step - loss: 0.0070 - accuracy: 0.9987

Epoch 10/10

30/30 [=====] - 12s 399ms/step - loss: 0.0089 - accuracy: 0.9973

```
model.save('Real_time.h5')
```

### TEST THE MODEL

```
from tensorflow.keras.models import load_model
```

```
from tensorflow.keras.preprocessing import
```

```
image import numpy as np import cv2
```

In [105]:

```
model = load_model('/content/Real_time.h5')
```

In [151]:

```
img = image.load_img('/content/Dataset/test_set/H/107.png',target_size = (100,100))img
```



```
from skimage.transform import resize def
```

```
detect(frame):
```

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

```
    img = resize(img,(64,64,1))
```

```
img = np.expand_dims(img,axis=0)
pred=np.argmax(model.predict(img))
op=['A','B','C','D','E','F','G','H','I']
print("THE PREDICTED LETTER IS ",op[pred])
```

In [150]:

```
img=image.load_img("/content/Dataset/test_set/H/107.png") detect(img)
1/1 [=====] - 0s 28ms/step
THE PREDICTED LETTER IS H
```

In [155]:

```
img = image.load_img('/content/Dataset/test_set/A/110.png') pred=detect(img)
1/1 [=====] - 0s 26ms/step
THE PREDICTED LETTER IS A
```

In [158]:

```
img=image.load_img('/content/Dataset/test_set/E/111.png') detect(img)
1/1 [=====] - 0s 30ms/step THE
PREDICTED LETTER IS E
```

## 7.2 Feature 2

The communication gap between deaf and dumb people and the general public can be bridged with a mobile application.

### **Mobile App:**

```
from flask import Flask, Response, render_template from
camera import Video
```

```
app = Flask(__name__) @app.route('/') def
index(): return
render_template('index.html')
```

```
def gen(camera): while
    True:
        frame = camera.get_frame() yield(b'--frame\r\n'
        b'Content-Type: image/jpeg\r\n\r\n' + frame +
        b'\r\n\r\n')
```

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

```
if __name__ == '__main__': app.run()
```

# **CHAPTER-8**


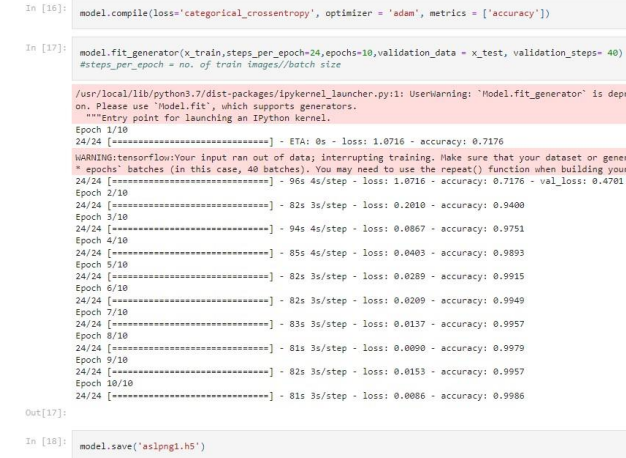
## **TESTING**

## 8.1 Test cases

- Our code was tested on various angle to check whether it gives the correct output.
- To satisfy the customer's expectations we tested it fully

## 8.2 User Acceptance Testing

Our project was tested by an end user to verify that it has working correctly.

S.No.	Parameter	Values	Screenshot
1	Model Summary		 <pre> In [31]: 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 [32]: from keras.models import Sequential from keras.layers import Dense from keras.layers import Convolution2D from keras.layers import MaxPooling2D from keras.layers import Dropout from keras.layers import Flatten  In [33]: model = Sequential()  In [34]: model.add(Convolution2D(32,(3,3),input_shape=(64,64,1), activation='relu')) #no. of feature detectors, size of feature detector, image size, activation function  In [35]: model.add(MaxPooling2D(pool_size=(2,2)))  In [36]: model.add(Flatten())  In [37]: model.add(Dense(units=512, activation = 'relu'))  In [38]: model.add(Dense(units=9, activation = 'softmax'))  In [39]: model.compile(loss='categorical_crossentropy', optimizer = 'adam', metrics = ['accuracy']) </pre>
2	Accuracy	Training Accuracy – 99.6%  Validation Accuracy –98.3%	 <pre> In [16]: model.compile(loss='categorical_crossentropy', optimizer = 'adam', metrics = ['accuracy'])  In [17]: model.fit_generator(x_train, steps_per_epoch=24, epochs=10, validation_data = x_test, validation_steps= 40) #steps_per_epoch = no. of train images/batch size  /usr/local/lib/python3.7/dist-packages/IPykernel_launcher.py:1: UserWarning: "Model.fit_generator" is deprecated. Please use "Model.fit", which supports generators. """Entry point for launching an IPython kernel.  Epoch 1/10 24/24 [=====] - ETA: 0s - loss: 1.0716 - accuracy: 0.7176 WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset on generator "epochs" batches (in this case, 40 batches). You may need to use the repeat() function when building your dataset. 24/24 [=====] - 96s 4s/step - loss: 1.0716 - accuracy: 0.7176 - val_loss: 0.4701 Epoch 2/10 24/24 [=====] - 82s 3s/step - loss: 0.2010 - accuracy: 0.9400 Epoch 3/10 24/24 [=====] - 94s 4s/step - loss: 0.0867 - accuracy: 0.9751 Epoch 4/10 24/24 [=====] - 85s 4s/step - loss: 0.0403 - accuracy: 0.9893 Epoch 5/10 24/24 [=====] - 82s 3s/step - loss: 0.0289 - accuracy: 0.9915 Epoch 6/10 24/24 [=====] - 82s 3s/step - loss: 0.0209 - accuracy: 0.9949 Epoch 7/10 24/24 [=====] - 83s 3s/step - loss: 0.0137 - accuracy: 0.9957 Epoch 8/10 24/24 [=====] - 81s 3s/step - loss: 0.0090 - accuracy: 0.9979 Epoch 9/10 24/24 [=====] - 82s 3s/step - loss: 0.0153 - accuracy: 0.9957 Epoch 10/10 24/24 [=====] - 81s 3s/step - loss: 0.0086 - accuracy: 0.9986  Out[17]:  In [18]: model.save('asipng1.h5') </pre>

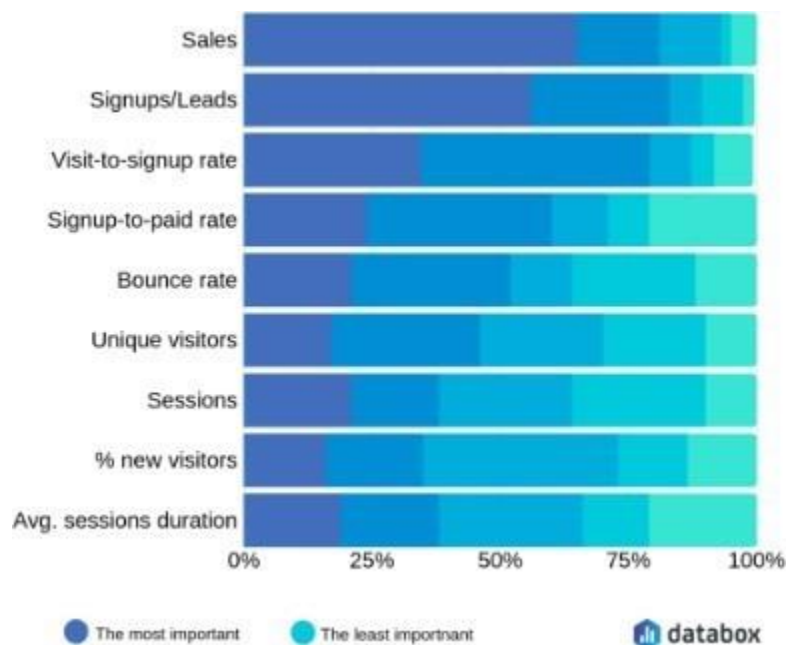


# **CHAPTER-9**

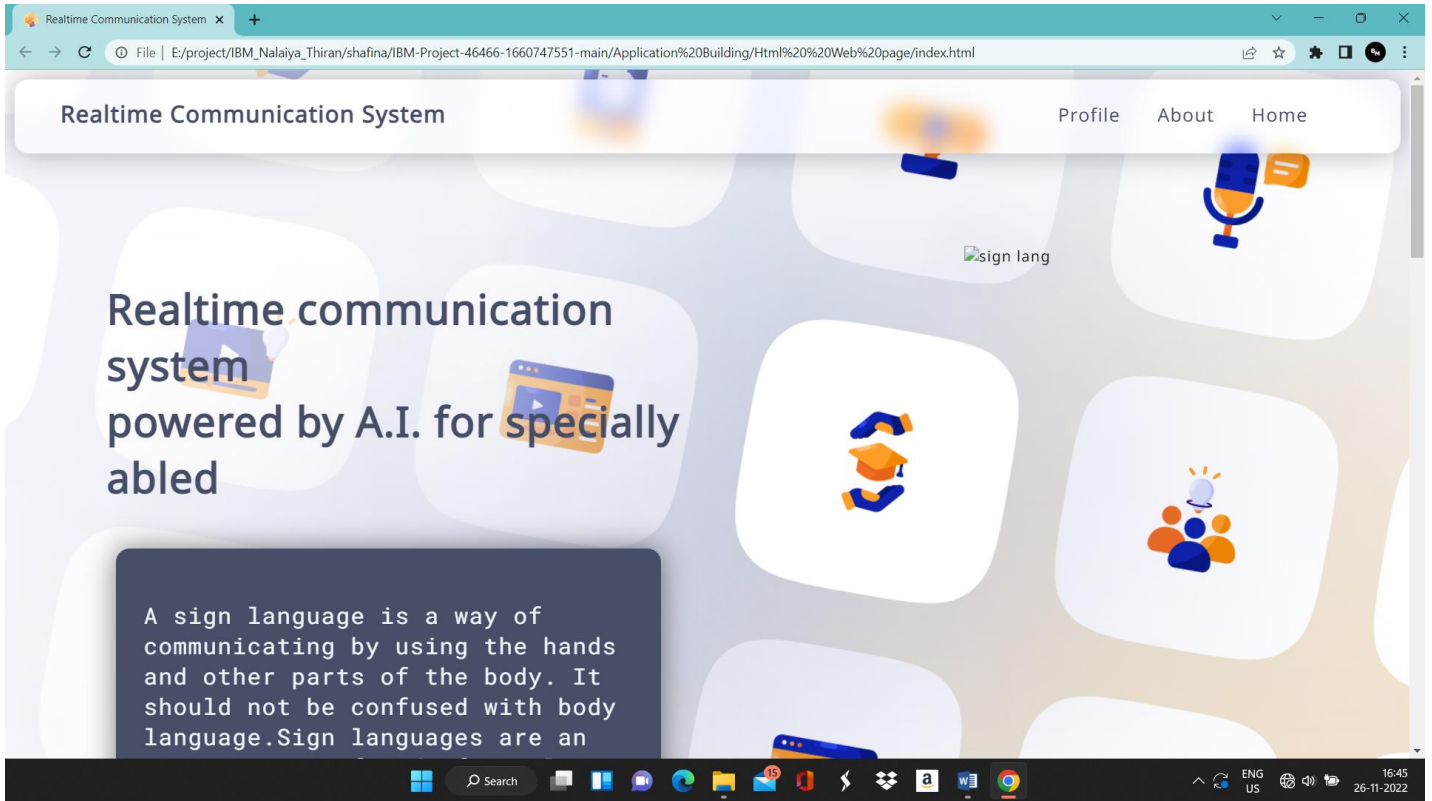
# **RESULTS**

## 9.1 Performance Metrics

- The proposed procedure was implemented and tested on a set of images.
- The training database consists of 15750 images of Alphabets from "A" to "I", while the testing database consists of 2250 images of Alphabets from "A" to "I".
- Once the gesture is recognized the equivalent alphabet is shown on the screen.



## Output:



**CHAPTER-10**

**ADVANTAGES &**

**DISADVANTAES**

### **Advantages:**

- The speech is converted to sign language very quick to provide greater and faster understanding to specially-abled people.
- The user interface is convenient and simple for both people.

### **Disadvantages:**

- The number of images and pixels for the model to train in the dataset is not high so accuracy is moderate level.
- It will be improved by changing the dataset.
- Currently, we have deployed a dataset in the model for the alphabets A to I only.

## **CHAPTER-11**

# **CONCLUSION**

### **CONCLUSION:**

It aims to bridge the communication gap between deaf people and the rest of society. The proposed methodology translates sign language into English alphabets

that are understandable to humans. This system sends hand gestures to the model, who recognizes them and displays the equivalent.

## **CHAPTER-12**

# **FUTURE SCOPE**

## **FUTURE OF SCOPE:**

With the introduction of gesture recognition, the web app can easily be expanded to recognize letters beyond 'T', digits, and other symbols plus gesture recognition can also allow controlling of software/hardware interfaces. Having a technology that can translate hand sign language to its corresponding alphabet is a game changer in the field of communication and Ai for specially-abled people such as those deaf or dumb.

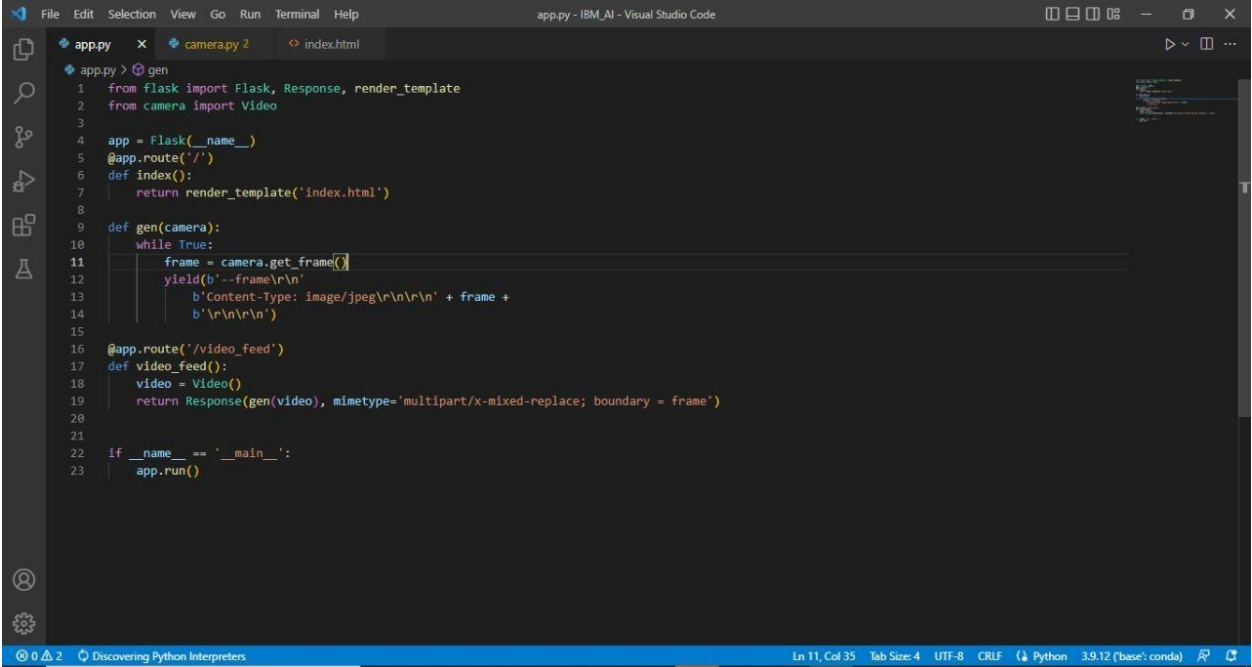


# APPENDIX

## APPENDIX:

Source code:

Flask:



The screenshot shows a Visual Studio Code window with the file explorer on the left displaying 'app.py', 'camera.py 2', and 'index.html'. The main editor area shows the code for 'app.py'. The code imports Flask and Video from camera, sets up a Flask app, and defines routes for a video feed. It uses a generator function 'gen' to yield video frames as they are received from the camera. The status bar at the bottom indicates the file is at line 11, column 35, and the Python interpreter is set to 3.9.12 (base: conda).

```
1 from flask import Flask, Response, render_template
2 from camera import Video
3
4 app = Flask(__name__)
5 @app.route('/')
6 def index():
7     return render_template('index.html')
8
9 def gen(camera):
10     while True:
11         frame = camera.get_frame()
12         yield(b'--frame\r\n'
13              b'Content-Type: image/jpeg\r\n\r\n' + frame +
14              b'\r\n\r\n')
15
16 @app.route('/video_feed')
17 def video_feed():
18     video = Video()
19     return Response(gen(video), mimetype='multipart/x-mixed-replace; boundary = frame')
20
21
22 if __name__ == '__main__':
23     app.run()
```

HTML:

```
File Edit Selection View Go Run Terminal Help
index.html - IBM AI - Visual Studio Code

app.py camera.py 2 index.html
template > index.html > html > head
1 <!DOCTYPE html>
2 <html lang="en">
3
4 <head>
5 <meta charset="utf-8">
6 <meta name="viewport" content="width=device-width, initial-scale=1.0, shrink-to-fit=no">
7 <title>REAL TIME COMMUNICATION </title>
8 <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css">
9 <link rel="stylesheet" href="https://use.fontawesome.com/releases/v5.12.0/css/all.css">
10 <link rel="stylesheet" href="Navbar-Centered-Brand.css">
11 </head>
12
13 <body style="background: #f5d441;">
14 <nav class="navbar navbar-light navbar-expand-md py-3" style="background: #22697a;">
15 <div class="container">
16 <div></div><a class="navbar-brand d-flex align-items-center" href="#"><span
17 class="bs-icon-sm bs-icon-rounded bs-icon-primary d-flex justify-content-center align-items-center me-2 bs-icon"><i
18 class="fas fa-flask"></i></span><h4 style="color: #a5eb24; font-style: oblique; text-align: center;"><strong> Real-Time
19 System Powered By AI&nbsp;For Specially Abled</strong></h4></a>
20 </div></div>
21 </nav>
22 <div>
23 <h2 style="text-align: center; webkit-text-fill-color: #045816;"><strong>TEAMID-- PNT2022TMD40538</strong></h2>
24 </div>
25 <section>
26 <div class="d-flex flex-column justify-content-center align-items-center">
27 <div class="d-flex flex-column justify-content-center align-items-center" id="div-video-feed"
28 style="width: 800px; height: 600px; margin: 10px; min-height: 480px; min-width: 640px; border-radius: 50px; border: 10px groove #0458
29 
31 </div>
32 </div>
33 </div>
Ln 11, Col 8 Spaces: 4 UTF-8 CRLF HTML
```

```
File Edit Selection View Go Run Terminal Help
index.html - IBM AI - Visual Studio Code

app.py camera.py 2 index.html
template > index.html > html > body > section > div.container > div.accordion-1.accordion.text-white > div.accordion-item > div.accordion-collapse.collapse.item-2 > div.accordion-body
32 </div>
33 </div>
34 <div class="d-flex flex-column justify-content-center align-items-center" style="margin-bottom: 20px;"><button
35 class="btn btn-info" type="button" data-bs-target="#modal-1" data-bs-toggle="modal"><strong> Quick Reference
36 <strong> ASL Alphabets</strong></button></div>
37 </section>
38 <section>
39 <div class="container">
40 <div class="accordion text-white" role="tablist" id="accordion-1">
41 <div class="accordion-item" style="font-style: oblique; background: rgb(33,37,41);">
42 <h2 class="accordion-header" role="tab"><button class="accordion-button" data-bs-toggle="collapse"
43 data-bs-target="#accordion-1 .item-1" aria-expanded="true"
44 aria-controls="accordion-1 .item-1"
45 style="font-style: inherit; background: #3e6d9c; color: rgb(255,255,255);">About The Project</button></h2>
46 <div class="accordion-collapse collapse show item-1" role="tabpanel" data-bs-parent="#accordion-1">
47 <div class="accordion-body">
48 <p class="mb-0">In our society, we have people with disabilities. The technology is developing day by day but no sign
49 </p>
50 </div>
51 </div>
52 <div class="accordion-item" style="font-style: oblique; background: rgb(33,37,41);">
53 <h2 class="accordion-header" role="tab"><button class="accordion-button collapsed"
54 data-bs-toggle="collapse" data-bs-target="#accordion-1 .item-2" aria-expanded="false"
55 aria-controls="accordion-1 .item-2"
56 style="font-style: oblique; background: #3e6d9c; color: rgb(231,241,255);">Developed By</button></h2>
57 <div class="accordion-collapse collapse item-2" role="tabpanel" data-bs-parent="#accordion-1">
58 <div class="accordion-body">
59 <p class="mb-0">Students From ANNAI MIRA COLLEGE OF ENGINEERING AND TECHNOLOGY<br>TEAM ID-- <strong>PNT2022TMD40
60 <strong>HARIPRASAD J</strong> 513519106006<br>3. <strong>PAVANKUMAR M</strong> 513519106014<br>4. <strong>YUVARAJ
61 </p>
62 </div>
63 </div>
64 </div>
Ln 62, Col 1 Spaces: 4 UTF-8 CRLF HTML
```

```

54 <div class="accordion-header" role="tab"><button class="accordion-button collapsed
55     data-bs-toggle="collapse" data-bs-target="#accordion-1 .item-2" aria-expanded="false"
56     style="font-style: oblique; background: #3E6D9C; color: #rgb(231,241,255);">Developed By</button></h2>
57 <div class="accordion-collapse collapse item-2" role="tabpanel" data-bs-parent="#accordion-1">
58 <div class="accordion-body">
59 <p class="mb-0">Students From ANNAI MIRA COLLEGE OF ENGINEERING AND TECHNOLOGY<br><br>TEAM ID-- <strong>PNT2022MID40
60 <strong>HARIPRASAD J</strong> 513519106006<br>3. <strong>PAVANKUMAR M</strong> 513519106014<br>4. <strong>VUVARAJ
61 </p>
62 </div>
63 </div>
64 </div>
65 </div>
66 </div>
67 </section>
68 <div class="modal fade" role="dialog" tabindex="-1" id="modal-1">
69 <div class="modal-dialog" role="document">
70 <div class="modal-content">
71 <div class="modal-header">
72 <h4 class="modal-title">American Sign Language - Alphabets</h4><button type="button"
73     class="btn-close" data-bs-dismiss="modal" aria-label="Close"></button>
74 </div>
75 <div class="modal-body"></div>
76 <div class="modal-footer"><button class="btn btn-secondary" type="button"
77     data-bs-dismiss="modal">Close</button></div>
78 </div>
79 </div>
80 </div>
81 <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
82 </body>
83 </html>
84

```

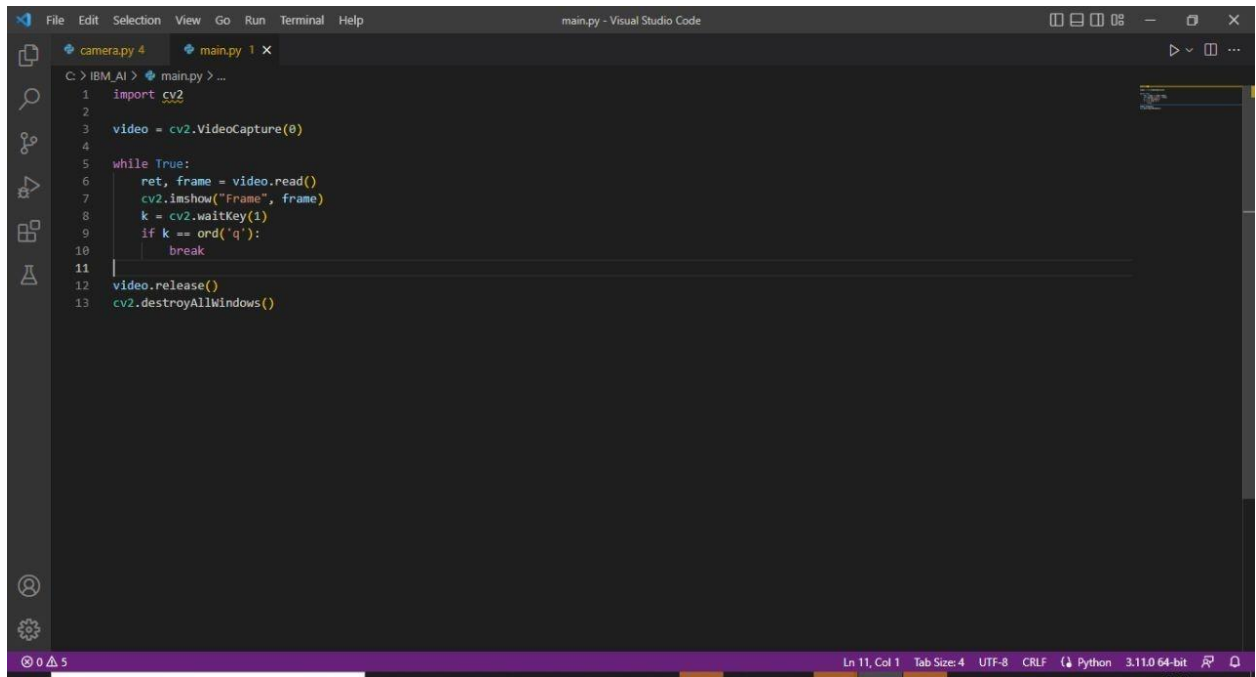
Camera:

```

1 import cv2
2 import numpy as np
3 from tensorflow.keras.models import load_model
4 from tensorflow.keras.preprocessing import image
5 import os
6
7 class Video(object):
8     def __init__(self):
9         self.video = cv2.VideoCapture(0)
10        self.roi_start = (50, 150)
11        self.roi_end = (250, 350)
12        #self.model = load_model('asl_model.h5') # Execute Local Trained Model
13        self.model = load_model('asl_model.h5') # Execute IBM Trained Model
14        self.index=['A','B','C','D','E','F','G','H','I']
15        self.y = None
16    def __del__(self):
17        k = cv2.waitKey(1)
18
19        self.video.release()
20    def get_frame(self):
21        ret, frame = self.video.read()
22        frame = cv2.resize(frame, (640, 480))
23        copy = frame.copy()
24        copy = copy[150:150+200, 50:50+200]
25        # prediction starts
26        cv2.imwrite('image.jpg', copy)
27        copy_img = image.load_img('image.jpg', target_size=(64, 64, 3))
28        x = image.img_to_array(copy_img)
29        x = np.expand_dims(x, axis=0)
30        pred = np.argmax(self.model.predict(x), axis=1)
31        self.y = pred[0]
32        cv2.putText(frame, 'The Predicted Alphabet is: '+str(self.index[self.y]), (100, 50), cv2.FONT_HERSHEY_SIMPLEX, 1, (0, 0, 0), 3)
33        ret, img = cv2.imencode('.jpg', frame)

```

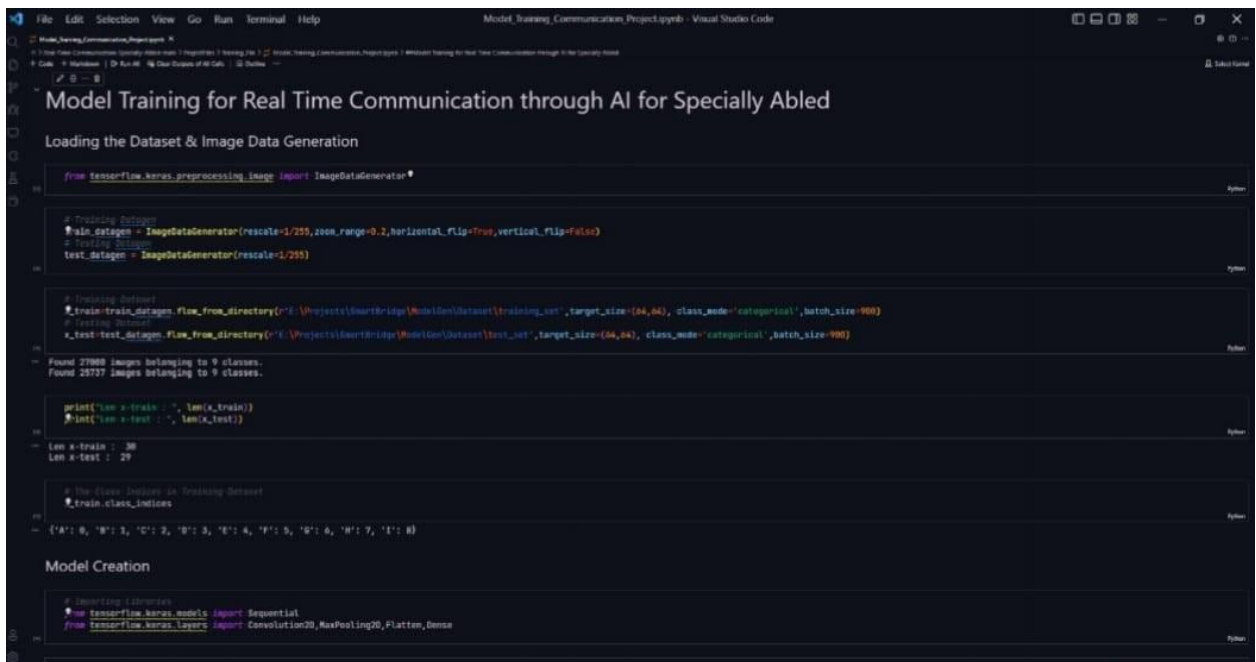
Main:



```
File Edit Selection View Go Run Terminal Help
main.py - Visual Studio Code

C:\IBM_AI> main.py > ...
1 import cv2
2
3 video = cv2.VideoCapture(0)
4
5 while True:
6     ret, frame = video.read()
7     cv2.imshow("Frame", frame)
8     k = cv2.waitKey(1)
9     if k == ord('q'):
10         break
11
12 video.release()
13 cv2.destroyAllWindows()
```

## Trained Model:



```
File Edit Selection View Go Run Terminal Help
Model_Training_Communications_Project.ipynb - Visual Studio Code

Model Training for Real Time Communication through AI for Specially Abled

Loading the Dataset & Image Data Generation

from tensorflow.keras.preprocessing.image import ImageDataGenerator

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

# Preparing Dataset
train_data_flow = train_datagen.flow_from_directory(r'E:\Projects\BaurBridge\Model\Dataset\training_set', target_size=(64,64), class_mode='categorical', batch_size=900)
# Testing Dataset
x_test = test_datagen.flow_from_directory(r'E:\Projects\BaurBridge\Model\Dataset\test_set', target_size=(64,64), class_mode='categorical', batch_size=900)

Found 27960 images belonging to 9 classes.
Found 23757 images belonging to 9 classes.

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

len x-train : 36
len x-test : 29

# Pre-View Images in Training Dataset
train_class_indices

('A': 0, 'B': 1, 'C': 2, 'D': 3, 'E': 4, 'F': 5, 'G': 6, 'H': 7, 'I': 8)

Model Creation

# Creating a Model
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D, MaxPooling2D, Flatten, Dense
```

**GitHub Repository:** <https://github.com/IBM-EPBL/IBM-Project-25163-1659954434.git>

