Real-Time CommunicationSystem Powered by AI for Specially Abled

A PROJECT REPORT

Submitted by

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CHAPTER-1

INTRODUCTION

1.1 Overview

People get to know one another by sharing their ideas, thoughts, and experiences with those around them. There are numerous ways to accomplish this, the best of which is the gift of "Speech." Everyone can very convincingly transfer their thoughts and understand each other through speech. It will be unjust if we overlook those who are denied this priceless gift: the deaf and dumb. In such cases, the human hand has remained the preferred method of communication. 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.

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.

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. The project's purpose is to create a system that translates sign language into a human-understandable language so that ordinary people may understand it.

CHAPTER-2

LITERATURE SURVEY

Literature survey:

A literature survey or a literature review in a project report is that section which shows thevarious 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

Some of the existing solutions for solving this problem are:

Technology

One of the easiest ways to communicate is through technology such as a smart phone or laptop. A deaf person can type out what they want to say and a person who is blind or haslow vision can use a screen reader to read the text out loud. A blind person can also use voice recognition software to convert what they are saying in to text so that a person whois Deaf can then read it.

Interpreter

If a sign language interpreter is available, this facilitates easy communication if the person who is deaf is fluent in sign language. The deaf person and person who is blind can communicate with each other via the interpreter. The deaf person can use sign language and the interpreter can speak what has been said to the person who is blind andthen translate anything spoken by the blind person into sign language for the deaf person.

Just Speaking

Depending on the deaf person's level of hearing loss, they may be able to communicate with a blind person who is using speech. For example, a deaf person may have enough residual hearing (with or without the use of an assistive hearing device such as a hearingaid) to be able to decipher the speech of the person who is blind or has low vision.

2.2 Reference

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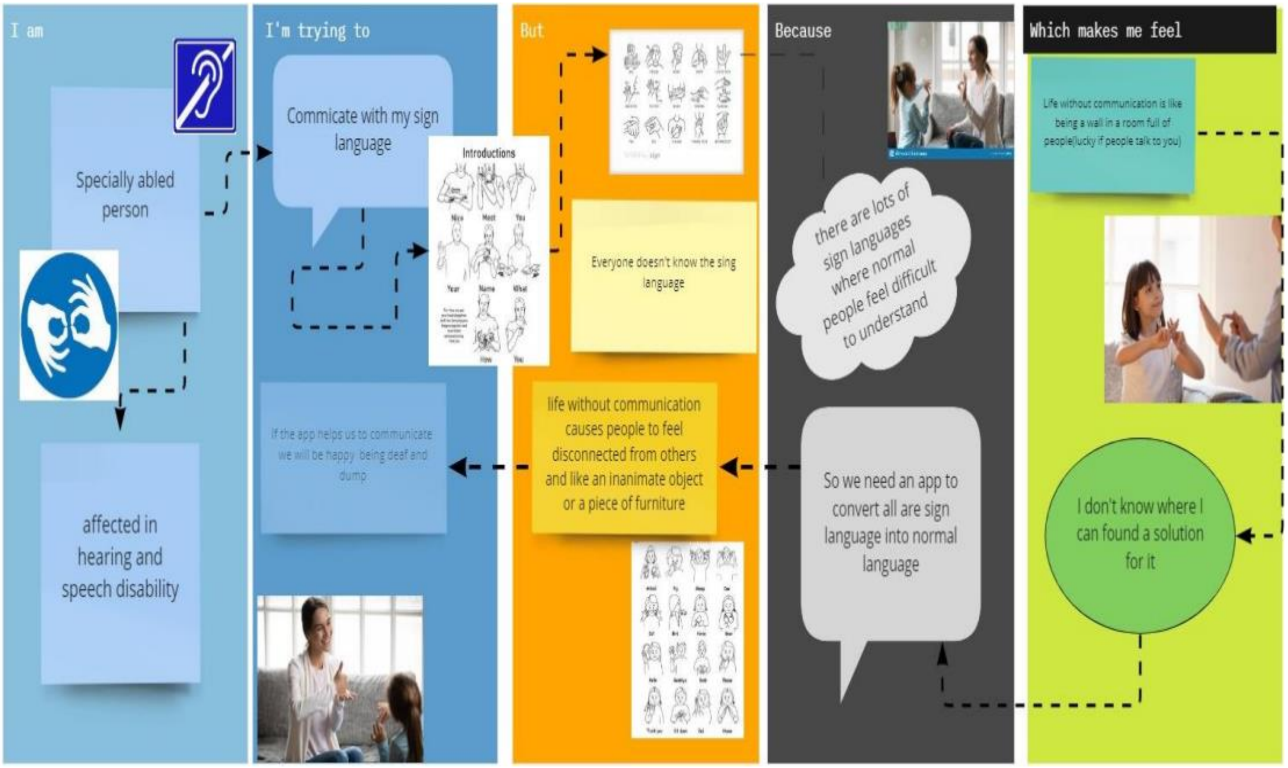
2.3 Problem Statement Definition

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.

It can remove accessibility barriers through different solutions using AI:

1. Image recognition for people with a visual impairment.
2. Facial recognition for people with a visual impairment.
3. Lip-reading recognition for people with a hearing impairment
4. Text summarization for people with a mental impairment.
5. Real-time captioning or translations for people with a hearing impairment



I am

Specially abled person

affected in hearing and speech disability

I'm trying to

Commicate with my sign language

If the app helps us to communicate we will be happy being deaf and dump

But

Everyone doesn't know the sing language

life without communication causes people to feel disconnected from others and like an inanimate object or a piece of furniture

Because

there are lots of sign languages where normal people feel difficult to understand

So we need an app to convert all are sign language into normal language

Which makes me feel

Life without communication is like being a wall in a room full of people(lucky if people talk to you)

I don't know where I can found a solution for it

CHAPTER-3

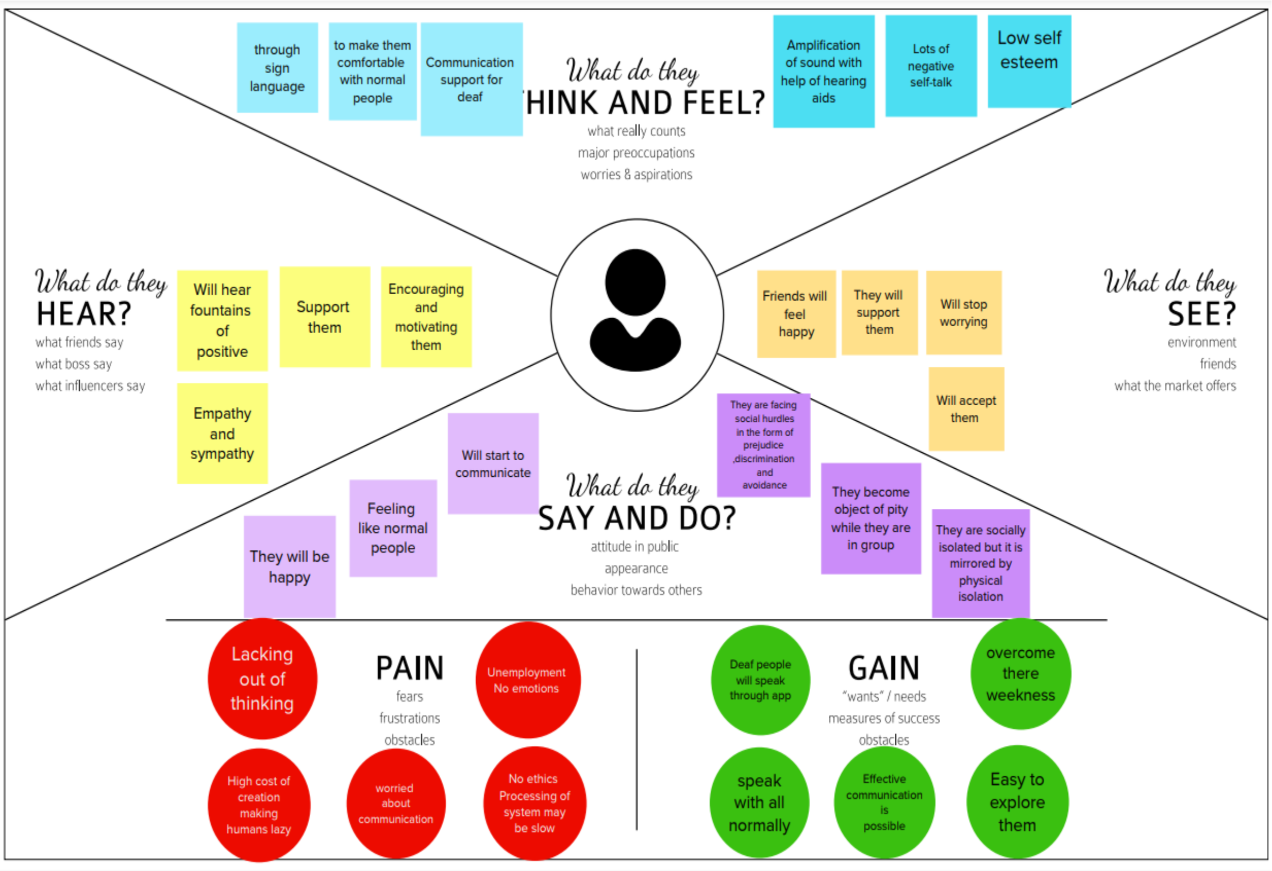
IDEATION &

PROPOSED SOLUTION

3.1 Empathy Map Canvas

Definition:

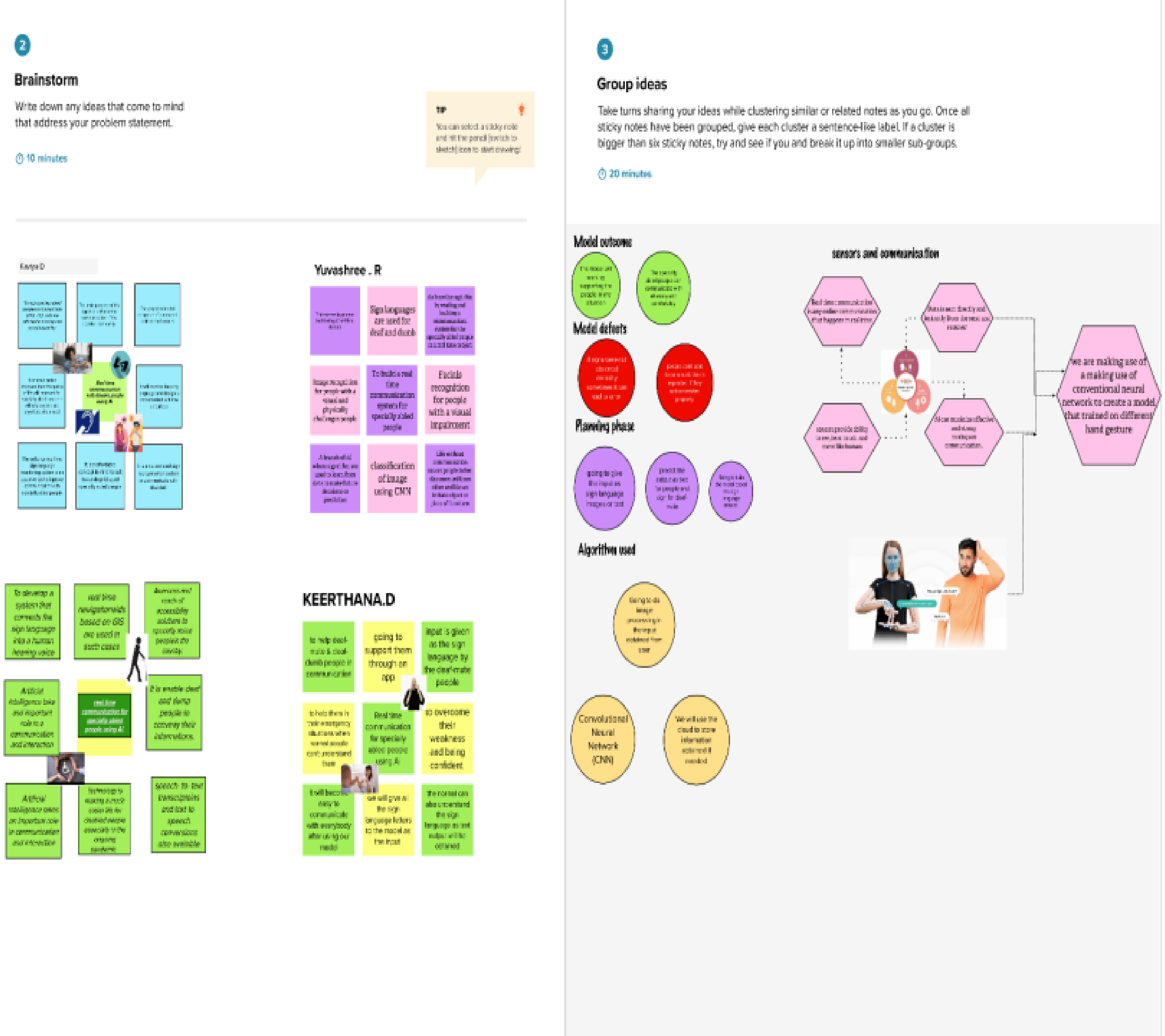
An empathy map canvas is a more in-depth version of the original empathy map, which helpsidentify and describe the user’s needs and pain points. And this is valuable information for improving the user experience. An empathy map canvas helps brands provide a better experience for users by helping teams 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.


through sign language
to make them comfortable with normal people
Communication support for deaf
What do they
THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations
Amplification of sound with help of hearing aids
Lots of negative self-talk
Low self esteem
What do they
HEAR?
what friends say
what boss say
what influencers say
Will hear fountains of positive
Support them
Encouraging and motivating them
Empathy and sympathy
What do they
SEE?
environment
friends
what the market offers
Friends will feel happy
They will support them
Will stop worrying
Will accept them
They are facing social hurdles in the form of prejudice ,discrimination and avoidance
Will start to communicate
Feeling like normal people
They will be happy
What do they
SAY AND DO?
attitude in public
appearance
behavior towards others
They become object of pity while they are in group
They are socially isolated but it is mirrored by physical isolation
Lacking out of thinking
PAIN
fears
frustrations
obstacles
Unemployment No emotions
High cost of creation making humans lazy
worried about communication
No ethics Processing of system may be slow
Deaf people will speak through app
GAIN
“wants” / needs
measures of success
obstacles
overcome there weekness
speak with all normally
Effective communication is possible
Easy to explore them

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.



2

Brainstorm

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

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Kavya D

Yuvashree . R

Sign languages are used for deaf and dumb

Image recognition for people with a visual and physically challenged people

To build a real time communication system for specially abled people

Facials recognition for people with a visual impairment

classification of image using CNN

To develop a system that converts the sign language into a human hearing voice

real time navigationaids based on GIS are used in such cases

Artificial intelligence take and important role in a communication and interaction

real time communication for specially abled people using AI

It is enable deaf and dump people to convey their informations.

Artificial intelligence plays an important role in communication and interaction

speech- to- text transcriptions and text to speech conversions also available

KEERTHANA.D

to help deaf-mute & deaf-dumb people in communication

going to support them through an app

input is given as the sign language by the deaf-mute people

Real time communication for specially abled people using AI

to overcome their weakness and being confident

It will become easy to communicate with everybody after using our model

we will give all the sign language letters to the model as the input

the normal can also understand the sign language as text output will be obtained

3

Group ideas

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

20 minutes

Model outcome

Model defects

Planning phase

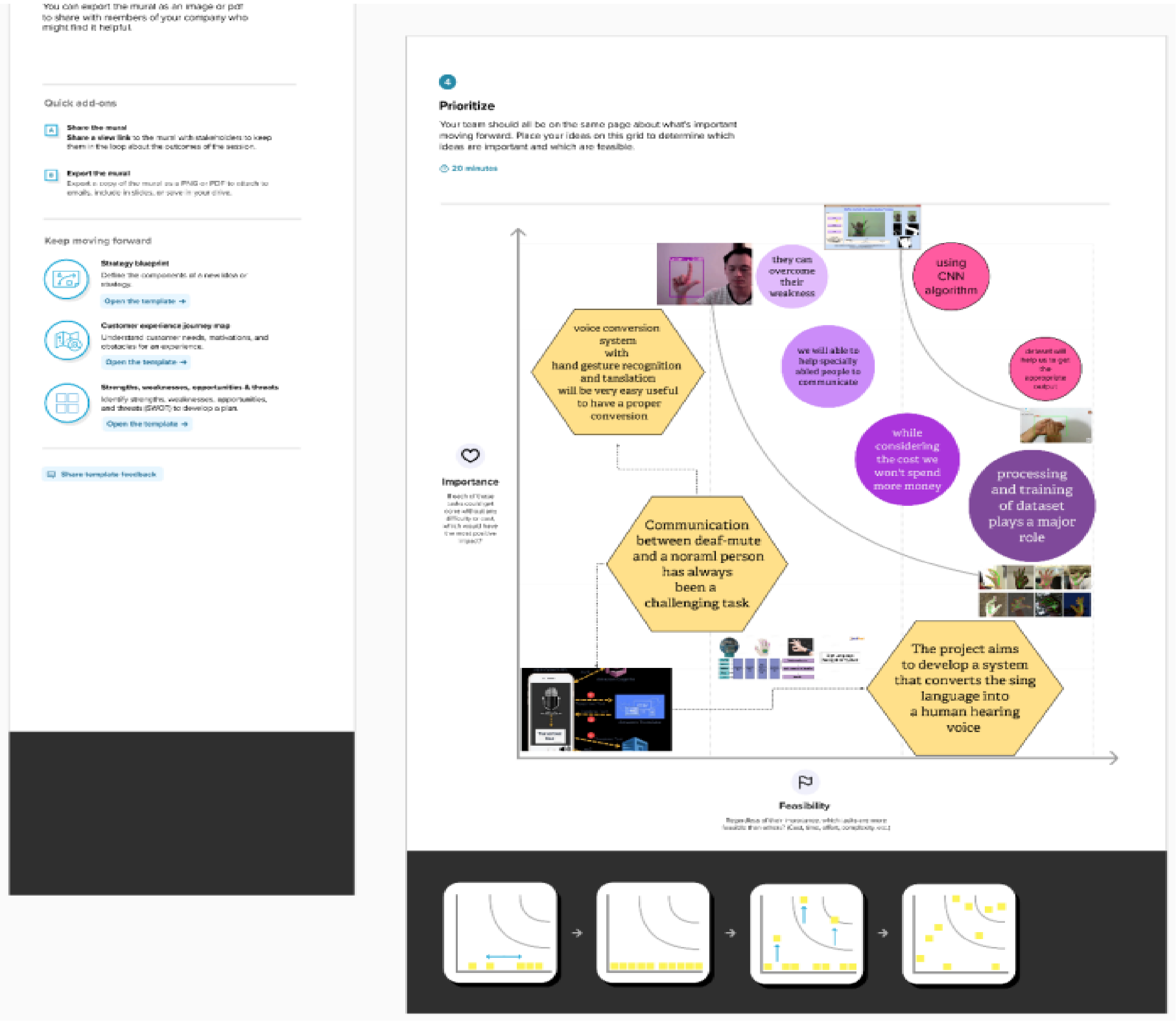
going to give the input as sign language images or text

Algorithm used

Convolutional Neural Network (CNN)

sensors and communication flow

we are making use of a making use of conventional neural network to create a model that trained on different hand gesture



You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.
Open the template →

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template →

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template →

Share template feedback

4

Prioritize

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

20 minutes

Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

they can overcome their weakness

using CNN algorithm

voice conversion system with hand gesture recognition and tanslation will be very easy useful to have a proper conversion

we will able to help specially abled people to communicate

dataset will help us to get the appropriate output

while considering the cost we won't spend more money

processing and training of dataset plays a major role

Communication between deaf-mute and a noraml person has always been a challenging task

The project aims to develop a system that converts the sing language into a human hearing voice

3.3Proposed solution

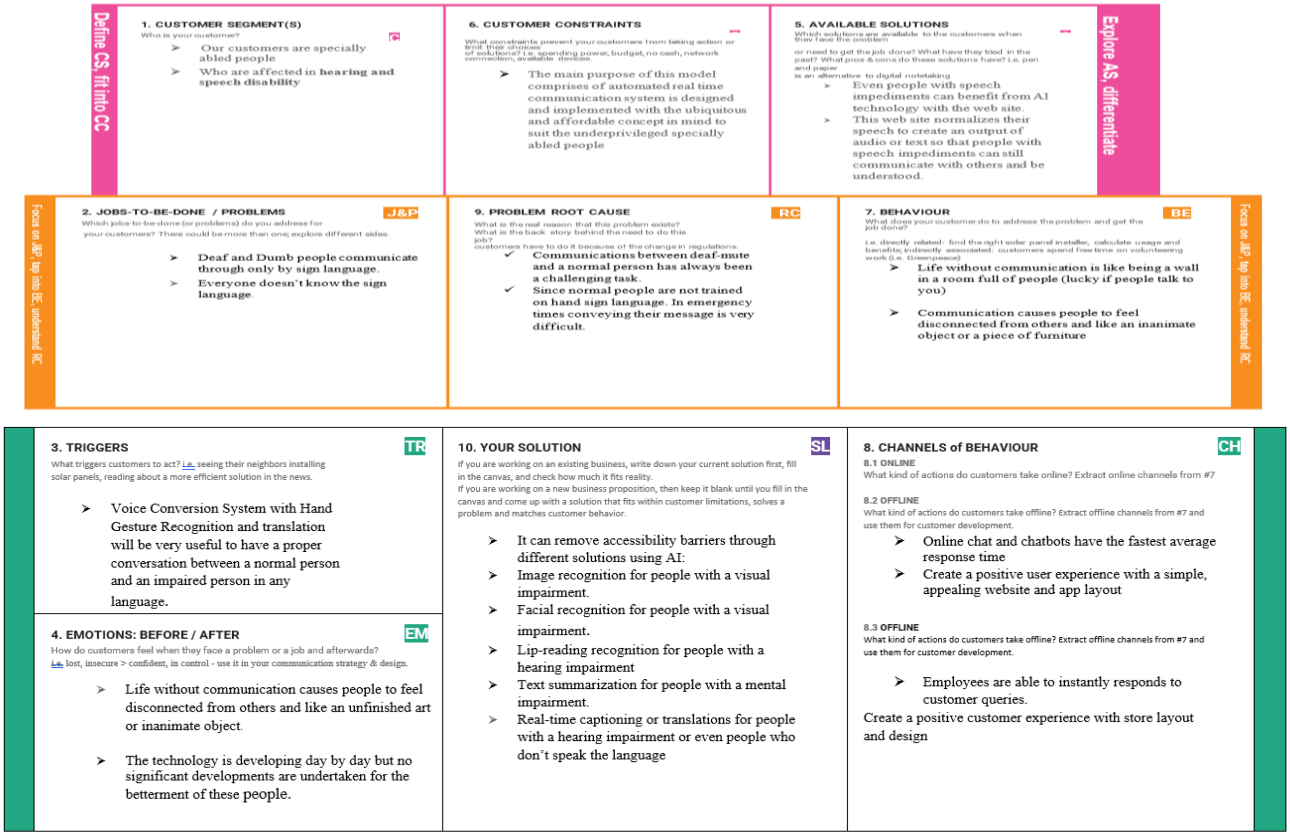
S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Deaf and Dumb people couldn't able tocommunicate with the normal people easily.
2.	Idea/Solution description	A real time ML based system is built for the real time sign language detection with a Tensor Flow object detection
3.	Novelty/Uniqueness	This model using SSD ML algorithm recognizing the signs as words instead of old traditional translators, that are very slow and taketoo 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 peoplewith 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 differentsign 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 andthat the solution you have realized for it actually solves the customer's problem.

There is a need of a method or an application that can recognize sign language gestures so that the communication is possible even if someone does not understand sign language. With this work, we intend to take a basic step in bridging this communication gap using Sign Language Recognition. Video sequences contain both the temporal and the spatial features. To train the model on spatial features, we have used inception model which is a deep convolutional neural network (CNN) and we have used recurrent neural network (RNN) to train the model on temporal features. Our dataset consists of Argentinean Sign Language (LSA) gestures, belonging to 46 gesture categories. The proposed model was able to achieve a high accuracy of 95.2% over a large set of images.


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

1. CUSTOMER SEGMENT(S)

Who is your customer?

- ➢ Our customers are specially abled people
- ➢ Who are affected in **hearing and speech disability**

6. CUSTOMER CONSTRAINTS

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

- ➢ The main purpose of this model comprises of automated real time communication system is designed and implemented with the ubiquitous and affordable concept in mind to suit the underprivileged specially abled people

5. AVAILABLE SOLUTIONS

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

- ➢ Even people with speech impediments can benefit from AI technology with the web site.
- ➢ This web site normalizes their speech to create an output of audio or text so that people with speech impediments can still communicate with others and be understood.

2. JOBS-TO-BE-DONE / PROBLEMS

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

- ➢ **Deaf and Dumb people communicate through only by sign language.**
- ➢ **Everyone doesn't know the sign language.**

9. PROBLEM ROOT CAUSE

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

- ✓ **Communications between deaf-mute and a normal person has always been a challenging task.**
- ✓ **Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult.**

7. BEHAVIOUR

What does your customer do to address the problem and get the job done?

i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

- ➢ **Life without communication is like being a wall in a room full of people (lucky if people talk to you)**
- ➢ **Communication causes people to feel disconnected from others and like an inanimate object or a piece of furniture**

3. TRIGGERS

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

- ➢ 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.

4. EMOTIONS: BEFORE / AFTER

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

- ➢ Life without communication causes people to feel disconnected from others and like an unfinished art or inanimate object.
- ➢ The technology is developing day by day but no significant developments are undertaken for the betterment of these people.

10. YOUR SOLUTION

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

- ➢ It can remove accessibility barriers through different solutions using AI:
- ➢ Image recognition for people with a visual impairment.
- ➢ Facial recognition for people with a visual impairment.
- ➢ Lip-reading recognition for people with a hearing impairment
- ➢ Text summarization for people with a mental impairment.
- ➢ Real-time captioning or translations for people with a hearing impairment or even people who don't speak the language

8. CHANNELS of BEHAVIOUR

8.1 ONLINE

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

8.2 OFFLINE

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

- ➢ Online chat and chatbots have the fastest average response time
- ➢ Create a positive user experience with a simple, appealing website and app layout

8.3 OFFLINE

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

- ➢ Employees are able to instantly responds to customer queries.

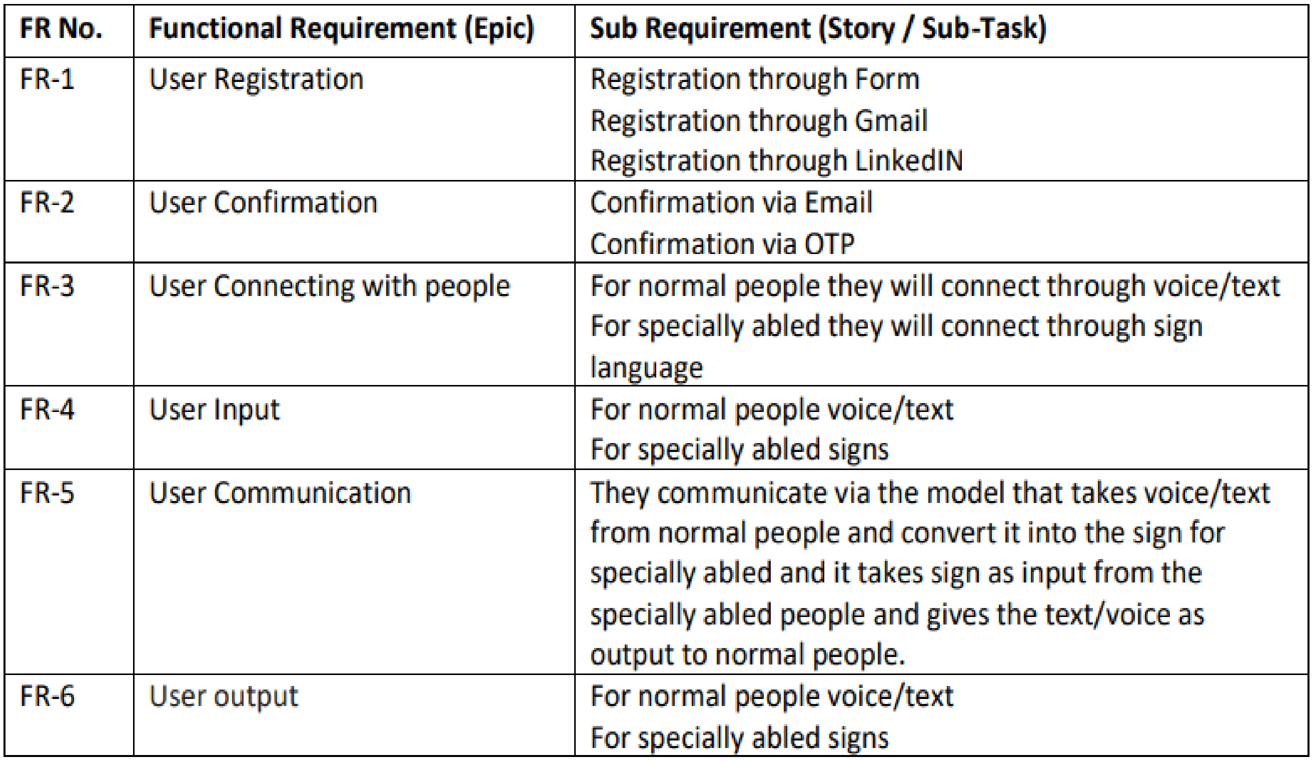
Create a positive customer experience with store layout and design

CHAPTER – 4

REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution.



FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Connecting with people	For normal people they will connect through voice/text For specially abled they will connect through sign language
FR-4	User Input	For normal people voice/text For specially abled signs
FR-5	User Communication	They communicate via the model that takes voice/text from normal people and convert it into the sign for specially abled and it takes sign as input from the specially abled people and gives the text/voice as output to normal people.
FR-6	User output	For normal people voice/text For specially abled signs

4.2 Non-functional Requirements:

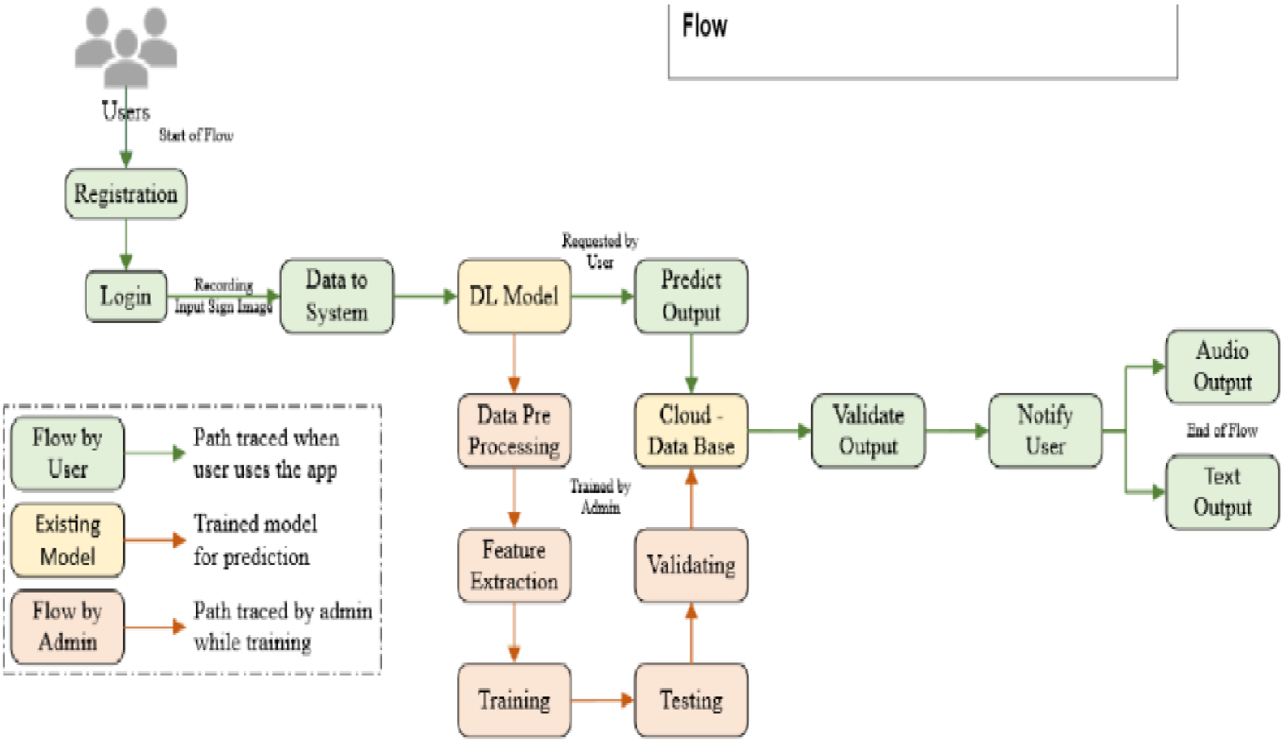
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	To convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb people.
NFR-2	**Security**	Converted information using signs into speech is accessed only by the user.
NFR-3	**Reliability**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

CHAPTER-5

PROJECT DESIGN

5.1Data 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, behavior, and other aspects of the software to stake
3. Define features, development phases, and solution requirements.
4. Provide specifications according to which the solution is defined, managed, and delivered.

Technical Architecture:

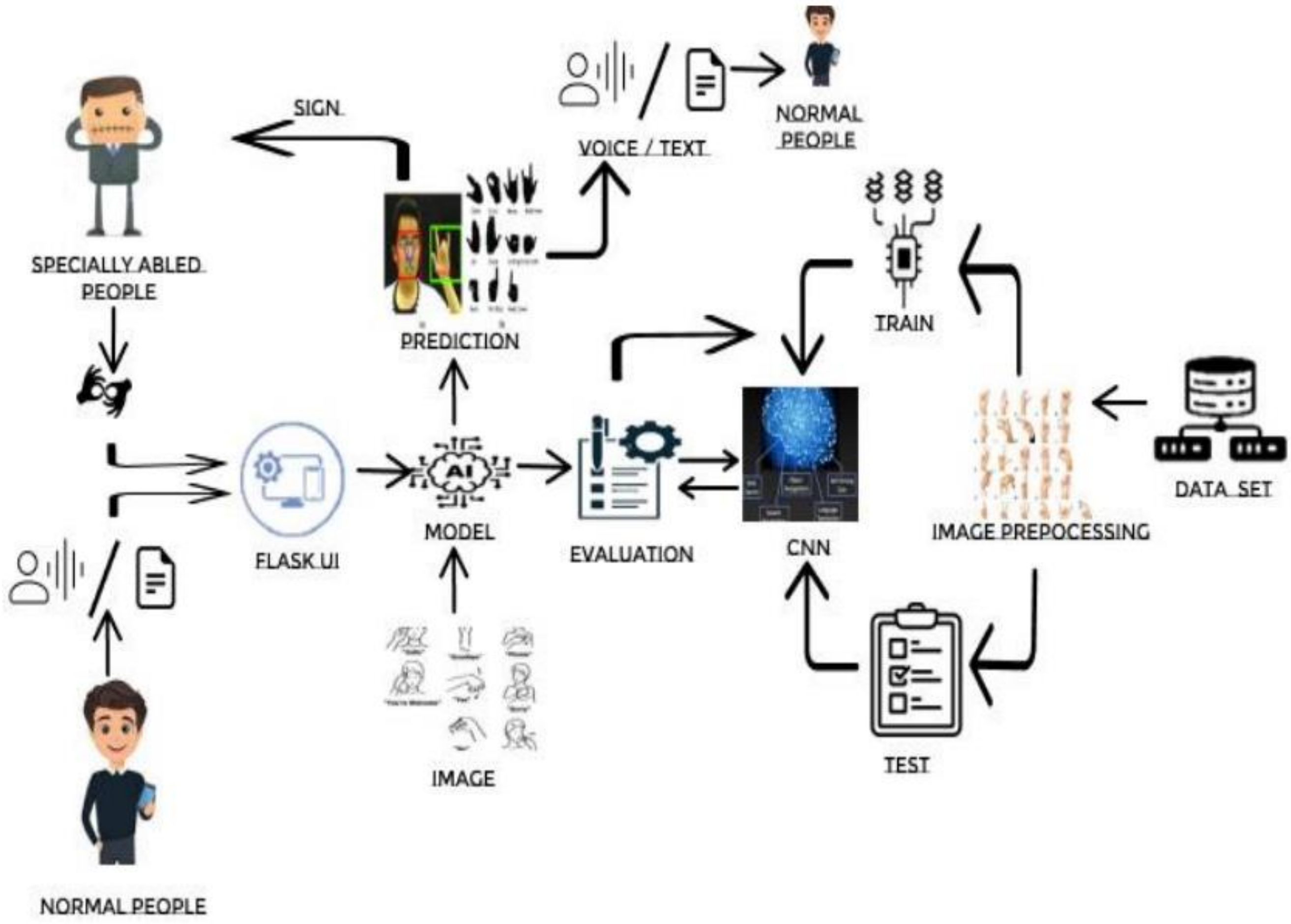


Table-1:

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.	java script, 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 recognizing 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 fordata 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.N	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 software.
3.	Scalable Architecture	The architecture will be scalable (Micro services).	Data, models, speed and consistency.
4.	Availability	The availability 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, useof cache etc.	Using Convolutional neural network, machine 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 could able 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 email once after my registration has been done for the app	I can get verification email and click ok to confirmation.	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 rand access my account by using their website &social media.	Medium	Sprint 2
		USN-4	As a customer,I could able to register for application through Gmail	via some third parties link	Low	Sprint 2
	Login	USN-5	As a customer, I could able to login into application by entering already registered email and password	I can type manually and also can used saved login credentials	High	Sprint 1

	Dashboard	USN-6	As a customer, I Can get all services and help in dashboard	I can access my dashboard And change profile	Medium	Sprint 2
Customer (Web user)	Registration	USN-7	As a customer, I Could able to login Through registered phone number by Using otp instead of Gmail	I could able to register & Login via phone number to access my account	High	Sprint 2
Customer Care executive	Service	USN-8	Can avail the service by calling customer care or reaching through E-mail.	Can avail the service by calling customer care or reaching through E-mail.	Medium	Sprint 1
Administrator		USN-9	Respective person in the Company should Take care all of this.	All the requirements are there.	High	Sprint 2
	Sign up	USN-10	Customer have to sign-up to use these things And all	Have to enter valid credentials.	High	Sprint 2

CHAPTER-6

PROJECT PLANNING

&SCHEDULING

6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation:

Sprint	Functional Requirement (Epic)	User Story / Task	Team Members
Sprint-1	Data Collection	Collect Dataset.	KEERTHANA D
Sprint-1		Image preprocessing	KAVIYA D
Sprint-2	Model Building	Import the requiredlibraries, add the necessary layers and compile the model	YUVASHREE R
Sprint-2		Training the image classification Model using CNN	SUMITHRA N
Sprint-3	Training and Testing	Training the model and testing the model's performance	YUVASHREE R
Sprint-4	Implementation of the application	Converting the input sign language images into English alphabetets	KEERTHANA D

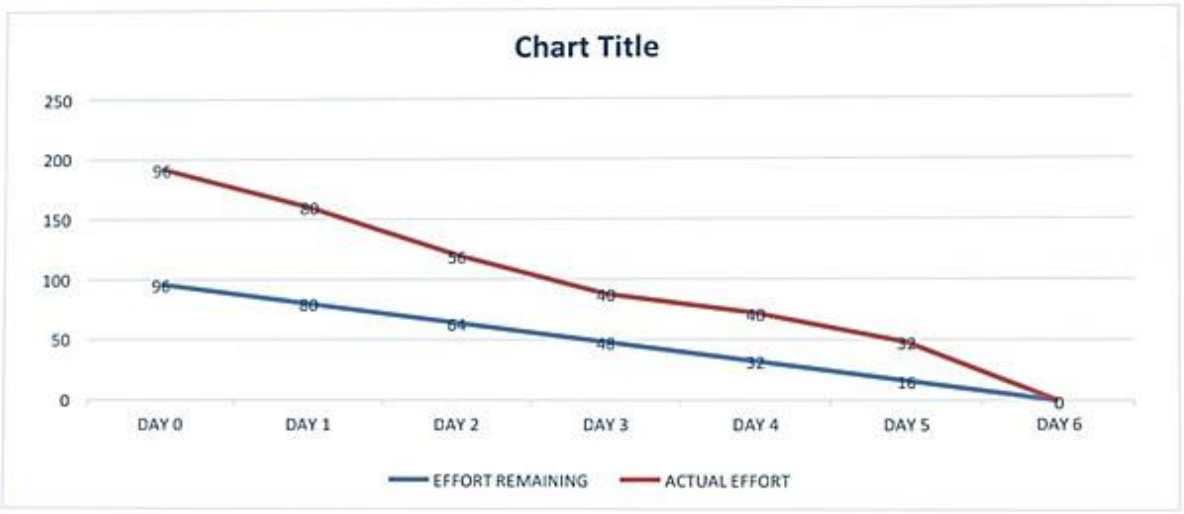
6.2 Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart:

Sprint	**Total Story Pointts**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Sprint Release Date (Actual)**
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	04 Nov 2022	04 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	11 Nov 2022	11 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	18 Nov 2022	18 Nov 2022

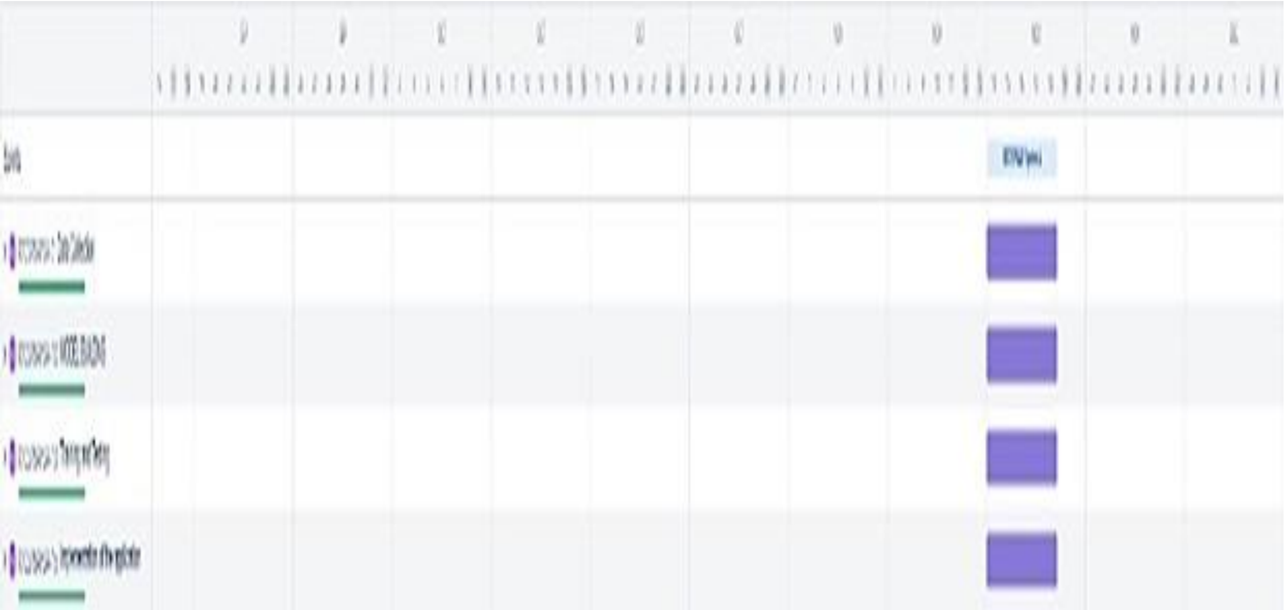
Burndown chart:

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

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.



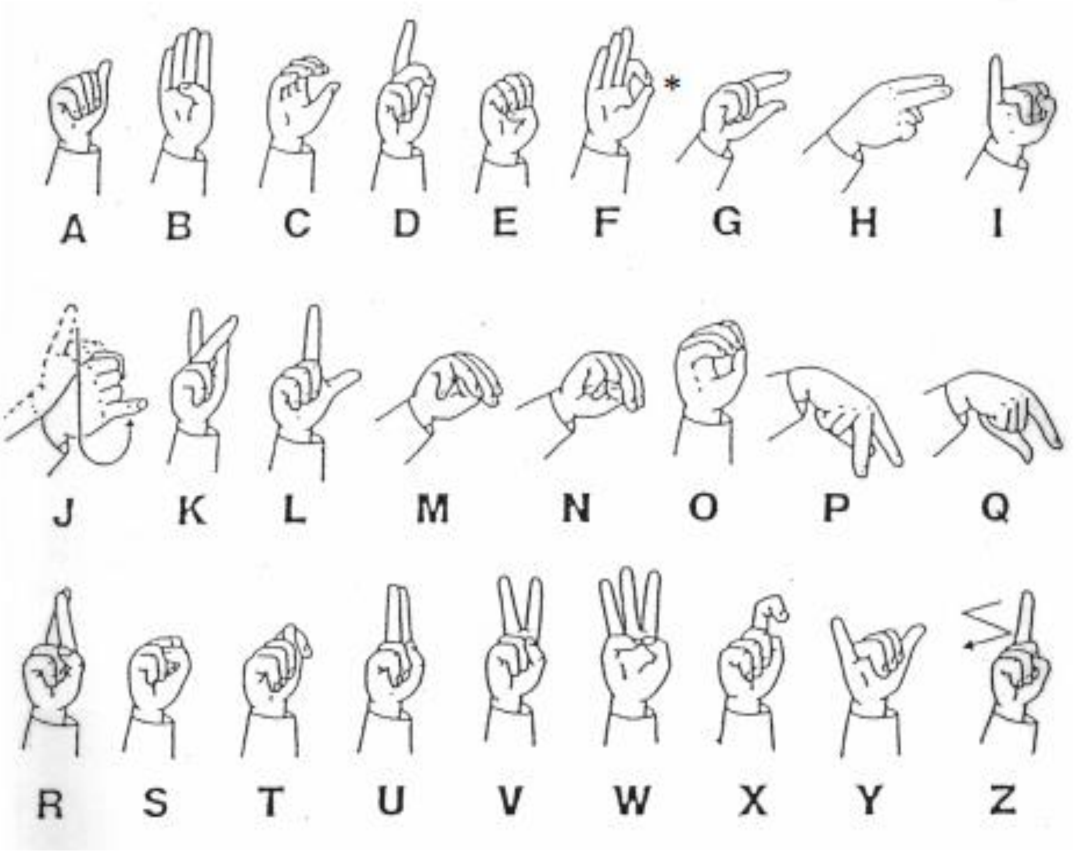
CHAPTER-7

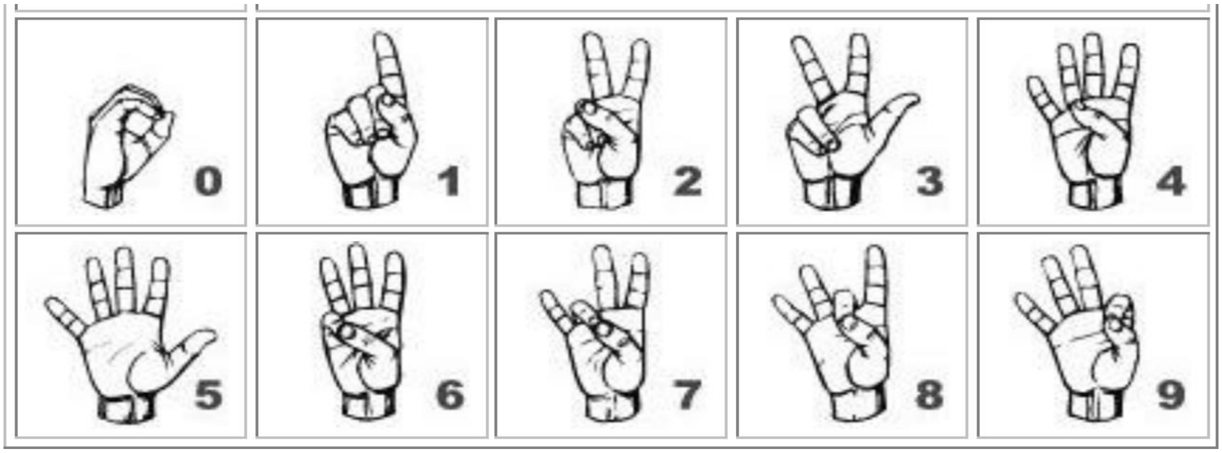
CODING & SOLUTIONING

(Explain the features added in the projectalong with code)

7.1 Features 1:

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





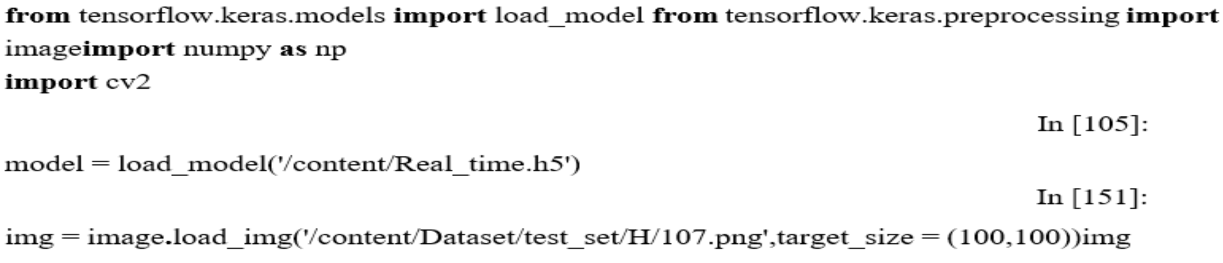
Model Building

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

#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'))
model. compile (loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
model.fit_generator(x_train,
steps_per_epoch=30,
epochs=10,validation_data=x_test,validat
ion_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 thatyourdataset or generator can generate at least
`steps_per_epoch * epochs` batches (in this case, 50batches). You may
need touse the repeat() function when building your dataset.
30/30 [==============================] - 18s 587ms/step - loss: 0.0083 -
accuracy:
0.9957 - val_loss: 0.2910 - val_accuracy:
0.9693Epoch 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

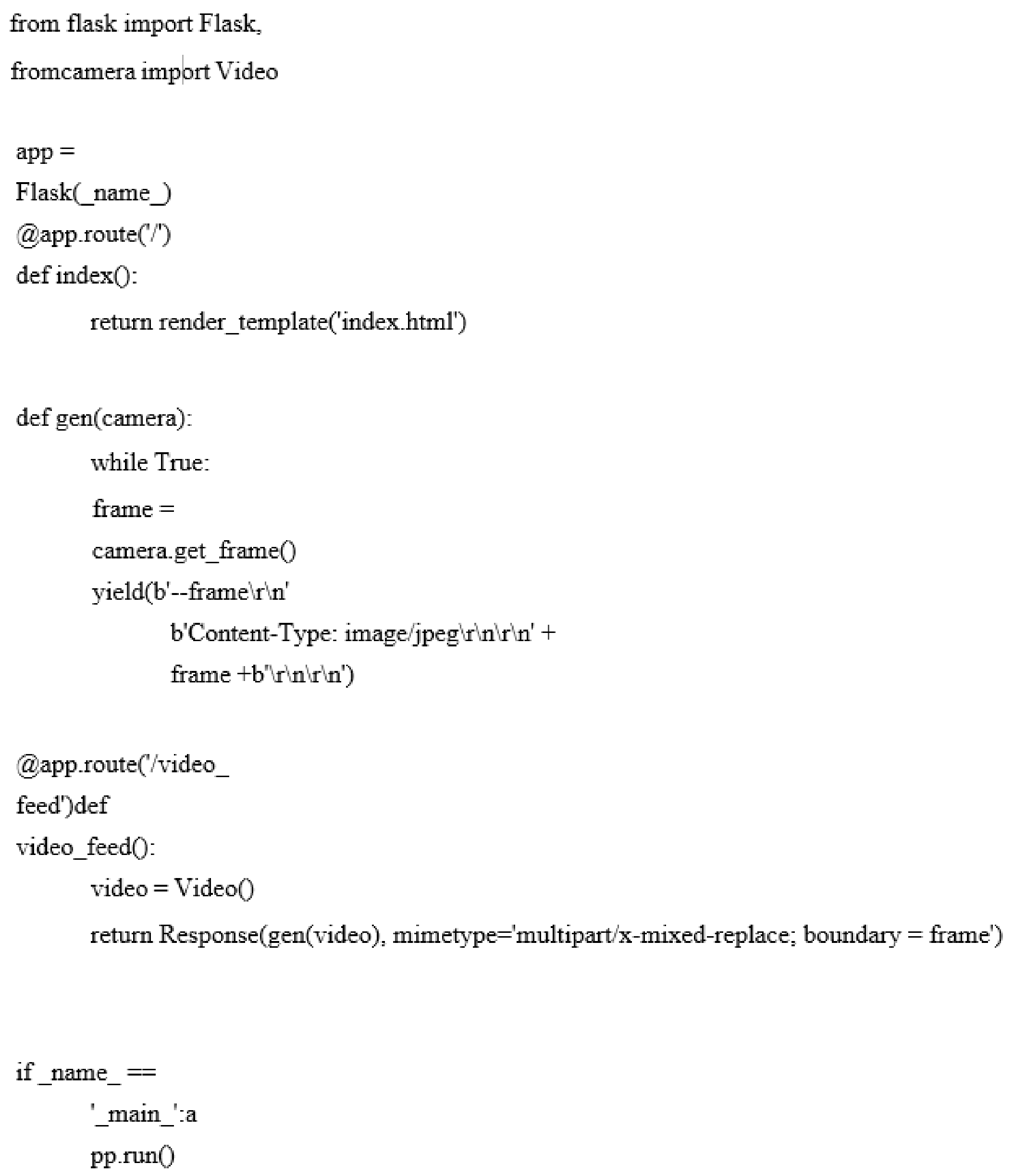


```
from tensorflow.keras.models import load_model from tensorflow.keras.preprocessing import
imageimport numpy as np
import cv2
                                                                                In [105]:
model = load_model('/content/Real_time.h5')
                                                                                In [151]:
img = image.load_img('/content/Dataset/test_set/H/107.png',target_size = (100,100))img
```

7.2 Features 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,
fromcamera 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_':a
        pp.run()
```

CHAPTER-8

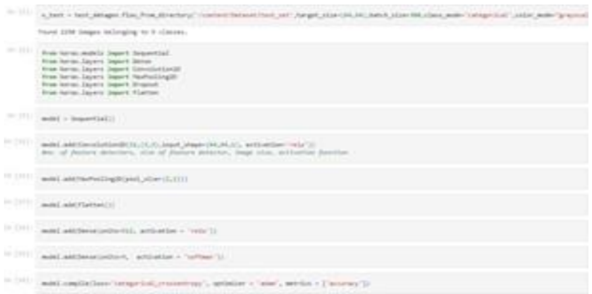
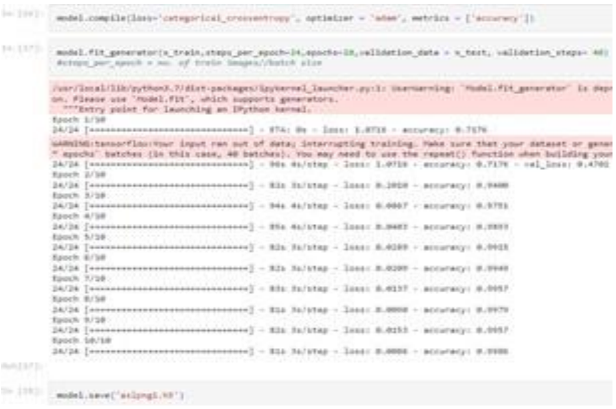
TESTING

8.1 Testing case

- 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		
2	Accuracy	Training Accuracy –99.6% Validation Accuracy –98.3%	

```
x_test = test_datagen.flow_from_directory('/content/Dataset/test_set',target_size=(64,64),batch_size=300,class_mode='categorical',color_mode='grayscal
Found 2250 images belonging to 9 classes.

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

model = Sequential()

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

model.add(MaxPooling2D(pool_size=(2,2)))

model.add(Flatten())

model.add(Dense(units=512, activation = 'relu'))

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

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

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

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 dep
on. Please use `Model.fit`, which supports generators.
  """Entry point for launching an IPython kernel.
Epoch 1/10
24/24 [==============================] - ETA: 0s - loss: 1.0718 - accuracy: 0.7176
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or gener
" epochs` batches (in this case, 40 batches). You may need to use the repeat() function when building your
24/24 [==============================] - 96s 4s/step - loss: 1.0718 - accuracy: 0.7176 - val_loss: 0.4702
Epoch 2/10
24/24 [==============================] - 81s 3s/step - loss: 0.1010 - accuracy: 0.9400
Epoch 3/10
24/24 [==============================] - 94s 4s/step - loss: 0.0667 - accuracy: 0.9751
Epoch 4/10
24/24 [==============================] - 89s 4s/step - loss: 0.0483 - accuracy: 0.9853
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: 0.9940
Epoch 7/10
24/24 [==============================] - 83s 3s/step - loss: 0.0137 - accuracy: 0.9957
Epoch 8/10
24/24 [==============================] - 81s 3s/step - loss: 0.0080 - 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]:

model.save('aslpng1.h5')
```

CHAPTER-9

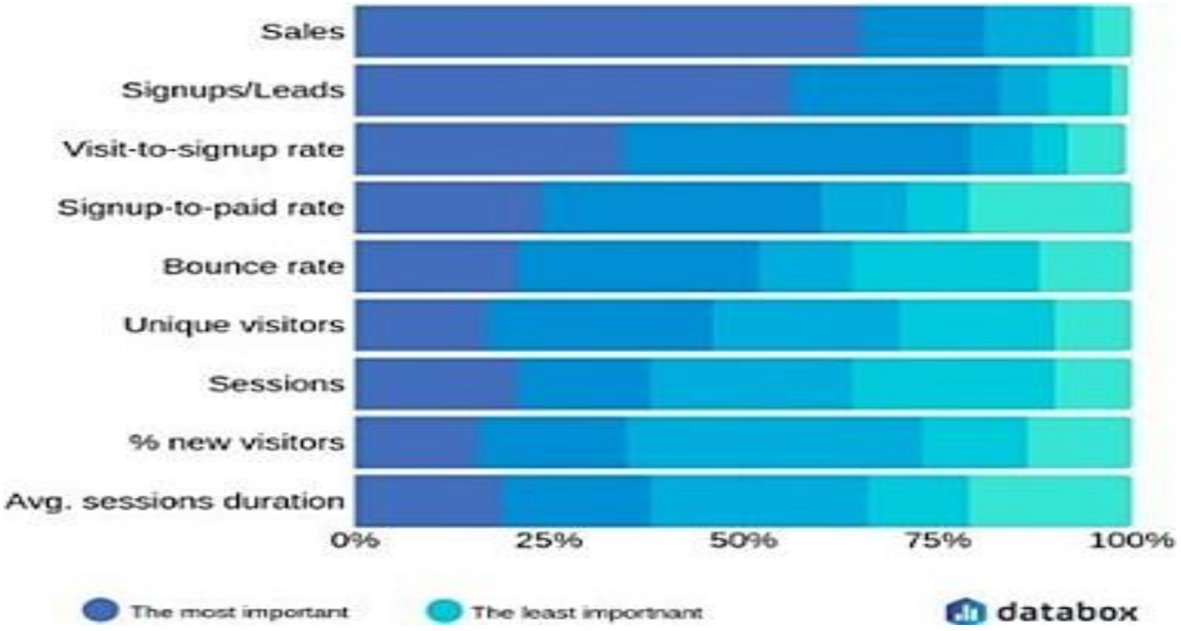
RESULTS

9.1 Performance Metrics

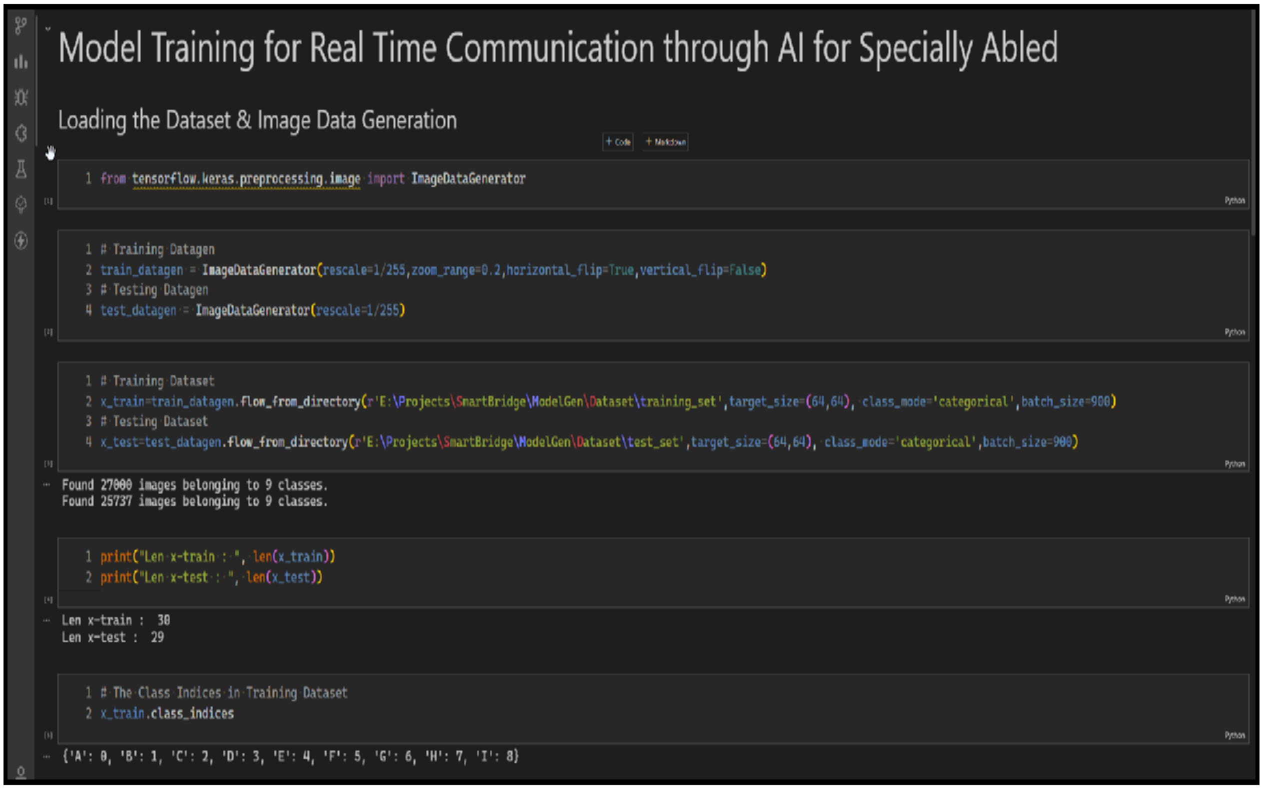
- The proposed procedure was implemented and tested on a set of images.

- The training database consists of 15750 images of Alphabets from "A" to "I", while the testingdatabase consists of 2250 images of Alphabets from "A" to "I".

- Once the gesture is recognized the equivalent alphabet is shown on the screen.



Training using Dataset Provided:



Model Training for Real Time Communication through AI for Specially Abled

Loading the Dataset & Image Data Generation

```python
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```python
# 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)
```

```python
# Training Dataset
x_train=train_datagen.flow_from_directory(r'E:\Projects\SmartBridge\ModelGen\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\SmartBridge\ModelGen\Dataset\test_set',target_size=(64,64), class_mode='categorical',batch_size=900)
```

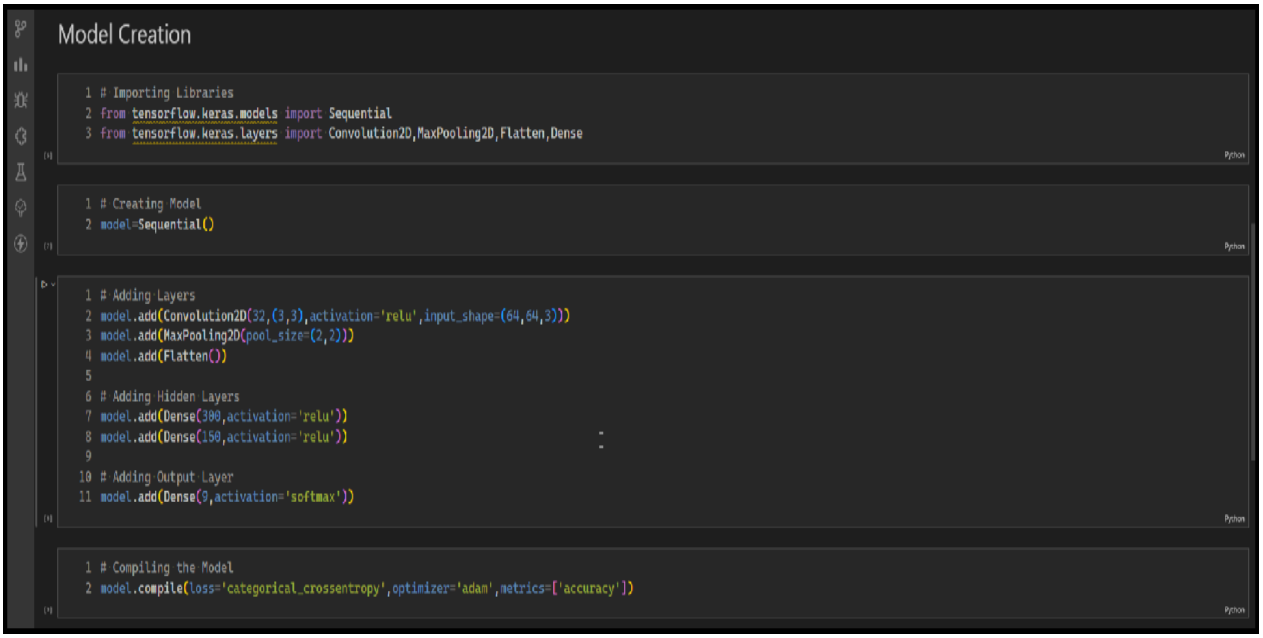
```
Found 27000 images belonging to 9 classes.
Found 25737 images belonging to 9 classes.
```

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

```
Len x-train :  30
Len x-test :  29
```

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

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



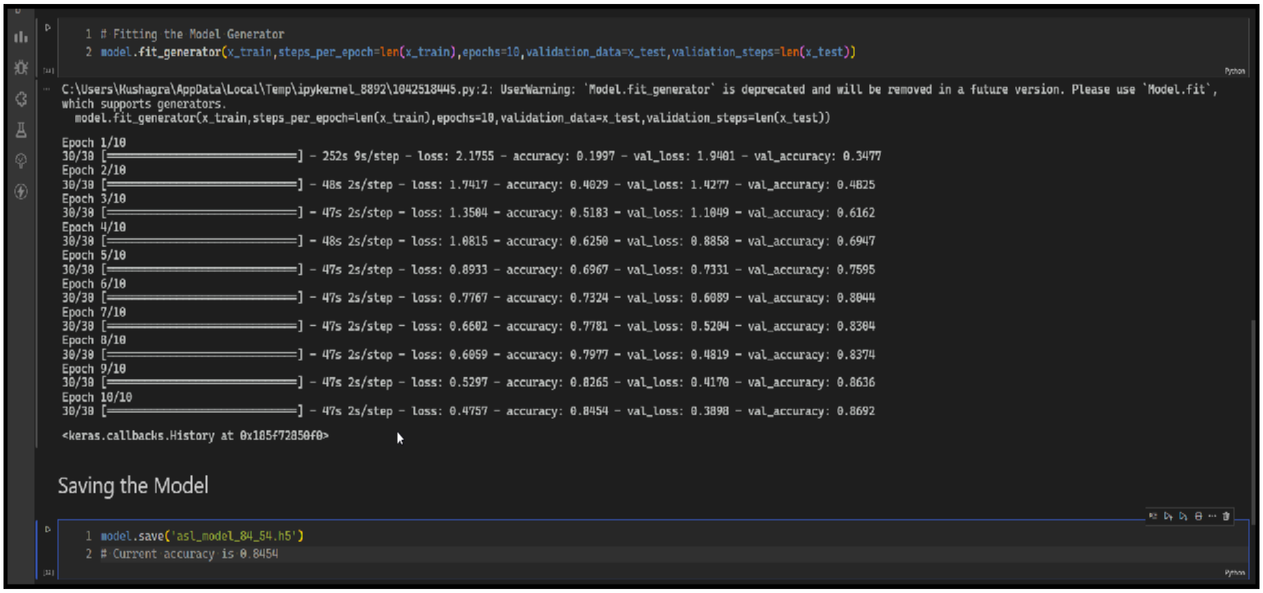
Model Creation

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

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

```python
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())

# Adding Hidden Layers
model.add(Dense(300,activation='relu'))
model.add(Dense(150,activation='relu'))

# Adding Output Layer
model.add(Dense(9,activation='softmax'))
```

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

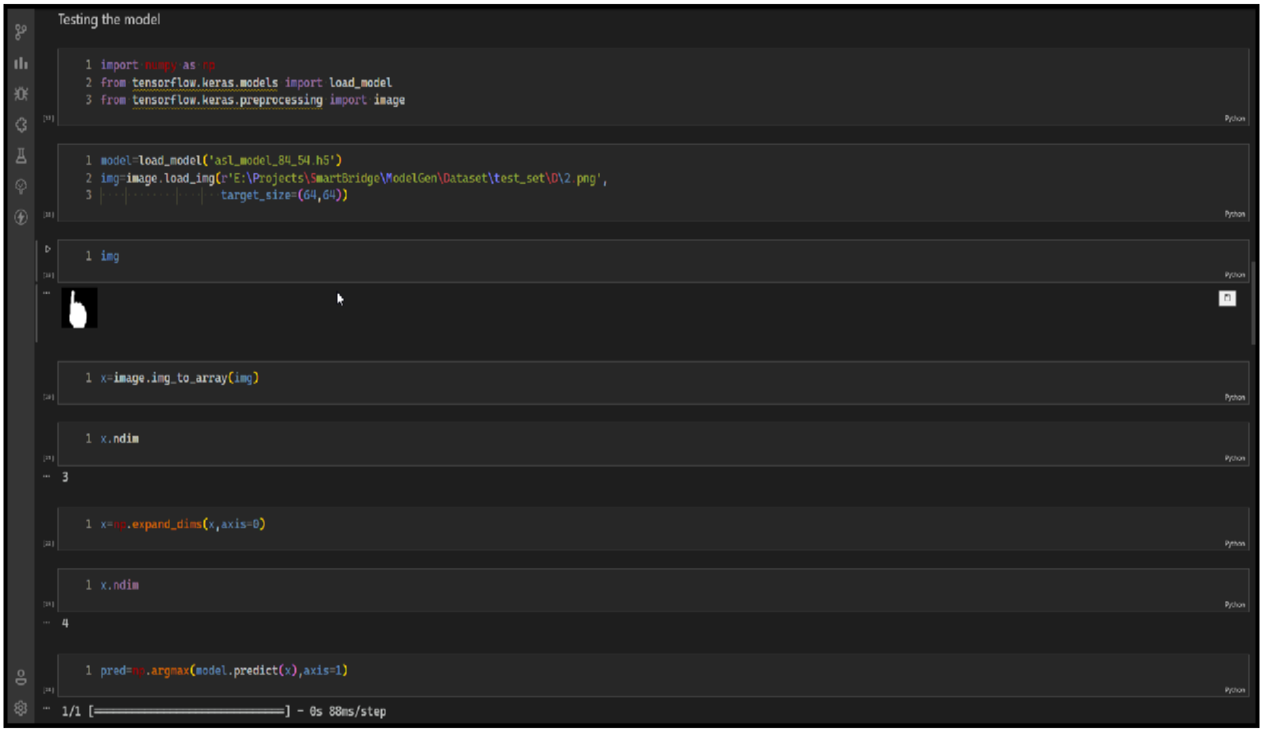


```
# Fitting the Model Generator
model.fit_generator(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))
```

```
C:\Users\Kushagra\AppData\Local\Temp\ipykernel_8892\1042518445.py:2: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which supports generators.
  model.fit_generator(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))

Epoch 1/10
30/30 [==============================] - 252s 9s/step - loss: 2.1755 - accuracy: 0.1997 - val_loss: 1.9401 - val_accuracy: 0.3477
Epoch 2/10
30/30 [==============================] - 48s 2s/step - loss: 1.7417 - accuracy: 0.4029 - val_loss: 1.4277 - val_accuracy: 0.4825
Epoch 3/10
30/30 [==============================] - 47s 2s/step - loss: 1.3504 - accuracy: 0.5183 - val_loss: 1.1049 - val_accuracy: 0.6162
Epoch 4/10
30/30 [==============================] - 48s 2s/step - loss: 1.0815 - accuracy: 0.6250 - val_loss: 0.8858 - val_accuracy: 0.6947
Epoch 5/10
30/30 [==============================] - 47s 2s/step - loss: 0.8933 - accuracy: 0.6967 - val_loss: 0.7331 - val_accuracy: 0.7595
Epoch 6/10
30/30 [==============================] - 47s 2s/step - loss: 0.7767 - accuracy: 0.7324 - val_loss: 0.6089 - val_accuracy: 0.8044
Epoch 7/10
30/30 [==============================] - 47s 2s/step - loss: 0.6602 - accuracy: 0.7781 - val_loss: 0.5204 - val_accuracy: 0.8304
Epoch 8/10
30/30 [==============================] - 47s 2s/step - loss: 0.6059 - accuracy: 0.7977 - val_loss: 0.4819 - val_accuracy: 0.8374
Epoch 9/10
30/30 [==============================] - 47s 2s/step - loss: 0.5297 - accuracy: 0.8265 - val_loss: 0.4170 - val_accuracy: 0.8636
Epoch 10/10
30/30 [==============================] - 47s 2s/step - loss: 0.4757 - accuracy: 0.8454 - val_loss: 0.3898 - val_accuracy: 0.8692

<keras.callbacks.History at 0x185f72850f0>
```

Saving the Model

```
model.save('asl_model_84_54.h5')
# Current accuracy is 0.8454
```



Testing the model

```
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
```

```
model=load_model('asl_model_84_54.h5')
img=image.load_img(r'E:\Projects\SmartBridge\ModelGen\Dataset\test_set\D\2.png',
                   target_size=(64,64))
```

```
img
```

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

```
x.ndim
```

```
3
```

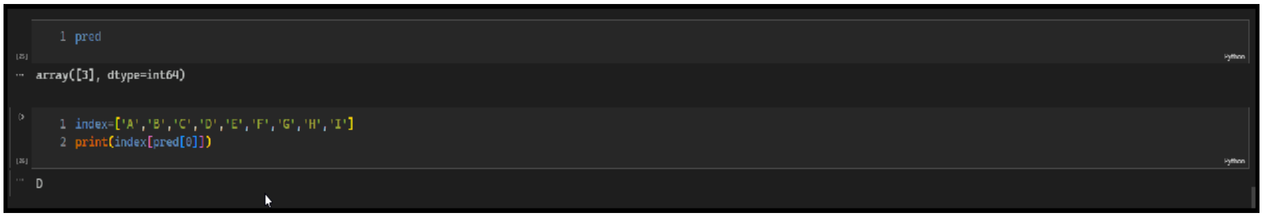
```
x=np.expand_dims(x,axis=0)
```

```
x.ndim
```

```
4
```

```
pred=np.argmax(model.predict(x),axis=1)
```

```
1/1 [==============================] - 0s 88ms/step
```



```
pred
```

```
array([3], dtype=int64)
```

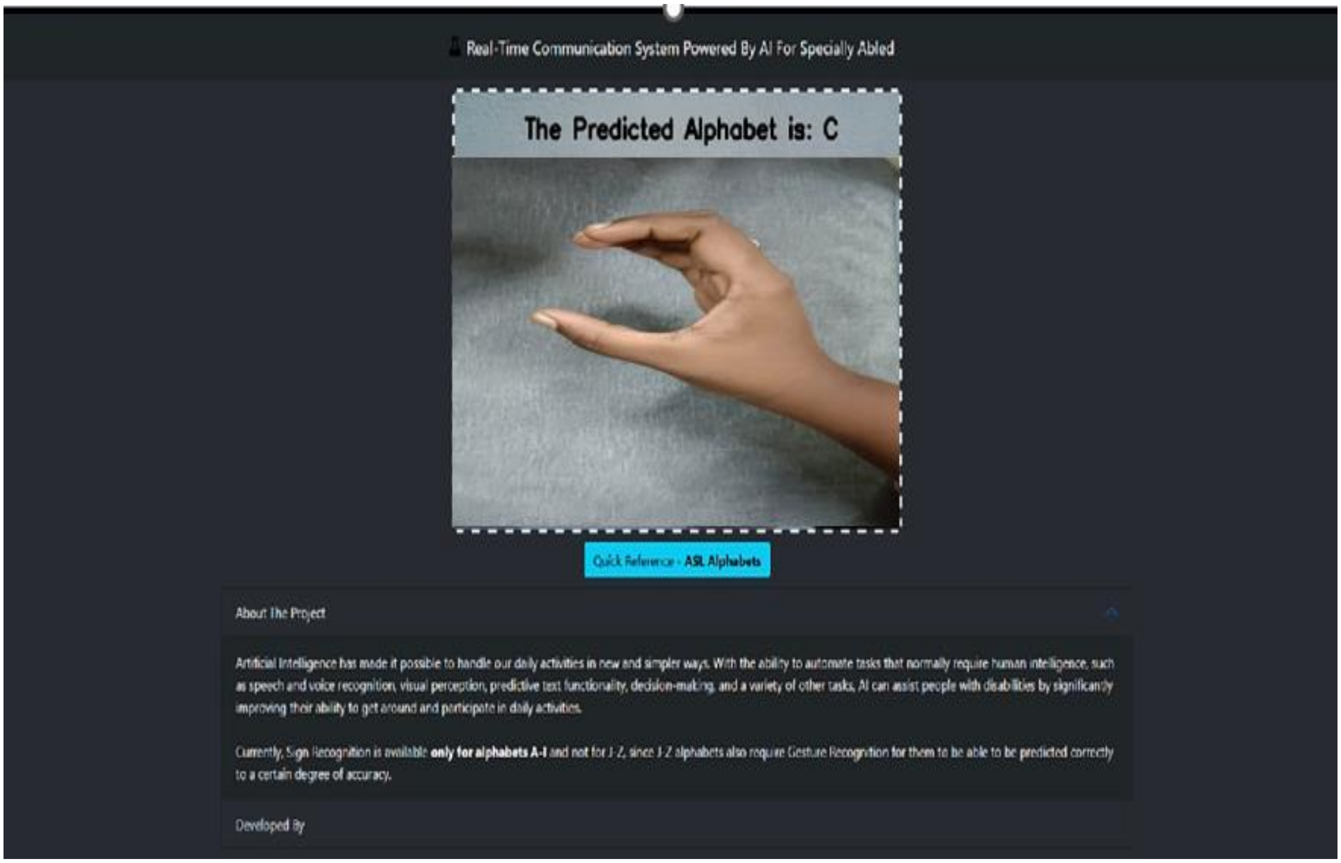
```
index=['A','B','C','D','E','F','G','H','I']
print(index[pred[0]])
```

```
D
```

Outputs:

The proposed procedure was implemented and tested with set of images. The set of 15750 images of Alphabets from “A” to “I” are used for training database and a set of 2250 images of Alphabets from “A” to “I” are used for testing database. Once the gesture is recognizing the equivalent Alphabet is shown on the screen.

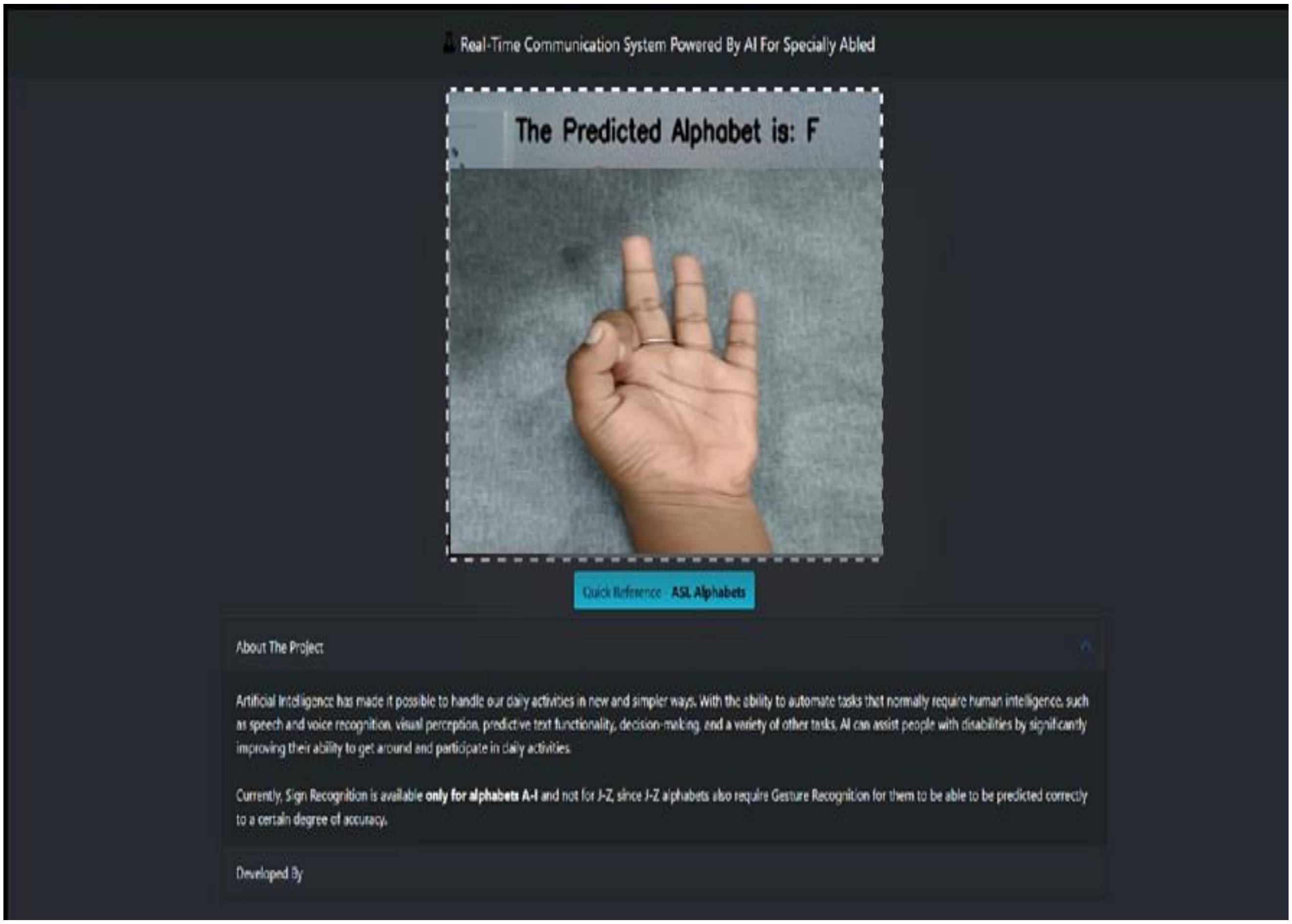
Some sample images of the output are provided below:


Real-Time Communication System Powered By AI For Specially Abled
Quick Reference - ASL Alphabets
About The Project
Developed By

The Predicted Alphabet is: C

Artificial Intelligence has made it possible to handle our daily activities in new and simpler ways. With the ability to automate tasks that normally require human intelligence, such as speech and voice recognition, visual perception, predictive text functionality, decision-making, and a variety of other tasks, AI can assist people with disabilities by significantly improving their ability to get around and participate in daily activities.

Currently, Sign Recognition is available **only for alphabets A-I** and not for J-Z, since J-Z alphabets also require Gesture Recognition for them to be able to be predicted correctly to a certain degree of accuracy.



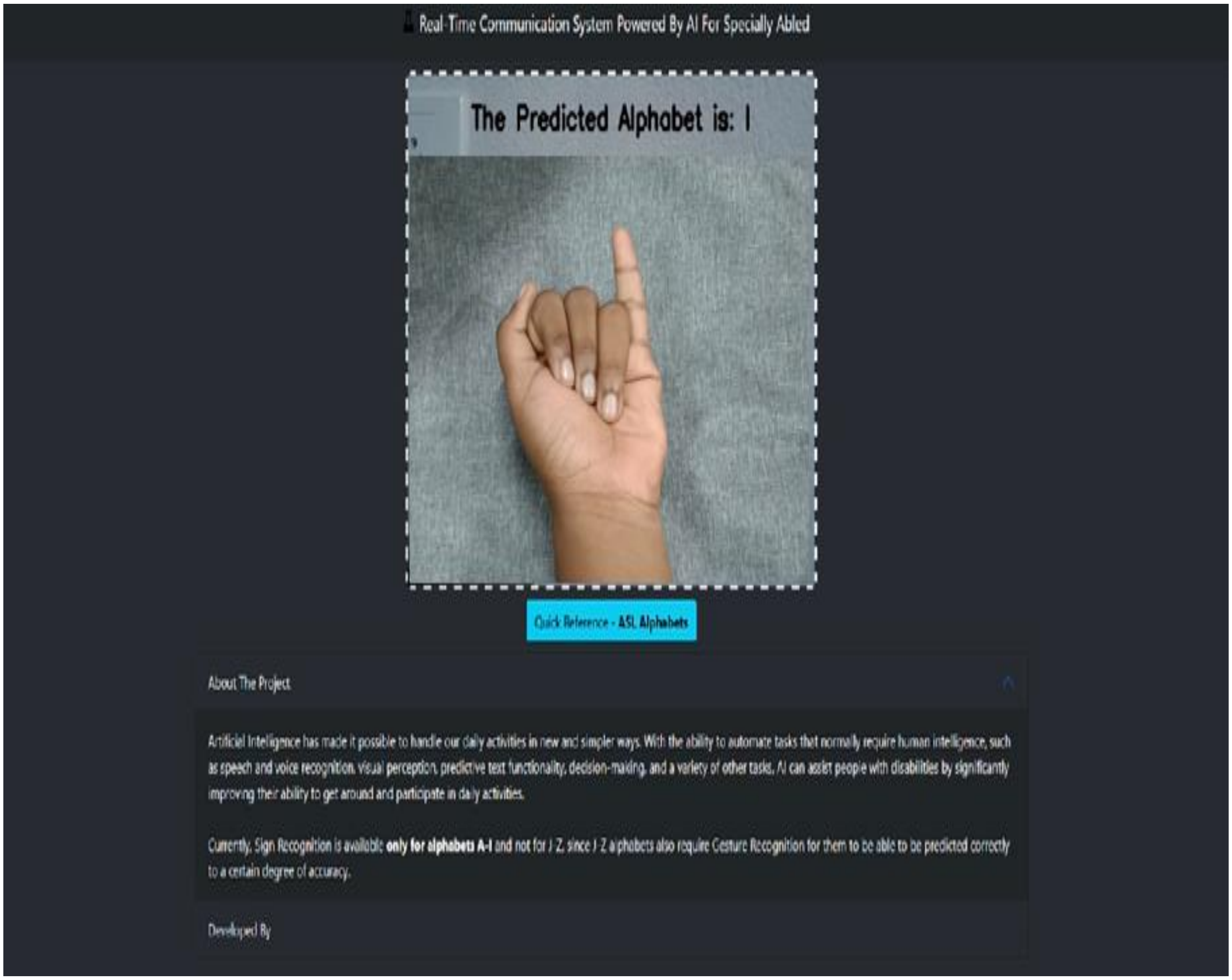
Real-Time Communication System Powered By AI For Specially Abled
The Predicted Alphabet is: F
Quick Reference - **ASL Alphabets**

About The Project

Artificial Intelligence has made it possible to handle our daily activities in new and simpler ways. With the ability to automate tasks that normally require human intelligence, such as speech and voice recognition, visual perception, predictive text functionality, decision-making, and a variety of other tasks, AI can assist people with disabilities by significantly improving their ability to get around and participate in daily activities.

Currently, Sign Recognition is available **only for alphabets A-I** and not for J-Z, since J-Z alphabets also require Gesture Recognition for them to be able to be predicted correctly to a certain degree of accuracy.

Developed By



Real-Time Communication System Powered By AI For Specially Abled

The Predicted Alphabet is: I

About The Project

Artificial Intelligence has made it possible to handle our daily activities in new and simpler ways. With the ability to automate tasks that normally require human intelligence, such as speech and voice recognition, visual perception, predictive text functionality, decision-making, and a variety of other tasks, AI can assist people with disabilities by significantly improving their ability to get around and participate in daily activities.

Currently, Sign Recognition is available **only for alphabets A-I** and not for J-Z, since J-Z alphabets also require Gesture Recognition for them to be able to be predicted correctly to a certain degree of accuracy.

Developed By

CHAPTER-10

ADVANTAGES

&

DISADVANTAES

ADVANTAGES & DISADVANTAGES

Advantages:

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

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

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

Disadvantages:

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

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

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

CHAPTER-11

CONCLUSION

CONCLUSION

Sign language is a useful tool for facilitating communication between deaf and hearing people. Because it allows for two-way communication, the system aims to bridge the communication gap between deaf people and the rest of society. The proposed methodology translates language into English alphabets that are understandable to humans.

This system sends hand gestures to the model, who recognizes them and displays the equivalent Alphabet on the screen. Deaf-mute people can use their hands to perform sign language, which will then be converted into alphabets, thanks to this project.

It aims to bridge the communication gap between deaf people and the rest of society. The proposed methodology translates sign language into English alphabetsthat are understandable to humans. This system sends hand gestures to the model, who recognizes them and displays the equivalent.

CHAPTER 12

FUTURE SCOPE

FUTURE SCOPE

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

With the introduction of gesture recognition, the web app can easily be expandedto recognize letters beyond 'I', digits, and other symbols plus gesture recognition canalso allow controlling of software/hardware interfaces. Having a technology that cantranslate 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.

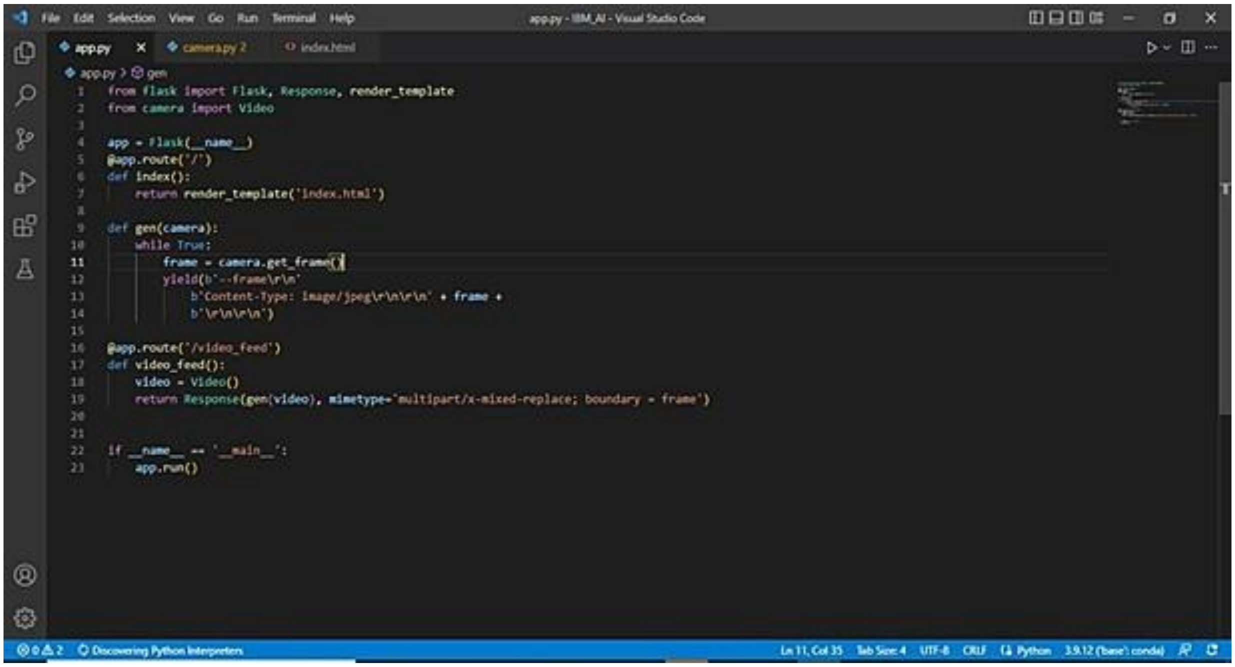
CHAPTER-13

APPENDIX

APPENDIX:

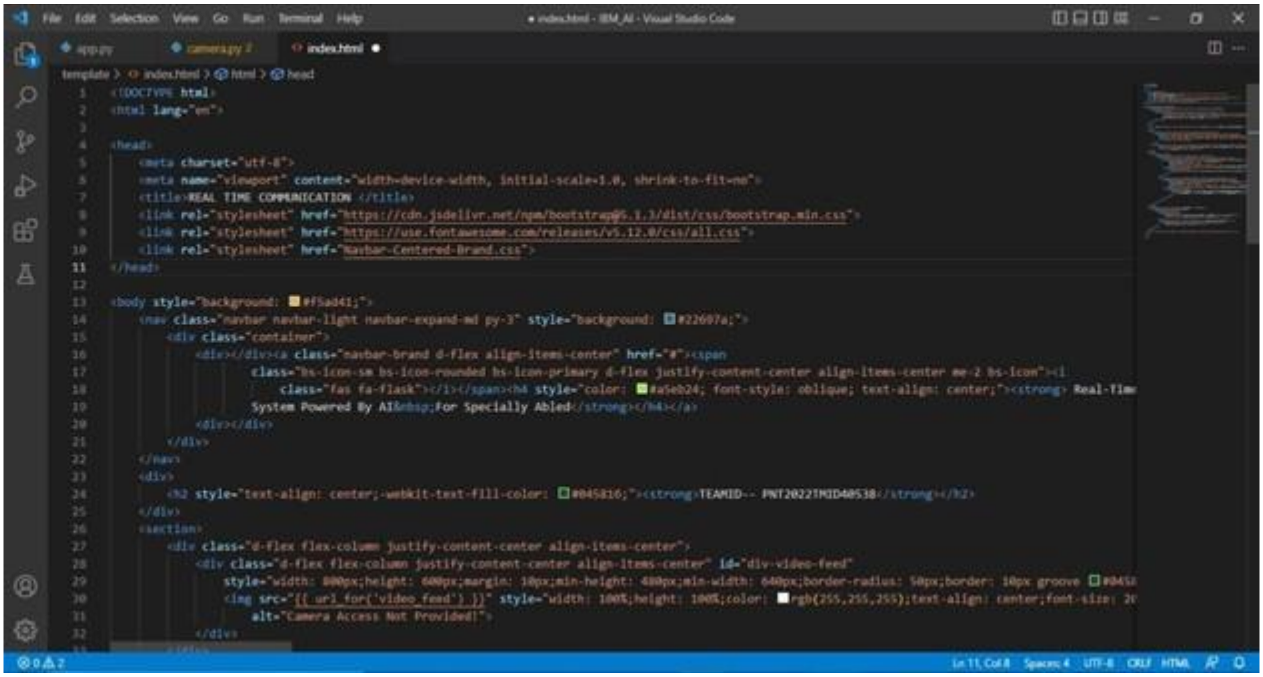
Source code:

Flask

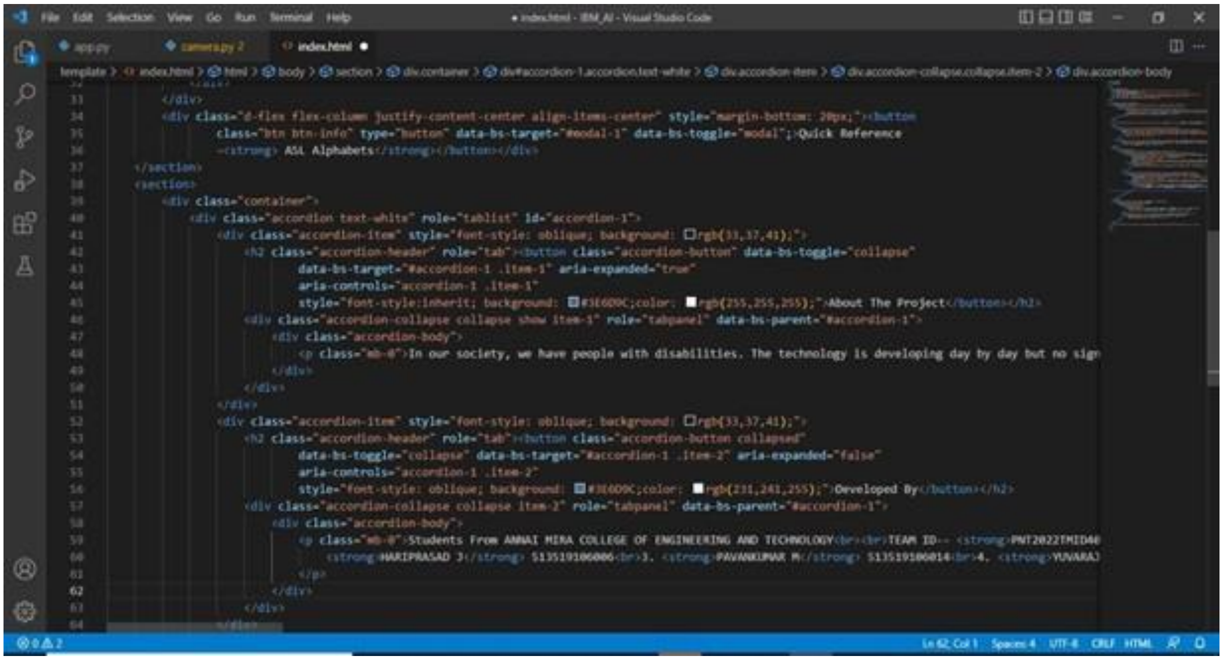


```python
from flask import Flask, Response, render_template
from camera import Video

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()
```

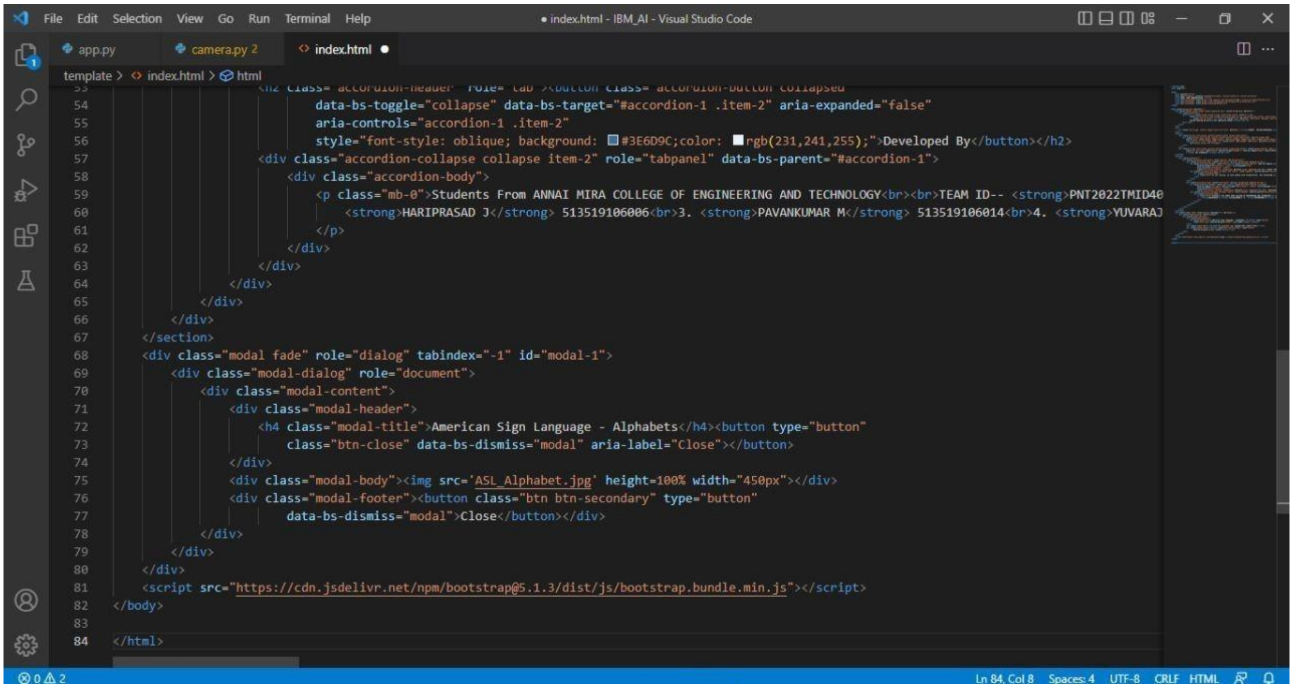
HTML:



```html
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0, shrink-to-fit=no">
    <title>REAL TIME COMMUNICATION </title>
    <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css">
    <link rel="stylesheet" href="https://use.fontawesome.com/releases/v5.12.0/css/all.css">
    <link rel="stylesheet" href="Navbar-Centered-Brand.css">
</head>

<body style="background: #f5ad41;">
    <nav class="navbar navbar-light navbar-expand-md py-3" style="background: #22607a;">
        <div class="container">
            <div></div><a class="navbar-brand d-flex align-items-center" href="#"><span
                    class="bs-icon-sm bs-icon-rounded bs-icon-primary d-flex justify-content-center align-items-center me-2 bs-icon"><i
                        class="fas fa-flask"></i></span><h4 style="color: #a5eb24; font-style: oblique; text-align: center;"><strong> Real-Time
                    System Powered By AI&nbsp;For Specially Abled</strong></h4></a>
            <div></div>
        </div>
    </nav>
    <div>
        <h2 style="text-align: center;-webkit-text-fill-color: #045816;"><strong>TEAMID-- PNT2022TMID40538</strong></h2>
    </div>
    <section>
        <div class="d-flex flex-column justify-content-center align-items-center">
            <div class="d-flex flex-column justify-content-center align-items-center" id="div-video-feed"
                style="width: 800px;height: 600px;margin: 10px;min-height: 480px;min-width: 640px;border-radius: 50px;border: 10px groove #045
                <img src="{{ url_for('video_feed') }}" style="width: 100%;height: 100%;color: rgb(255,255,255);text-align: center;font-size: 2
                    alt="Camera Access Not Provided!">
            </div>
```

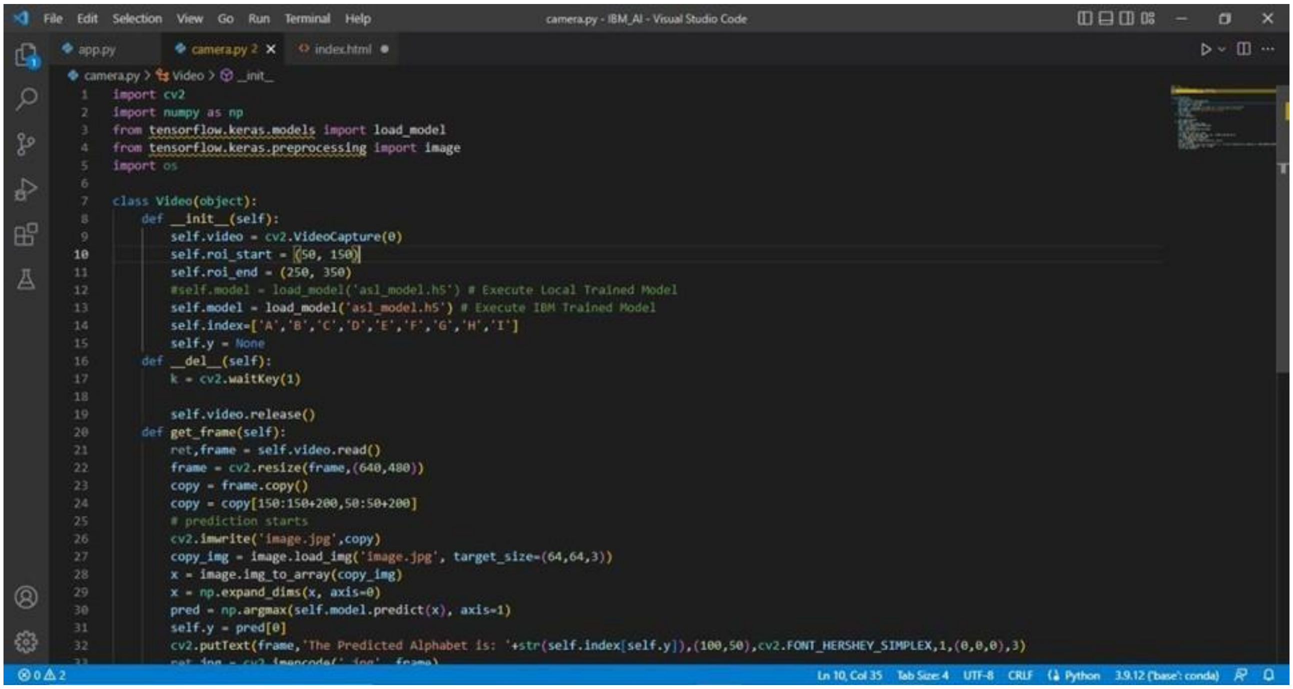

File Edit Selection View Go Run Terminal Help
● index.html - IBM_AI - Visual Studio Code
app.py
camera.py 2
index.html ●
template > index.html > html > body > section > div.container > div#accordion-1.accordion.text-white > div.accordion-item > div.accordion-collapse.collapse.item-2 > div.accordion-body
⊗ 0 ⚠ 2
Ln 62, Col 1 Spaces: 4 UTF-8 CRLF HTML

```
            </div>
            <div class="d-flex flex-column justify-content-center align-items-center" style="margin-bottom: 20px;"><button
                    class="btn btn-info" type="button" data-bs-target="#modal-1" data-bs-toggle="modal">Quick Reference
                    <strong> ASL Alphabets</strong></button></div>
        </section>
        <section>
            <div class="container">
                <div class="accordion text-white" role="tablist" id="accordion-1">
                    <div class="accordion-item" style="font-style: oblique; background: rgb(33,37,41);">
                        <h2 class="accordion-header" role="tab"><button class="accordion-button" data-bs-toggle="collapse"
                                data-bs-target="#accordion-1 .item-1" aria-expanded="true"
                                aria-controls="accordion-1 .item-1"
                                style="font-style:inherit; background: #3E6D9C;color: rgb(255,255,255);">About The Project</button></h2>
                        <div class="accordion-collapse collapse show item-1" role="tabpanel" data-bs-parent="#accordion-1">
                            <div class="accordion-body">
                                <p class="mb-0">In our society, we have people with disabilities. The technology is developing day by day but no sign
                            </div>
                        </div>
                    </div>
                    <div class="accordion-item" style="font-style: oblique; background: rgb(33,37,41);">
                        <h2 class="accordion-header" role="tab"><button class="accordion-button collapsed"
                                data-bs-toggle="collapse" data-bs-target="#accordion-1 .item-2" aria-expanded="false"
                                aria-controls="accordion-1 .item-2"
                                style="font-style: oblique; background: #3E6D9C;color: rgb(231,241,255);">Developed By</button></h2>
                        <div class="accordion-collapse collapse item-2" role="tabpanel" data-bs-parent="#accordion-1">
                            <div class="accordion-body">
                                <p class="mb-0">Students From ANNAI MIRA COLLEGE OF ENGINEERING AND TECHNOLOGY<br><br>TEAM ID-- <strong>PNT2022TMID40
                                    <strong>HARIPRASAD J</strong> 513519106006<br>3. <strong>PAVANKUMAR M</strong> 513519106014<br>4. <strong>YUVARAJ
                                </p>
                            </div>
                        </div>
                    </div>
```


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
⊗ 0 ⚠ 2
Ln 84, Col 8 Spaces: 4 UTF-8 CRLF HTML

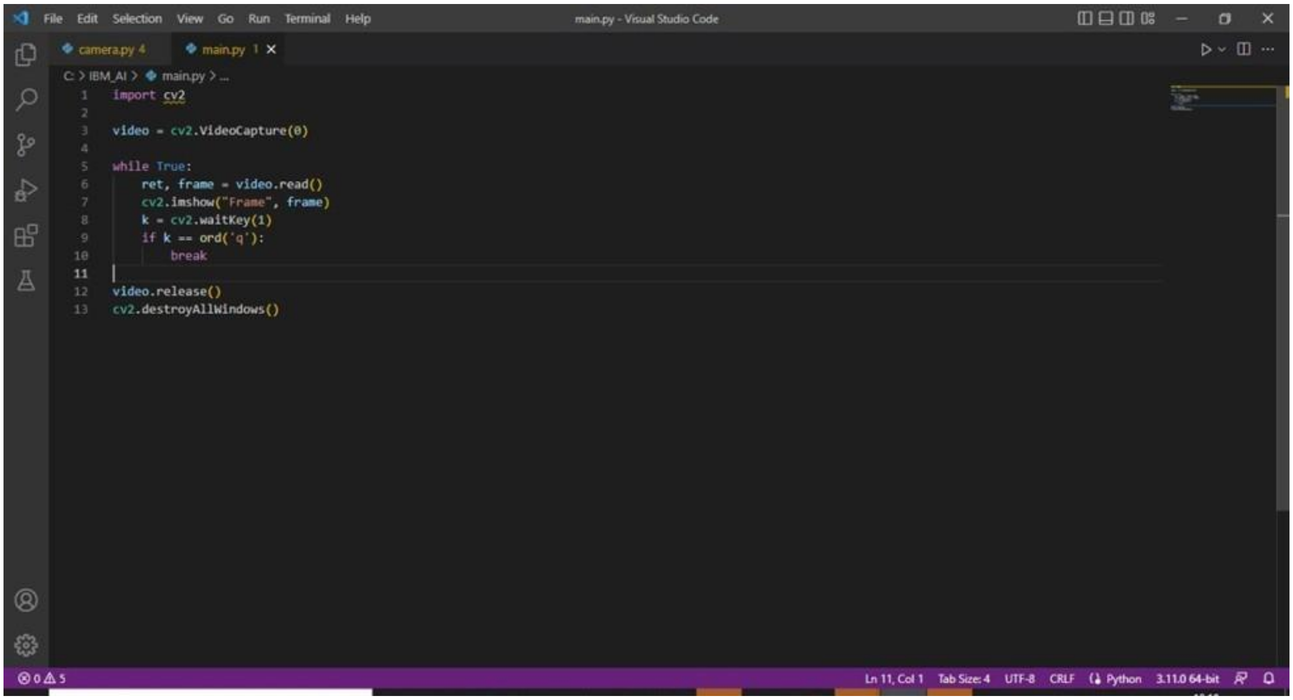
```
                        <h2 class="accordion-header" role="tab"><button class="accordion-button collapsed"
                                data-bs-toggle="collapse" data-bs-target="#accordion-1 .item-2" aria-expanded="false"
                                aria-controls="accordion-1 .item-2"
                                style="font-style: oblique; background: #3E6D9C;color: rgb(231,241,255);">Developed By</button></h2>
                        <div class="accordion-collapse collapse item-2" role="tabpanel" data-bs-parent="#accordion-1">
                            <div class="accordion-body">
                                <p class="mb-0">Students From ANNAI MIRA COLLEGE OF ENGINEERING AND TECHNOLOGY<br><br>TEAM ID-- <strong>PNT2022TMID40
                                    <strong>HARIPRASAD J</strong> 513519106006<br>3. <strong>PAVANKUMAR M</strong> 513519106014<br>4. <strong>YUVARAJ
                                </p>
                            </div>
                        </div>
                    </div>
                </div>
            </div>
        </section>
        <div class="modal fade" role="dialog" tabindex="-1" id="modal-1">
            <div class="modal-dialog" role="document">
                <div class="modal-content">
                    <div class="modal-header">
                        <h4 class="modal-title">American Sign Language - Alphabets</h4><button type="button"
                            class="btn-close" data-bs-dismiss="modal" aria-label="Close"></button>
                    </div>
                    <div class="modal-body"><img src='ASL_Alphabet.jpg' height=100% width="450px"></div>
                    <div class="modal-footer"><button class="btn btn-secondary" type="button"
                            data-bs-dismiss="modal">Close</button></div>
                </div>
            </div>
        </div>
        <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
    </body>

</html>
```

Camera:


File Edit Selection View Go Run Terminal Help
camera.py - IBM_AI - Visual Studio Code
app.py
camera.py 2
index.html
camera.py > Video > __init__
Ln 10, Col 35 Tab Size: 4 UTF-8 CRLF Python 3.9.12 ('base': conda)

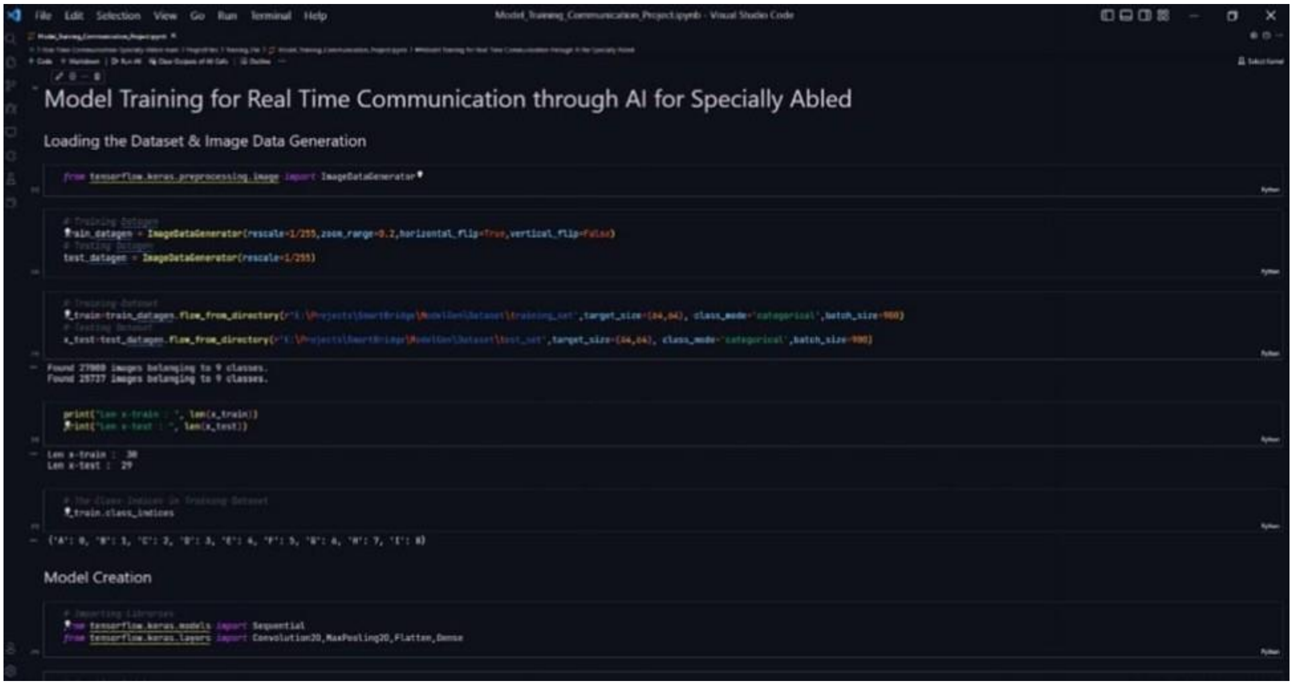
```python
import cv2
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import os

class Video(object):
    def __init__(self):
        self.video = cv2.VideoCapture(0)
        self.roi_start = (50, 150)
        self.roi_end = (250, 350)
        #self.model = load_model('asl_model.h5') # Execute Local Trained Model
        self.model = load_model('asl_model.h5') # Execute IBM Trained Model
        self.index=['A','B','C','D','E','F','G','H','I']
        self.y = None
    def __del__(self):
        k = cv2.waitKey(1)

        self.video.release()
    def get_frame(self):
        ret,frame = self.video.read()
        frame = cv2.resize(frame,(640,480))
        copy = frame.copy()
        copy = copy[150:150+200,50:50+200]
        # prediction starts
        cv2.imwrite('image.jpg',copy)
        copy_img = image.load_img('image.jpg', target_size=(64,64,3))
        x = image.img_to_array(copy_img)
        x = np.expand_dims(x, axis=0)
        pred = np.argmax(self.model.predict(x), axis=1)
        self.y = pred[0]
        cv2.putText(frame,'The Predicted Alphabet is: '+str(self.index[self.y]),(100,50),cv2.FONT_HERSHEY_SIMPLEX,1,(0,0,0),3)
        ret,jpg = cv2.imencode('.jpg', frame)
```

Main


File Edit Selection View Go Run Terminal Help
main.py - Visual Studio Code
camera.py 4
main.py 1
C: > IBM_AI > main.py > ...
Ln 11, Col 1 Tab Size: 4 UTF-8 CRLF Python 3.11.0 64-bit

```python
import cv2

video = cv2.VideoCapture(0)

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

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

Trained Model



File Edit Selection View Go Run Terminal Help
Model_Training_Communication_Project.ipynb - Visual Studio Code
+ Code + Markdown | Run All | Clear Outputs of All Cells | Outline

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 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)
```

```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'E:\Projects\SmartBridge\ModelGen\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\SmartBridge\ModelGen\Dataset\test_set',target_size=(64,64), class_mode='categorical',batch_size=900)
```

```
Found 27000 images belonging to 9 classes.
Found 25737 images belonging to 9 classes.
```

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

```
Len x-train :  30
Len x-test :  29
```

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

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

Model Creation

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

GitHub Repository:

https://github.com/IBM-EPBL/IBM-Project-18667-1659688