

REAL-TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

PROJECT REPORT

Kings Engineering College
B.E Electronics & Communication Engineering
(2019 - 2023)

TEAM ID - PNT2022TMID25478

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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 language. 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 getfx 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 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.

Problem:

Vedha has difficulty in hearing. He uses sign language to communicate with others. But he can't able to communicate with normal people who don't understand sign language.

Solution:

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 ,the system enhances the user friendly experience.

Problem:

Ram is a dumb by birth. He uses sign language to communicate with others. But he can't able to communicate with normal people who don't understand sign language.

Solution:

To create a app for understanding sign language and convert into Speech signal as output for normal people.

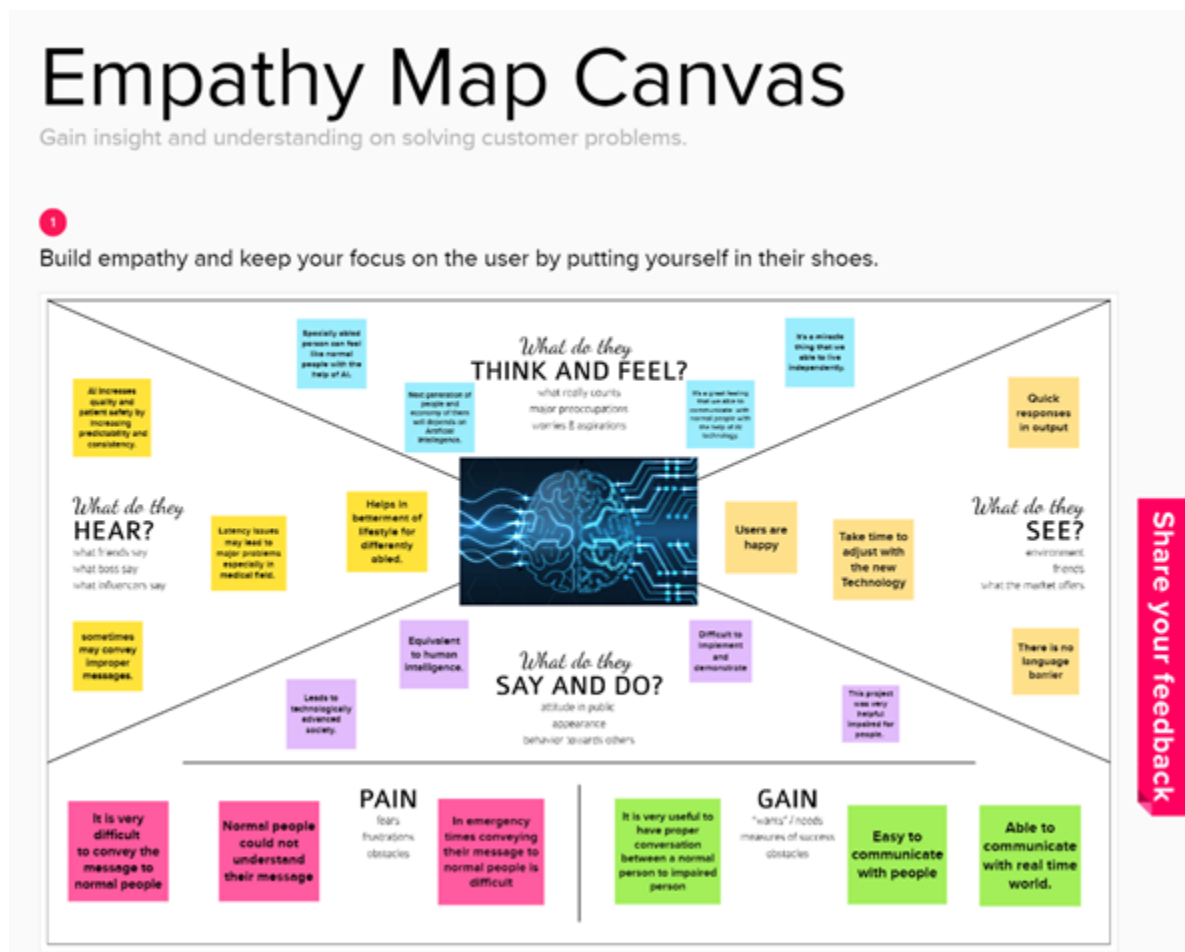
CHAPTER-3

**IDEATION AND
PROPOSEDSOLUTION**

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 has to be recognized to form the whole statement in old methods.
4.	Social Impact/Customer satisfaction	It drastically reduces 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.

Problem-Solution fit canvas 2.0		Purpose / Vision	
Define CS, fit into	1. CUSTOMER SEGMENT(S) <small>Who is your customer?</small> <p>People who lost their speech or hearing ability by birth or due to some other factors.</p>	6. CUSTOMER <small>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.</small> <p>Difficult accessibility, not user friendly, need more technical knowledge to handle, cost,...etc. There are so many choice of solutions available but due to these some constraints, choice of solutions were limited.</p>	5. AVAILABLE SOLUTIONS <small>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.</small> <p>The first ever approach to sign language it has only 6 sign gestures detection. Using colored hands for hand position recognition. But our model is trained to detect different sign languages without any colour gloves, using bare hands only.</p>
	2. JOBS-TO-BE-DONE / PROBLEMS <small>Which jobs to be done (or problems) do you address for your customers? There could be more than one, explore different sides.</small> <p>Deaf and dumb people couldn't able to convey their messages to the normal people easily. Deaf people cannot hear the words as others speaks and dumb people cannot express their feelings by words.</p>	9. PROBLEM ROOT CAUSE <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? I.e. customers have to do it because of the change in regulations.</small> <p>In Previously developed solution, they have to use coloured hand gloves for hand position recognition. Also, the old method uses traditional translators which take too much of time to process.</p>	7. BEHAVIOUR <small>What does your customer do to address the problem and get the job done? I.e. directly related: find the right solar panel modules, calculate usage and benefits, indirectly associated: customers spend free time on volunteering work I.e. Greenpeace!</small> <p>In our device, there's an option called problem detection display in which our customer can able to see the type of problem occurs & solution will be displayed.</p>
	3. TRIGGERS <small>What triggers customers to act? I.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</small> <p>By comparing normal people, Specially Abled people should depend on others and want to live their life independently like other people</p>	10. YOUR SOLUTION <small>If you are working on an existing business, write down your current solution first, fit in the canvas, and check how much it fits really. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</small> <p>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.</p>	8. CHANNELS of BEHAVIOUR <small>8.1 ONLINE What kind of actions do customers take online? Extract online channels from #7</small> <p>Advertise on online with influencers to test the product and promote it also on blog channels</p>
Identify strong TR & EM	4. EMOTIONS: BEFORE / AFTER <small>How do customers feel when they face a problem or a job and afterwards? I.e. how insecure a customer is created - use it in your communication strategy & domain.</small> <p>BEFORE: It is very difficult to convey the message to normal people. AFTER: They overcome their reluctance to have communication with normal people.</p>		<small>8.2 OFFLINE What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</small> <p>On offline, we have our product experience stores where our customer can experience the product in real</p>
			<small>Extract online & offline CH of BE</small>

CHAPTER- 4

REQUIREMENT ANALYSIS

4.1 Functional Requirements

FR No.	Functional Requirement	Sub Requirements
FR-1	User Registration	Registration through Form 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 levels of authorization namely standard access level and advanced access level.
FR-5	External interface	Ethernet, Wi-Fi, USB to provide internet facility to access the resources with real time communication.
FR-6	Reporting	If any issues found in the application, automatically it will be notified to the developer.

4.2 Non-Functional Requirements

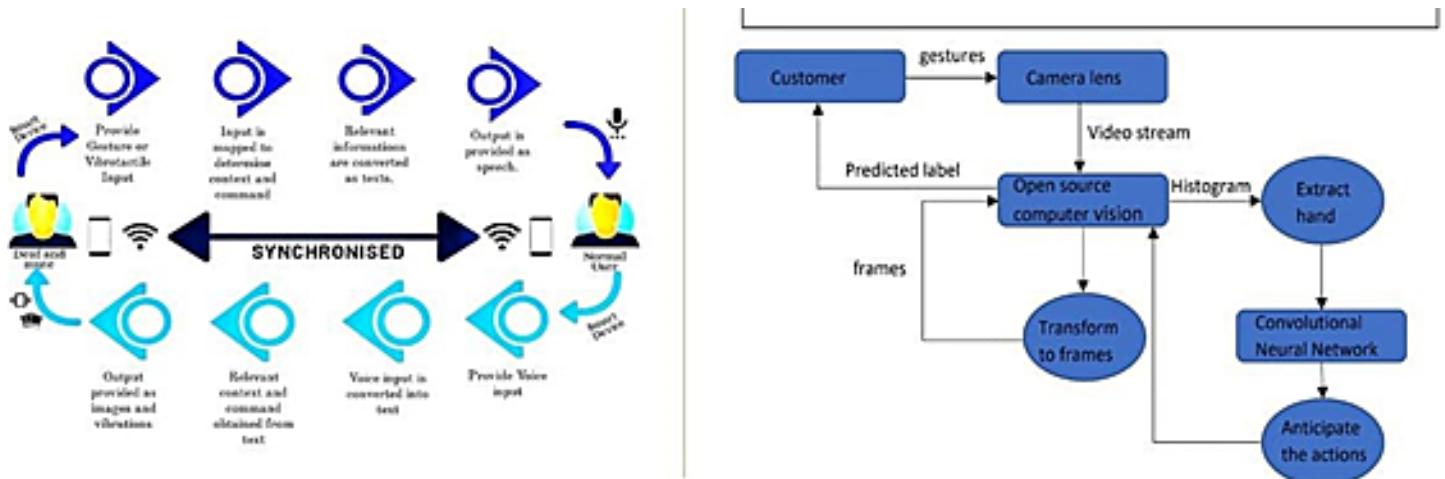
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	To convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb people.
NFR-2	Security	Converted information using signs into speech is accessed only by the user.
NFR-3	Reliability	Provides 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 to human-understandable language and speech is 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.

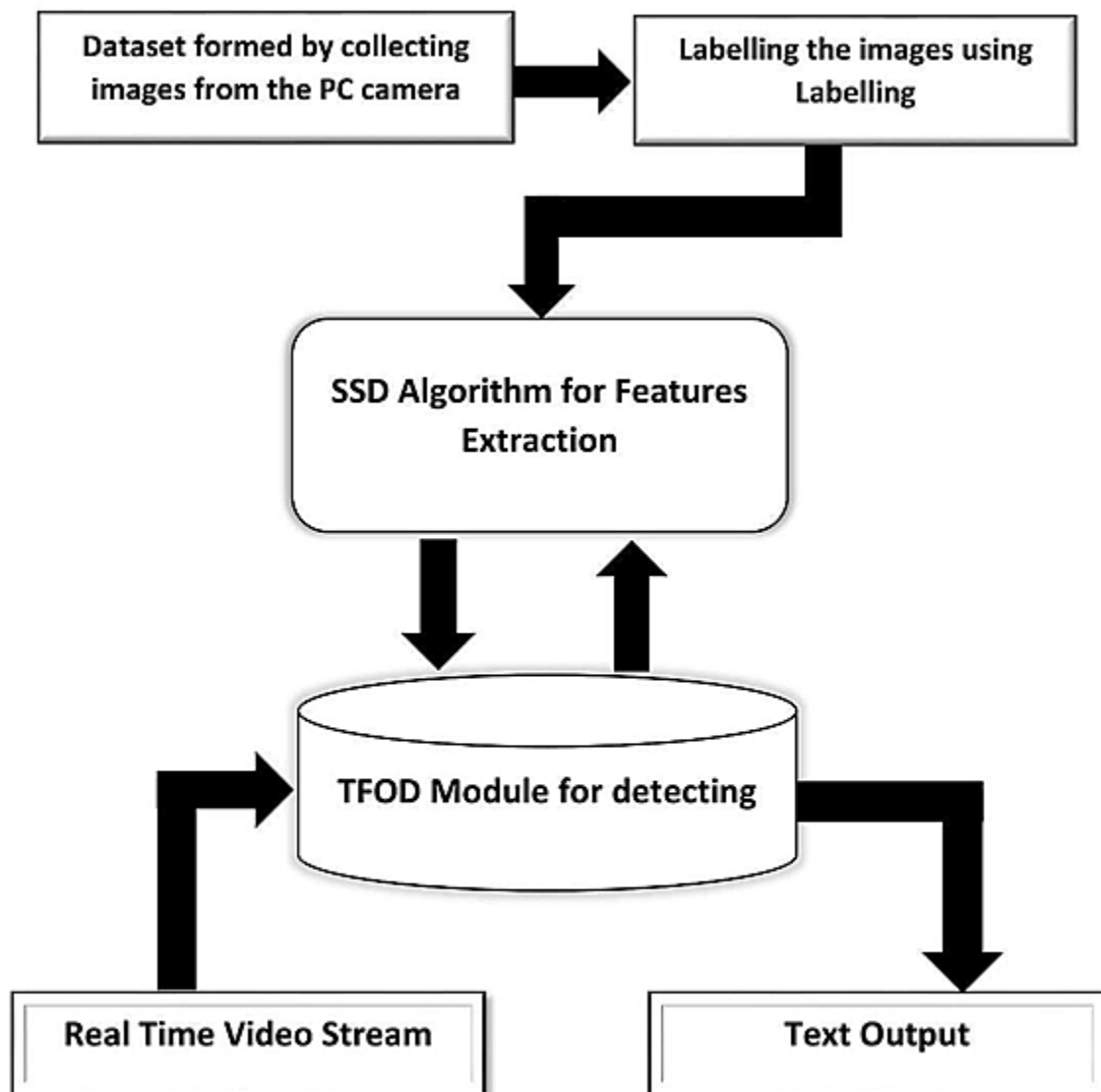


5.2 Solution & Technical Architecture

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:

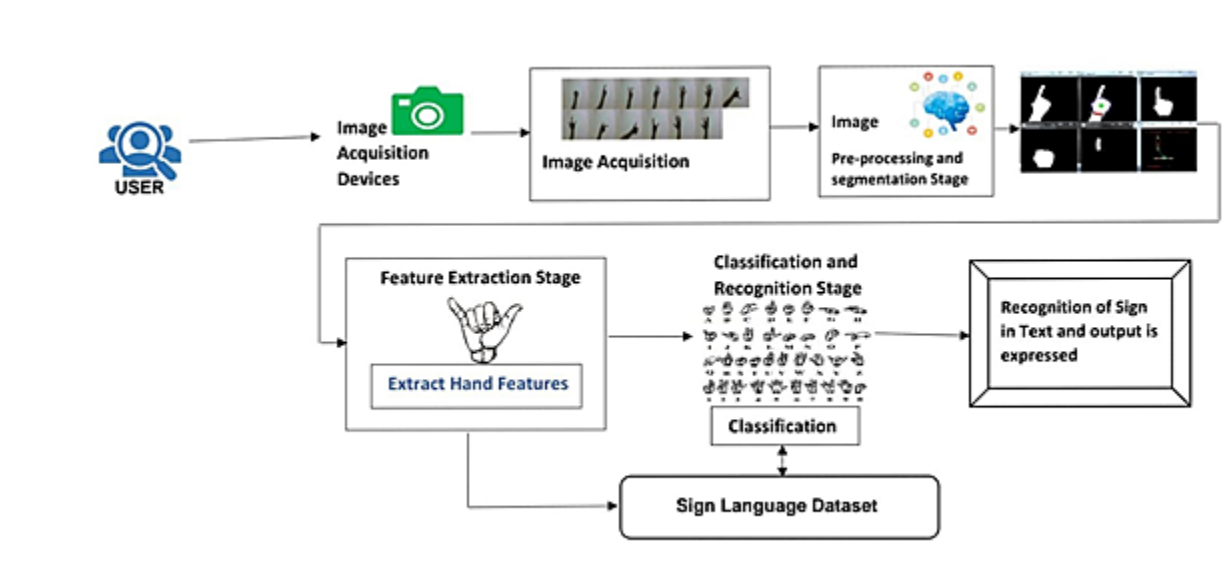


Table-1:**Components and Technologies:**

S.NO	Component	Description	Technology
1.	User Interface	Customer have to login through their respective website or phonenumber. 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, 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, use of cache etc..,	Using Convolutional neural network, machine learning for conversation and improve the sensitivity of the performance..

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story/ Task	Acceptance criteria	Priority	Release
Customer (Mobileuser)	Registration	USN-1	As customer, I couldable to registerfor theapp by entering my E-mail and proper password.	I could able to access myregistered account.	High	Sprint 1
		USN-2	As a user, I'll get the acknowledgement verification emailonce after my registrationhasbeen donefor theapp	I can get verification emailand clickok to confirmit..	High	Sprint 1
		USN-3	As a customer, Icould able to register for application via their official websites and social media.	I could able to registerand access my account by usingtheirwebsite & socialmedia.	Medim	Sprint 2
		USN-4	As a customer, Icould able to register for application through Gmail	via some thirdparties link	Low	Sprint 2
	Login	USN-5	As a customer, I could able to logininto application by entering alreadyregistered email and password	I can type manually and also can used saved logincredentials	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 (Webuser)	Registration	USN-7	As a customer, I could be able to login through registered phone number by using otp instead of Gmail	I could be 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 of 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

User Type	Functional Requirement (Epic)	User Story Number	User Story/ Task	Acceptance criteria	Priority	Release
	Wish list	USN-11	Customer's desired choice to avail these services.	As a customer can review and choose their services as he wants/preferred.	Medium	Sprint 1
	Enrollment	USN-12	Now, customer can avail all services once he/she enrolled.	As a customer, it's quite 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	VARSHINI.H
Sprint-1		USN-2	Image preprocessing	8	Medium	RENUKADEVI.M
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model	10	High	YUVASHREE.S
Sprint-2		USN-4	Training the image classification model using CNN	7	Medium	SUSHMITHA.J
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	VARSHINI.H
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	8	Medium	SUSHMITHA.J

6.2 Sprint Delivery Schedule

ProjectTracker,Velocity & BurndownChart:

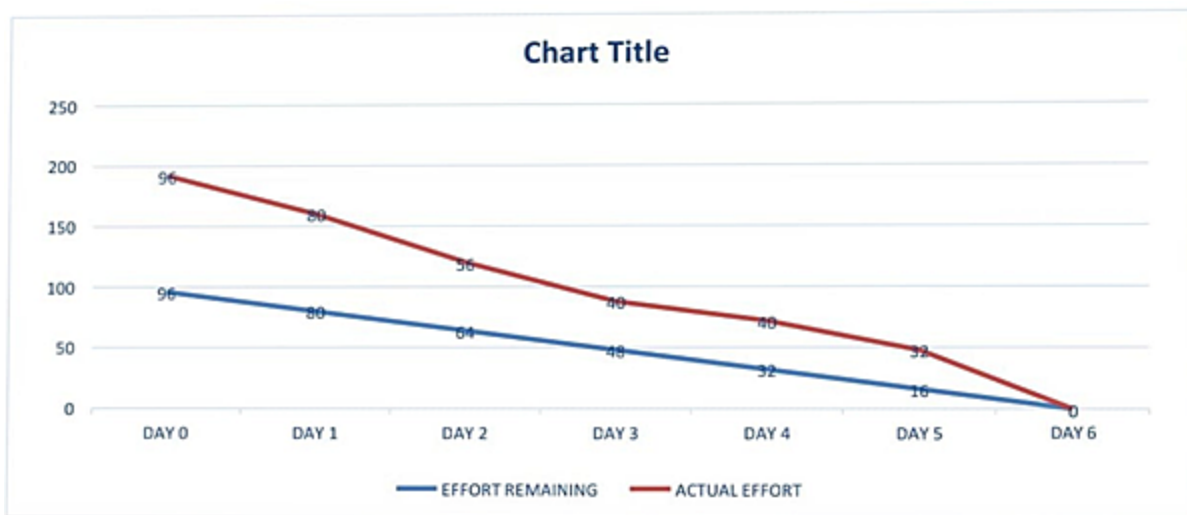
Sprint	Total StoryPoints	Duration	Sprint Start Date	Sprint EndDate (Planned)	Story Points Completed (ason PlannedEnd Date)	Sprint Release Date(Actual)
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	04 Nov 2022	5	04 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	11 Nov 2022	7	11 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	18 Nov 2022	5	18 Nov 2022

Velocity:

$$AV = 6/10 = 0.6$$

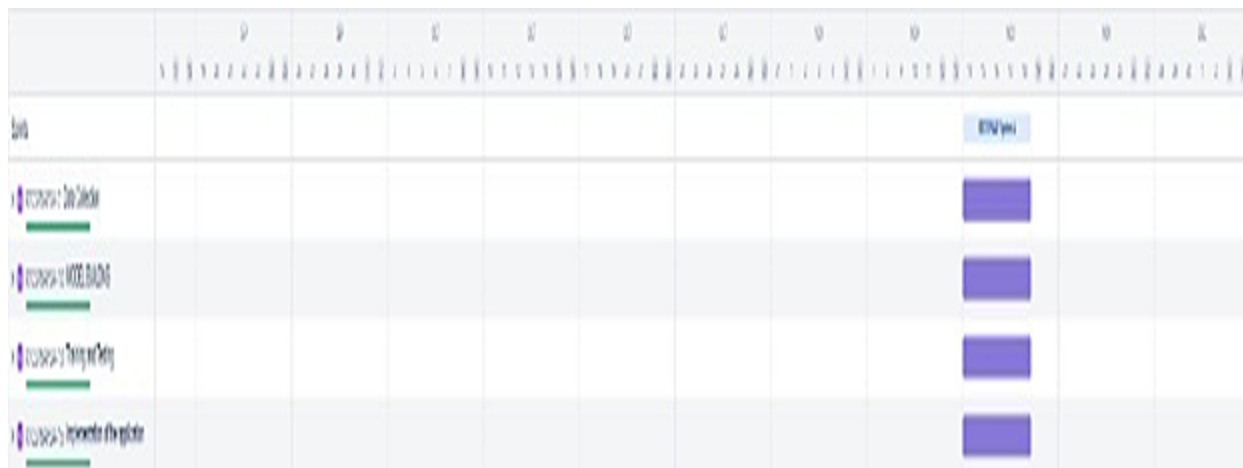
Burndown chart:

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

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.



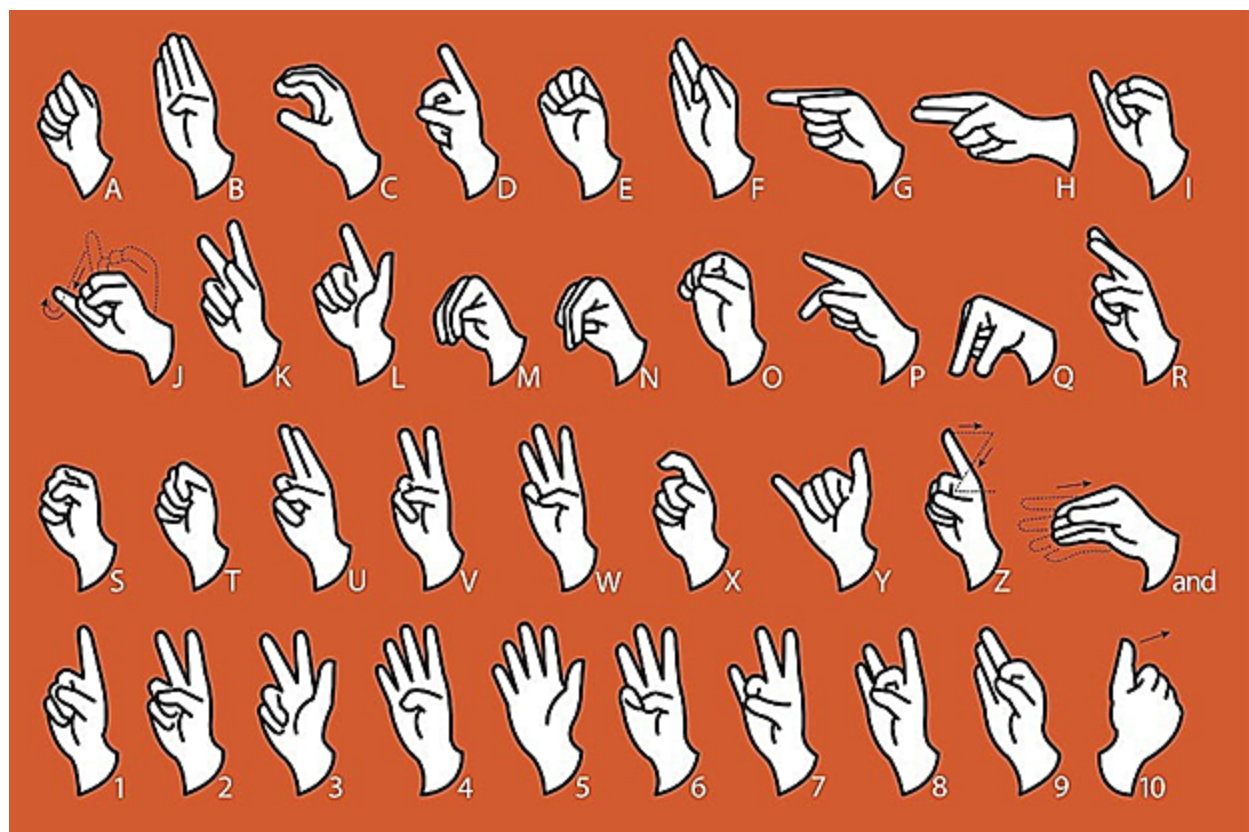
CHAPTER-7

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
from keras.layers import 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
yourdataset 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
```



```
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,
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__':a
    pp.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.

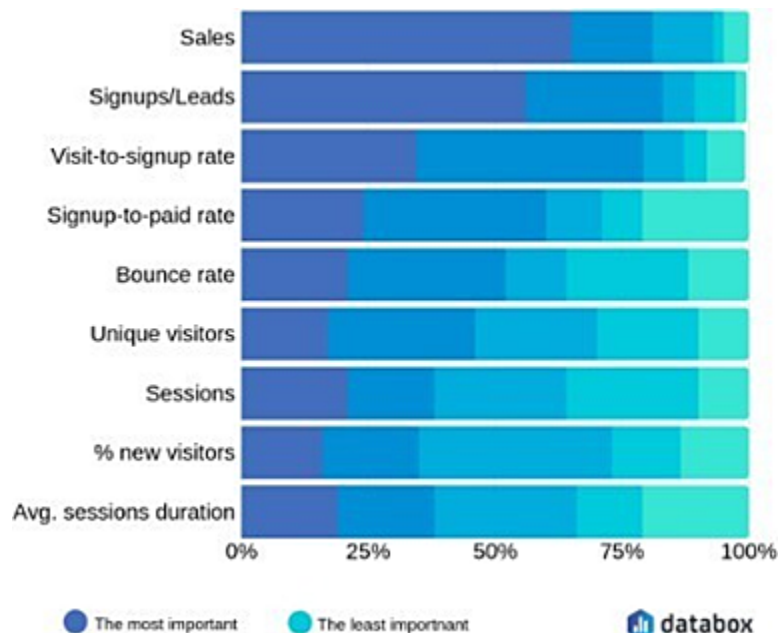
S.N o.	Parameter	Values	Screenshot
1	Model Summary		<pre> In [1]: x_test = test_datagen.Flow_from_directory("../content/Datasets/test_set", target_size=(64,64), batch_size=32, class_mode='categorical', color_mode='grayscale') Print 128 images belonging to 5 classes. In [2]: from keras.models import Sequential from keras.layers import Dense from keras.layers import Convolution2D from keras.layers import MaxPooling2D from keras.layers import Flatten from keras.layers import Activation In [3]: model = Sequential() In [4]: model.add(Convolution2D(32,(3,3),input_shape=(64,64,3), activation='relu')) #no. of feature detectors, size of feature detector, image size, activation function In [5]: model.add(MaxPooling2D(pool_size=(2,2))) In [6]: model.add(Flatten()) In [7]: model.add(Dense(units=100, activation = 'relu')) In [8]: model.add(Dense(units=8, activation = 'softmax')) In [9]: model.compile(loss='categorical_crossentropy', optimizer = 'adam', metrics = ['accuracy']) </pre>
2	Accuracy	Training Accuracy –99.6% Validation Accuracy –98.3%	<pre> In [10]: 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 [=====] - 67s - loss: 1.8716 - accuracy: 0.7176 WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator epochs: batches (in this case, 40 batches). You may need to use the repeat() function when building your 24/24 [=====] - 54s 4s/step - loss: 1.8716 - accuracy: 0.7176 - val_loss: 0.4793 Epoch 2/10 24/24 [=====] - 82s 3s/step - loss: 0.2818 - accuracy: 0.9400 Epoch 3/10 24/24 [=====] - 54s 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: 0.9925 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 In [17]: In [18]: model.save("xslpng1.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:

IBM Project Name: Real-Time Communication System Powered by AI for Specially Abled

TEAM ID: PNT2022TMID25478

TEAM Lead:VARSHINI H

TEAM Member 1:RENUKADEVI M

TEAM Member 2:YUVASHREE S

TEAM Member 3:SUSHMITHA J

FINAL OUTPUT

Import datagenerator to train and test

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

In [83]:

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

In [84]:

```
test_datagen = ImageDataGenerator(rescale = 1./255)
```

In [85]:

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

In [82]:

Apply ImageDataGenerator Functionality To Train And Test set

```
from google.colab import drive
```

In [86]:

In [87]:

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
print("This dataset has been created and uploaded by IBM-TeamID-IBM-Project-50210-1660899973")
```

This dataset has been created and uploaded by IBM-TeamID-IBM-Project-50210-1660899973

In [88]:

```
x_train=
train_datagen.flow_from_directory(r"/content/drive/MyDrive/dataset/dataset/training_set",target_size=(64,64),class_mode="categorical",batch_size=48)
Found 10324 images belonging to 9 classes.
```

In [89]:

```
x_test =
test_datagen.flow_from_directory(r"/content/drive/MyDrive/dataset/dataset/test_set",target_size= (64,64),class_mode= "categorical",batch_size=48)
Found 2280 images belonging to 9 classes.
```

In [90]:

```
x_train.class_indices
```

Out[90]:

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

In [51]:

```
x_test.class_indices
```

Out[51]:

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

MODEL BUILDING

In [91]:

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

In [92]:

```
model=Sequential()
```

In [93]:

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

In [94]:

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

In [95]:

```
model.add(Flatten())
```

In [96]:

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

In [97]:

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

In [98]:

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

In [99]:

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

In []:

```
a=len(x_train)
```

```
b=len(x_test)
```

Length of training and testing data

In []:

```
print(a)
```

```
print(b)
```

```
216
```

```
48
```

TEST THE MODEL

In [31]:

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

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

```
import numpy as np
```

```
import cv2
```

In [32]:

```
img =
```

```
image.load_img('/content/drive/MyDrive/dataset/dataset/test_set/F/107.png',target_size =  
(500,500))
```

```
img
```

Out[32]:

In [102]:

```
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 [101]:

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

```
def detect(frame):
```

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

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

```
    if(np.max(img)>1):
```

```
        prediction=model.predict(img)
```

```
        print(prediction)
```

```
        prediction=model.predict_classes(img)
```

```
        print(prediction)
```

In [39]:

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

In [34]:

```
frame=cv2.imread('/content/drive/MyDrive/dataset/dataset/test_set/F/107.png')
data=detect(frame)
from google.colab.patches import cv2_imshow
cv2_imshow(frame)
cv2.waitKey(0)
cv2.destroyAllWindows()

1/1 [=====] - 0s 285ms/step
THE PREDICTED LETTER IS  I
```

In [79]:

```
frame=cv2.imread('/content/drive/MyDrive/dataset/dataset/test_set/C/12.png')
data=detect(frame)
from google.colab.patches import cv2_imshow
cv2_imshow(frame)
cv2.waitKey(0)
cv2.destroyAllWindows()

1/1 [=====] - 0s 78ms/step
THE PREDICTED LETTER IS  A
```

In [103]:

```
frame=cv2.imread('/content/drive/MyDrive/dataset/dataset/training_set/D/1008.png')
data=detect(frame)
from google.colab.patches import cv2_imshow
cv2_imshow(frame)
cv2.waitKey(0)
cv2.destroyAllWindows()

1/1 [=====] - 0s 75ms/step
THE PREDICTED LETTER IS  E
```

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-11

CONCLUSION

FUTURE OF SCOPE:

With the introduction of gesture recognition, the web app can easily be expanded to recognize letters beyond 'l', 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.

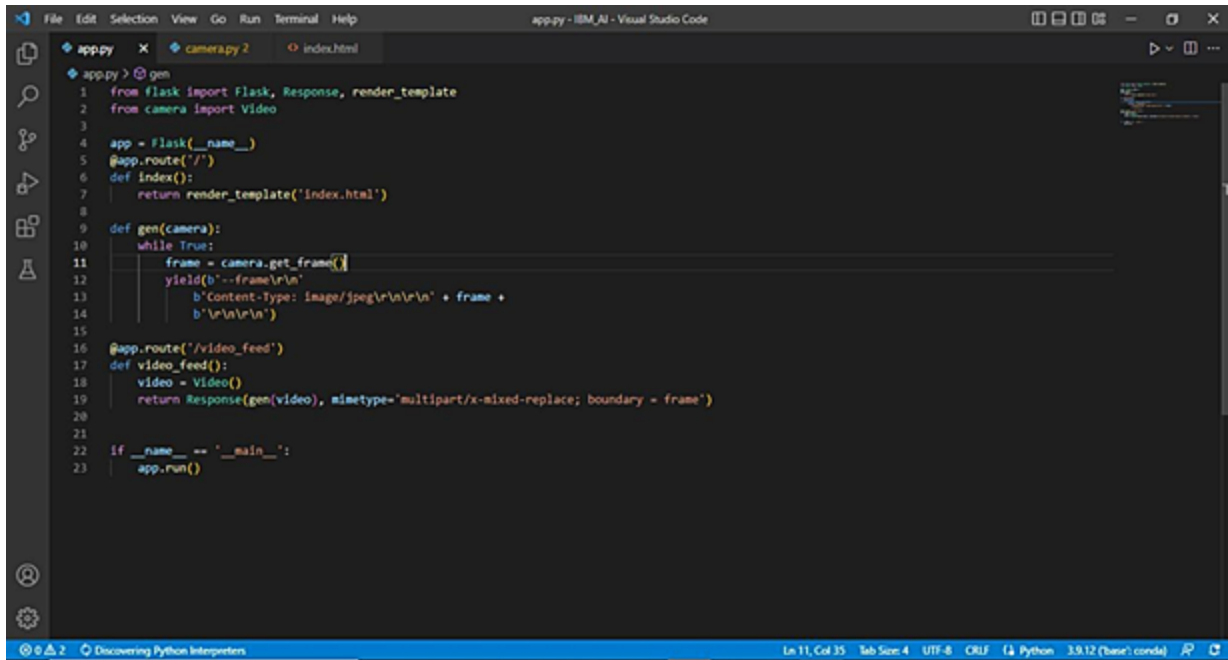
CHAPTER-13

APPENDIX

APPENDIX:

Source code:

Flask:



```
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\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

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: #f5d4d1;">
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;&nbsp;&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>TEAKID-- PNT2022THID40538</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 #045816"
29         
32     </div>
33   </section>
34 </body>
35 </html>
```

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

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
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">Quick Reference
36   <strong> ASI 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: #045816;">
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: #045816; color: #045816;">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           </div>
50         </div>
51       </div>
52       <div class="accordion-item" style="font-style: oblique; background: #045816;">
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: #045816; color: #045816;">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>PNT2022THID40
60             <strong>HARIPRASAD </strong> 513519106006<br><br><strong>PAVANILPAAR M</strong> 513519106014<br><br><strong>YUVARAJ
61           </p>
62         </div>
63       </div>
64     </div>
65   </div>
66 </section>
```

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

template > index.html > html
53
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 aria-controls="accordion-1 .item-2"
57 style="font-style: oblique; background: #3E6D9C;color: #rgb(231,241,255);">Developed By</button></h2>
58 <div class="accordion-collapse collapse item-2" role="tabpanel" data-bs-parent="#accordion-1">
59 <div class="accordion-body">
60 <p>mb-0>Students From ANNAI MIRA COLLEGE OF ENGINEERING AND TECHNOLOGY<br><br>TEAM ID-- <strong>PNT2022TMD40
61 <strong>HARIPRASAD J</strong> 513519106006<br>3. <strong>PAVANKUMAR M</strong> 513519106014<br>4. <strong>YUVARAJ
62 </p>
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"><img src='ASL_Alphabet.jpg' height=100% width="450px"></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
84 </html>

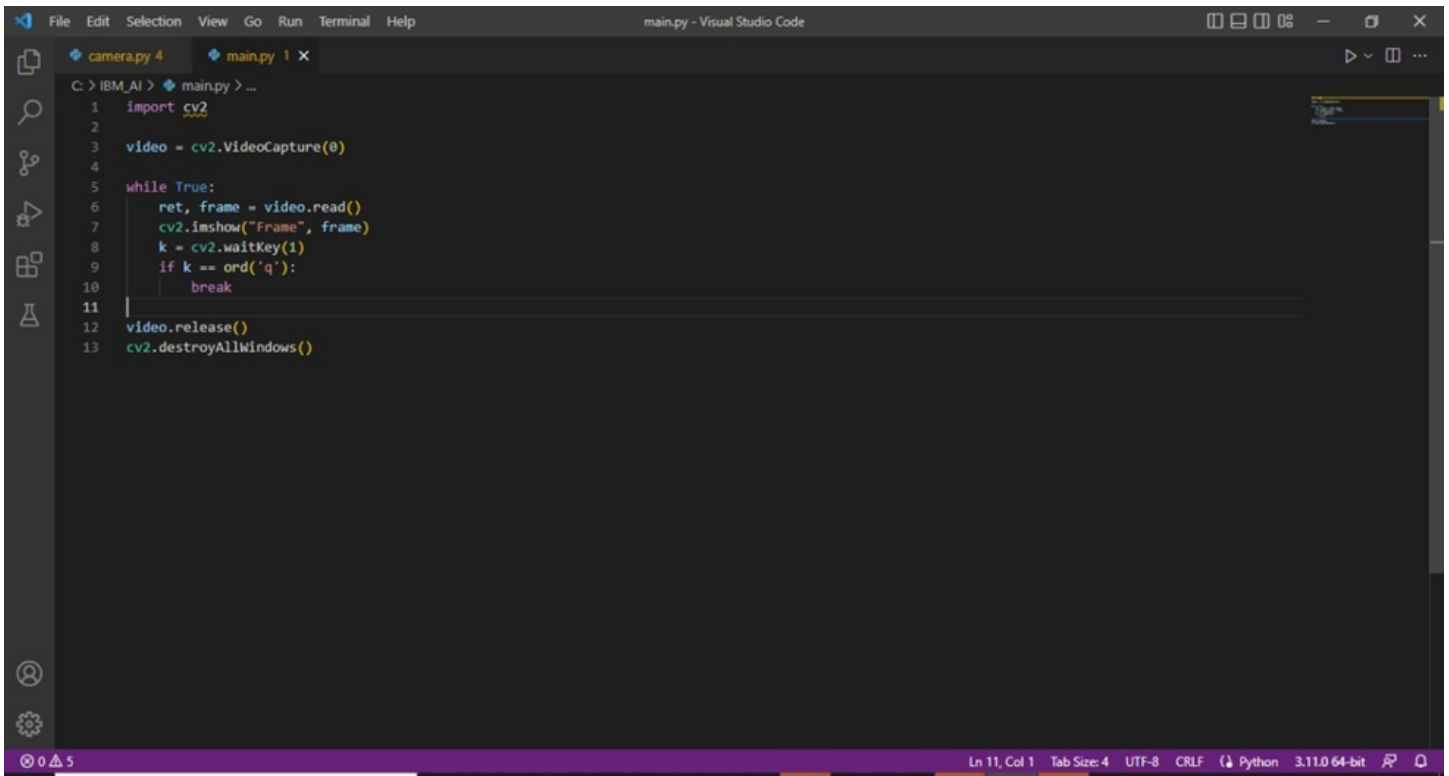
Ln 84, Col 8 Spaces: 4 UTF-8 CRLF HTML
```

Camera:

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

camera.py > Video > _init_
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.imwrite('img.jpg', frame)
```

Main:

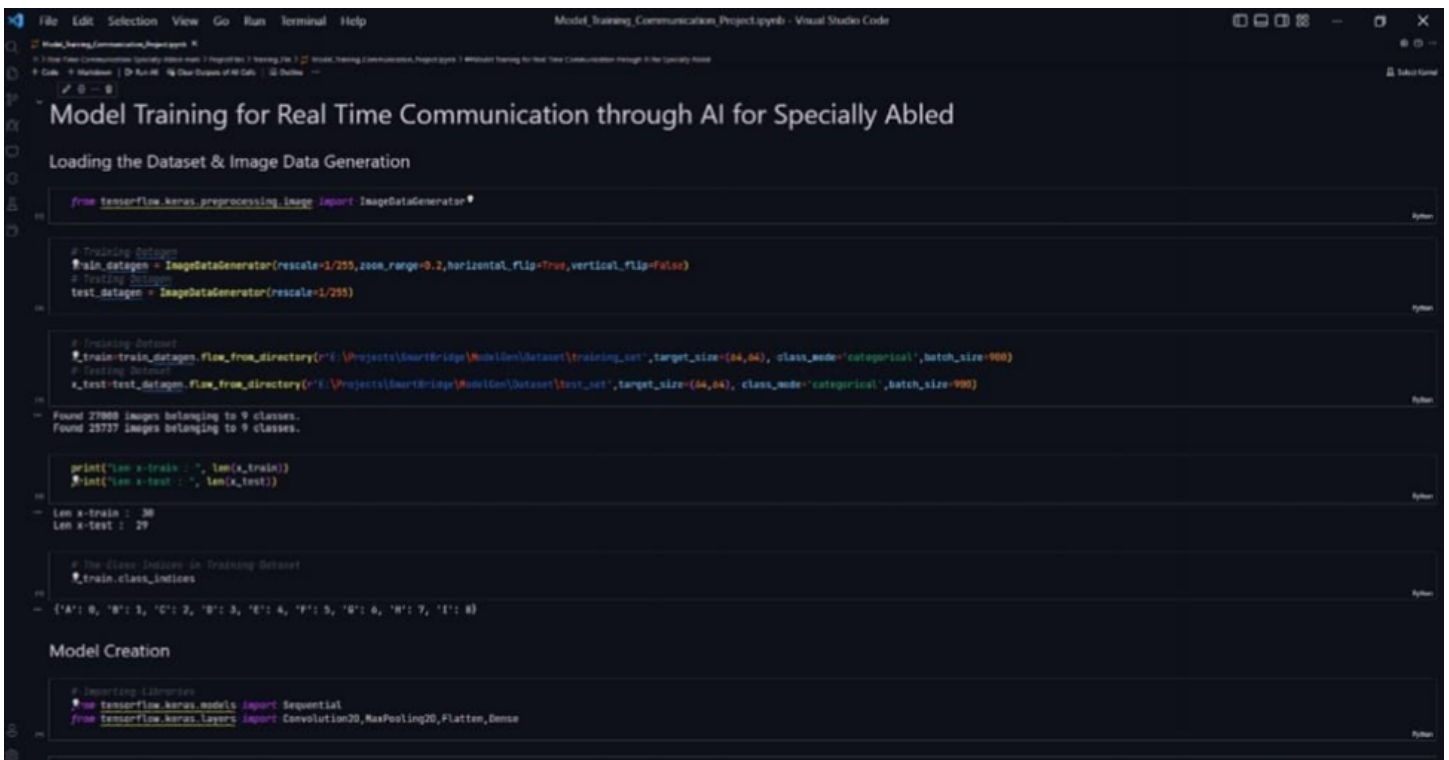


```
File Edit Selection View Go Run Terminal Help
main.py - Visual Studio Code

camera.py 4 main.py 1 x

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)

# Training Dataset
train=train_datagen.flow_from_directory(r'K:\Projects\SmartBridge\ModelGen\Dataset\training_set', target_size=(64,64), class_mode='categorical', batch_size=100)
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'K:\Projects\SmartBridge\ModelGen\Dataset\test_set', target_size=(64,64), class_mode='categorical', batch_size=100)

Found 27980 images belonging to 9 classes.
Found 25727 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
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-39752-1660497070>