REAL-TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

A PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1. Project 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. The communication and technologies associated with it is devoloping day by day. Especially, In the domain of Artificial Intelligence- healthcare systems, communication between specially abled and normal persons is becoming popular day by day. Differently abled peoples require better forms of communication, so that they can significantly improve their ability to get around and participate in daily activities.

1.2. Purpose

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

2. LITERATURE SURVEY

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. However, this is often not the most effective form of communication, as it is very dependent on the individual circumstances of both people and their environment (for example, some places may have too much background noise).

2.2. References

1.Bayan Mohammed Saleh, Reem Ibrahim Al-Beshr ,Muhammad Usman Tariq (September 2020), **D-Talk: Sign Language Recognition System for People with Disability using Machine Learning and Image Processing, International Journal of Advanced Trends in Computer Science and Engineering 9(4):4374-4382**
DOI:10.30534/ijatcse/2020/29942020

2**.** Ong Chin Ann, Marlene lu, Bee Theng Lau**(**January 2011), **A Face Based Real Time Communication for Physically and Speech Disabled People.**
DOI:10.4018/978-1-60960-541-4.ch003

3. B.K. Sy, J.R. Deller, **An AI-based communication system for motor and speech disabled persons: design methodology and prototype testing , IEEE Transactions on Biomedical Engineering (Volume: 36, Issue: 5, May 1989)**
DOI: **10.1109/10.24260**

4. Yukai Song; William Taylor; Yao Ge; Kia Dashtipour; Muhammad Ali Imran; Qammer H. Abbasi, **Design and Implementation of a Contactless AI-enabled Human Motion Detection System for Next-Generation Healthcare**, 2021 IEEE International Conference on Smart Internet of Things (SmartIoT),
DOI: 10.1109/SmartIoT52359.2021.00027

5. M. Bartlett, G. Littlewort, I. Fasel, J. Movellan, **Real Time Face Detection and Facial Expression Recognition: Development and Applications to Human Computer Interaction, 2003 Conference on Computer Vision and Pattern Recognition Workshop**
DOI:10.1109/CVPRW.2003.10057

6. Yash Patil, Sahil Krishnadas, Adya Kastwar, Sujata Kulkarni, **AI-Enabled Real-Time Sign Language Translator, Book: Soft Computing: Theories and Applications (pp.357-365)**
DOI:10.1007/978-981-15-4032-5_33

7. Chaithanya Kumar Mummadi, Frederic Philips Peter Leo, Keshav Deep Verma, Shivaji Kasireddy, Philipp M. Scholl, Jochen Kempfle, Kristof Van Laerhoven, **Real-Time and Embedded Detection of Hand Gestures with an IMU-Based Glove,**
DOI:10.3390/informatics5020028

8. R. L. Weerasinghe, G. U. Ganegoda, **A Comprehensive Review on Vision-based Sign Language Detection and Recognition, Conference: 2022 International Research Conference on Smart Computing and Systems Engineering (SCSE),** DOI:10.1109/SCSE56529.2022.9905100

9. Mohamed Aktham Ahmed, Bilal Bahaa, A. A. Zaidan, Mahmood Maher Salih, **A Review on Systems-Based Sensory Gloves for Sign Language Recognition State of the Art between 2007 and 2017**
DOI:10.3390/s18072208

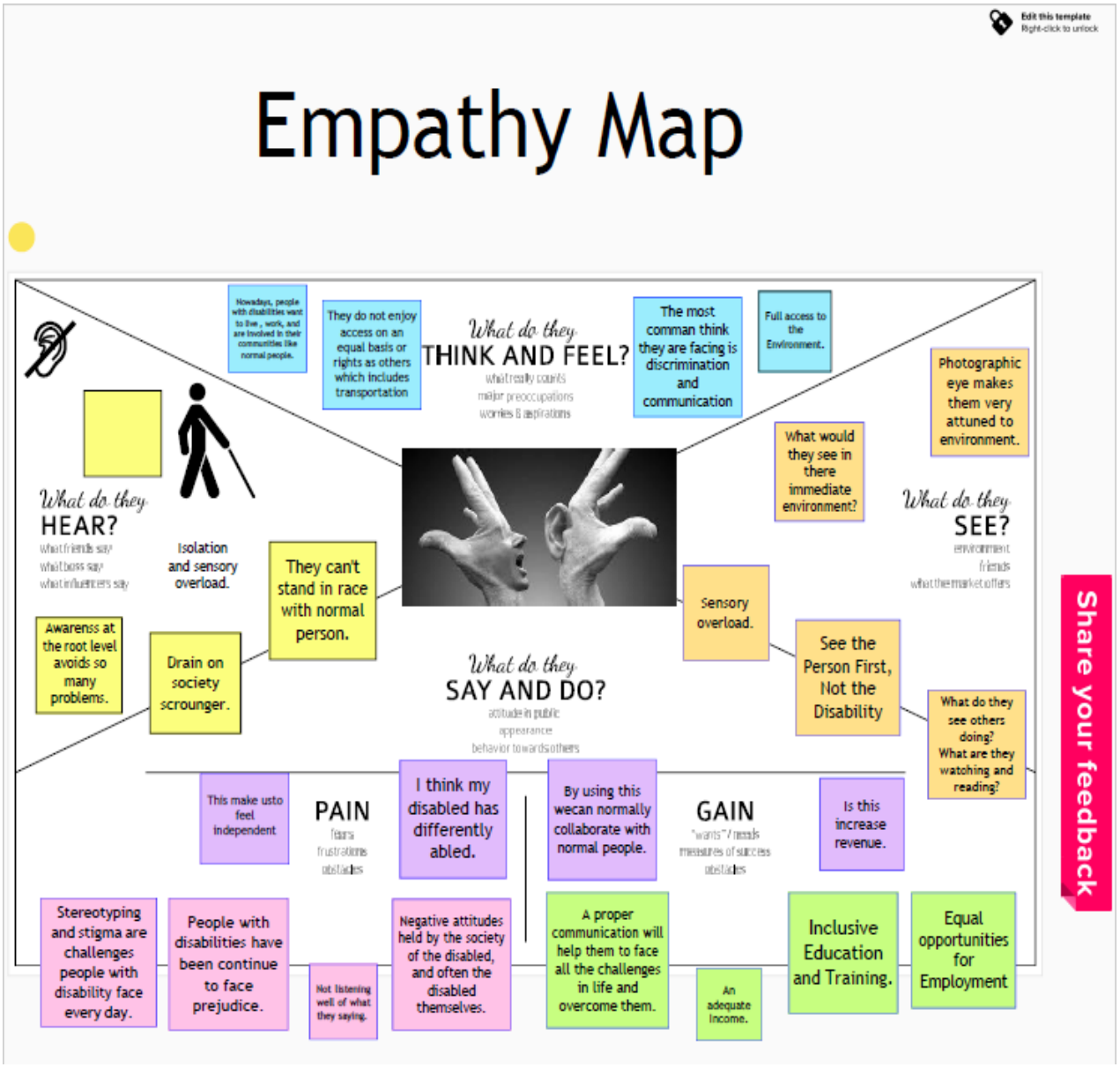
10. Deepali Rajaram Naglot, Milind Kulkarni, **Real time sign language recognition using the leap motion controller, Conference: 2016 International Conference on Inventive Computation Technologies (ICICT),**
DOI:10.1109/INVENTIVE.2016.7830097

2.3. Problem Statement Definition

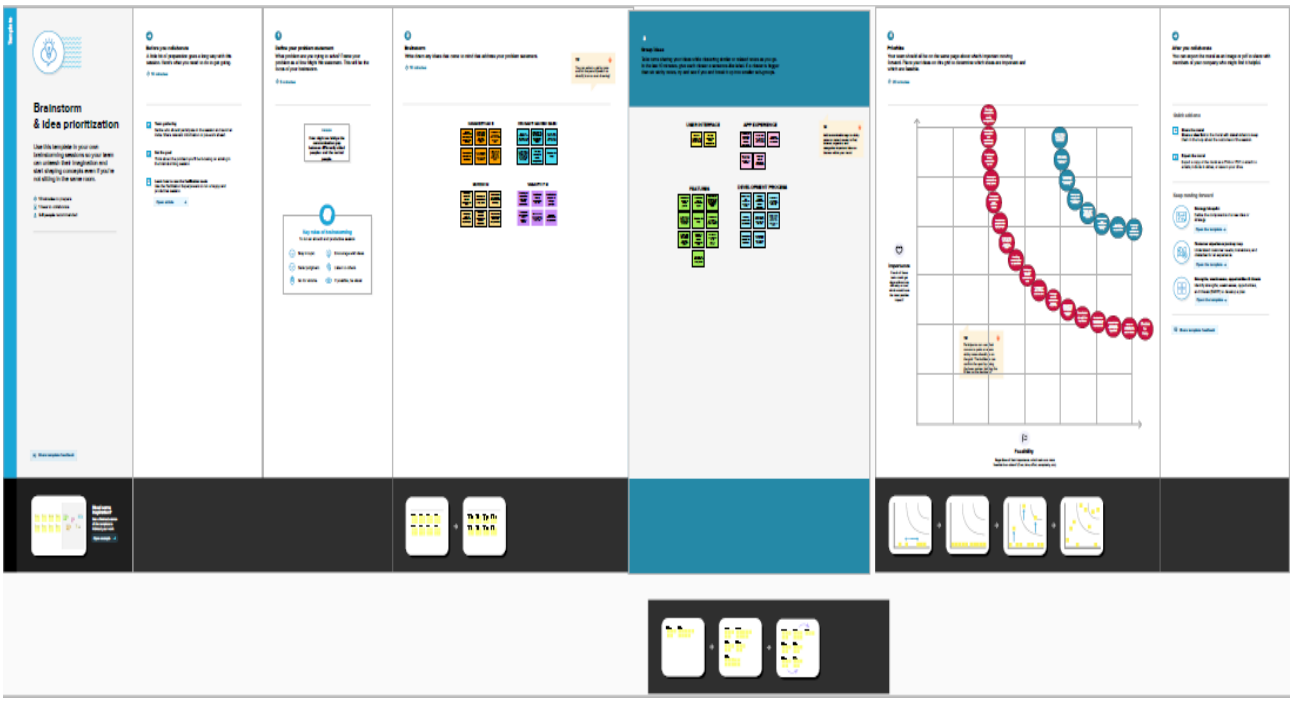
In our society, we have people with disabilities.The communication and technologies associated with it is devoloping day by day. Especially, In the domain of Artificial Intelligence- healthcare systems, communication between specially abled and normal persons is becoming popular day by day. Differently abled peoples require better forms of communication with the help of new technologies so that they can significantly improve their ability to get around and participate in daily activities. Since normal people are not trained, it is very difficult for them to understand their needs. Hence, normal people need special mechanisms to communicate with the differently abled and thus understand their needs and concerns and to have a proper communication medium.
The project focuses on developing a system which 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.

3. IDEATION & PROPOSED SOLUTION

3.1. Empathy Map Canvas



3.2. Ideation & Brainstorming

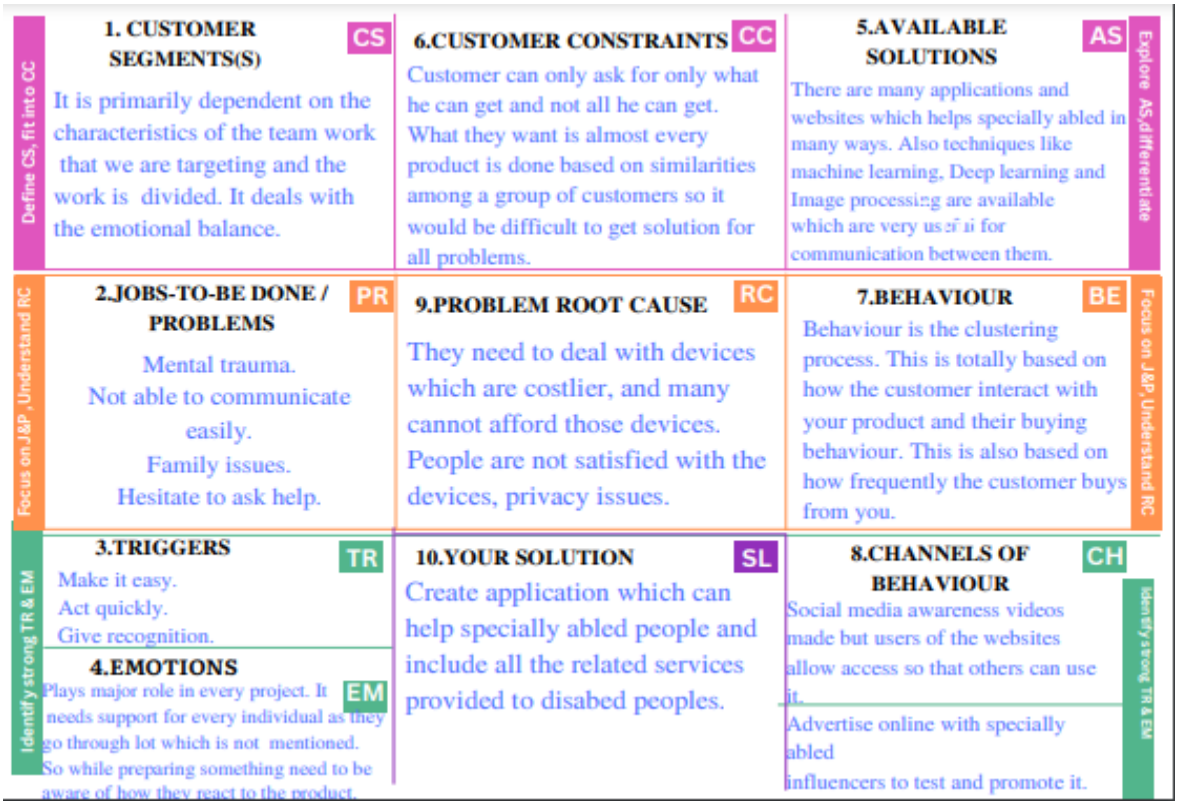


3.3. Proposed solution

This paper describes the system that overcomes the problem faced by the speech and hearing impaired. The objectives of the research are as follow:

1. To design and develop a system which lowers the communication gap between speech-hearing impaired and normal world.
2. To build a communication system that enables communications between deaf-dumbperson and a normal person.
3. A convolution neural network is being used to develop a model that is trained on various hand movements. This model is used to create an app. This programme allows deaf and hard of hearing persons to communicate using signs that are then translated into human- readable text.

3.4. Problem Solution Fit



4. REQUIREMENT ANALYSIS

4.1. Functional Requirements:

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 Logging in via LinkedIn
FR-2	User Confirmation	Email Confirmation OTP Confirmation
FR-3	User login	Logging in via their respective username and password
FR-4	Instructions and demo video	Helps users in understanding the use and functionality of the software

FR-5	Capture image and record audio	Granting access to the camera and microphone
FR-6	Implementation of application	Accessing the database Conversion of sign language to normal language and vice-versa

4.2. Non-functional Requirements:

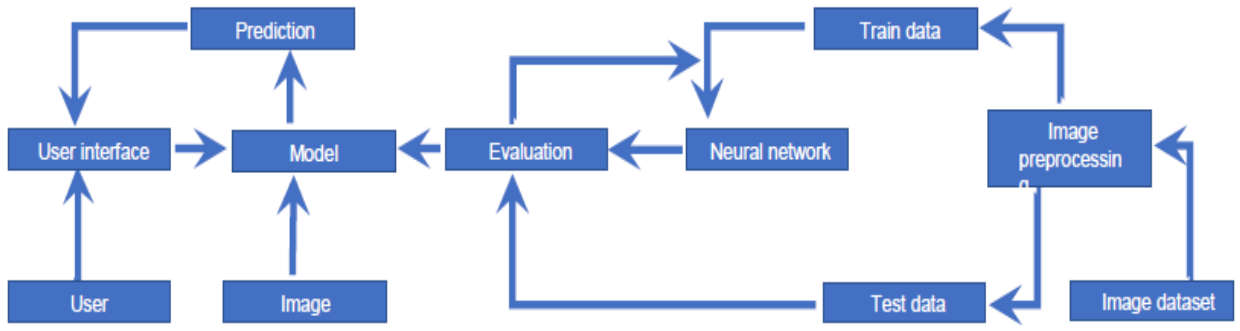
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The software is efficient and simple for users to understand and utilise.
NFR-2	**Security**	All information contained within the system, or a portion of it, is protected from malware attacks and illegal access.
NFR-3	**Reliability**	The application performs without any failure and does not produce any glitch.
NFR-4	**Performance**	The system responds quickly under different load conditions.
NFR-5	**Availability**	The system is accessible for a user at any given pointof time.
NFR-6	**Scalability**	It evaluates the heaviest workloads at which the system will still function properly.

5. PROJECT DESIGN

5.1. Data Flow Diagrams

Data Flow Diagrams:



5.2. Solution & Technical Architecture

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2

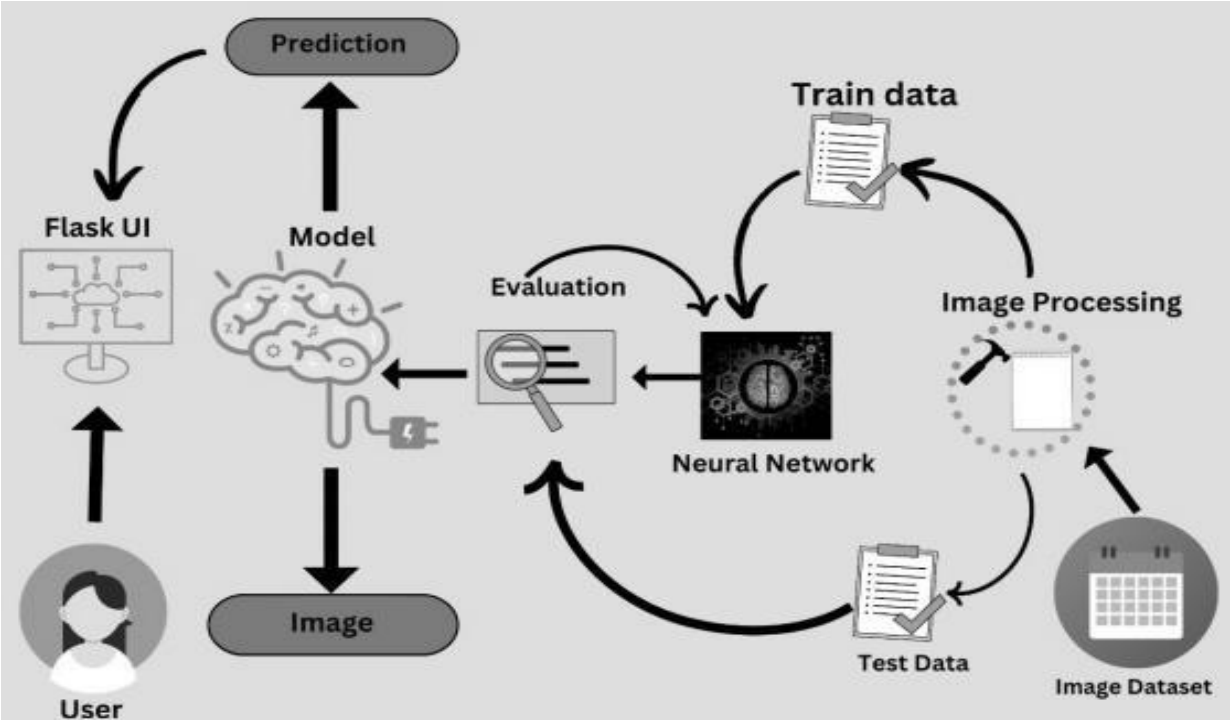


Table-1 : Components & Technologies

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g.Flask UI, Mobile App, image etc.	HTML, CSS, Javascript ,python etc.
2.	Application Logic-1	Logic for a process in the application	Python ,Jupyter,colab
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Dataset	Sample images etc.	Python,numpy,pandas etc.
6.	Model	Prediction of sample images	CNN model etc.
7.	File Storage	Storing the Predicted images	Google Colab
8.	External API-1	Purpose of External API used in the application	Tessract,Numpy

9.	External API-2	Purpose of External API used in the application	NN model
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure	Google Colab,Jupyter notebook,etc	Keras,Pytessract,Python, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open Source Notebook	Jupyter Notebook,Google colab,keras,Tessarct,etc	Image Reading,Image detection
2.	Security Implementations	Image willl be secure and not optimized	e.g. Pixels, color recongnization,etc
3.	Scalable Architecture	Reading the image and training and testing themoodel and predict the output	CNN model
4.	Availability	All applications are open sources available for free to use	Jupyter Notebbok,Keras,Google Colab
5.	Performance	The performance is good and can predict as muchas fast by using the application.	Google colab

5.3. User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Open application	USN-1	Open the application with a help of webpage or mobile application.	Can open in app/chrome	High	Sprint-1
	Home page	USN-2	Link directed into home page.	-	High	Sprint-1
	Introduction page	USN-3	Click on the demo/ introduction.	Introduction page willopen. Follow the instructions given.	Medium	Sprint-2
	Launch application	USN-4	Click launch to move the next page.	Launch the application, it will redirected to thenext page.	Medium	Sprint-1
	Selecting the conversion	USN-5	User need to select the conversion	User should select the conversion from text tosign or sign to text.	High	Sprint-1
	Output / conversion	USN - 6	Output on regional language	The gesture or text willdisplay		
Customer (Web user)	same for both users					
Customer Care Executive	Same for both normal and specially abled people					
Administrator	same for all the users					

6. PROJECT PLANNING & SCHEDULING

6.1. Sprint Planning & Estimation

Milestone	Function (Epic)	Milestone Story Number	Story / Task
Milestone 1	Data collection	M1	To develop our project, we are gathering data and generating two folders: one for training and the other for testing.
Milestone 2	Image preprocessing	M2	Importing libraries for image data generators and using their features to train the test set.
Milestone 3	Model building	M3	Importing the libraries for model Building,setting up the model, Convolution layer addition, layer pooling, layer flattening, Dense layer addition, compiling the model fit and saving it.
Milestone 4	Testing the model	M4	First import the packages. The testimage is then preprocessed and predicted when the model has been saved and loaded.
Milestone 5	Application layer	M5	Create the HTML pages and the Flask application.
Milestone 6	Train CNN model	M6	Create an IBM Cloud account and trainyour image classification model.
Milestone 7	Final result	M7	To ensure that all processes result in the desired outcome.

Milestone Activity Plan

6.2. Sprint Delivery Schedule

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	VASANTH PM, MUKESH M
Sprint-1		USN-2	Image preprocessing	8	Medium	MUKESH M, NAVANEETHAN B
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model	10	High	ORUGANTI MAHESH BABU, NAVANEETHAN B
Sprint-2		USN-4	Training the image classification modelusing CNN	7	Medium	MUKESH M, VASANTH PM
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	VASANTH PM, ORUGANTI MAHESH BABU
Sprint-4	Implementation of the application	USN-6	Converting the input sign languageimages into English alphabets	8	Medium	NAVANEETHAN B, ORUGANTI MAHESH BABU

Project Tracker & Velocity:

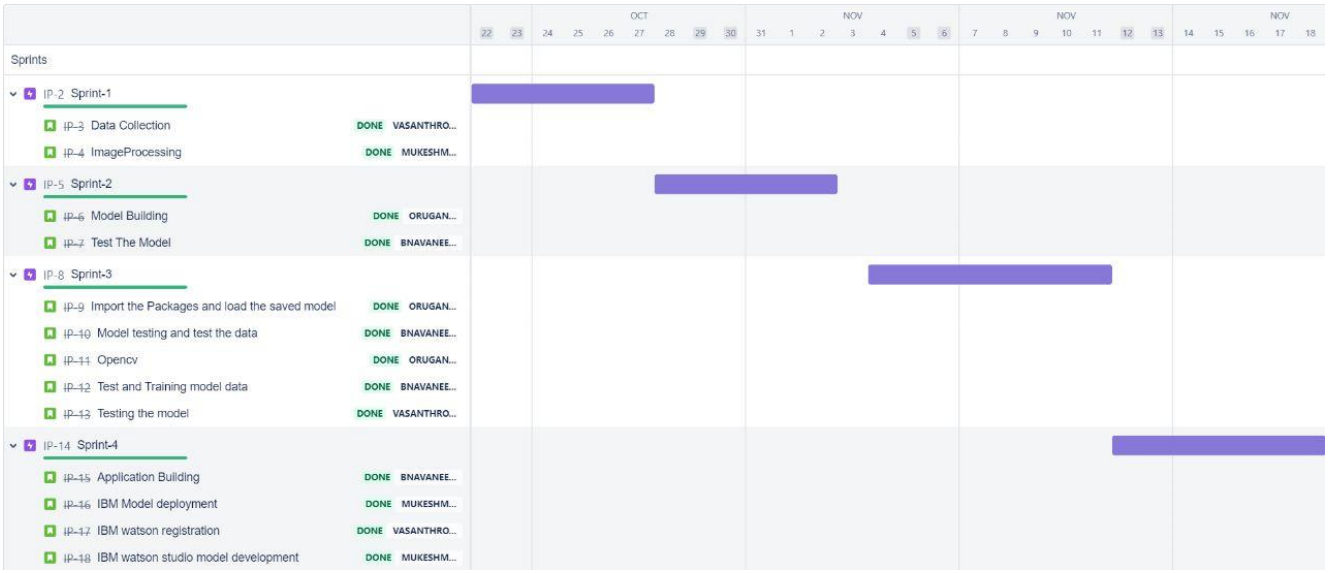
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	10	6 Days	22 Oct 2022	27 Oct 2022	8	27 Oct 2022
Sprint-2	10	6 Days	28 Oct 2022	02 Nov 2022	5	02 Nov 2022
Sprint-3	10	6 Days	05 Nov 2022	09 Nov 2022	7	09 Nov 2022
Sprint-4	10	6 Days	12 Nov 2022	18 Nov 2022	5	18 Nov 2022

Velocity:

$$AV = \frac{sprint\ duration}{velocity}$$

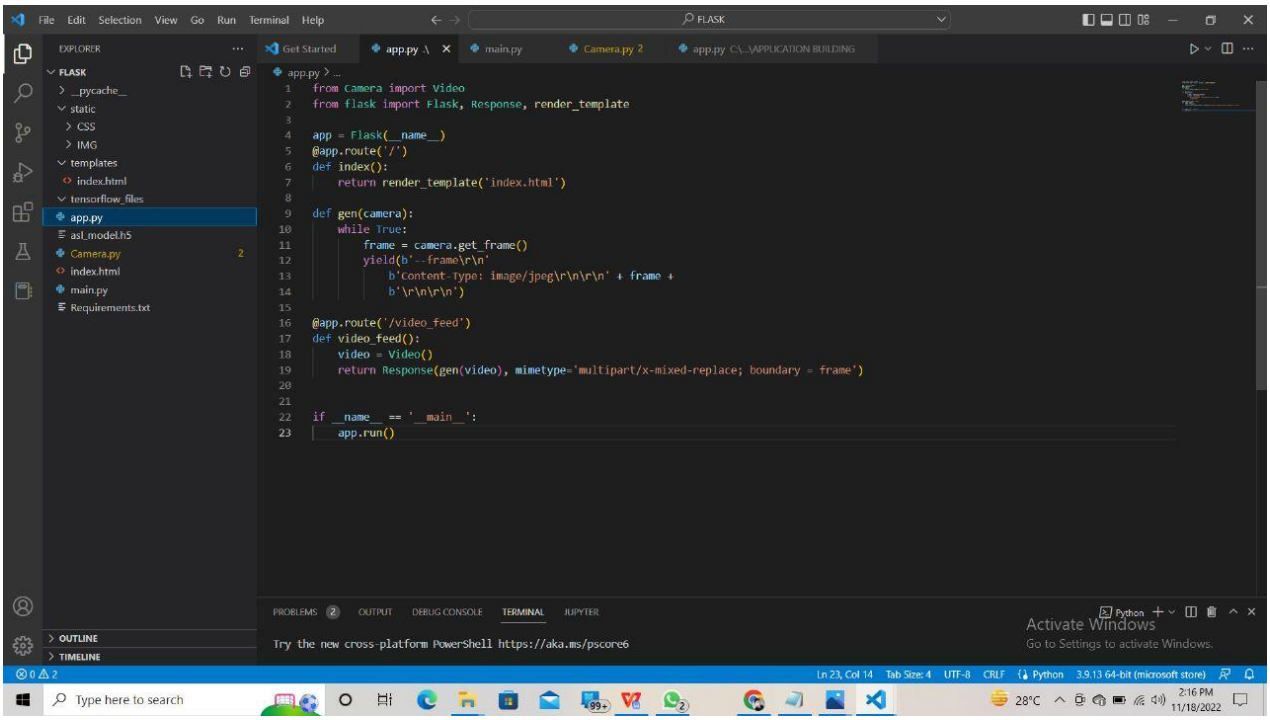
AV = 6/10 = 0.6

6.3. Reports from JIRA:

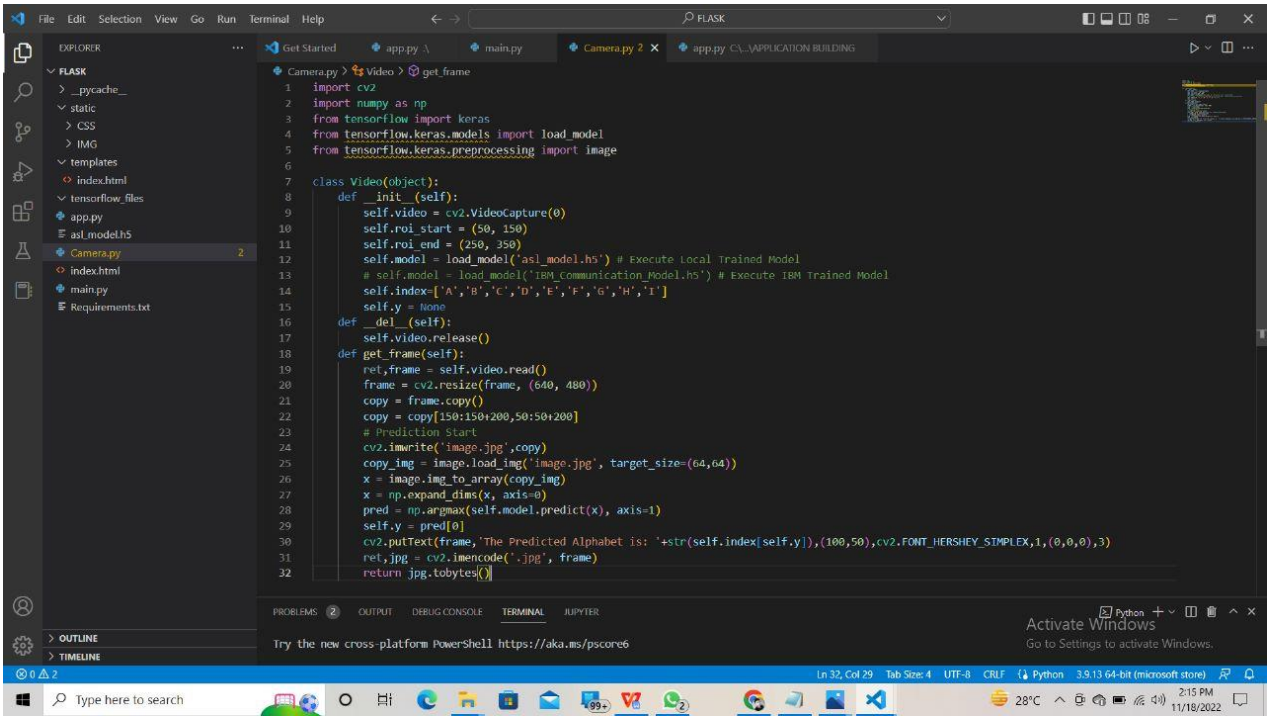


7.CODING & SOLUTIONING:

7.1. APP:



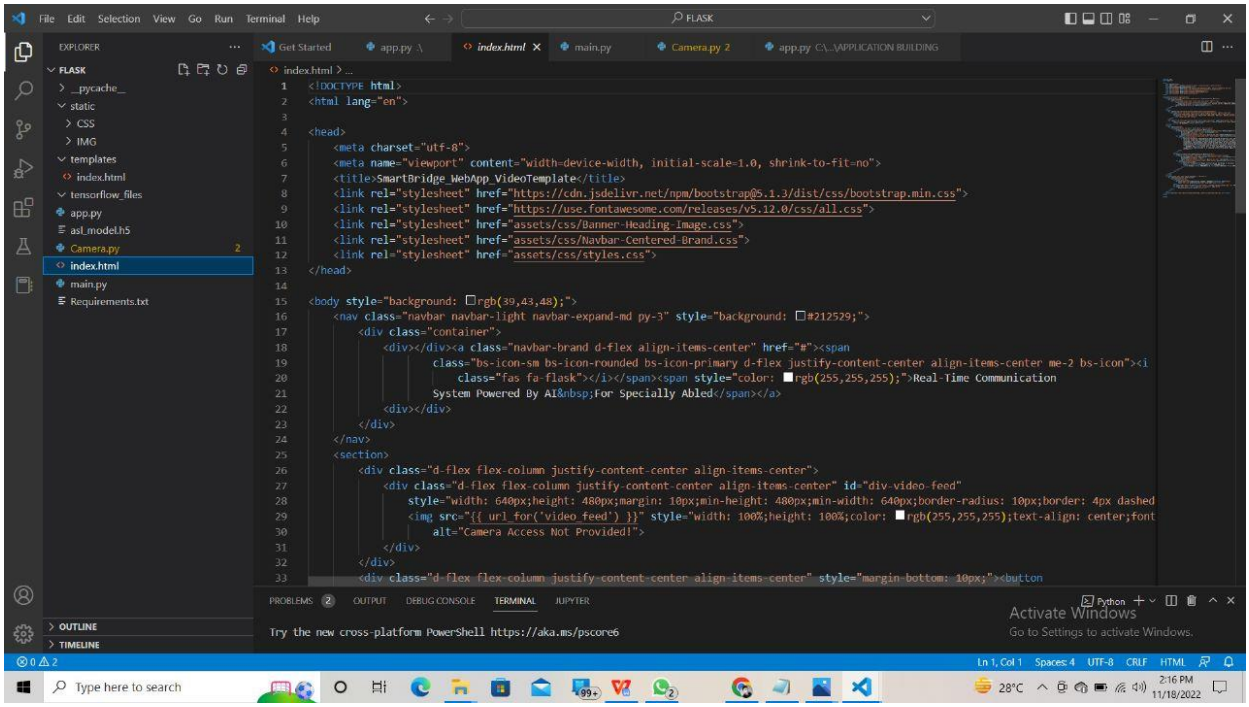
7.2. CAMERA:



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

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('IBM_Communication_Model.h5') # Execute IBM Trained Model
        self.index=['A','B','C','D','E','F','G','H','I']
        self.y = None
    def __del__(self):
        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 Start
        cv2.imwrite('image.jpg',copy)
        copy_img = image.load_img('image.jpg', target_size=(64,64))
        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)
        return jpg.tobytes()
```

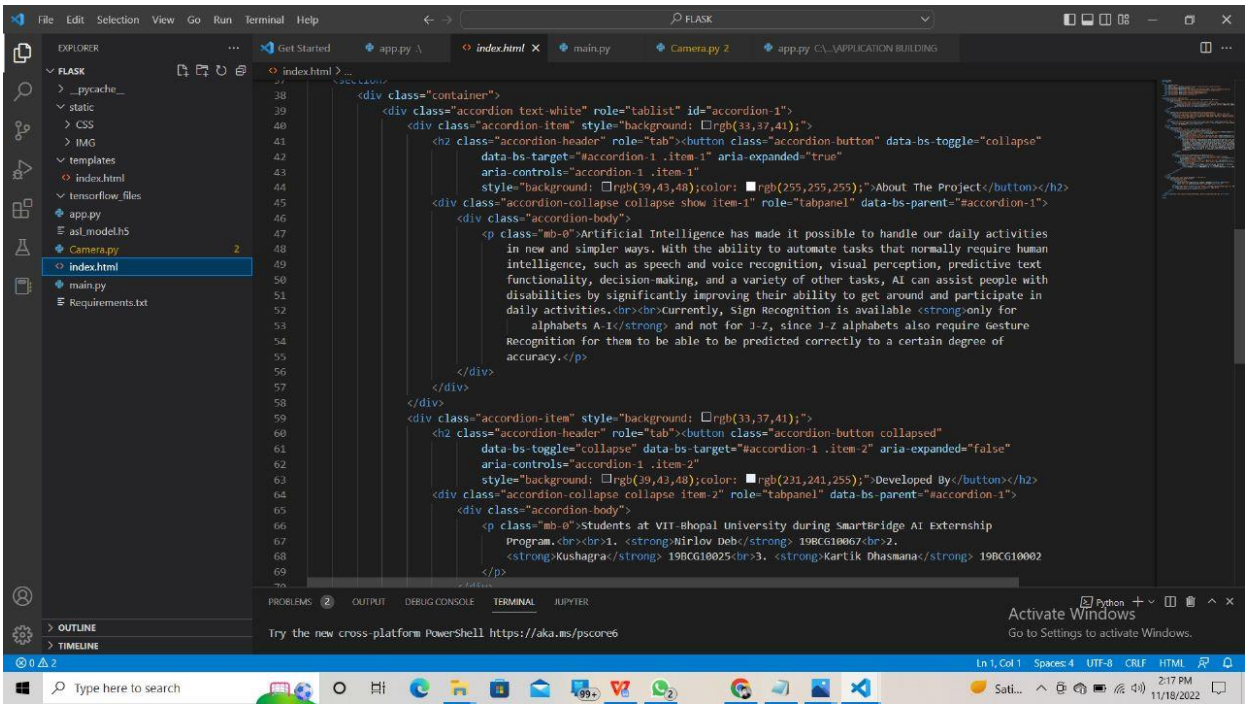
7.3. HTML INDEX:



```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>SmartBridge_WebApp_VideoTemplate</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="assets/css/Banner-Heading-Image.css">
    <link rel="stylesheet" href="assets/css/Navbar-Centered-Brand.css">
    <link rel="stylesheet" href="assets/css/styles.css">
</head>

<body style="background: rgb(39,43,48);">
    <nav class="navbar navbar-light navbar-expand-md py-3" style="background: #212529;">
        <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><span style="color: rgb(255,255,255);">Real-Time Communication
                    System Powered By AI For Specially Abled</span></a>
            <div></div>
        </div>
    </nav>
    <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: 640px;height: 480px;margin: 10px;min-height: 480px;min-width: 640px;border-radius: 10px;border: 4px dashed
                <img src="{{ url_for('video_feed') }}" style="width: 100%;height: 100%;color: rgb(255,255,255);text-align: center;font
                    alt="Camera Access Not Provided!">
            </div>
        </div>
        <div class="d-flex flex-column justify-content-center align-items-center" style="margin-bottom: 10px;"><button
```


File Edit Selection View Go Run Terminal Help
FLASK
EXPLORER
Get Started
app.py
index.html
main.py
Camera.py 2
app.py C:\...\APPLICATION BUILDING
index.html > ...
FLASK
__pycache__
static
CSS
IMG
templates
index.html
tensorflow_files
app.py
asl_model.h5
Camera.py 2
index.html
main.py
Requirements.txt

<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="background: rgb(39,43,48);color: rgb(255,255,255);">About The Project</button></h2>

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.

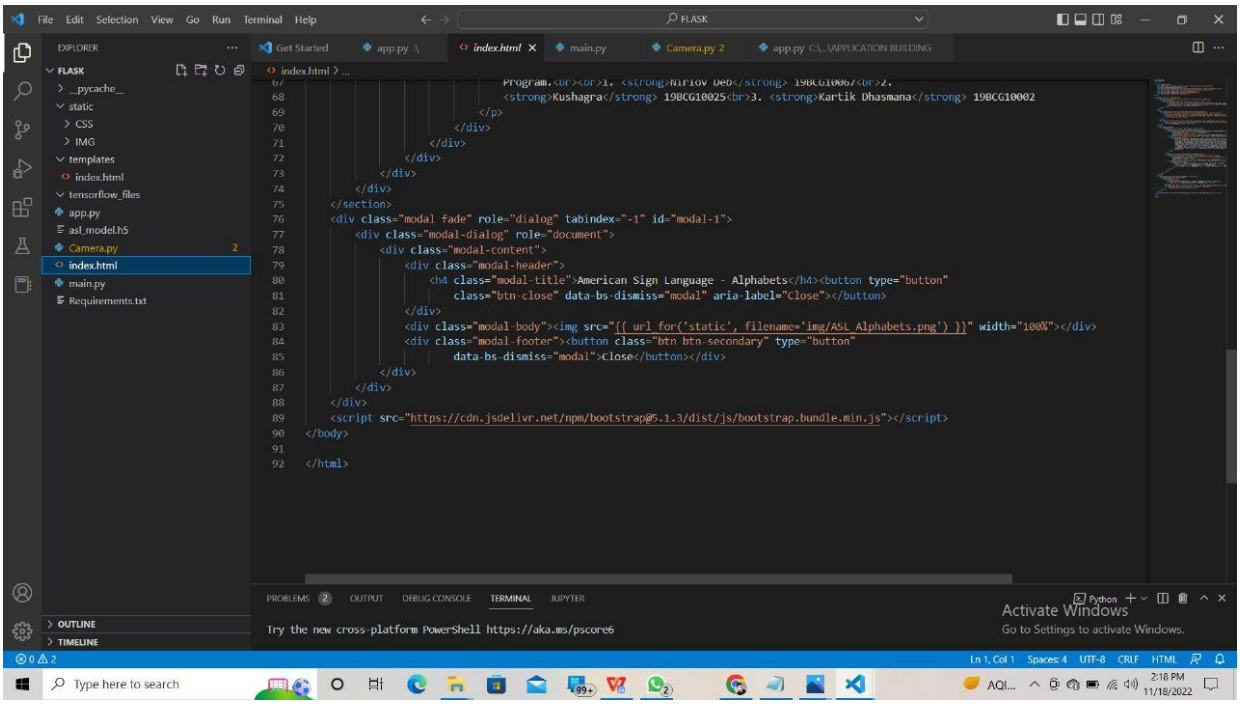
Currently, Sign Recognition is available only for
alphabets A-I and not for J-Z, since J-Z alphabets also require Gesture
Recognition for them to be able to be predicted correctly to a certain degree of
accuracy.

<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="background: rgb(39,43,48);color: rgb(231,241,255);">Developed By</button></h2>

Students at VIT-Bhopal University during SmartBridge AI Externship
Program.

1. Nirlov Deb 19BCG10067
2.
Kushagra 19BCG10025
3. Kartik Dhasmana 19BCG10002

PROBLEMS 2 OUTPUT DEBUG CONSOLE TERMINAL JUPYTER
Try the new cross-platform PowerShell https://aka.ms/pscore6
Activate Windows
Go to Settings to activate Windows.
Ln 1, Col 1 Spaces: 4 UTF-8 CRLF HTML
Type here to search
2:17 PM
11/18/2022


File Edit Selection View Go Run Terminal Help
FLASK
EXPLORER
Get Started
app.py
index.html
main.py
Camera.py 2
app.py C:\...\APPLICATION BUILDING
index.html > ...
FLASK
__pycache__
static
CSS
IMG
templates
index.html
tensorflow_files
app.py
asl_model.h5
Camera.py 2
index.html
main.py
Requirements.txt
Program.

1. Nirlov Deb 19BCG10067
2.
Kushagra 19BCG10025
3. Kartik Dhasmana 19BCG10002

</section>

<h4 class="modal-title">American Sign Language - Alphabets</h4><button type="button"
class="btn-close" data-bs-dismiss="modal" aria-label="Close"></button>

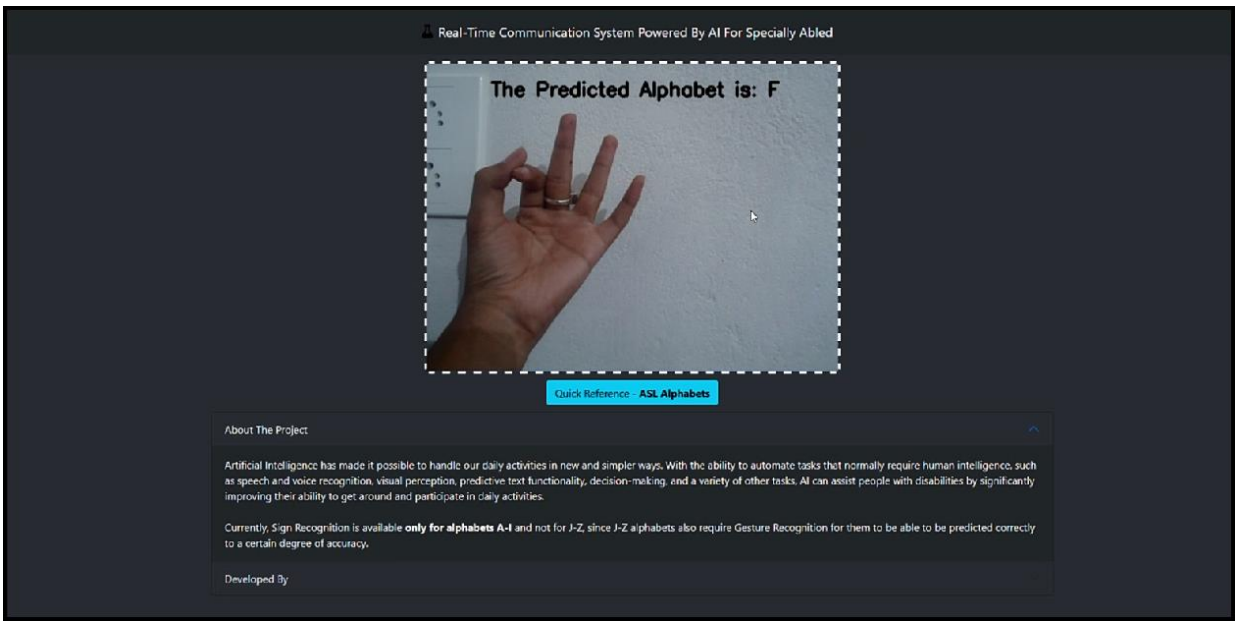
<img src="{{ url_for('static', filename='img/ASL Alphabets.png') }}" width="100%">
<button class="btn btn-secondary" type="button"
data-bs-dismiss="modal">Close</button>

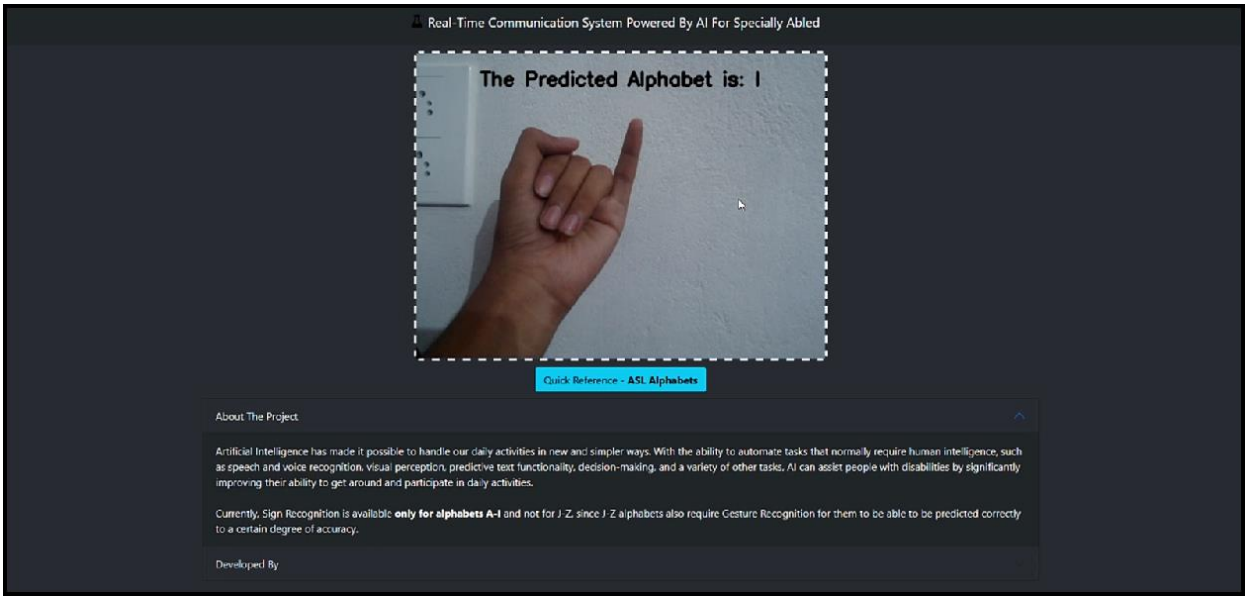
<script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
</body>
</html>
PROBLEMS 2 OUTPUT DEBUG CONSOLE TERMINAL JUPYTER
Try the new cross-platform PowerShell https://aka.ms/pscore6
Activate Windows
Go to Settings to activate Windows.
Ln 1, Col 1 Spaces: 4 UTF-8 CRLF HTML
Type here to search
2:18 PM
11/18/2022

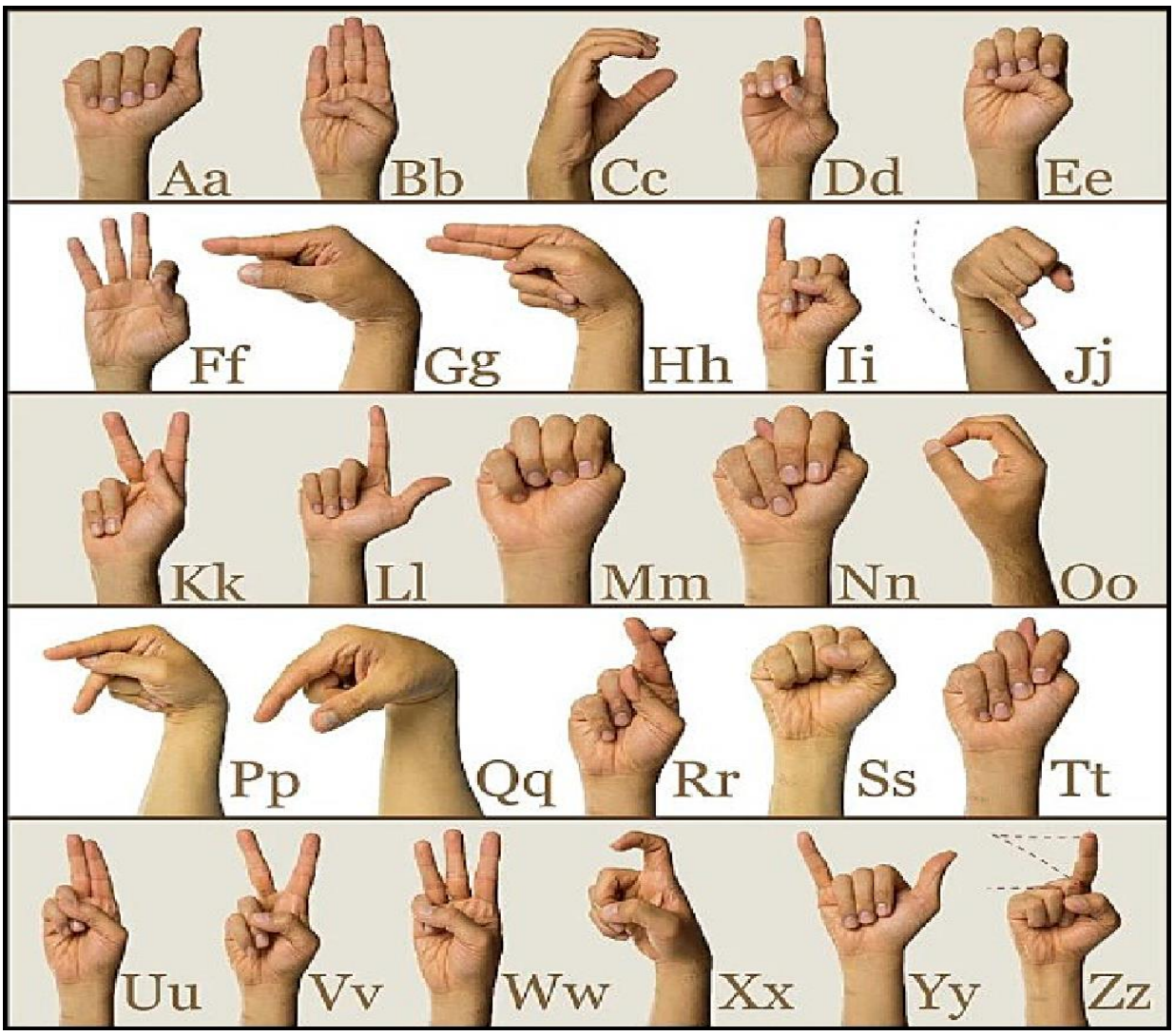
8. RESULTS:

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 recognise the equivalent Alphabet is shown on the screen.

Some sample images of the output are provided below:







American Sign Language Standard Reference

9. ADVANTAGES & DISADVANTAGES

Advantages:

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

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

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 requiresome 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 thatcan easily be improved by change in dataset.

10. 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 gapbetween 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 recognises them and displays the equivalentAlphabet 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.

11. 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 deafand 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.

12.APPENDIX:

12.1. Source Code:

Main:

```
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()
```

App:

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

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()
```

Camera:

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

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('IBM_Communication_Model.h5') # Execute IBM Trained Model
        self.index=['A','B','C','D','E','F','G','H','I']
        self.y = None
```

```
        def _del_(self):
                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 Start
                cv2.imwrite('image.jpg',copy)
                copy_img = image.load_img('image.jpg', target_size=(64,64))
                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)
                return jpg.tobytes()
```

Index 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>SmartBridge_WebApp_VideoTemplate</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="assets/css/Banner-Heading-Image.css">
    <link rel="stylesheet" href="assets/css/Navbar-Centered-Brand.css">
    <link rel="stylesheet" href="assets/css/styles.css">
</head>

<body style="background: rgb(39,43,48);">
    <nav class="navbar navbar-light navbar-expand-md py-3" style="background: #212529;">
        <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><span style="color: rgb(255,255,255);">Real-Time Communication
                    System Powered By AI&amp;nbsp;For Specially Abled</span></a>
            <div></div>
        </div>
    </nav>
    <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: 640px;height: 480px;margin: 10px;min-height: 480px;min-width: 640px;border-radius: 10px;border: 4px dashed rgb(255,255,255) ;">
                <img src="{{ url_for('video_feed') }}" style="width: 100%;height: 100%;color: rgb(255,255,255);text-align: center;font-size: 20px;"
                    alt="Camera Access Not Provided!">
            </div>
        </div>
        <div class="d-flex flex-column justify-content-center align-items-center" style="margin-bottom: 10px;"><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="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="background: rgb(39,43,48);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">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.<br><br>Currently, Sign
Recognition is available <strong>only for alphabets A-I</strong> 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.</p>

                        </div>

                    </div>

                </div>

                <div class="accordion-item" style="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="background: rgb(39,43,48);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 at Sona college of Technology <br><br>

1. <strong>Navaneethan B</strong> 1919103071<br>2.

                        <strong>Oruganti Mahesh Babu</strong> 1919103078<br>3.
<strong>Mukesh M</strong> 1919103069<br>4. <strong>Vasanth  PM</stong> 1919103711

                    </p>

                </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-drismiss="modal" aria-label="Close"></button>

            </div>

            <div class="modal-body"><img src="{{ url_for('static',
filename='img/ASL_Alphabets.png') }}" width="100%"></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>
```

GITHUB LINK: **https://github.com/IBM-EPBL/IBM-Project-24655-1659946955**

PROJECT DEMO LINK: **https://drive.google.com/file/d/1W-MChDlLGmszWmZg8YoiuVqovngAqPh4/view?usp=sharing**