ARTIFICIAL INTELLIGENCE

REAL TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

PROJECT REPORT

IBM PROJECT – TEAM ID:PNT2022TMID39569

TEAM LEAD

G HARISH KUMAR-510619104025

TEAM MEMBERS

B MOHAMED WASEEM - 510619104039

R KAMALESH - 510619104032

J AJITH - 510619104006

R KISHORE KUMAR – 510619104035

OF

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

C.ABDUL HAKEEM COLLEGE OF ENGINEERING AND TECHNOLOGY

ANNA UNIVERSITY:CHENNAI – 600 025

S.NO	TABLE OF CONTENT
1	**INTRODUCTION** 1.1 Project Overview 1.2 Purpose
2	**LITERATURE SURVEY** 2.1 Existing problem 2.2 References 2.3 Problem Statement Definition
3	**IDEATION & PROPOSED SOLUTION** 3.1 Empathy Map Canvas 3.2 Ideation & Brainstorming 3.3 Proposed Solution 3.4 Problem Solution fit
4	**REQUIREMENT ANALYSIS** 4.1 Functional requirement 4.2 Non-Functional requirements
5	**PROJECT DESIGN** 5.1 Data Flow Diagrams 5.2 Solution & Technical Architecture 5.3 User Stories
6	**PROJECT PLANNING & SCHEDULING** 6.1 Sprint Planning & Estimation 6.2 Sprint Delivery Schedule 6.3 Reports from JIRA
7	**CODING & SOLUTIONING (Explain the features added in the project along with code)** 7.1 Feature 1 7.2 Feature 2
8	**TESTING** 8.1 Test Cases 8.2 User Acceptance Testing
9	**RESULTS** Performance Metrics
10	**ADVANTAGES & DISADVANTAGES**
11	**CONCLUSION**
12	**FUTURE SCOPE**
13	**APPENDIX** Source Code GitHub & Project Demo Link

1.INTRODUCTION

1.1 Project Overview

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.

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. We are making use of a convolution neural network to create a model that is trained on different hand gestures. A Web Application is built which uses this model. This application enables deaf and dumb people to convey their information using signs which get converted to human understandable language.

2.LITERATURE SURVEY

2.1 Existing problem

Survey 1:

LUO CH, SHIH CH(1996):

ADAPTIVE MORSE-CODED SINGLE-SWITCH COMMUNICATION SYSTEM FOR THE DISABLED:

Luo CH, Shih CH et.al. proposed an approach to help persons with impaired hand coordination and dexterity by developing a Morse code based keyboard. Morse code, with an easy-to operate, single switch input system has been selected as an excellent communication adaptive device. It has already been successfully applied as a communication tool for people with severe physical handicaps in areas that would otherwise not be accessible to them, including writing, typing, calculating, and drawing. The major disadvantage the difficulty of maintaining precise time intervals, a Morse code time series, especially when typed by a severely physically disabled person, is generated with an unstable typing speed. Therefore, a suitable adaptive automatic recognition method is needed.

Survey 2:

MARCIA B. DUGAN(2003):

LIVING WITH HEARING LOSS:

Marcia B. Dugan et.al. proposed approach provides a way to communicate via text messages over a regular phone line for the users who are normal as well who are deaf using TTY(Text Telephony) technique. TTY requires specialized equipment's that usually consists of a type writer like keyboard, a telephony coupler and some form of visual display. The major disadvantage in their proposed system is that the possession of TTY equipment isn't as widespread within the general masses during that period of time which makes it complicated for communication to occur between deaf and non deaf individuals.

Survey 3:

G. LEITNER, S. PLATTNER, AND M. HITZ(2006):

USABILITY EVALUATION OF MOBILE APPLICATIONS IN LEISURE-ORIENTED CONTEXTS:

G. Leitner,S. Plattner, and M. Hitz et.al. proposed pictogram based communication system between a patient and physicians aids non native language speakers or people with speech, hearing or cognitive impairments to communicate the relevant medical information or others signs to physicians in a more efficient way. It makes use of intuitive icons and interactive symbols which are easy to access and difficult to misplace. The advantages of their proposed system is that the Quick, simple, easy and intuitive communication is used to assist the person who is injured or paralyzed with the help of medical personnel as well.

Survey 4:

WONG SENG YUE AND NOR AZAN MAT ZIN(2013):

VOICE RECOGNITION AND VISUALIZATION MOBILE APPS GAME FOR TRAINING AND TEACHING HEARING HANDICAPS CHILDREN:

Wong S. et al. suggested an application for teaching earless kids who have issues in acquiring knowledge, understanding and responding, to overcome this issue by providing a reciprocative virtual environment. The concept was to inspire them to exercise, maintain and improve without any aid from anybody else. If the audio correlates a word exactly in the database, the pictorial output is seen. This type of matching causes a major disadvantage in their project as

it needs to store a huge amount of predefined audio formats with their corresponding word patterns and it also consumes more time during communication as it needs to match with the words and audios present in the database each time and during each message.

Survey 5:

M.BANDODKAR, AND V.CHOURASIA(2014):

LOW COST REAL TIME COMMUNICATION BRAILLE HANDGLOVE FOR VISUALLY IMPAIRED USING SLOT SENSORS AND VIBRATION MOTORS:

Bandodkar et.al. developed a Braille hand glove for visually impaired using slot sensors and vibration motors. This system is designed a one handed braille glove for English characters. the motors are attached to five fingers and to the palm. Another system UbiBraille is designed for two handed braille system which uses index finger, middle finger and ring finger to wear six ring vibrators as the actuators.

Survey 6:

CHING-HUA CHUAN, ERIC REGINA, AND CAROLINE GUARDINO(2014):

AMERICAN SIGN LANGUAGE RECOGNITION USING LEAP MOTION SENSOR:

Ching-Hua Chuan et.al. used a palm-sized, handy and a low-cost 3D motion sensor for recognition of American Sign Language. They used Support Vector Machine and K-nearest neighbour to analyse the 26 English alphabets in American Sign Language utilizing the imitative aspects of the collected data. The testing results in the high mean classification rate of 79.83% and 72.78% was attained by a SVM and k-nearest neighbour accordingly.

Survey 7:

M.V.N.R.P.KUMAR, ASHUTOSH KUMAR, S.B. ARAWANDEKAR, A. A. BHOSALE AND R. L. BHOSALE(2015):

AVR BASED GESTURE VOCALIZER USING SPEECH SYNTHESIZER IC:

M.V.N.R.P. Kumar et.al. created a system consisting of a gadget that converts a sign into audio and text to enable the contact among the silent societies and the hearing people. Data glove can detect almost all the hand movements and AVR microcontroller based system converts described movements into audio and text form on LCD for the hearing impaired. The tongue-tied people can use these gloves to depict gestures that will be transformed into audio so that hearing people can effortlessly comprehend its interpretation.

Survey 8:

AMRITHA SURESH, BINNY PAULOSE, RESHMA JAGAN AND JOBY GEORGE (2016):

VOICE BASED EMAIL FOR BLIND:

A voice based email architecture is proposed by Amritha Suresh, Binny Paulose, Reshma Jagan and Joby George which will help blind people to access email. The proposed system makes use of Speech Recognition, Interactive Voice Response and Mouse Click events. Also, for additional security purposes voice recognition is used for user verification. The existing system is not user friendly for blind people as it does not give any audio feedback to readout contents for them.

2.2 References

1. Luo CH, Shih CH. Adaptive Morse-coded single-switch communication system for the disabled. Int J of Biomed Comput 1996;41:99–106.
2. Living With Hearing Loss, Marcia B. Dugan, 2003.
3. G. Leitner, S. Plattner, and M. Hitz, “Usability evaluation of mobile applications in leisure-oriented contexts,” Information and Communication Technologies in Tourism, pp. 158–169, 2006.
4. Wong Seng Yue and Nor Azan Mat Zin, ”Voice Recognition and Visualization Mobile

   Apps Game for Training and Teaching Hearing Handicaps Children,” The 4th International Conference on Electrical Engineering and Informatics (ICEEI), pp. 479 486, 2013.
5. M.Bandodkar, and V.Chourasia,”Low cost real time communication Braille hand-glove for visually impaired using slot sensors and vibration motors”2014.
6. Ching-Hua Chuan, Eric Regina, and Caroline Guardino,” American Sign Language Recognition Using Leap Motion Sensor,” 13th IEEE International Conference on Machine Learning and Applications, 2014.

7. M.V.N.R.P.kumar, Ashutosh Kumar, S.B. Arawandekar, A. A. Bhosale and R. L. Bhosale, ”AVR Based Gesture Vocalizer Using Speech Synthesizer IC,” International Journal of Research in Advent Technology, Vol.3, No.5, 2015.
8. Amritha Suresh, Binny Paulose, Reshma Jagan and Joby George, "Voice Based Email for Blind". International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET) - Volume 2, Issue 3, 2016, pp. 93-97.

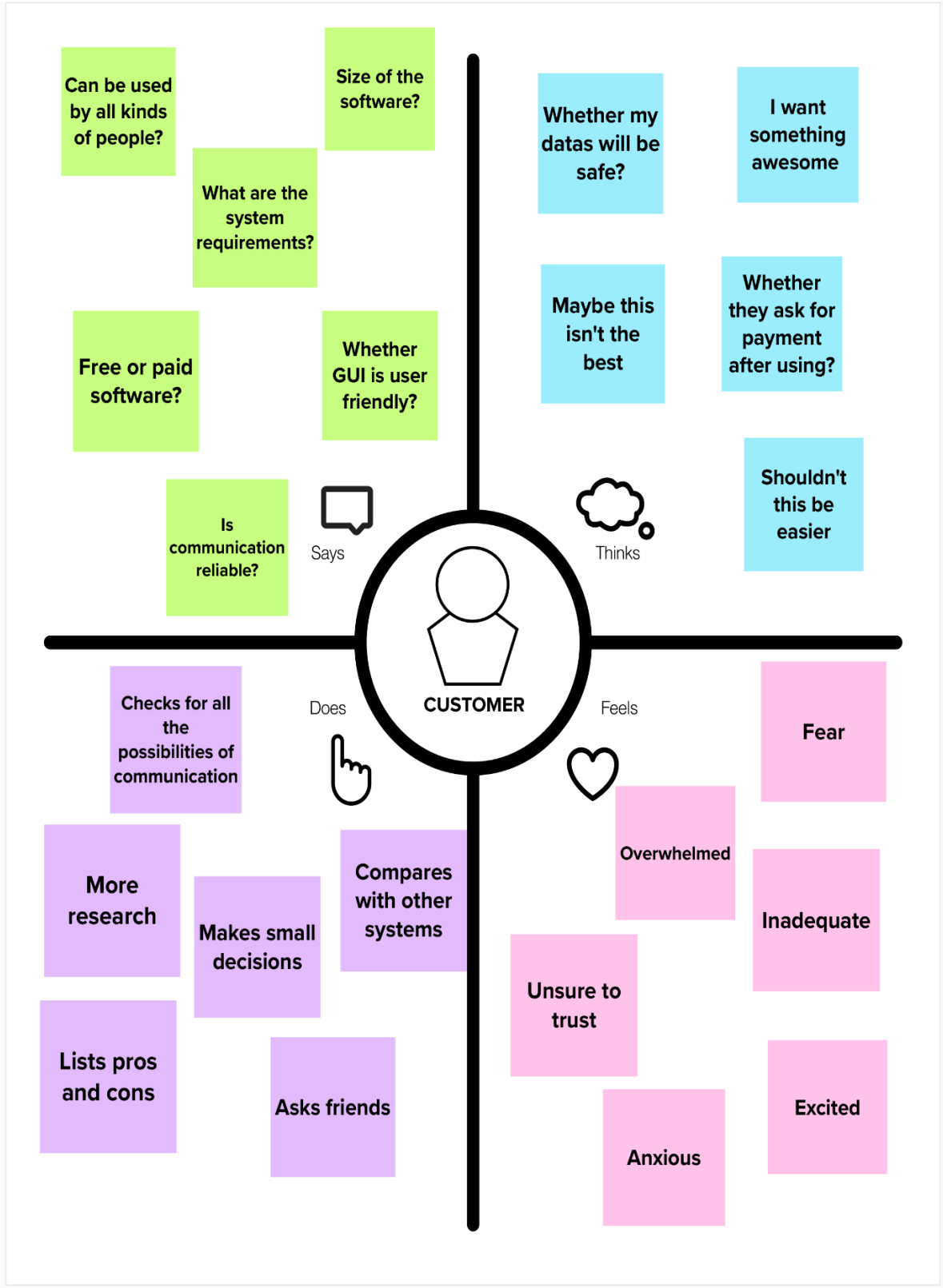
2.3 Problem Statement Definition

Communication plays a significant role in making the world a better place. Communication creates bonding and relations among the people, whether persona, social, or political views. Most people communicate efficiently without any issues, but many cannot due to disability. They cannot hear or speak, which makes Earth a problematic place to live for them. Even simple basic tasks become difficult for them. Disability is an emotive human condition. It limits the individual to a certain level of performance. Being deaf and dumb pushes the subject to oblivion, highly introverted. In a world of inequality, this society needs empowerment. Harnessing technology to improve their welfare is necessary. In a tech era, no one should be limited due to his or her inability. The application of technology should create a platform or a world of equality despite the natural state of humans. On the other hand, technology is the most innovative thing on Earth for every time the clock ticks, researchers, software engineers, programmers, and information technology specialists are always coming up with bright ideas to provide convenience to everyone.

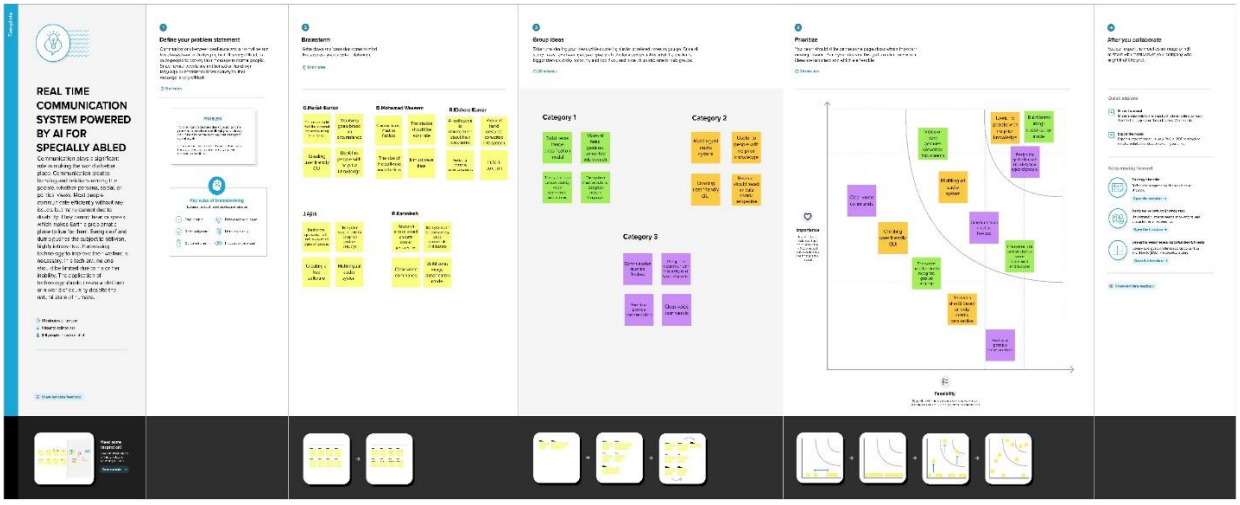
Our project is to build an efficient real time communication system powered by ai for specially abled to overcome the disabilities faced by them during communication.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

S.NO.	PARAMETER	DESCRIPTION
1.	Problem statement (Problem to be solved)	Communication between specially abled person 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.
2.	Idea/Solution description	This system is built by using the AI. By using this system they can interact with people easily. They can able to convey what they are trying to speak, especially in emergency time.
3.	Novelty/Uniqueness	The application will make understand people what the specially abled person trying to convey and it also helps people to communicate with the specially abled. They can use this system to communicate with people at any time.

4.	Social Impact/Customer Satisfaction	This system provides an effective support to both the specially abled person and the normal person to build their conversation And creates satisfaction to both of them.
5.	Business Model (Revenue Model)	This system covers a wide range of users who are even specially abled, enabling them to communicate by any means.
6.	Scalability of the solution	Implementing this system provides the specially abled person to effectively communicate with other peoples and vice versa without any difficulties. And creates a platform or a world of equality despite the natural state of humans.

3.4 Problem Solution Fit

1. CUSTOMER SEGMENT(S) - Deaf and mute peoples. - And other specially abled peoples.	**6. CUSTOMER STATE LIMITATIONS** - Should have speaker and mic. - Smart Device with active Internet Connection.	**5. AVAILABLE SOLUTIONS** - Rely on other person: the specially abled people should convey his message to some one and he needs to convey the message of specially abled person to the required receiver.
2. PROBLEMS / PAINS - Specially abled people should manually visit other people to convey his message and the people who receives the message may or may not understand his message. - Or the specially abled people should convey his message to some one and he needs to convey the message of specially abled person to the required receiver.	**9. ROOT/CAUSE** - Every time the specially abled person may not rely on some others to convey his message. - Might have worries under their Communication Privacy	**7. BEHAVIOUR** - Being a specially abled makes them feel difficult to covey his messages to the normal person and receive there messages. - In emergency times conveying their messages is very difficult.Consumes more time for providing banking functionalities to customers.

3. TRIGERS TO ACT To make the life easier for specially abled people and to save time from manual communication and want to become smart through technologies.	**10. YOUR SOLUTION** **To build an effective and efficient real time communication system for specially abled using AI and IBM WATSON to provide an easy communication system to 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 specially abled and makes communication in a safe and secured manner and consider customer privacy and make available communication features 24*7 to them.**	**8. CHANNELS OF BEHAVIOUR** **ONLINE:** Through Advertising in social medias, news platform makes customer to know and recognize the effectiveness of real time communication system for specially abled and their instant and secure features.
4. EMOTIONS **BEFORE:** Specially abled people feel stressful through manual communication. **AFTER:** Customers feel Smart and easier through this effective communication system which makes their life comfortable.		**OFFLINE:** words of mouth among customers.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

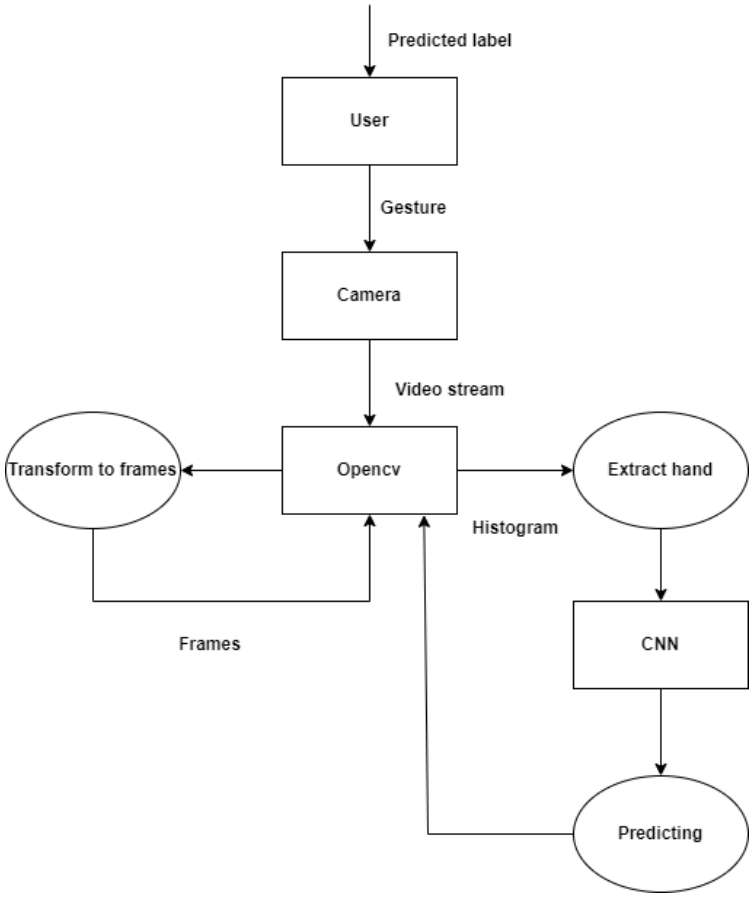
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration is done through Form
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Authentication	Authentication through Facial recognition Authentication through Password authentication protocol
FR-4	External interfaces	Microphone , Camera Ethernet , Wi-Fi and USB dongle to provide internet facilities
FR-5	Reporting	If any issues are faced by the customer or user it will be directly notified to the developer.
FR-6	Compliance to Rules or Laws	Privacy policy , Terms and Conditions , End user agreement.

4.2 Non-Functional requirements

NFR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system should be easily usable to the persons with disabilities.
NFR-2	**Security**	All the communication information is accessed only by the user.
NFR-3	**Reliability**	It setting the pace of the future and helping peoplein need.
NFR-4	**Performance**	Enables people with disabilities to step into a worldwhere their difficulties are understood and taken into account.
NFR-5	**Availability**	Provides automatic recovery as much as possible.
NFR-6	**Scalability**	The improvement in the specially abled personsinteraction with the environments.

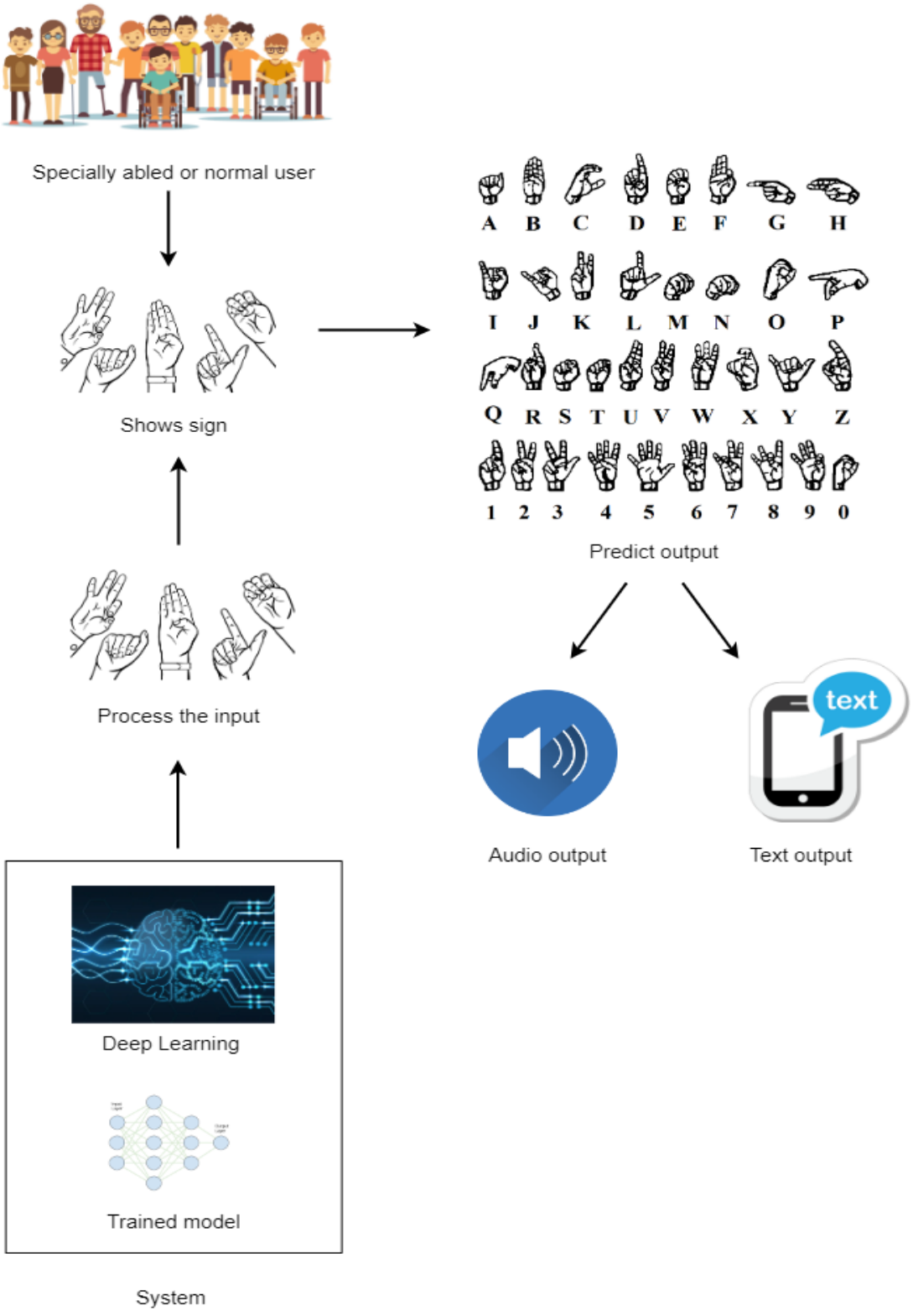
5.PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

Solution Architecture:



Technical Architecture:

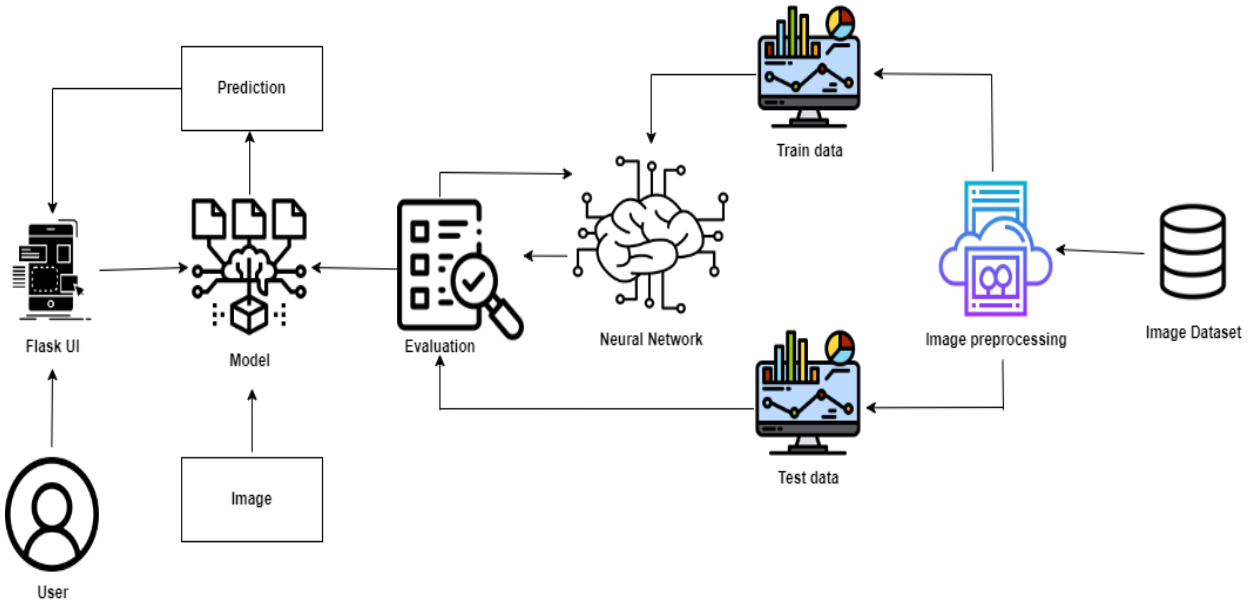


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	User visits the website and get redirected to the application by clicking an button .	HTML, CSS, JavaScript.
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 should be highly flexible, scalable and effective ,fast ,reliable.	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 acquisation
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 frameworks used in the project are	Tensor flow, Theano, RNN, PyTorch
2.	Security Implementations	the security / access controls are implemented using firewalls etc.	Firewall and other security related softwares.
3.	Scalable Architecture	the scalability of architecture (3 – tier, Micro- services)	Data , models, operate at size, speed , consistency and complexity
4.	Availability	the availability of application (e.g. use of load balancers, distributed servers etc.)	Image and facial recognition, speech recognition and real time captioning.
5.	Performance	Design aspects for the performance of the application (number of requests per second, use of Cache, use of CDN's) etc.	Full and effective participation, equality of opportunity, accessibility, using machine learning for communication.

5.3 User Stories

User Story Number	User Story / Task
USN-1	Collecting the Dataset
USN-2	Image Pre-processing
USN-3	Import the required libraries.
USN-4	Add the necessary layers and compile the model.
USN-5	Training the image classification model using CNN and others systems.
USN-6	Training the model and testing the model's performance
USN-7	Converting the input sign language images into English alphabets
USN-8	Build HTML code to create a web based interface for the users to communicate with each other.

USN-9	Build a Python code to integrate the HTML files created.
USN-10	To run the application based on python on Flask Server.
USN-11	Build the system and deploy the model in IBM cloud

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	05 Nov 2022	7	05 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	12 Nov 2022	8	12 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022	7	19 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

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

$$AV = 6/10 = 0.6$$

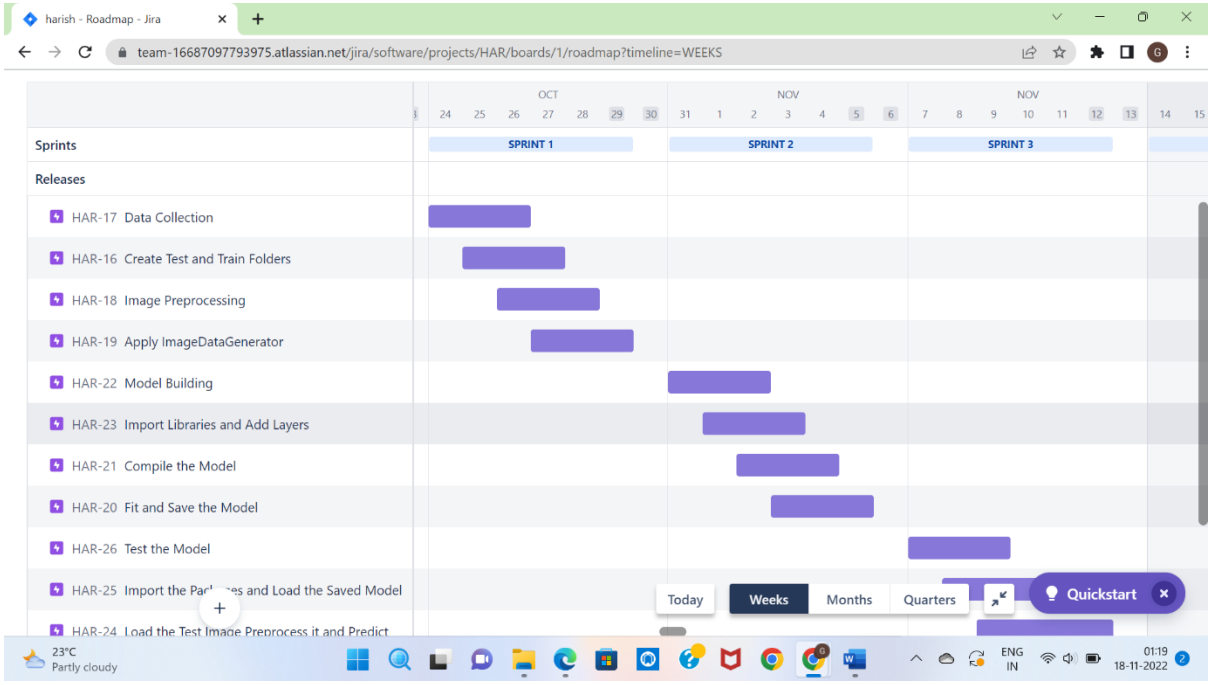
6.2 Sprint Delivery Schedule

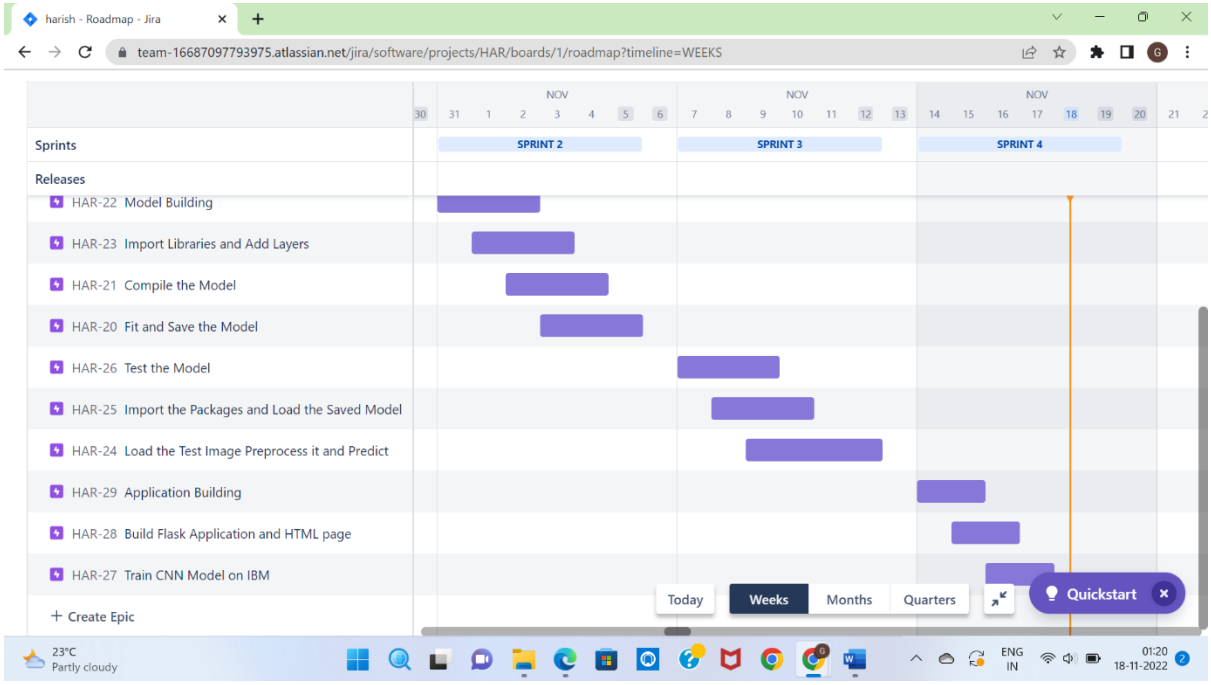
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collecting the Dataset	10	High	G.Harish Kumar, R.Kamalesh, B.Mohamed Waseem

Sprint-1		USN-2	Image Pre-processing	7	Medium	G.Harish Kumar, R.Kamalesh, B.Mohamed Waseem
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model.	10	High	R.Kishore Kumar,J.Ajith
Sprint-2		USN-4	Training the image classification model using CNN and others systems.	7	Medium	R.Kishore Kumar, J.Ajith
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	10	High	G.Harish Kumar, R.Kamalesh, B.Mohamed Waseem, R.Kishore Kumar, J.Ajith
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	10	High	G.Harish Kumar, R.Kamalesh, B.Mohamed Waseem, R.Kishore Kumar, J.Ajith
Sprint-4		USN-7	Build the system and deploy the model in IBM cloud	7	Medium	G.Harish Kumar, R.Kamalesh, B.Mohamed Waseem, R.Kishore Kumar, J.Ajith

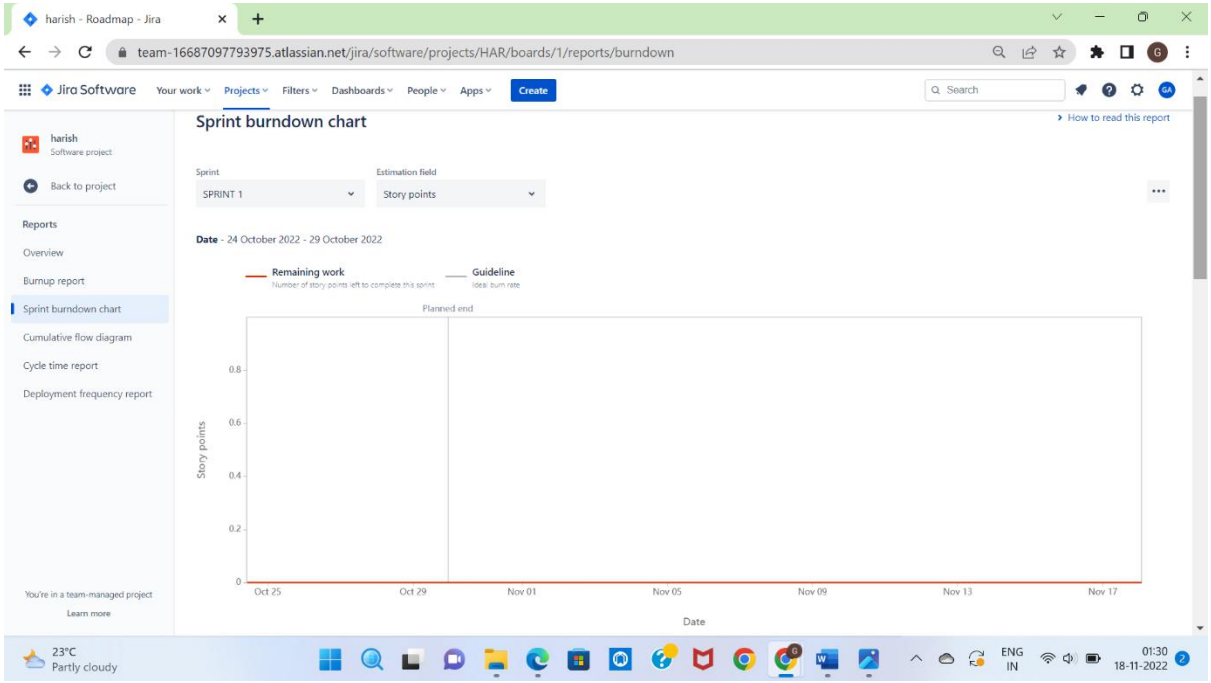
6.3 Reports from JIRA

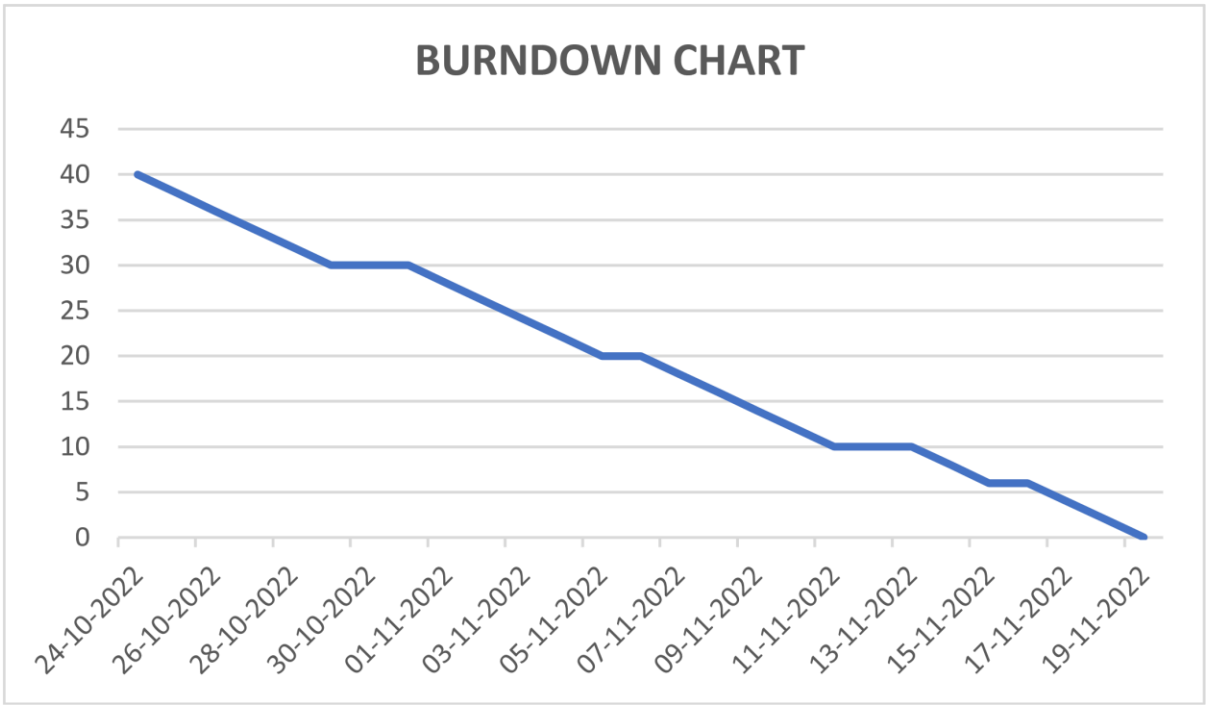
ROADMAP





SPRINT BURNDOWN CHART





7.CODING & SOLUTIONING

7.1 Feature 1

The user is given with a webpage in which after clicking on the “Click Here” button then the camera is opened and here the hand gestures is given.

```
def predict():
        print("[INFO] starting video stream...")
        vs = cv2.VideoCapture(0)

        (W, H) = (None, None)

        while True:
            (grabbed, frame) = vs.read()

            if not grabbed:
                break

            if W is None or H is None:
                (H, W) = frame.shape[:2]
            output = frame.copy()
            # r = cv2.selectROI("Slect", output)
            # print(r)
            cv2.rectangle(output, (81, 79), (276,274), (0,255,0), 2)
            frame = frame[81:276, 79:274]
            frame = cv2.cvtColor(frame, cv2.COLOR_RGB2GRAY)
            _, frame = cv2.threshold(frame, 95, 255, cv2.THRESH_BINARY_INV)
            frame = cv2.cvtColor(frame, cv2.COLOR_GRAY2RGB)
```

7.2 Feature 2

After the camera is opened in the webpage then an certain frame is given with an fixed size in the screen where the hand gestures is given then the character based on the hand gesture shown is represented on the screen.

```
img = resize(frame,(64,64,3))
            img = np.expand_dims(img,axis=0)
            if(np.max(img)>1):
                img = img/255.0


            result = np.argmax(model.predict(img))
            index=['A', 'B','C','D','E','F','G','H','I']
            result=str(index[result])
```

```
            cv2.putText(output, "The Predicted Letter : {}".format(result),
(10, 50), cv2.FONT_HERSHEY_PLAIN,
                        2, (150,0,150), 2)
            cv2.putText(output, "Press q to exit", (10,450),
cv2.FONT_HERSHEY_PLAIN, 2, (0,0,255), 2)


            speech = gTTS(text = result, lang = 'en', slow = False)

            cv2.imshow("Output", output)
            key = cv2.waitKey(1) & 0xFF

            if key == ord("q"):
                break


        print("[INFO] cleaning up...")
        vs.release()
        cv2.destroyAllWindows()
        return render_template("index.html")
```

8.TESTING

8.1 Test Cases

				Date	18-Nov-22								
				Team ID	PNT2022TMID39569								
				Project Name	Real-Time Communication System Powered by AI for Specially Abled								
				Maximum Marks	4 marks								
Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Test Data**	**Expected Result**	**Actual Result**	**Status**	**Commnets**	**TC for Automation(Y/N)**	**BUG ID**	**Executed By**
Webpage_TC_001	UI	Home Page	Verify the user is able to view the page	1. Latest web browser 2. Proper Internet Connection	1. Enter the url of the websiteand click go 2. Verify the webpage is loadingor not	no test data required	The webpage should be visible to the user	The webpage is visible	Pass	The test case passed without any issues	Y	1	Kamalesh R
Webpage_TC_002	UI	Home Page	Verify the page is responsive for all devices	1. Mobile device 2. Desktop device 3. Tablet device 4. Web browser 5.Internet connection	1. Enter the url of the websiteand click go 2. Verify the webpage is loadingproperly with proper alignments in all the devices	no test data required	The webpage should be properly visible to the user	The webpage is visible in all the devices	Pass	The test case passed without any issues	Y	2	Harish Kumar G
Webpage_TC_003	UI	Home Page	Verify the page is responding for the Link	1. Latest web browser 2. Proper Internet Connection3.Proper working mouse , touchpad or touch screen	1. Enter the url of the websiteand click go 2. Verify the webpage is loadingand working properly while clicking the link	no test data required	The webpage should be stable during the clicking of the link	The webpage is responding stably	Pass	The test case passed without any issues	Y	3	Mohamed Waseem B
Webpage_TC_004	UI	Home Page	Verify the webpage is easily understandable to the user	1. Latest web browser 2. Proper Internet Connection	1. Enter the url of the website and click go 2. After page is loaded check for all the informations in the webpage	no test data required	The webpage should be easily understandable to the user	The webpage is clear and easy for the user to work with it	Pass	The testcase passed without any issues	Y	4	Kishore Kumar R
Flask_TC_001	Functional	Flask app	Verify whether the camera opens	1. Latest web browser 2. Proper Internet Connection 3.Good Camera Availability	1. Enter the url of the websiteand click the link 2. Verify the webpage redirects to the python opencv and opens the camera	Proper working camera	The webapp should open the camera properly	The webapp opens the camera properly	Pass	The test case passed without any issues	Y	5	Kamalesh R
Flask_TC_002	Functional	Flask app	Verify the flask app use the saved model	1. Latest web browser 2. Proper Internet Connection 3.Good Camera Availability 4.Proper lighting	1. Enter the url of the websiteand click the link 2. Verify the webpage redirects to the python opencv for accepting the video inputs and predecting according to the preloaded gestures of alphabets	gestures shown by the user	The webapp should predict the alphabets properly	The webapp predicts the alphabets accurately	Pass	The test case passed without any issues, but it requires more dataset to predict the alphabet accuretly	Y	6	Ajith J
Flask_TC_003	Functional	Flask app	Verify the quit button is working to close the window	1. Proper working keyboard	1.After finishing the prediction press Q to quit the window	pressing Q on the keyboard	The web app should be able to close the window properly	The app closed the window successfully	Pass	The testcase passed without any issues.	Y	7	Harish Kumar G

8.2 User Acceptance Testing

Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Low Severity	Medium Severity	High Severity	Subtotal Bugs
By Ui	1	1	2	4
By Functionality	0	2	1	3
Duplicate	0	4	6	10
External	0	0	0	0
Fixed	1	3	3	7
Not Reproduced	0	0	0	0
Skipped	0	0	0	0
Won't Fix	0	0	0	0
Totals	2	10	12	24

Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
User Interface	4	0	0	4
Flask Application	3	0	0	3
Exception Reporting	1	0	0	1
Final Report Output	1	0	0	1
Version Control	2	0	0	2

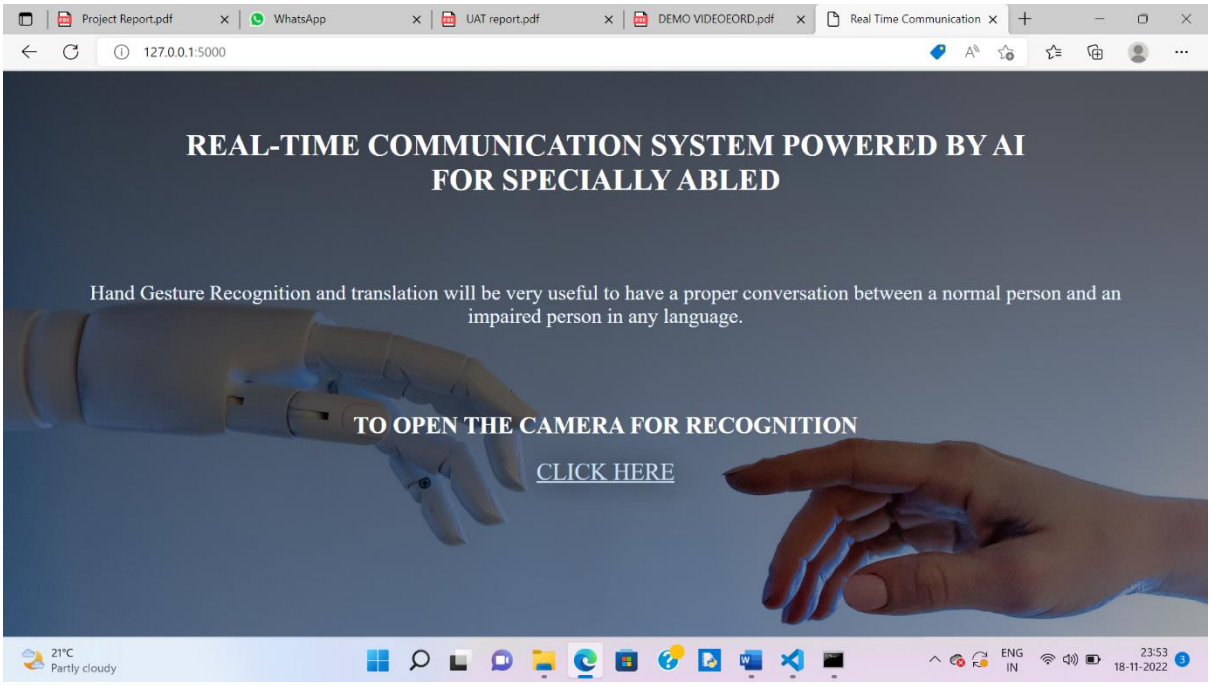
9.RESULTS

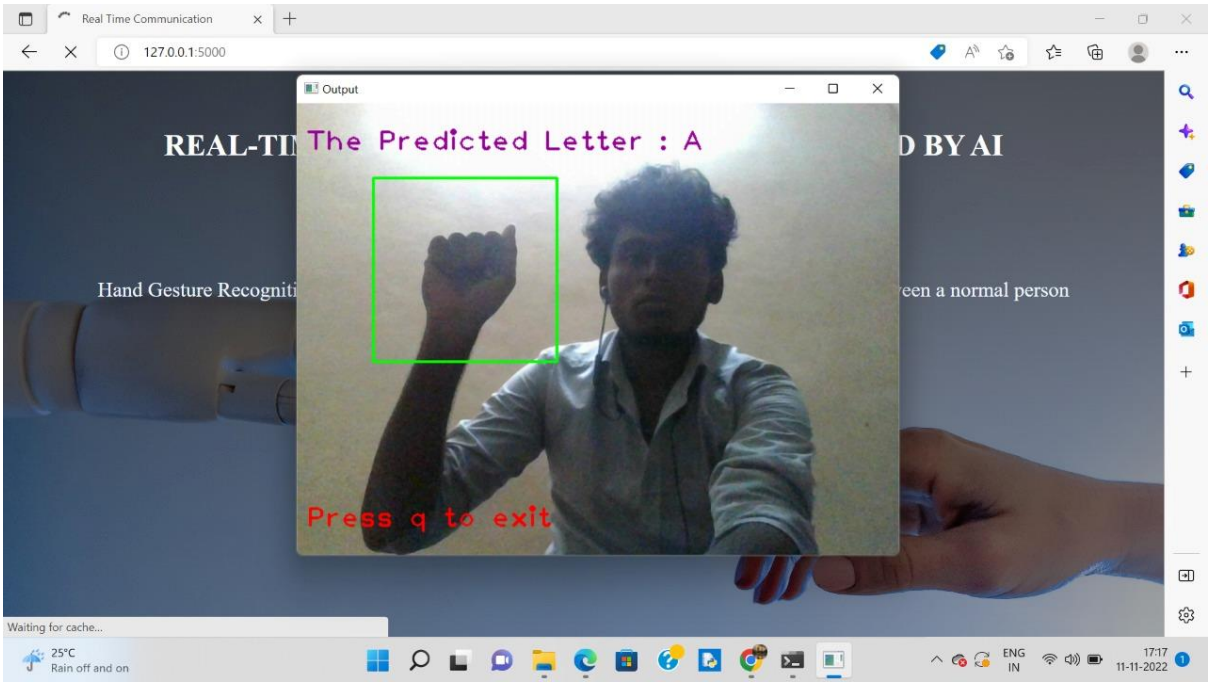
RUNNING APP:

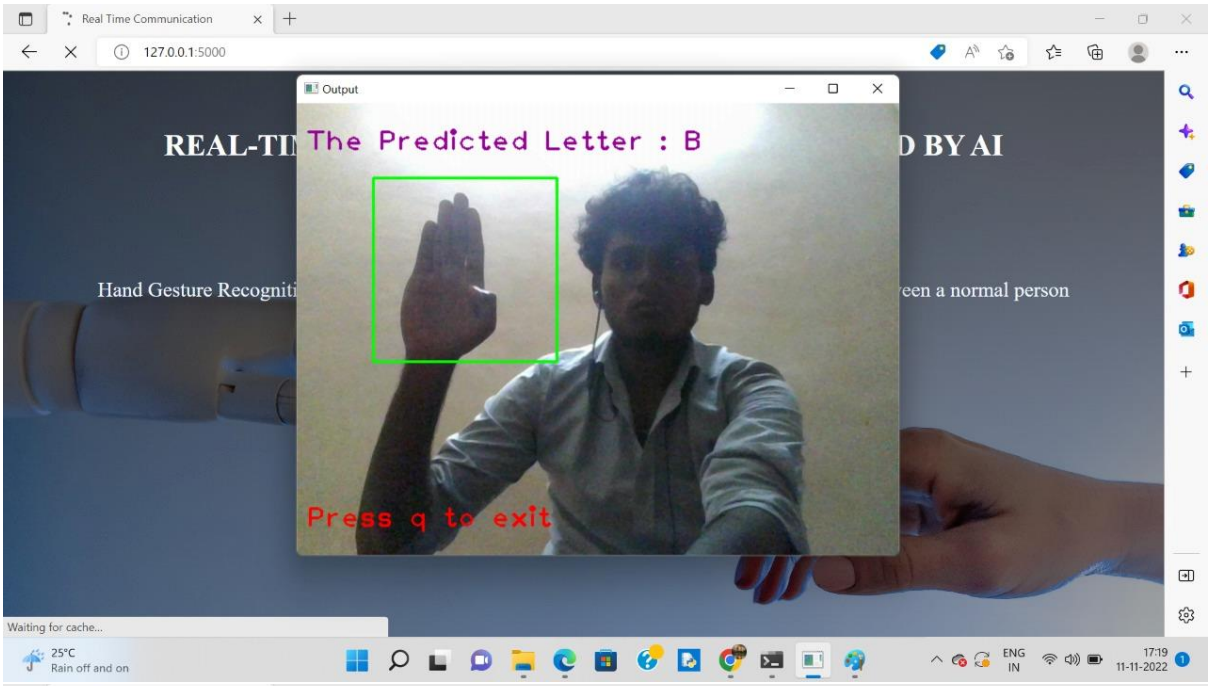
```
from flask import Flask,render_template,request
import cv2
from keras.models import load_model
import numpy as np
from gtts import gTTS
import os
from keras.preprocessing import image
from skimage.transform import resize
app = Flask(__name__)

model=load_model("aslpng1.h5")

vals = ['A', 'B','C','D','E','F','G','H','I']

@app.route('/', methods=['GET'])
def index():
    return render_template('index.html')
@app.route('/index', methods=['GET'])
def home():
    return render_template('index.html')
@app.route('/predict', methods=['GET', 'POST'])
def predict():
        print("[INFO] starting video stream...")
        vs = cv2.VideoCapture(0)

        (W, H) = (None, None)

        while True:
            (grabbed, frame) = vs.read()

            if not grabbed:
                break

            if W is None or H is None:
                (H, W) = frame.shape[:2]
            output = frame.copy()
            # r = cv2.selectROI("Slect", output)
            # print(r)
            cv2.rectangle(output, (81, 79), (276,274), (0,255,0), 2)
            frame = frame[81:276, 79:274]
            frame = cv2.cvtColor(frame, cv2.COLOR_RGB2GRAY)
            _, frame = cv2.threshold(frame, 95, 255, cv2.THRESH_BINARY_INV)
            frame = cv2.cvtColor(frame, cv2.COLOR_GRAY2RGB)
```

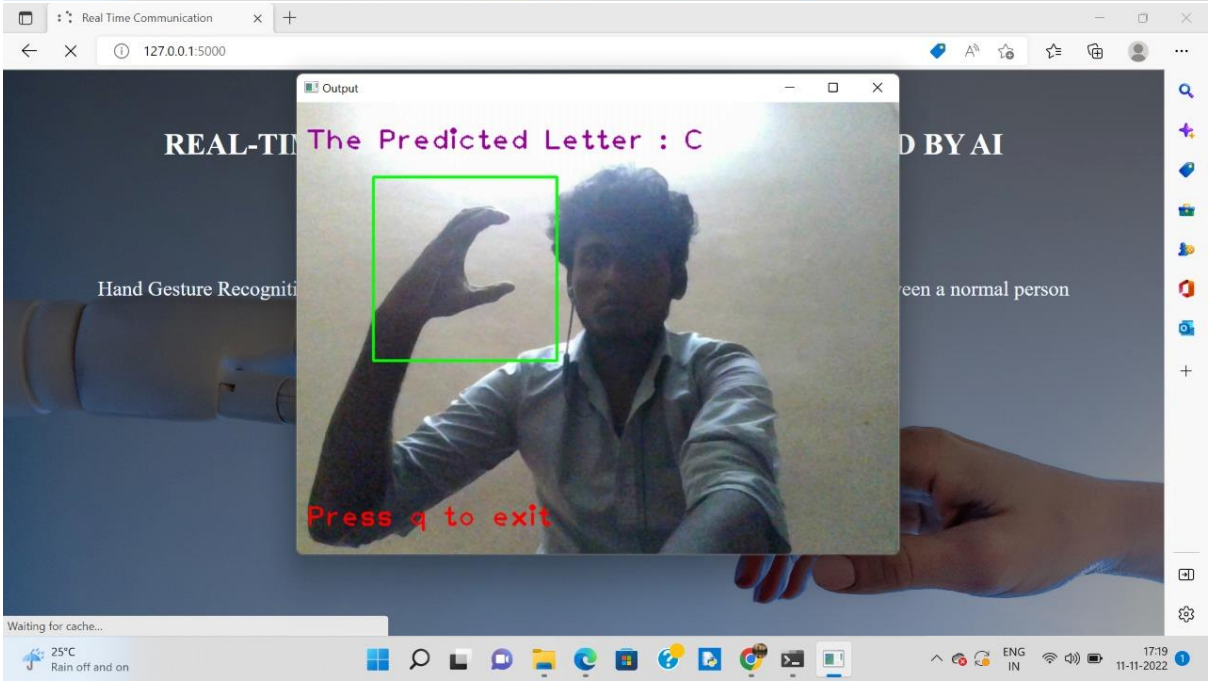
```
            img = resize(frame,(64,64,3))
            img = np.expand_dims(img,axis=0)
            if(np.max(img)>1):
                img = img/255.0


            result = np.argmax(model.predict(img))
            index=['A', 'B','C','D','E','F','G','H','I']
            result=str(index[result])


            cv2.putText(output, "The Predicted Letter : {}".format(result),
(10, 50), cv2.FONT_HERSHEY_PLAIN,
                        2, (150,0,150), 2)
            cv2.putText(output, "Press q to exit", (10,450),
cv2.FONT_HERSHEY_PLAIN, 2, (0,0,255), 2)


            speech = gTTS(text = result, lang = 'en', slow = False)

            cv2.imshow("Output", output)
            key = cv2.waitKey(1) & 0xFF

            if key == ord("q"):
                break


        print("[INFO] cleaning up...")
        vs.release()
        cv2.destroyAllWindows()
        return render_template("index.html")


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

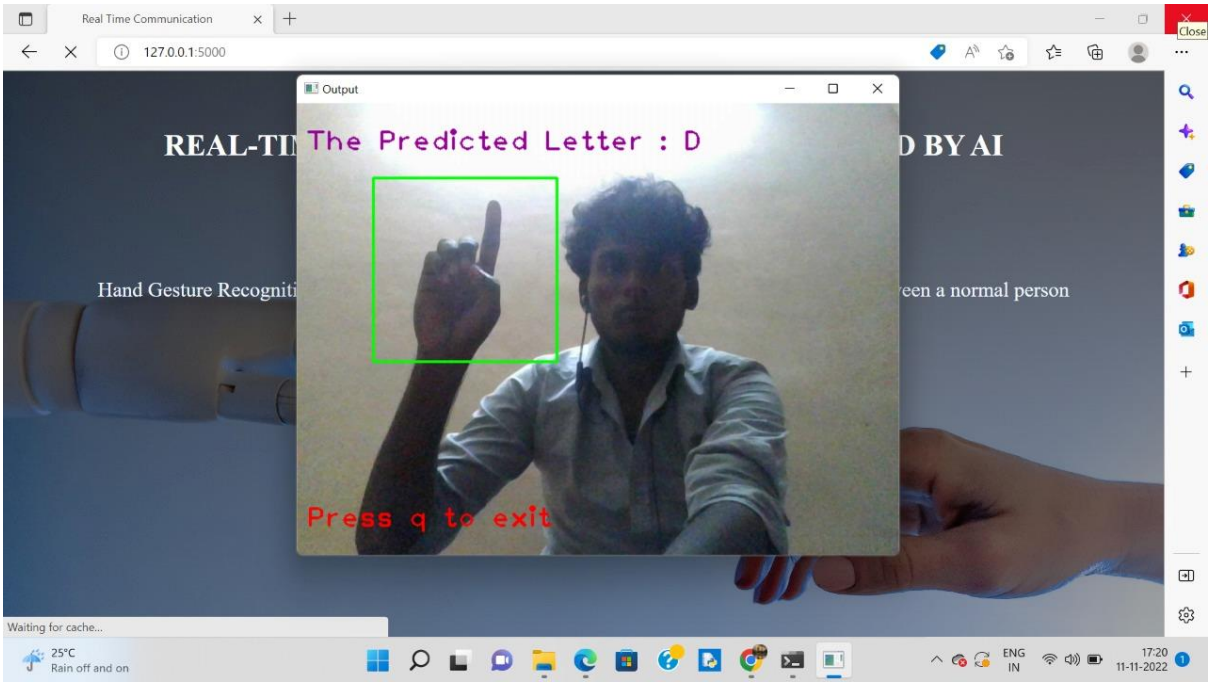
OUTPUT:

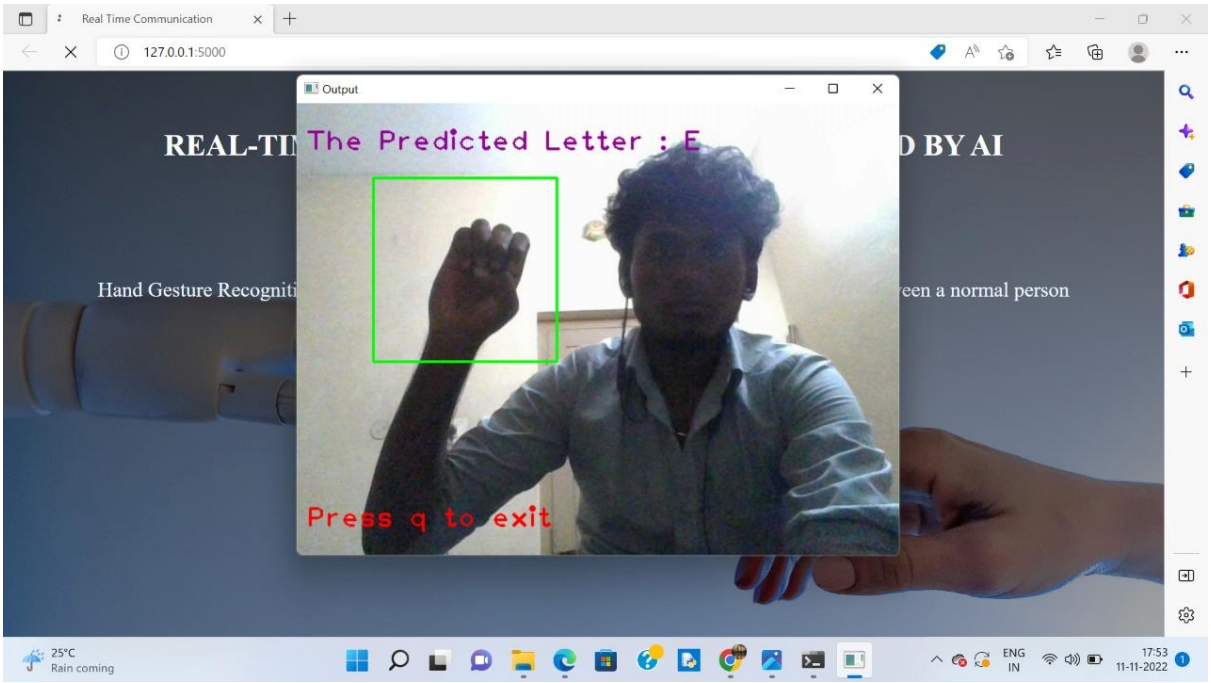

Project Report.pdf
WhatsApp
UAT report.pdf
DEMO VIDEOEORD.pdf
Real Time Communication
127.0.0.1:5000
REAL-TIME COMMUNICATION SYSTEM POWERED BY AI
FOR SPECIALLY ABLED
Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language.
TO OPEN THE CAMERA FOR RECOGNITION
CLICK HERE
21°C
Partly cloudy
ENG
IN
23:53
18-11-2022

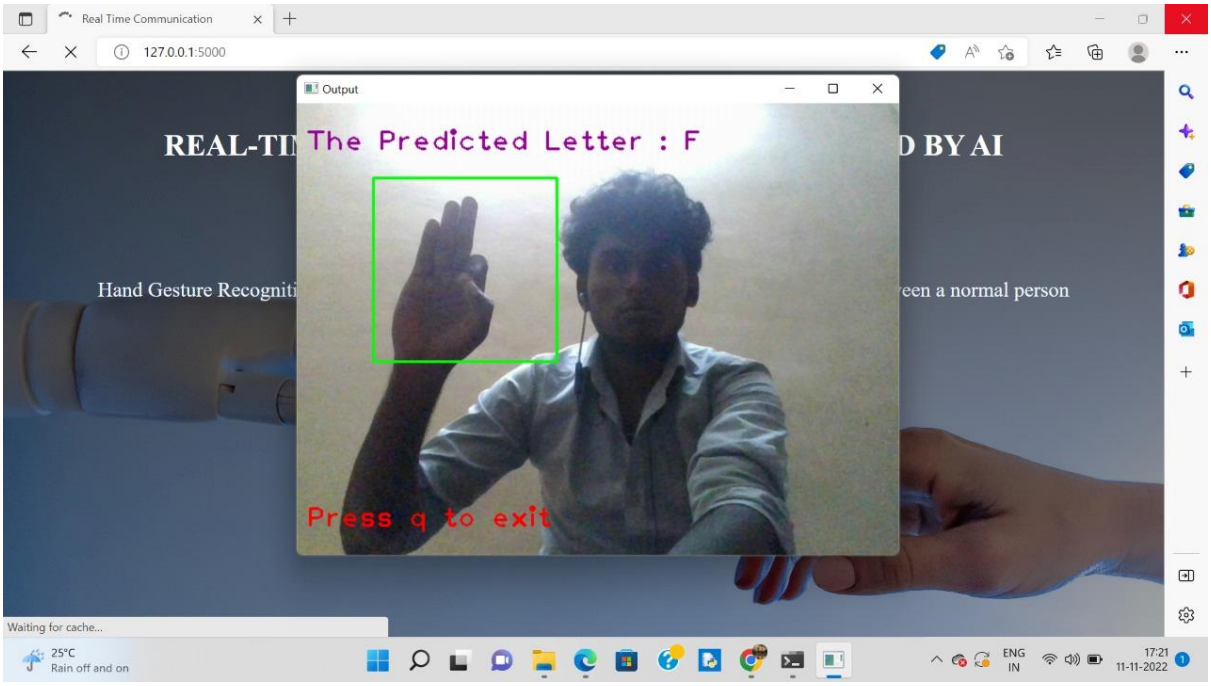

Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : A
Press q to exit
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:17
11-11-2022

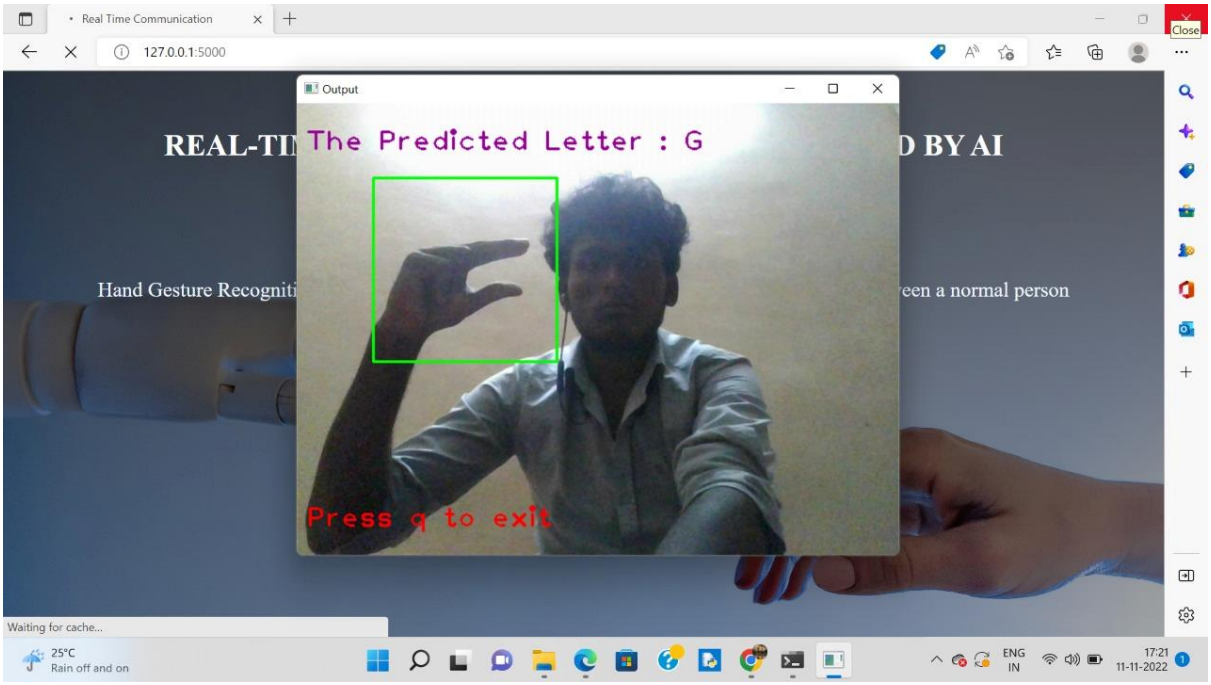

Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : B
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:19
11-11-2022

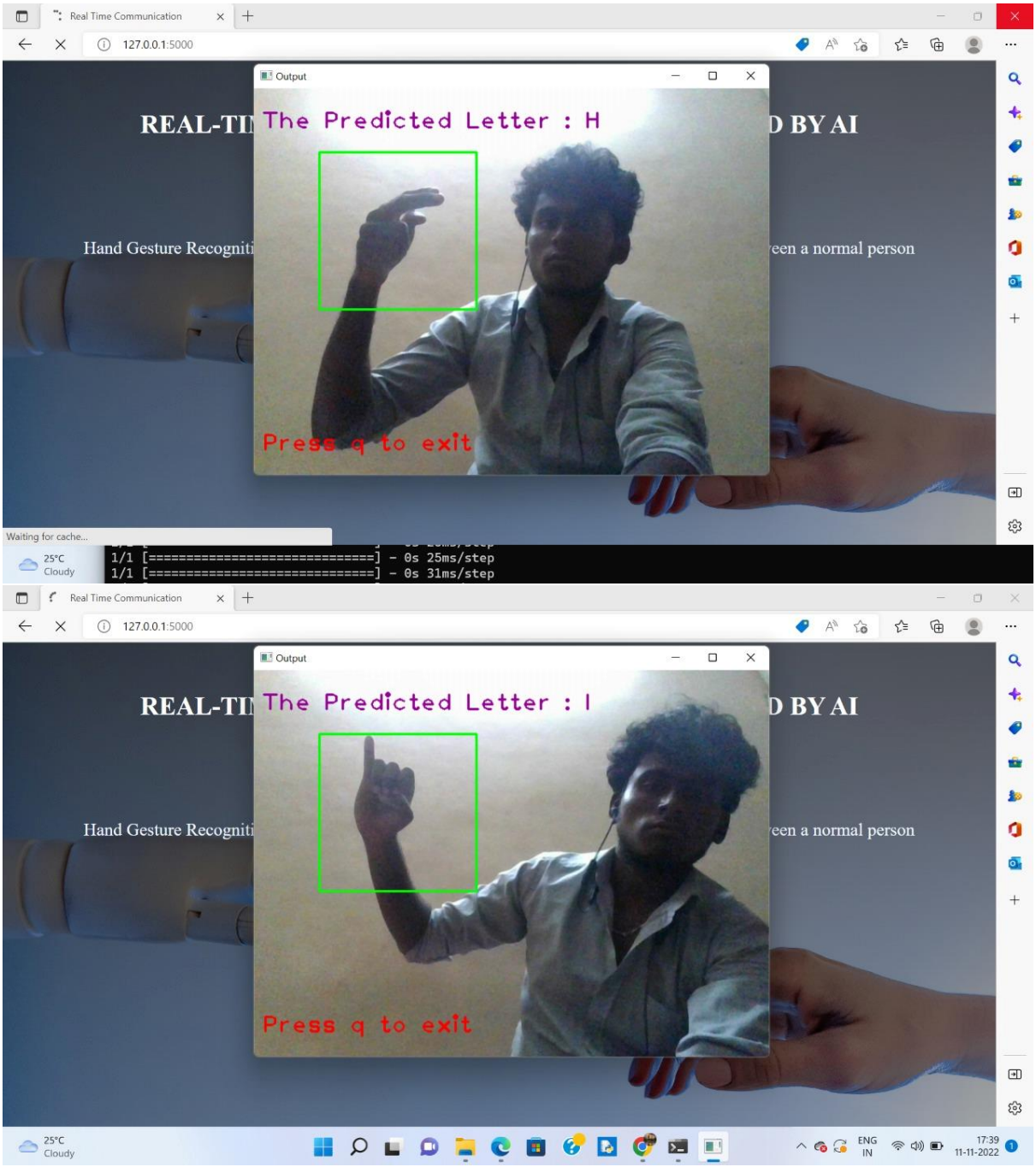

Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : C
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:19
11-11-2022


Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : D
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:20
11-11-2022


Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : E
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
25°C
Rain coming
ENG
IN
17:53
11-11-2022


Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : F
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:21
11-11-2022


Real Time Communication
127.0.0.1:5000
Close
Output
The Predicted Letter : G
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Rain off and on
ENG
IN
17:21
11-11-2022


Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : H
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
Waiting for cache...
25°C
Cloudy
1/1 [==============================] - 0s 25ms/step
1/1 [==============================] - 0s 31ms/step
Real Time Communication
127.0.0.1:5000
Output
The Predicted Letter : I
Press q to exit
REAL-TI
D BY AI
Hand Gesture Recogniti
een a normal person
25°C
Cloudy
ENG
IN
17:39
11-11-2022

Model Performance Testing:

S.No.	Parameter	Values	Screenshot
1.	Model Summary	Total params: 15,751,049 Trainable params: 15,751,049 Non-trainable params: 0	Screenshot-1
2.	Accuracy	Training Accuracy – 97.53 Validation Accuracy -98.60	Screenshot-2

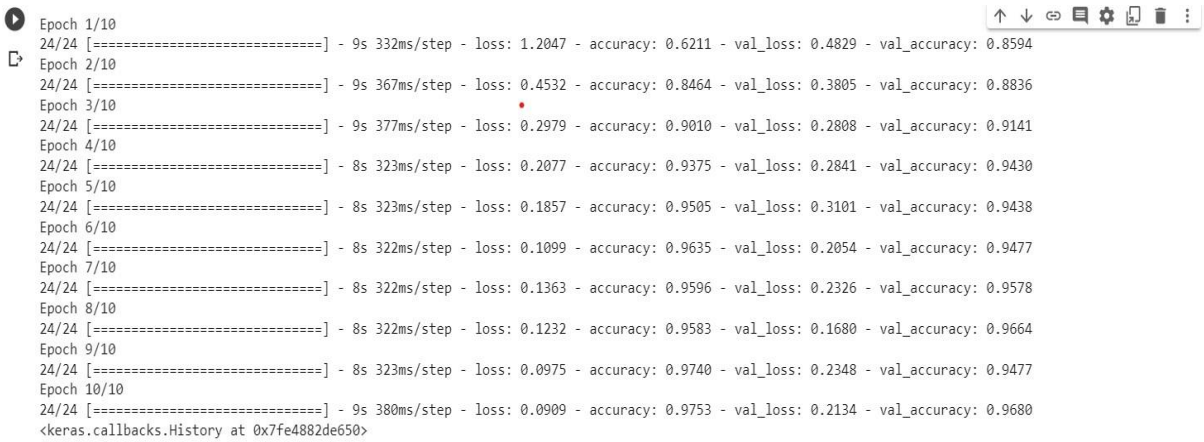
Screenshots – Please refer to the next page for Screenshots

Screenshot-1 :

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 62, 62, 32)        896

 max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
 )

 flatten (Flatten)           (None, 30752)             0

 dense (Dense)               (None, 512)               15745536

 dense_1 (Dense)             (None, 9)                 4617

=================================================================
Total params: 15,751,049
Trainable params: 15,751,049
Non-trainable params: 0
_________________________________________________________________
```

Screenshot-2:



```
Epoch 1/10
24/24 [==============================] - 9s 332ms/step - loss: 1.2047 - accuracy: 0.6211 - val_loss: 0.4829 - val_accuracy: 0.8594
Epoch 2/10
24/24 [==============================] - 9s 367ms/step - loss: 0.4532 - accuracy: 0.8464 - val_loss: 0.3805 - val_accuracy: 0.8836
Epoch 3/10
24/24 [==============================] - 9s 377ms/step - loss: 0.2979 - accuracy: 0.9010 - val_loss: 0.2808 - val_accuracy: 0.9141
Epoch 4/10
24/24 [==============================] - 8s 323ms/step - loss: 0.2077 - accuracy: 0.9375 - val_loss: 0.2841 - val_accuracy: 0.9430
Epoch 5/10
24/24 [==============================] - 8s 323ms/step - loss: 0.1857 - accuracy: 0.9505 - val_loss: 0.3101 - val_accuracy: 0.9438
Epoch 6/10
24/24 [==============================] - 8s 322ms/step - loss: 0.1099 - accuracy: 0.9635 - val_loss: 0.2054 - val_accuracy: 0.9477
Epoch 7/10
24/24 [==============================] - 8s 322ms/step - loss: 0.1363 - accuracy: 0.9596 - val_loss: 0.2326 - val_accuracy: 0.9578
Epoch 8/10
24/24 [==============================] - 8s 322ms/step - loss: 0.1232 - accuracy: 0.9583 - val_loss: 0.1680 - val_accuracy: 0.9664
Epoch 9/10
24/24 [==============================] - 8s 323ms/step - loss: 0.0975 - accuracy: 0.9740 - val_loss: 0.2348 - val_accuracy: 0.9477
Epoch 10/10
24/24 [==============================] - 9s 380ms/step - loss: 0.0909 - accuracy: 0.9753 - val_loss: 0.2134 - val_accuracy: 0.9680
<keras.callbacks.History at 0x7fe4882de650>
```

10.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 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.

11.CONCLUSION

Sign language is a useful tool for facilitating communication between deaf and hearing peop le. Because it allows for two-way communication, the system aims to bridge the communication gap between deaf people and 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 equiv alent Alphabet on the screen. Deaf-mute people can use their hands to perform sign language, which will then be converted into alphabets.

12.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.

13.APPENDIX

Source Code

Index.html:

```
<!DOCTYPE html>
   <html>
    <head>
        <link rel="stylesheet" type="text/css" href="../static/css/style.css">
        <link rel= "stylesheet" type= "text/css" href= "{{
url_for('static',filename='css/style.css') }}">
        <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/6.0.0-
beta3/css/all.min.css" integrity="sha512-
Fo3rlrZj/k7ujTnHg4CGR2D7kSs0v4LLanw2qksYuRlEzO+tcaEPQogQ0KaoGN26/zrn20ImR1DfuL
WnOo7aBA==" crossorigin="anonymous" referrerpolicy="no-referrer" />
        <title>Real Time Communication</title>

    <body>
     <div class="title">
         <h1>
            REAL-TIME COMMUNICATION SYSTEM POWERED BY AI
            <BR>FOR SPECIALLY ABLED
         </h1>
     </div>
       <div>
           <p>
               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.
           </p>
       </div>
        <div>
             <h2 style="align-content: center">TO OPEN THE CAMERA FOR
RECOGNITION</h2>
             <a href="{{ url_for('predict') }}">CLICK HERE</a>
        </div>
```

```
    </body>
</html>
```

App.py:

```
from flask import Flask,render_template,request
import cv2
from keras.models import load_model
import numpy as np
from gtts import gTTS
import os
from keras.preprocessing import image
from skimage.transform import resize
app = Flask(__name__)

model=load_model("aslpng1.h5")

vals = ['A', 'B','C','D','E','F','G','H','I']

@app.route('/', methods=['GET'])
def index():
    return render_template('index.html')
@app.route('/index', methods=['GET'])
def home():
    return render_template('index.html')
@app.route('/predict', methods=['GET', 'POST'])
def predict():
        print("[INFO] starting video stream...")
        vs = cv2.VideoCapture(0)

        (W, H) = (None, None)

        while True:
            (grabbed, frame) = vs.read()

            if not grabbed:
                break

            if W is None or H is None:
                (H, W) = frame.shape[:2]
            output = frame.copy()
            # r = cv2.selectROI("Slect", output)
            # print(r)
            cv2.rectangle(output, (81, 79), (276,274), (0,255,0), 2)
            frame = frame[81:276, 79:274]
```

```
            frame = cv2.cvtColor(frame, cv2.COLOR_RGB2GRAY)
            _, frame = cv2.threshold(frame, 95, 255, cv2.THRESH_BINARY_INV)
            frame = cv2.cvtColor(frame, cv2.COLOR_GRAY2RGB)


            img = resize(frame,(64,64,3))
            img = np.expand_dims(img,axis=0)
            if(np.max(img)>1):
                img = img/255.0


            result = np.argmax(model.predict(img))
            index=['A', 'B','C','D','E','F','G','H','I']
            result=str(index[result])


            cv2.putText(output, "The Predicted Letter : {}".format(result),
(10, 50), cv2.FONT_HERSHEY_PLAIN,
                        2, (150,0,150), 2)
            cv2.putText(output, "Press q to exit", (10,450),
cv2.FONT_HERSHEY_PLAIN, 2, (0,0,255), 2)


            speech = gTTS(text = result, lang = 'en', slow = False)

            cv2.imshow("Output", output)
            key = cv2.waitKey(1) & 0xFF

            if key == ord("q"):
                break


        print("[INFO] cleaning up...")
        vs.release()
        cv2.destroyAllWindows()
        return render_template("index.html")


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

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-15594-1659601289

Project Demo Link:

https://youtu.be/dlABaguA4pg