REAL TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

NALAIYA THIRAN PROJECT BASED LEARNING
On
PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

A PROJECT REPORT

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BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC

(An Autonomous Institution, Affiliated to Anna University, Chennai)

COIMBATORE – 641 032

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Submitted for Project Viva-Voice conducted on ……..

INTERNAL EXAMINER

EXTERNAL EXAMINER

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
1	INTRODUCTION	5
	1.1 PROJECT OVERVIEW	6
	1.2 PURPOSE	6
2	LITERATURE SURVEY	
	2.1 EXISTING PROBLEM	7
	2.2 REFERENCES	8
	2.3 PROBLEM STATEMENT DEFINITION	9
3	IDEATION & PROPOSED SOLUTION	
	3.1 EMPATHY MAP CANVAS	10
	3.2 IDEATION & BRAINSTORMING	11
	3.3 PROPOSED SOLUTION	14
	3.4 PROBLEM SOLUTION FIT	15
4	REQUIREMENT ANALYSIS	
	4.1 FUNCTIONAL REQUIREMENT	16
	4.2 NON-FUNCTIONAL REQUIREMENTS	17
5	PROJECT DESIGN	
	5.1 DATA FLOW DIAGRAMS	17
	5.2 SOLUTION & TECHNICAL ARCHITECTURE	18
	5.3 USER STORIES	20
6	PROJECT PLANNING & SCHEDULING	
	6.1 SPRINT PLANNING & ESTIMATION	22
	6.2 SPRINT DELIVERY SCHEDULE	23
	6.3 REPORTS FROM JIRA	23
7	CODING & SOLUTIONING	
	7.1 FEATURE 1	24
	7.2FEATURE 2	25
8	TESTING	
	8.1 TEST CASES	26
	8.2 USER ACCEPTANCE TESTING	27
9	RESULTS	
	9.1 PERFORMING METRICS	28
10	ADVANTAGES & DISADVANTAGES	29
11	CONCLUSION	30
12	FUTURE SCOPE	30
13	APPENDIX	
	13.1 SOURCE CODE	31
	13.2 GITHUB & PROJECT DEMO LINK	37

1. INTRODUCTION

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.

Depending on the type of disability and profile, communicating with others can be a challenge. The same holds true for staying connected to others in a world that's more and more digitized with the growing importance of social media and our dependence to the Internet. But technology and AI leave no one behind and can be at the service of people with disabilities. A lot of apps use artificial intelligence to favor accessibility.

Sign Language is the well-structured code, which uses hand gestures instead of sound to convey meaning, simultaneously combining hand shapes, orientations and movement of the hands. Communicative hand glove is an electronic device that can translate sign language into speech and text in order to make the communication possible between the deaf and/or mute with the general public. This technology has been used in a variety of application areas, which demands accurate interpretation of sign language. In this project, the words/letters conveyed by the disabled person are displayed on a screen and also spoken on a speaker.

1.1 PROJECT OVERVIEW

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.

1.2 PURPOSE

To develop an application trained with Artificial Intelligence algorithm that can capture the hand sign gestures made by the impaired people to communicate with other people through the application. 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.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

[1] Researchers are actively investigating methods to develop sign language recognition systems, but they face many challenges during the implementation of such systems which include recognition of hand poses and gestures. This paper focuses on the sign language alphabet recognition system because the letters are the core of any language.

There are two types of sign language recognition methods, namely sensor-based and image-based. The first method is dependent on localized sensors or wearing specific gloves. The second method uses different types of cameras. It is based on image processing which does not require equipment such as sensors. Various datasets are created because of many factors such as regional differences, type of images (RGB or Depth) and so on. In this study, an American Sign Language Alphabet (ASLA) dataset is created and developed a deep learning- based method for its recognition.

The creation of the dataset was dependent on many factors such as illumination and the distance between the camera and hand, which is adjusted to improve the performance of the convolutional neural network model. While in other datasets, the distance of the hand from the camera was reported to be fixed such as 0.5 m, 0.75 m or 1 m. This dataset contains images varying 0.5 m, 0.75 m and 1 m hand distance.

In the field of deep learning, when a new dataset is created, it may be considered a new contribution to the field mainly because each dataset has its specific features to improve existing models. However, the availability of several datasets often creates more challenges that require solutions. Therefore, the creation of a custom dataset with special conditions may be considered as a new contribution in the field of sign language interpretation.

Convolutional neural network involves less pre-processing compared to other image classification algorithms. The use of a CNN reduces the images into a format that is easier to process while preserving features that are essential for making accurate predictions. There are four types of operations in a CNN: convolution, pooling, flattening, and fully connected layers

According to the results of the experiments, the training was executed for the first dataset [23] and the obtained accuracy was 99.41% with a 0.0204 loss. Secondly, the training was implemented to the second dataset [24], for which the obtained accuracy was 99.48% and the loss was 0.0210. This study can be improved by adding more images for more letters and words into the dataset. Also, more images can be added to improve accuracy and reduce loss. By the addition of new words and terms, the proposed system may be improved to predict a complete word.

[2] Currently treating sign language issues and producing high quality solutions has attracted researchers and practitioner’s attention due to considerable prevalence of hearing disabilities around the world.

The literature shows that Arabic sign language (ARSL) is one of the most popular sign languages due to its rate of use.

ARSL is categorized into two groups:

1. The first group is ARSL alphabetic (ARSLA), where each Arabic letter is represented by a sign.
2. The second group is ARSL, where words are represented by signs i.e., picture.

This paper introduces a real time ARSLA recognition model using deep learning architecture. As a methodology, the proceeding steps were followed.

[3] Due to the lack of assistive resources, hard-of-hearing people cannot live independently. Sign language or gesture language is the natural language and it is the primary mode of communication for hard-of-hearing people. Researchers and IT companies are continuously trying to find the best solutions to minimize the communication barriers for Hearing-impaired people. Existing translation techniques for speech to sign language on the web platform are consuming higher resources.

2.2 REFERENCES

1.DeepASLR: A CNN based human computer interface for American Sign Language recognition for hearing-impaired individuals
https://www.sciencedirect.com/science/article/pii/S2666990021000471

2.A Real Time Arabic Sign Language Alphabets (ARSLA) Recognition Model Using Deep Learning Architecture

Received: 27 March 2022 / Revised: 27 April 2022 / Accepted: 5 May 2022 / Published: 10 May 2022

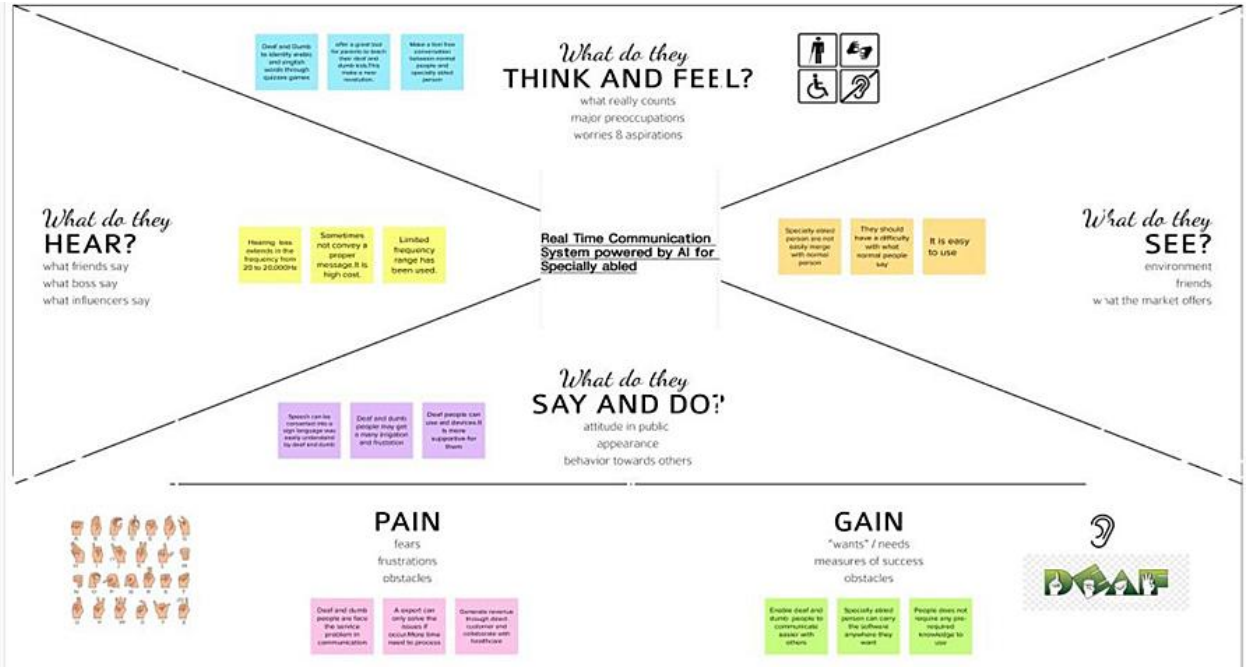
https://www.mdpi.com/2073-431X/11/5/78

2.3 PROBLEM STATEMENT DEFINITION

Problem Statement (PS):	People with disabilities are not able to communicate with the people and society. Though technologies are evolving but there is no significant growth for these people. So, an AI system is developed to communicate with people in real time.
I am **(Specially abled person)**	A Specially abled person, who finds difficulties in communicating with the people and couldn't able to convey what they feel. And so, the talented ones not able to express what they feel.
I'm trying to	Communicate with normal persons to convey the information which I intend to.
But	I can't able to communicate easily with the people and they find it difficult to understand.
Because	Only few knows the hand sign language not most of the people knows. So, it is a problem that every impaired person has.
Which makes me feel	Frustrated, Lose confidence, Anxiety.

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAINSTORMING

TEAM ID: PNT2022TMID10160
TEAM LEAD: MOURISH MANO RANJAN B
TEAM MEMBERS:
MARI NEELA PARVATHY S
MONISHA R
NICKSON ABRAHAM D

2

Brainstorm

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

10 minutes

TIP

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

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

MARI NEELA PARVATHY

- Easy to use
- Trustworthy
- Safe and secure
- Feel free conversation between specially abled and normal people

MONISHA

- Quick results
- Does not need any experience for using this application
- Environment Friendly
- PowerPoi tool that helps user with a hearing and speaking impairment

MOURISH MANO RANJAN

- AI algorithms is used
- Sensors and Camera helps to anlayse the hand signs
- Quick response
- Accurate understanding of how the person tries to communicate

NICKSON ABRAHAM

- Cost-free
- User Friendly and comfortable
- Gives the best result
- Boosts confidence among the impaired people to communicate

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Technology

AI uses it's potential to develop solutions to many physical and cognitive challenges for disabled people face at work and daily life to promote social inclusion for them.

Recruiting the disabled people

Increased morale and corporate culture. Helps the disabled people and can show their skills and talents. Enhances an Organization's Reputation, Brand.

Model Analogy

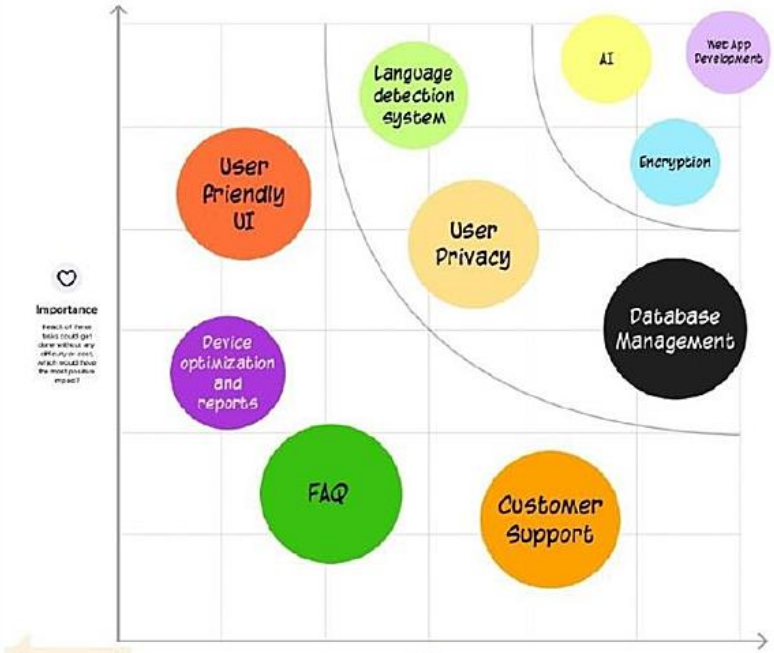
Detailed UI which is user friendly. Datas are stored and Model is trained using AI algorithm. It is safe and secure.

4

Prioritize

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

20 minutes



TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the H key on the keyboard.

After you collaborate

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

Quick add-ons

- **Share the mural**
  Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- **Export the mural**
  Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

- **Strategy Blueprint**
  Define the components of a new idea or strategy.
  Open the template →
- **Customer experience journey map**
  Understand customer needs, motivations, and obstacles for an experience.
  Open the template →
- **Strengths, weaknesses, opportunities & threats**
  Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
  Open the template →

Share template feedback

2

Brainstorm

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

10 minutes

TIP

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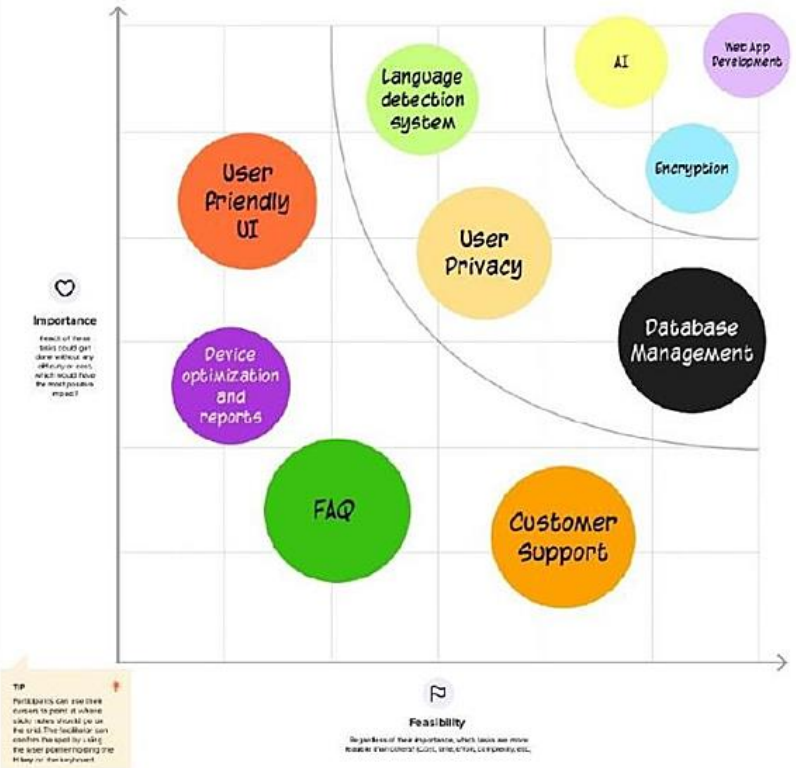

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the M key on the keyboard.

After you collaborate

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

Quick add-ons

- **Share the mural**
  Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
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  Open the template →
- **Strengths, weaknesses, opportunities & threats**
  Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
  Open the template →

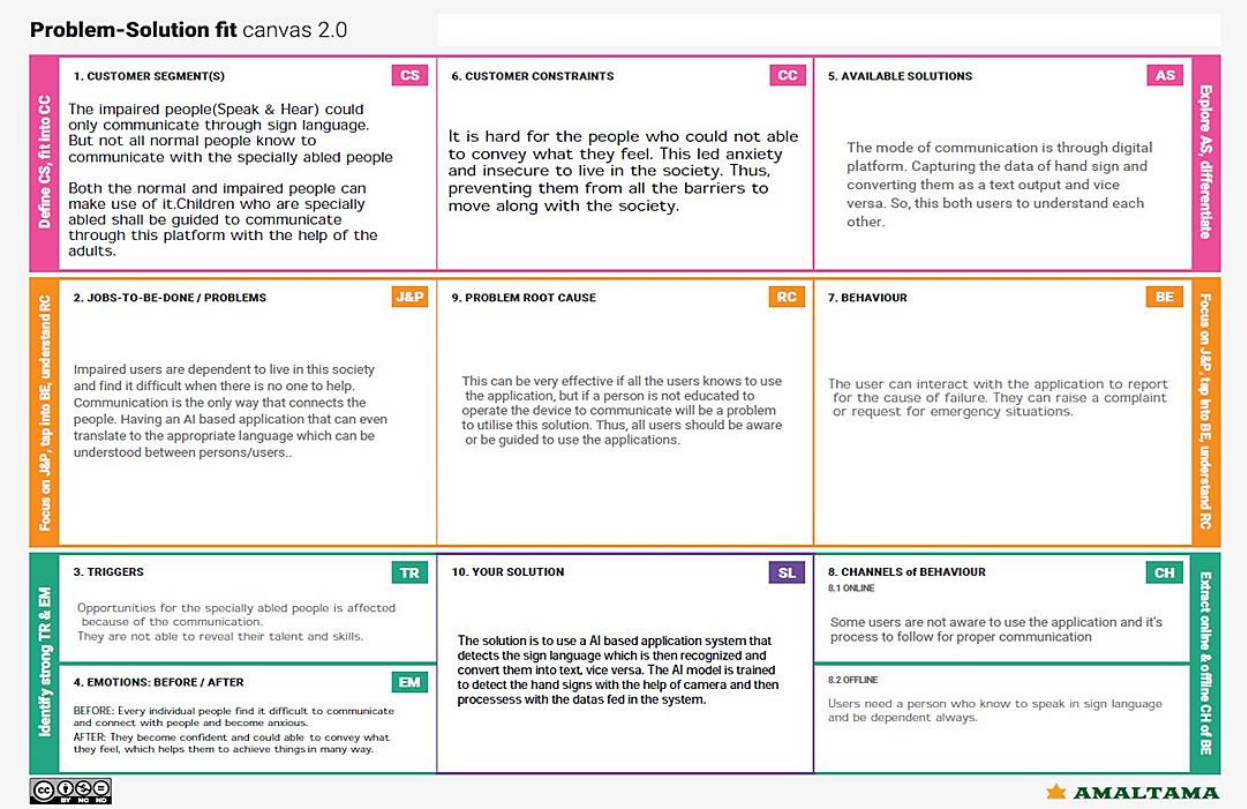
Share template feedback

3.3 PROPOSED SOLUTION

Proposed Solution:

S.No.	Parameter	Description
1.	Proposed Statement (Problem to be solved)	To create an application for communication using AI
2.	Idea / Solution Description	We will be developing an application using AI, so that the hearing and speaking impaired people can communicate with the help of the application with normal people
3.	Novelty / Uniqueness	Fast mode of communication and highly reliable
4.	Social Impact / Customer Satisfaction	It makes the impaired person to connect with people, show their potential and boosts their confidence
5.	Business Model (Revenue Model)	This application helps the people to understand what the other person is trying to convey by sign language
6.	Scalability of the solution	This use of application will reach all the impaired persons globally and have a positive impact

3.4 PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Input	User inputs are either voice or text.
FR-2	Feature extraction	It extracts feature using heuristic and visual similarity approach.
FR-3	Prediction	Model predicts the given input meaning and provides as hand-sign video output using AI algorithm.
FR-4	Classifier	Model sends all output to classifier and produces final result.
FR-5	Announcement	Model then displays the expected result of what the user is expecting to deliver
FR-6	Accuracy	This model needs the capability of retrieving and displaying accurate result for a communication.

4.2 NON-FUNCTIONAL REQUIREMENT

Non-functional Requirements:

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

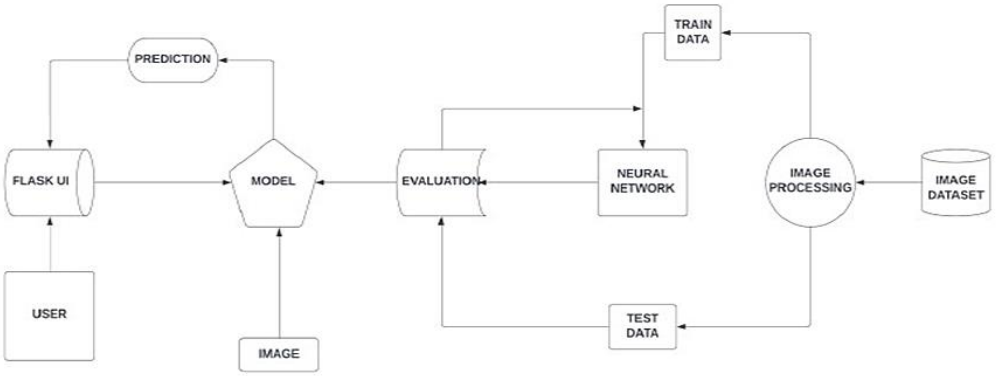
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Users can give the input directly in the text bar provided in the interface.
NFR-2	**Security**	The application does not store any sensitive and personal data of the user.
NFR-3	**Reliability**	The predictions are made based of verified AI model which has been tests multiple times.
NFR-4	**Performance**	The accuracy is high and it can predict accurately than existing any traditional detection method.
NFR-5	**Availability**	It is available and compatible on all platform and devices.
NFR-6	**Scalability**	The application can be used among all people across worldwide and adapt elsewhere.

5. PROJECT DESIGN

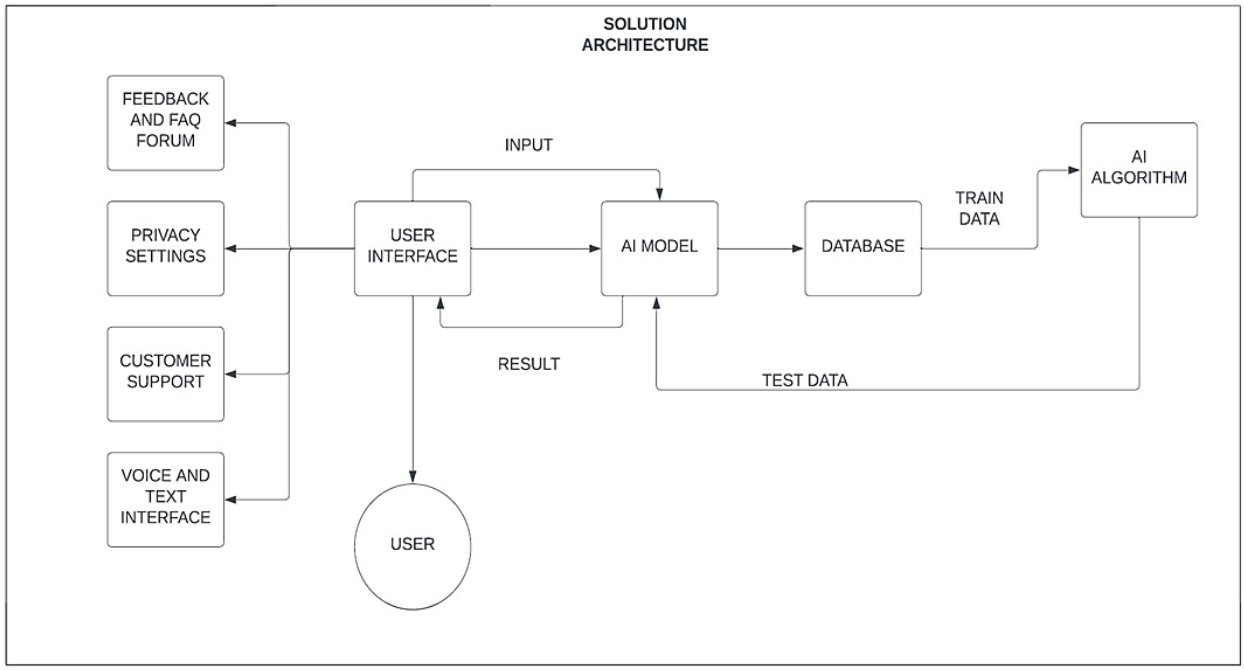
5.1 DATA FLOW DIAGRAMS

Data Flow Diagrams:

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 AND TECHNICAL ARCHITECTURE



Technical Architecture:

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

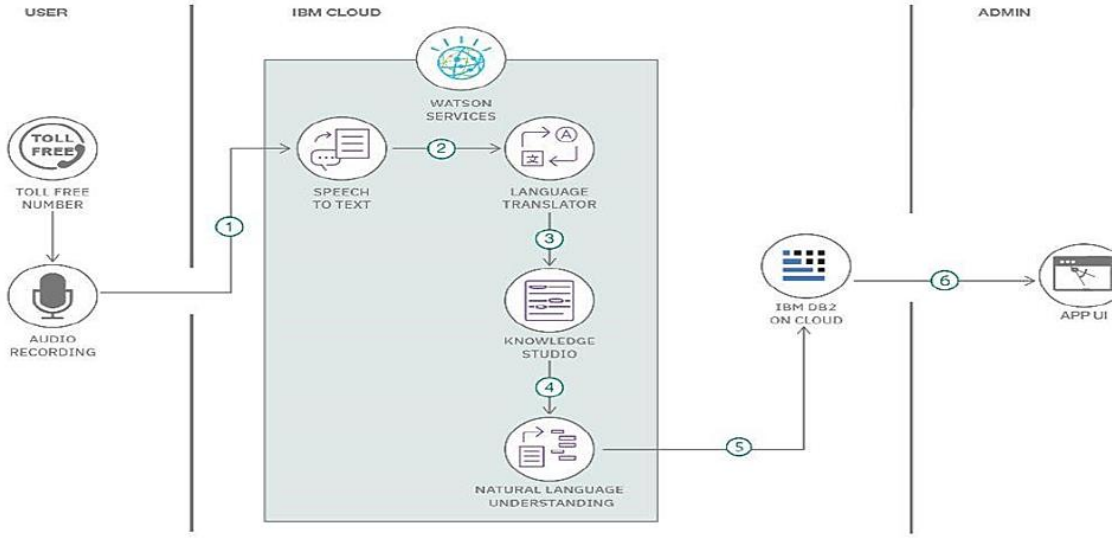


Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS and JavaScript
2.	Application Logic	Logic for a process in the application	Python
3.	File Storage	File storage requirements	Local Filesystem
4.	Machine Learning Model	Purpose of Machine Learning Model	Communication
5.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud	Local, IBM cloud

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Tensorflow, keras and CNN
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	AVS Firewall Security, SIEM
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	HTML and CSS implementation
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	

S.No	Characteristics	Description	Technology
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Cookies and cache implementation

5.3 USER STORIES

User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (All platforms)	User input	USN-1	As a user, I can input the particular text in the required field and waiting for validation.	The text entered; the text input must satisfy the search requirement	High	Sprint-1
System	Feature extraction		Here system can extract feature using heuristic and visual similarity approach	It must have satisfied the previous Acceptance criteria	High	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
System	Prediction		Here the Model will predict the hand-sign images using Machine Learning algorithms		High	Sprint-1
System	Classifier		Here it will send all the model output to classifier in order to produce final result		High	Sprint-1
System	Announcement		Displays the converted text to respective hand-sign translation and vice versa			
Customer (All platforms)	Feedback	USN-2	As a user, I can send feedback about the application fault and opinions for improvement	The user must have used the application few times	Low	Sprint-3
Customer (All platforms)	Bugs	USN-3	As a user, I can report bugs in the application	The user must have used the application few times	Medium	Sprint-2
Admin	Tips		Here use of application interface tips is provided for the Customers/Users		Low	Sprint-3

6. PROJECT PLANNING AND SCHEDULING

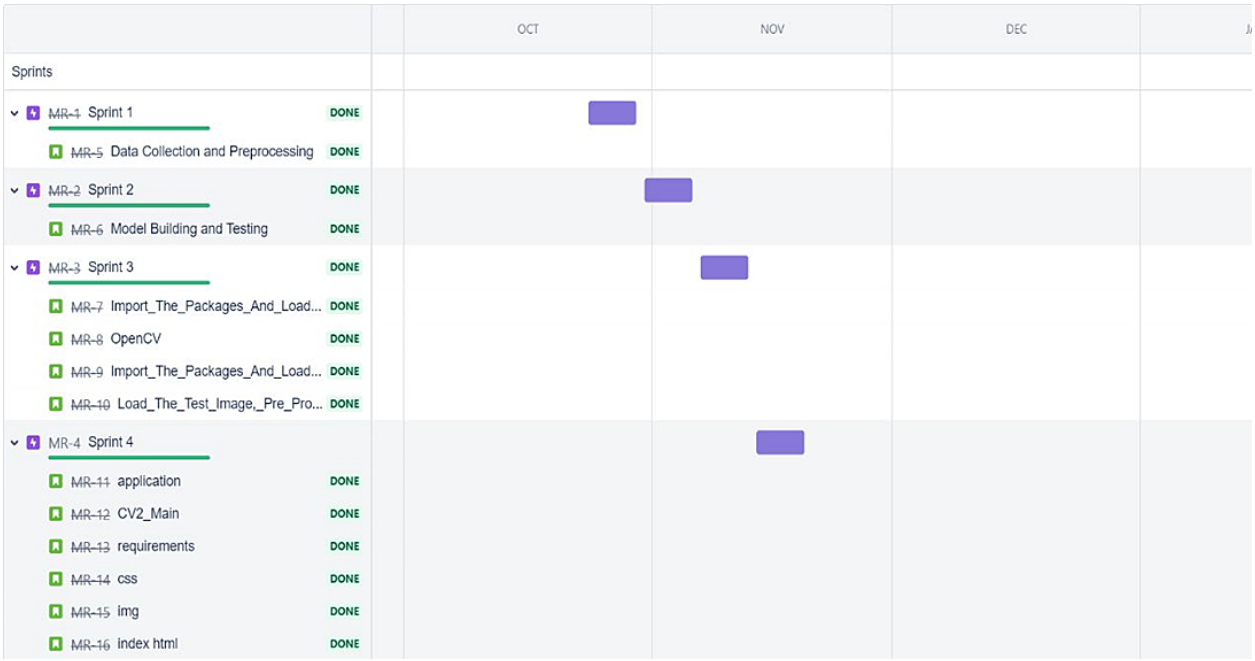
6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User input	USN-1	As a user, I can input the captured video or text and waiting for validation.	2	High	Mourish,Nickson
Sprint-1	Feature extraction	USN-1	Here system can extract feature using heuristic and visual similarity approach.	1	High	Mourish, Monisha
Sprint-1	Prediction	USN-1	Here the Model will predict the hand sign gestures using Deep Learning algorithms	2	High	Mourish, Neela
Sprint-1	Classifier	USN-1	Here it will send all the model output to classifier in order to produce final result	2	High	Nickson, Monisha
Sprint-1	Announcement	USN-1	Displays the accurate information either through video or text	1	High	Nickson,Mourish
Sprint-2	Bugs	USN-2	As a user, I can report bugs in the application	1	Medium	Mourish Mano Ranjan, Monisha
Sprint-2	Feedback	USN-3	As a user, I can send feedback about the application and opinions for improvement	1	Low	Monisha, Mari Neela Parvathy
Sprint-3	Tips	USN-4	Here cyber security tips are provided for the Customers/Users	1	Low	Mourish,Nickson

6.2 SPRINT DELIVERY SCHEDULE

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	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 REPORTS FROM JIRA



7. CODING AND SOLUTIONING

7.1 FEATURE 1

Import The Required Model Building Libraries

In [9]:
```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Convolution2D
from keras.layers import MaxPooling2D
from keras.layers import Dropout
from keras.layers import Flatten
```

Initialize The Model

In [11]:
```
model=Sequential()
```

Add The Convolution Layer

In [12]:
```
model.add(Convolution2D(32, (3,3), input_shape=(64,64,1), activation= 'relu'))
#no. of feature detectors, size of featuredetector, image size, activation function
```

Add The Pooling Layer

In [14]:
```
model.add(MaxPooling2D(pool_size=(2,2)))
```

Add The Flatten Layer

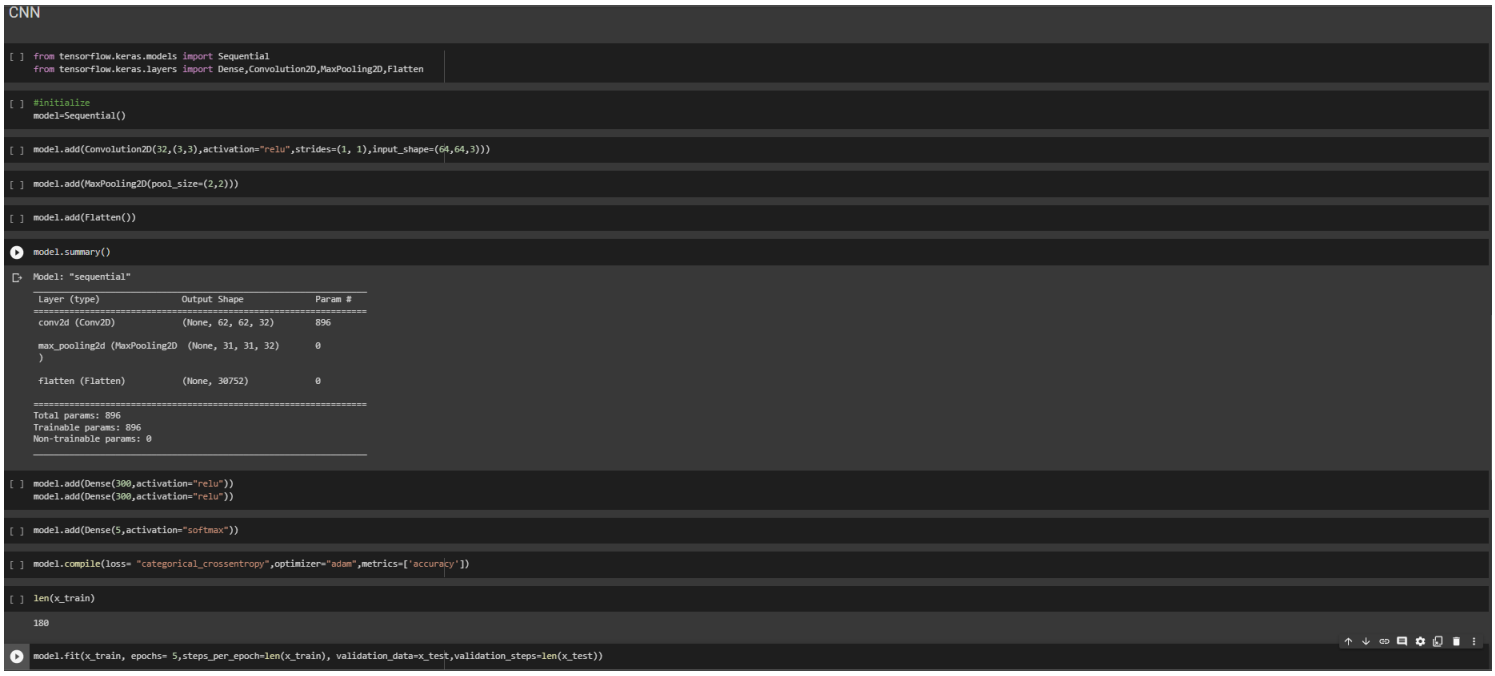
In [15]:
```
model.add(Flatten())
```

Adding The Dense Layers

In [16]:
```
model.add(Dense(units=512, activation='relu'))
model.add(Dense(units=9, activation='softmax'))
```

This project deals with certain layers which is added in the program, libraries and frameworks are also added like Tensorflow, Keras, openCV and Flask. These parameters are essential for the program to execute efficiently and effectively. This determines the flow of the code and its operation.

7.2 Feature 2



We use CNN (Convolutional Neural Network) because it is a subtype of neural networks that is mainly used for applications in image and speech recognition. It's built-in convolutional layers reduce the high dimensional of images without losing its information. That is why we use the CNN algorithm in this case. It is designed to map image data (two-dimensional data) to an output variable (one-dimensional data). It is easy to understand and fast implement. It has the highest accuracy among all algorithms that predicts images.

8. TESTING

8.1 Test Cases & User Acceptance Testing

Test Case	Feature Type	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Coments
Home page_TC_1	Camera Access	Provided Access	An URL to test	There will be a dropdown box to allow or block for camera access	Random https:// Urls	Camera Access Enabled	Works Properly	Pass	
Home page_TC_2	Camera Access	Not Provided Access	An URL to test	There will be a dropdown box to allow or block for camera access	Random https:// Urls	Camera Access Disabled	Not Works Properly	Fail	
Home page_TC_3	Camera Access	Provided Access	An URL to test	There will be a dropdown box to allow or block for camera access	Random https:// Urls	Camera Access Enabled	Works Properly	Pass	
Prediction_TC_1	Predicting using the AI Model	Predicting the hand sign gesture	Trained AI model	Live video feed to capture	Random https:// Urls	Gives the correct Prediction Output	Works Properly	Pass	
Prediction_TC_2	Predicting using the AI Model	Predicting the hand sign gesture	Trained AI model	Live video feed to capture	Random https:// Urls	Gives the correct Prediction Output	Works Properly	Pass	
Prediction_TC_3	Predicting using the AI Model	Predicting the hand sign gesture	Trained AI model	Live video feed to capture	Random https:// Urls	Not within the region of interest	Not Works Properly	Fail	
Prediction_TC_4	Predicting using the AI Model	Predicting the hand sign gesture	Trained AI model	Live video feed to capture	Random https:// Urls	Gives the correct Prediction Output	Works Properly	Pass	

Prediction_TC_5	Predicting using the AI Model	Predicting the hand sign gesture	Trained AI model	Live video feed to capture	Random https:// Urls	Gives the correct Prediction Output	Works Properly	Pass	
Redirect_TC_1	Redirect to about and contact us	Move from one page to another page		Click the page on the navigation you wish to go to	Click on the navigation menu	Moves to the selected page	Works Properly	Pass	
Redirect_TC_2	Redirect to about and contact us	Move from one page to another page		Click the page on the navigation you wish to go to	Click on the navigation menu	Moves to the selected page	Works Properly	Pass	
Redirect_TC_3	Redirect to about and contact us	Move from one page to another page		Click the page on the navigation you wish to go to	Click on the navigation menu	Moves to the selected page	Works Properly	Fail	Due to Multiple request and system issues
Redirect_TC_4	Redirect to about and contact us	Move from one page to another page		Click the page on the navigation you wish to go to	Click on the navigation menu	Moves to the selected page	Works Properly	Pass	
Contact_Us_TC_1	Contact the developers	Contact the developers regaurding bugs and Feedback		Click Contact us and once page open enter the required details		Send the Message and redirect to home page	Works Properly	Pass	
Contact_Us_TC_2	Contact the developers	Contact the developers regaurding bugs and Feedback		Click Contact us and once page open enter the required details		Send the Message and redirect to home page	Works Properly	Fail	Due to network Connectivity
Contact_Us_TC_3	Contact the developers	Contact the developers regaurding bugs and Feedback		Click Contact us and once page open enter the required details		Send the Message and redirect to home page	Works Properly	Pass	
Contact_Us_TC_4	Contact the developers	Contact the developers regaurding bugs and Feedback		Click Contact us and once page open enter the required details		Send the Message and redirect to home page	Works Properly	Fail	Presence of Incomplete Field
Contact_Us_TC_5	Contact the developers	Contact the developers regaurding bugs and Feedback		Click Contact us and once page open enter the required details		Send the Message and redirect to home page	Works Properly	Pass	

9.RESULTS

9.1 PERFORMANCE METRICS

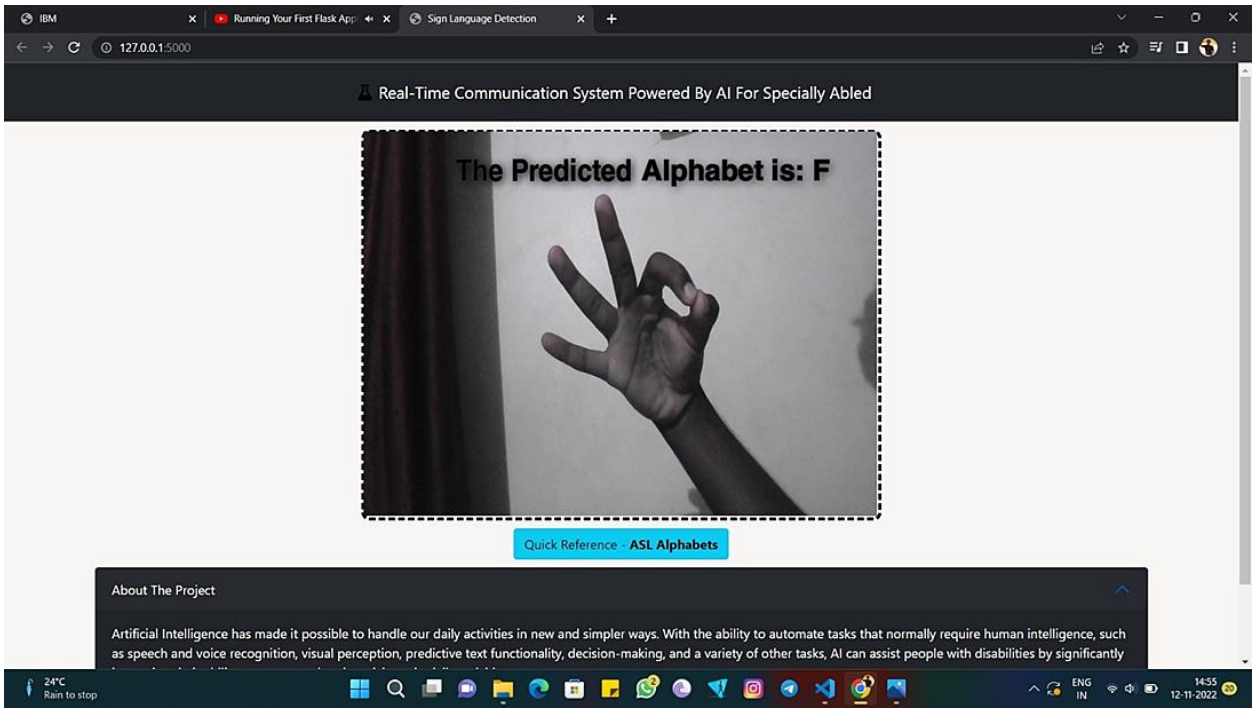
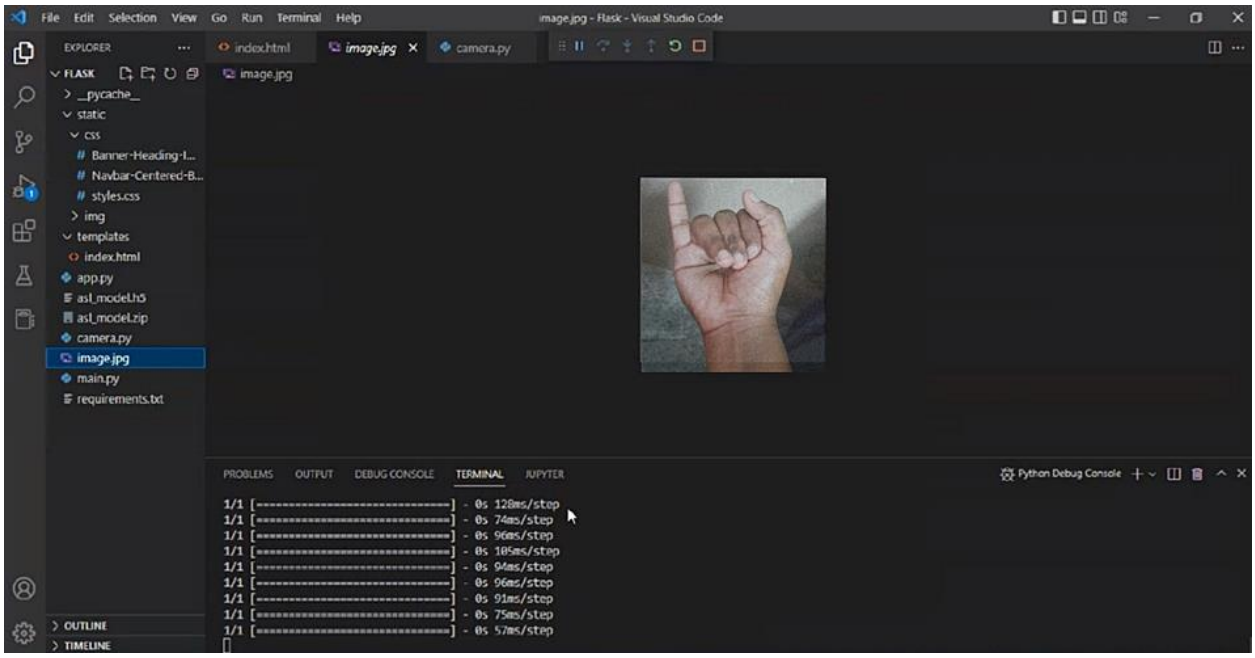


IMAGE PREDICTION



10. ADVANTAGES & DISADVANTAGES

Advantages

1. This project aims to develop an application that converts the sign language into a text in the desired language to convey a message to normal people, as well as convert text into understandable sign language for the deaf and dumb.
2. We are making use of a convolution neutral network to create model that is trained on different hand gestures.
3. This application enables deaf and dumb people to convey their information using signs which get converted to human understandable language and text is given as output.

Disadvantages

1. This requires a good internet connection to establish proper outputs.
2. Some people may not be as educated to use these kind of facilities which requires a proper guidance to use effectively.
3. People are supposed to have smart devices to use this mode of communication.

11.CONCLUSION

From this literature survey done on the communication system for specially-abled people, it is proposed to implement this project **Real time communication System powered by AI for specially-abled** using mobile application. The methodology is based on Hidden Markov Models movement of H-frame, Image processing and Object detection combined together.

12.FUTURE SCOPE

1. The application forms the base infrastructure for a complete communication-aid system for the deaf and mute.
2. To expand its capabilities, more languages can be easily added by adjusting sensor values.
3. Further, reliance on a dedicated computer system to enable the TTS functionality can be eliminated by adding a portable computer like the Raspberry Pi, which can handle the TTS while retaining portability of such a system.

13.APPENDIX

13.1 SOURCE CODE

APP.PY:

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

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

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

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


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

BANNER HEADING:

```css
.fit-cover {
  object-fit: cover;
}
```

HTML.PY:

```
<!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>Sign Language Detection</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(247, 246, 244);">
    <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 rgb(0, 0,
                <img src="{{ url_for('video_feed') }}" style="width: 100%;height: 100%;color: rgb(0, 0, 0);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>
            </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">
```



```
                    <div class="modal-header">
                        <h4 class="modal-title">American Sign Language - Alphabets</h4><button type="button"
                            class="btn-close" data-bs-dismiss="modal" aria-label="Close"></button>
                    </div>
                    <div class="modal-body"><img src="{{ 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>
```

MAIN.PY:

```python
import cv2

video = cv2.VideoCapture(0)

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

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

NAVBAR CENTERED:

```css
.bs-icon {
  --bs-icon-size: .75rem;
  display: flex;
  flex-shrink: 0;
  justify-content: center;
  align-items: center;
  font-size: var(--bs-icon-size);
  width: calc(var(--bs-icon-size) * 2);
  height: calc(var(--bs-icon-size) * 2);
  color: var(--bs-primary);
}

.bs-icon-xs {
  --bs-icon-size: 1rem;
  width: calc(var(--bs-icon-size) * 1.5);
  height: calc(var(--bs-icon-size) * 1.5);
}

.bs-icon-sm {
  --bs-icon-size: 1rem;
}

.bs-icon-md {
  --bs-icon-size: 1.5rem;
}

.bs-icon-lg {
  --bs-icon-size: 2rem;
}

.bs-icon-xl {
  --bs-icon-size: 2.5rem;
}
```

```css
.bs-icon.bs-icon-primary {
  color: var(--bs-white);
  background: var(--bs-primary);
}

.bs-icon.bs-icon-primary-light {
  color: var(--bs-primary);
  background: rgba(var(--bs-primary-rgb), .2);
}

.bs-icon.bs-icon-semi-white {
  color: var(--bs-primary);
  background: rgba(255, 255, 255, .5);
}

.bs-icon.bs-icon-rounded {
  border-radius: .5rem;
}

.bs-icon.bs-icon-circle {
  border-radius: 50%;
}
```

WEBSTREAMING:

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

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

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

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


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

13.2 GitHub & Project Demo Link

DEMO VIDEO

GITHUB LINK:
https://github.com/IBM-EPBL/IBM-Project-38890-1660386453