### REAL-TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

#### PROJECT REPORT

#### **SUBMITTED BY**

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# In partial fulfilment for the award of the degree

Of

# **BACHELOR OF ENGINEERING**

In

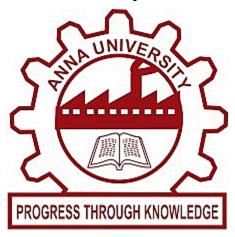
# **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**



V.S.B.ENGINEERING COLLEGE ,KARUR

# V.S.B ENGINEERING COLLEGE, KARUR

(Approved by AICTE & Affiliated by Anna University, Chennai)



### **BONAFIDE CERTIFICATE**

Certified that this **IBM-NALAIYATHIRAN** report titled "Real Time Communication System Powered By AI For Specially Abled" is the bonafide record work by M.DHIWICSHEN (922519104034), R.ARUNKUMAR (922519104013), M.KALIDOSS (922519104062) and S.GOKUL (922519104044) for IBM-NALAIYATHIRAN in VII semester of **B.E.**, degree course in Computer Science and Engineering branch during the academic year of 2022-2023.

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### 1.INTRODUCTION

Communication should be universal without any barriers or limitations. This paper establishes a method for providing equality, turning the disabilities of the hearing and, or speech impaired individuals to abilities, creating a base where both the disabled and the able can communicate without any barrier. Our objective is to blend deaf and dumb within society make them able to use their personal computers more effectively and efficiently. There is need to develop an application that will create an interactive platform where the sign language can be translated to voice output and writing, and voice and writing input can also be converted to sign language. The bigger picture is creating an interactive model of communication for deaf and dumb people. Developing an app will support this vulnerable society of impaired people and enhance communication among people. The application will allow ease in communication, improving their interaction, and hence better life. Our goal is to design a human computer interface system that can accurately identify the language of the deaf and dumb. With the use of image processing and artificial intelligence, many techniques and algorithms have been developed in this area. Each character speech recognition system is trained to recognize the characters and convert them into the required pattern. The proposed system aims to give speech speechless, a real-time character language is captured as a series of images, and it is processed and then converted into speech and text.

#### 1.1PROJECT OVERVIEW

Gesture is a non-verbal means of communication. It refers to expressing an idea using position, orientation or movement of a body part. Gesture recognition is the mathematical interpretation of orientation or motion of human body by a computational system. In this project, the words expressed by hand gestures by the speech and hearing impaired are converted into verbal means of communication. The translated output is displayed on a screen and spoken on a speaker. Dumb people are usually face some problems on normal communication with other people in society. It has been observed that they sometimes find it difficult to interact with normal people with their gestures. Because people with hearing problems or deaf people cannot speak like normal people, they have to depend on a kind of visual communication in most cases. To overcome these problems, we have proposed a system that uses cameras to capture and convert videos of hand gestures from dumb people who turn into speech for understanding normal people. of the sign language is an important research problem for communication with the hearing impaired. The system does not require that the hand is perfectly aligned to the

camera. The project uses the image processing system to identify, especially the English alphabetical character language used by the deaf to communicate. 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.

### 1.2PURPOSE

We are making use of a convolution neural network to create a model that is trained on different hand gestures. An app is built which uses this model. This app enables deaf and dumb people to convey their information using signs which get converted to human-understandable language and speech is given as output. It can remove accessibility barriers through different solutions. They Are Image recognition for people with a visual impairment, Facial recognition for people with a visual impairment, Lip-reading recognition for people with a hearing impairment, Real-time captioning or translations for people with a hearing impairment or even people who don't speak the language. AI has a huge impact on people with disabilities' everyday lives: a person with a mental impairment can easily comprehend the world around him thanks to text summarization. What may at first be a complicated message to decipher turns out to be an easy-to-understand text. Things that at first were difficult or impossible for them are now easily accessible on a daily basis. AI enables people with disabilities to step into a world where their difficulties are understood and taken into account. Technology adapts and helps transform the world into an inclusive place with artificial intelligence accessibility.

There is a certain sense of equality as AI puts everybody, with or without disabilities, at the same level. A lot of apps use artificial intelligence to favor accessibility. For Blind people some AI apps like Google Assistant, VoiceOver, TalkBack, Cortana And For Physical disabilities peoples Some apps like Siri, Google Assistant, Google voice Access etc.. Are available.

### 2.LITERATURE SURVEY

The author describes [1] the development of AI applications is a multidisciplinary effort, involving multiple roles collaborating with the AI developers, an umbrella term they use to include data scientists and other AI-adjacent roles on the same team. During these collaborations, there is a knowledge mismatch between AI developers, who are skilled in data science, and external stakeholders who are typically not. This difference leads to communication gaps, and the onus falls on AI developers to explain data science concepts to their collaborators. In this paper, they report on a study including analyses of both interviews with AI developers and artifacts they produced for communication. Using the analytic lens of shared mental models, they report on the types of communication gaps that AI developers face, how AI developers communicate across disciplinary and organizational boundaries, and how they simultaneously manage issues regarding trust and expectations.

The author advocates [2] for a significant reorientation and reconceptualization of communication studies in order to accommodate the opportunities and challenges introduced by increasingly intelligent machines, autonomous decision-making systems, and smart devices. Historically the discipline of communication has accommodated new technology by transforming these innovations into a medium of human interaction and message exchange. With the computer, this transaction is particularly evident with the development of computer-mediated communication (CMC) in the later half of the 20th century. In CMC, the computer is understood and investigated as a more-or-less neutral channel of message transfer and instrument of human interaction. This formalization, although not necessarily incorrect, neglects the fact that the computer, unlike previous technological advancements, also occupies the position of participant in communicative exchanges. Evidence of this is already available in the science of AI and has been explicitly described by some of the earliest writings on communication and the computer. Its basic framework in order to address and respond to the unique technological challenges and opportunities of the 21st century.

The author defines [3] Artificial Intelligence-Mediated Communication (AI-MC) as interpersonal communication in which an intelligent agent operates on behalf of a communicator by modifying, augmenting, or generating messages to accomplish communication goals. The recent advent of AI-MC raises new questions about how technology may shape human communication and requires re-evaluation – and potentially expansion – of many of Computer-Mediated Communication's (CMC) key theories, frameworks, and findings. A research agenda around AI-MC should consider the design of these technologies and the psychological, linguistic, relational, policy and ethical implications of introducing AI into human—human communication. This article aims to articulate such an agenda.

### 2.1 EXISTING PROBLEM

- 1. Existing system(or) frameworks has too many false positives. The system predicts the gestures inaccurately.
- 2. Real Time recognition of gestures into text/speech and text/speech into gestures is not available.

### 2.2 REFERENCES

- 1. PiorKowski, D., Park, S., Wang, A. Y., Wang, D., Muller, M., & Portnoy, F. (2021). How ai developers overcome communication challenges in a multidisciplinary team: A case study. Proceedings of the ACM on Human-Computer Interaction, 5(CSCW1), 1-25.
- 2. Gunkel, D. J. (2012). Communication and artificial intelligence: Opportunities and challenges for the 21st century. communication+ 1, 1(1), 1-25.
- 3. Hancock, J. T., Naaman, M., & Levy, K. (2020). AI-mediated communication: Definition, research agenda, and ethical considerations. Journal of Computer-Mediated Communication, 25(1), 89-100.

### 2.3 PROBLEM STATEMENT DEFINITION

In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used.

Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language. The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb.



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Specially abled	I want to hear	I unable to hear	I cannot hear	frustrated
PS-2	Specially abled	I want to speak	I unable to speak	I cannot speak	frustrated

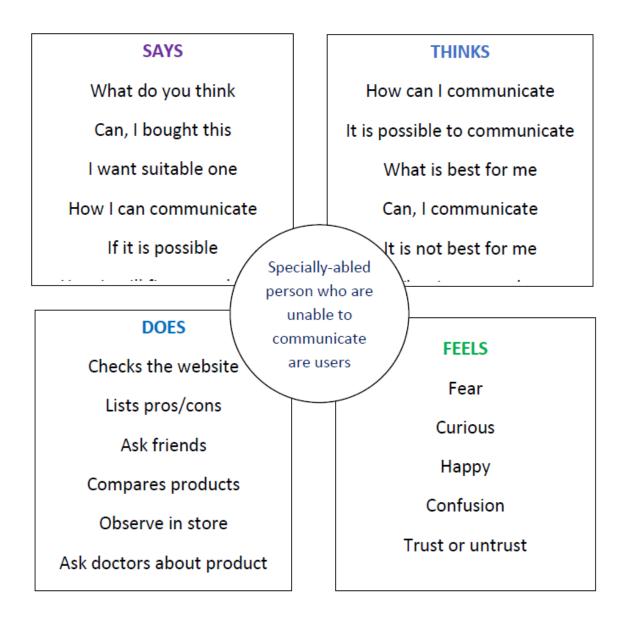
### 4.IDEATION & PROPOSED SOLUTION

Ideation is the creative process of generating new ideas, which can be accomplished through a variety of ideation techniques, such as brainstorming and prototyping. If done right, ideation is what helps founders and executives determine the right problem to solve and how to solve it. This approach starts with the user and puts him in the center of the whole development. His needs, emotions, feelings, and problems should be the most important things for the development team.

Explorers started to formulate their first ideas around design thinking in 60'; you can find them in the book of L. Bruce Arche, "Experiences in Visual Thinking." Their goal was to use the tools and best practices reserved for creative people – like painters, writers, or designers – in utility products or services development.

For some time, design thinking in the IT world was a bit forgotten, or let's say honestly – it wasn't the most popular methodology in the times of Agile or Scrum, but its popularity is constantly growing, as implementing design thinking is giving some visible improvements to your project – like faster and better decision making, helps you to get a clear vision about problems of your target group, reduce the risk of the whole project, etc.

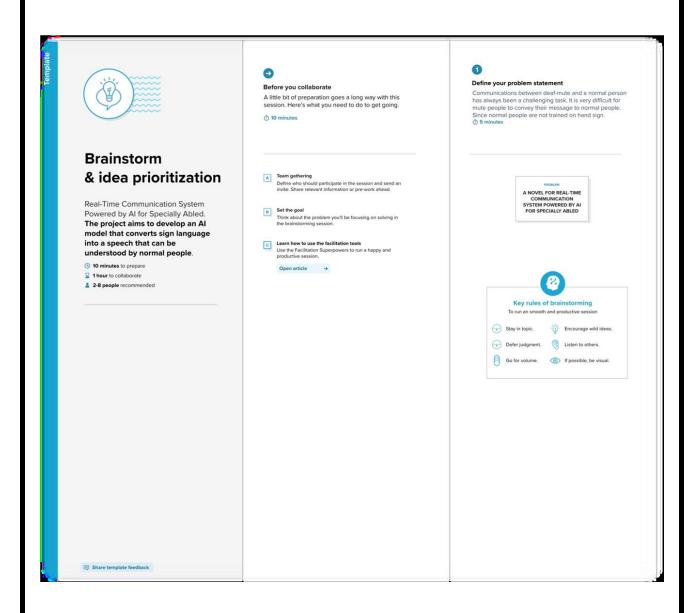
### 3.1 EMPATHY MAP CANVAS



# 3.2 IDEATION AND BRAINSTORMING

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

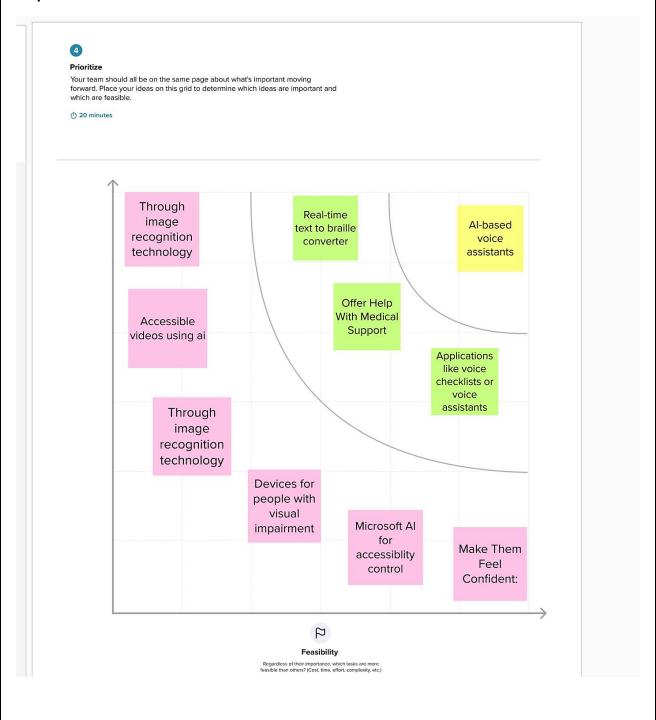
Step-1: Team Gathering, Collaboration and Select the Problem Statement.



# Step-2: Brainstorm, Idea Listing and Grouping.



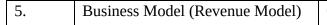
# Step-3: Idea Prioritization.



# 3.3 PROPOSED SOLUTION.

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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 deafmute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice  Conversion System with Hand Gesture  Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language. The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb.

2.	Idea / Solution description	The goal of communication is to convey
		information—and the understanding of
		that information—from one person or
		group to another person or group. This
		communication process is divided into
		three basic components: A sender
		transmits a message through a channel to
		the receiver. (Figure shows a more
		elaborate model.) The sender first
		develops an idea, which is composed into
		a message and then transmitted to the
		other party, who interprets the message
		and receives meaning. Information
		theorists have added somewhat more
		complicated language. Developing a
		message is known as encoding.
		Interpreting the message is referred to as
		decoding.
3.	Novelty / Uniqueness	By use of sensors specially abled person
		will communicate
4.	Social Impact / Customer	Specially abled persons will able to
	Satisfaction	communicate effectively. There will be equality



Communication plays a significant role in the day-to-day life of humans. Similarly, the role of communication is crucial in the business world. If you want to survive in the business world, it is essential to communicate properly.

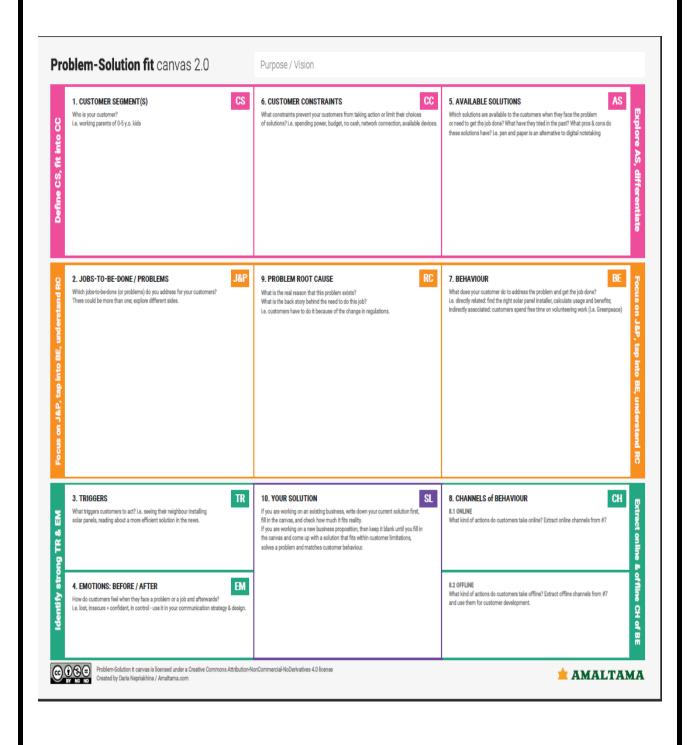
The primary purpose of communication is to deliver a piece of information from one party to another in its original form.

Communication is considered successful only if the other party receives the meaning as intended by the sender.

With time, organizations have learned the importance of communication because communication doesn't only take place within the organization but also outside the organization with the customers and stakeholders.

Therefore, the need to have a communication model that fulfils all requirements of the organization become essential. A communication model's role is to simplify the complex process of communication and determine where and with whom the communication takes place.

# 3.4 PROBLEM SOLUTION FIT



# **4.REQUIREMENT ANALYSIS**

Requirements analysis is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional specifications.

According to the guidelines issued by IFLA, Government of India and University Grants Commission (India) has opined that the blind students also have the same needs and requirements for seeking information as sighted students.

It has also been stated that the visually impaired students also need that the required information may be accessed in their chosen format. He has described the barriers being faced by the blind students for seeking their information resources and has emphasized on utilizing IT tools and following the suggested guideline for improving the accessibility of library and information services to the blind students.

# **4.1FUNCTIONAL REQUIREMENT**

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form, Gmail and LinkedIN
FR-2	User Confirmation	Confirmation via Email and OTP
FR-3	Image Capture Processing	Provides Access to capture Image through the Camera Provides Access to Upload the Captured image through Gallery
FR-4	Text conversion	Converts the Sign language into a text using Convolutional Neural Network (CNN) Model.
FR-5	Sentence Translation	Recognizes the seperate Signs Of One-By-One and it Could provide a Translation in the situation where Signed Extract System(SEE) is provided.
FR-6	Review	Users Can Give their Feedback on the Review page about the Application.

# **4.2 NON FUNCTIONAL REQUIREMENTS**

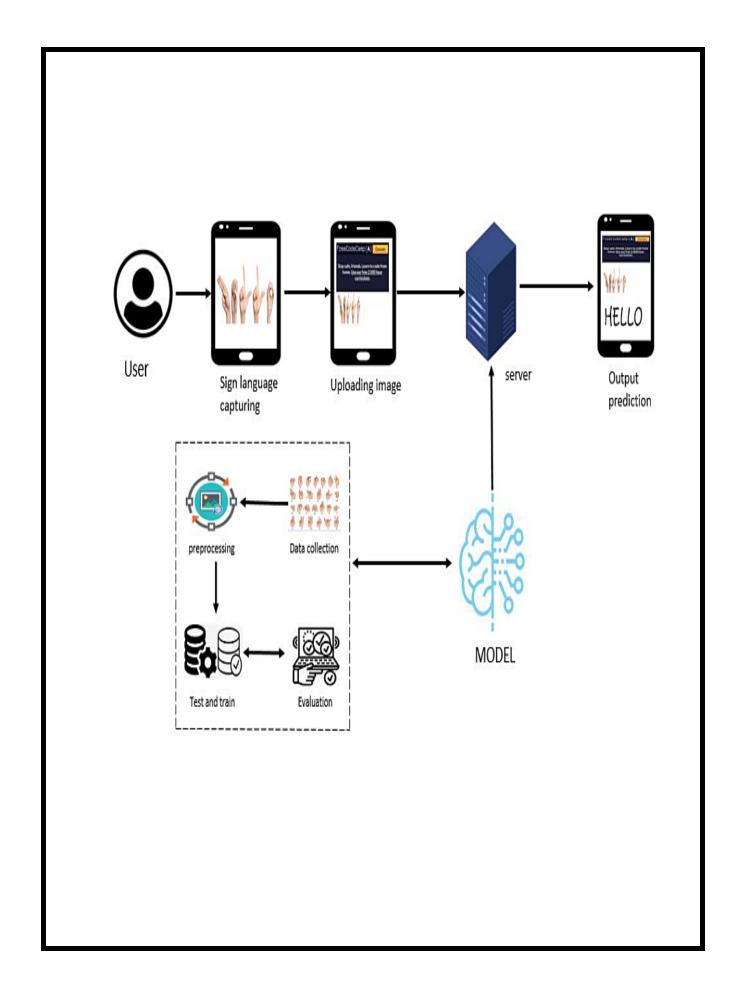
Non-Functional Requirement	Description
Usability	For the Deaf and Dumb people convert the speech into Understandable sign Languages
Security	Best security system for the specially abled persons
Reliability	Sign Method is Relevant to use for Differently abled persons
Performance	Time for converting Signs into speech will be fast for real time communications.
Availability	Provides Automatic Recovery
Scalability	Deaf and Dumb People Convey the Information through their Signs for the human understandable
	Usability  Security  Reliability  Performance  Availability

### 5.PROJECT DESIGN

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

### **5.1 DATA FLOW DIAGRAMS**

A data-flow diagram is a way of representing a flow of data through a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no control flow there are no decision rules and no loops.



# 5.2 SOLUTION AND TECHNICAL ARCHITECTURE

The Deliverable shall include the architectural diagram as below and the information as per the table 1 & table 2.

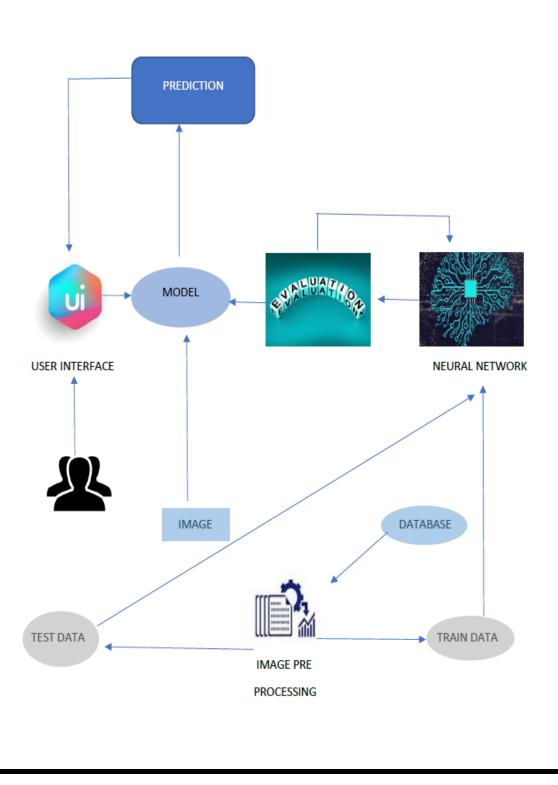


Table 1:
Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	User interface is the point of human computer interaction and communication Device	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Convert speech into sign language	Java / Python
3.	Application Logic-2	Convert sign language to speech	IBM Watson STT service
4.	Application Logic-3	Convert speech to Readable content	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	Method used to organize and store data on Hard drive	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API	Defines the communication Between normal and deaf people	IBM Weather API, etc.

9.	Machine Learning Model	Training	Object	Recognition	Model,
			etc.		

# Table 2: Application Characteristics:

S.	Characteris	Description	Technology
No	tics		
1	Open-Source	It is a open source which enables rapid	Bootstrap, Spring boot,
	Frameworks	development of secure and maintainable websites.	React JS etc
2	Security	Technical tools and techniques that are	SHA-256, Encryptions,
	Implementatio	used to implement security services	IAM Controls, OWASP
	ns		etc.
3	Scalable	Supports High Workloads without any	Devops
	Architecture	Fundamental changes	
4	Availability	Check Whether the application is working	Conferencing
		properly.	Technology
5	Performance	Indicates how that the app is functioning	Natural Language
		and how the app is response to the end user	Processing(NLP)

# **5.3 USER STORIES**

Type Requireme nt (Epic) Numb er Criteria ty S  Custom Registrati USN-1 As a user, I can I can access High	Relea se Sprint-
nt (Epic)     Numb er       Custom er     USN-1 As a user, I can register for the application by     I can access High my account / dashboard	Sprint-
Custom Registrati USN-1 As a user, I can I can access High register for the my account / application by dashboard	•
Custom Registrati USN-1 As a user, I can I can access High register for the application by dashboard	•
er on register for the my account / application by dashboard	•
(Mobile application by dashboard	1
user) entering my	
5.559	
email, password,	
and confirming	
my password.	
USN-2 As a user, I will I can receive High S	Sprint-
receive confirmation 1	1
confirmation email email & click	
once I have confirm	
registered for the	
application	
USN-3 As a user, I can I can Low S	Sprint-
register for the register &	2
application access the	
through Facebook dashboard	
with	
Facebook	
Login	
USN-4 As a user, I can Medi S	Sprint-
register for the um 1	1
application	
through Gmail	

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						ntering email &			
					р	assword			
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Custom	R	egistrati	U	SN-1		s a user, I can	I can access	High	Sprint-
er (Web	or	ו			re	egister for the	my account /		1
user)					a	pplication by	dashboard		
					е	ntering my			
					е	mail, password,			
					a	nd confirming			
					m	ny password.			
	1				_		T	T	
		Login		USN-	-2	As a user, I can		High	Sprint-
						log into the			1
						application by			
						entering email			
						& password			_
User Typ	ре	Function		User		User Story /	Acceptance	Priori	Relea
		Requiren		Story		Task	criteria	ty	se
		ent (Epic)		c) Num					
				er					
		Dashboai	rd				I can access	Medi	Sprint-
							my	um	2
							Dashboard		
		Upload		USN-	-3	As a user, I	I can able to	High	Sprint-
		image				Can Upload the	see the		3
						sign Language	appropriate		
						image for	text for the		
	Į.							•	Ī
						Translating into	sign		

	T	T		T		, , , , , , , , , , , , , , , , , , , ,
Customer	Solution	USN-4	As a user, If	Help desk	Medi	Sprint-
Care			User get any	will respond	um	3
Executive			Queries, then	the user with		
			they	a solution for		
			Get	their		
			suggestions	Queries.		
			through			
			Helpdesk			
Administra	Manage	USN-5	Do It Yourself	Set of	High	Sprint-
tor			service for	predefined		4
			Delivering	Requiremen		
			Everything.	ts that must		
				be met to		
				mark a user		
				story		
				complete		

# **6.PROJECT PLANNING & SCHEDULING**

Project planning is all about choosing and designing effective policies and methodologies to attain project objectives. Project scheduling is a procedure of assigning tasks to get them completed by allocating appropriate resources within an estimated budget and time-frame. The project planning phase refers to two phases they are as Follows:Developing a project to make it ready for investments and Determines the jobs/tasks required to attain project objectives

# **6.1 SPRINT PLANNING AND ESTIMATION**

Sprint	Functional	User	User Story /Task	Story	Priori	Team
	Requirement(E	Story		Points	ty	Members
	pic)	Number				
Sprint-	Data Collection	USN-1	Collect Dataset.	10	High	Dhiwicshen
1						M Kalidoss
						M
Sprint-		USN-2	Image	10		Dhiwicshen
1			preprocessing			M Gokul S
Sprint-	Model Building	USN-3	Import the	10	Medi	Arunkum
2			required		um	ar R Gokul
			libraries, add			S
			the necessary			
			layers and			
			compile the			
			model			
Sprint-		USN-4	Training the	10		Arunkum
2			image			ar R Gokul
			classification			S
			model using			
			CNN			
Sprint-	Training and	USN-5	Training the	20	High	Dhiwicshen
3	Testing		model and			M Gokul S
			testing the			
			model's			
			performance			
Sprint-	Implementation	USN-6	Converting the	20	Medi	Arunkumar
4	of the		input sign		um	R Kalidoss
	application		language			M
			images into			
			English			
			alphabets			

# **6.2 SPRINT DELIVERY SCHEDULE**

Sprint	Total Story Points	Durati on	Sprint Start Date	Sprint End Date(Planne d)	Story Points Completed (as onPlannedEndD ate)	Sprint Release Date(Actual)
Sprint-1	20	7Days	24Oct 2022	29Oct 2022	20	29Oct 2022
Sprint-2	15	6 Days	31Oct 2022	05Nov 2022	20	05Nov 2022
Sprint-3	20	6 Days	07Nov 2022	12Nov 2022	20	12Nov 2022
Sprint-4	20	6Days	14Nov 2022	19Nov 2022	20	19Nov 2022

# **Velocity:**

Imagine we have a10-days Sprint duration, and the velocity of the team is 20(points per sprint).

Sprint 1 Average velocity:

Average velocity = 20 / 7 = 2.6

Sprint2 Average velocity:

Average velocity = 15 / 6 = 2.3

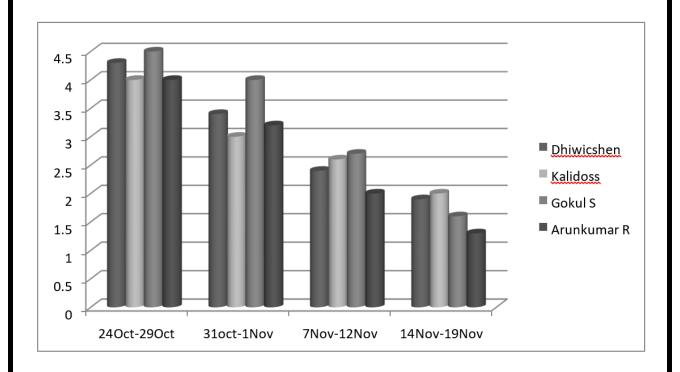
Sprint 3 Average velocity:

Average velocity = 20 / 6 = 3.2

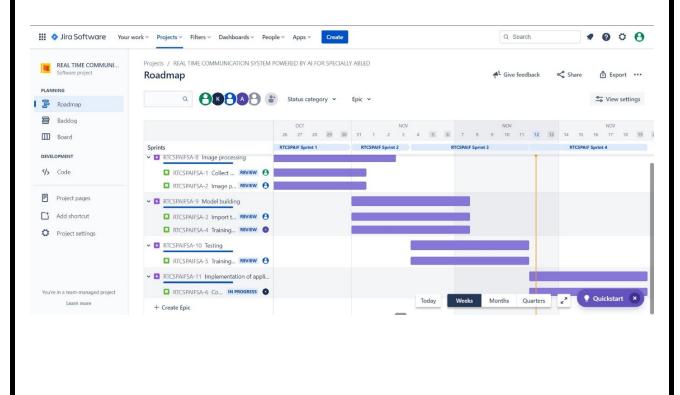
Sprint 4 Average velocity:

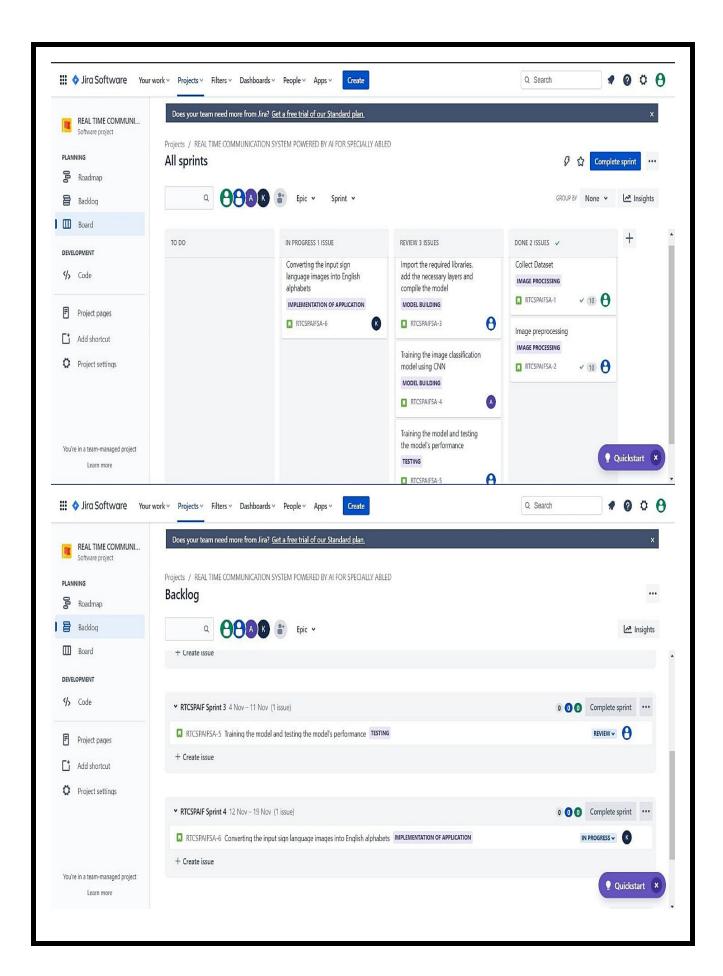
Average velocity= 20/6 = 3.2

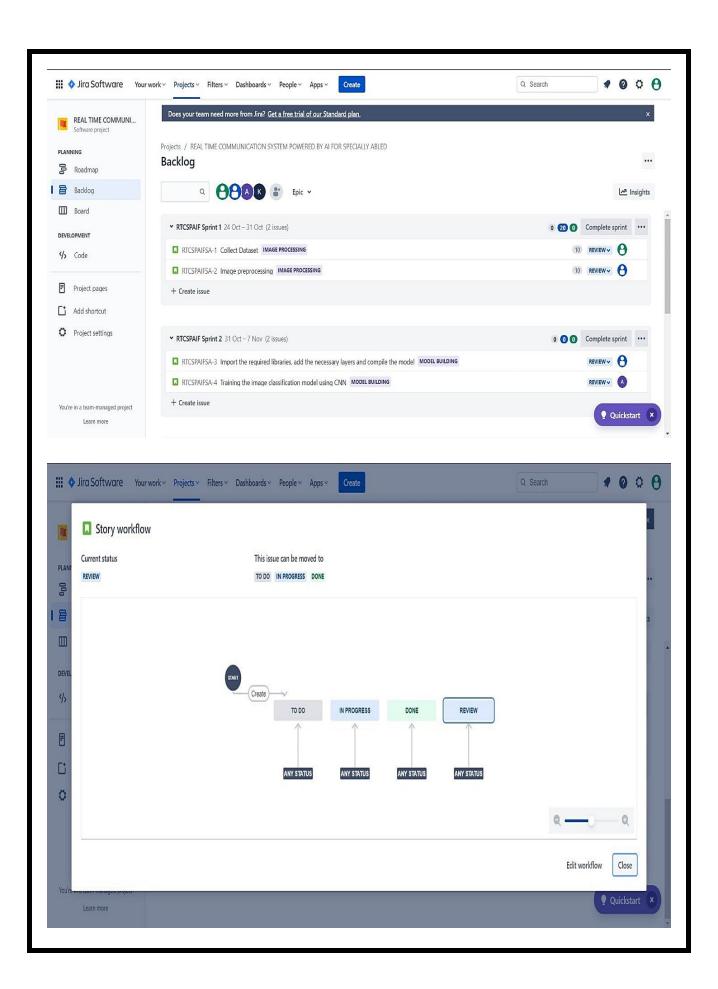
# **Burndown Chart:**



# **6.3 REPORTS FROM JIRA:**







# **7.CODING & SOLUTIONING:**

### 7.1 IMAGE PREPROCESSING.

Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. These iconic images are of the same kind as the original data captured by the sensor, with an intensity image usually represented by a matrix of image function values (brightnesses). The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g. rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used.

# **Image Processing**

```
Training Set
```

# 7.2 MODEL BUILDING.

#### **Model Building**

```
Image Processing
```

# **Import Libraries.**

#### **Import Libraries**

```
In [3]: from tensorflow.keras.models import Sequential
    from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

# **Creating Model**

#### **Creating Model**

```
In [4]: model=Sequential()
```

# **Adding Convolution Layer**

### **Adding Convolution Layer**

```
In [5]: model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,1)))
```

# **Adding Pooling Layer**

### **Adding Pooling Layer**

In [6]: model.add(MaxPooling2D(pool\_size=(2,2)))

# **Adding Flatten Layer**

#### **Adding Flatten Layer**

In [7]: model.add(Flatten())

# **Adding Dense Layer**

### **Adding Dense Layer**

```
In [8]: model.add(Dense(300,activation='relu'))
    model.add(Dense(512,activation='relu'))

Adding Output Layer
In [9]: model.add(Dense(9,activation='softmax'))
```

# **Compile The Model**

### **Compile the Model**

In [10]: model.compile(loss='categorical\_crossentropy',optimizer='adam',metrics=['accuracy'])

# Fit And Save Model

# Fit and Save model

```
In [15]: model.fit(x_train, steps_per_epoch=len(x_train), epochs=10, validation_data=x_test, validation_steps=len(x_test))
     18/18 [============ - 162s 9s/step - loss: 0.9189 - accuracy: 0.6797 - val_loss: 0.3481 - val_accuracy: 0.91
     Epoch 2/10
     18/18 [========] - 36s 2s/step - loss: 0.0768 - accuracy: 0.9785 - val loss: 0.2014 - val accuracy: 0.963
     Epoch 5/10
     Epoch 6/10
     18/18 [=========] - 34s 2s/step - loss: 0.0150 - accuracy: 0.9962 - val_loss: 0.2270 - val_accuracy: 0.968
     Epoch 7/10
     18/18 [============= ] - 32s 2s/step - loss: 0.0110 - accuracy: 0.979 - val_loss: 0.1975 - val_accuracy: 0.975
     Epoch 8/10
     18/18 [=========] - 35s 2s/step - loss: 0.0086 - accuracy: 0.9984 - val_loss: 0.2031 - val_accuracy: 0.976
     18/18 [============ ] - 35s 2s/step - loss: 0.0068 - accuracy: 0.9987 - val_loss: 0.1937 - val_accuracy: 0.976
     Epoch 10/10
```

Out[15]: <keras.callbacks.History at 0x1d02c630dc0>

## 7.3 TESTING THE MODEL.

```
TEST THE MODEL
In [40]: from tensorflow.keras.models import load_model
       from tensorflow.keras.preprocessing import image
       import numpy as np
       import cv2
       Load Model
In [41]: model = load_model('Model.h5')
       Load Image
Out[59]:
In [53]: from skimage.transform import resize
       def detect(frame):
          img=image.img_to_array(frame)
          img=image.img_to_array(rrame)
img = resize(img,(64,64,1))
img = np.expand_dims(img,axis=0)
pred=np.argmax(model.predict(img))
op=['A','B','C','D','E','F','G','H','I']
print("THE PREDICTED LETTER IS ",op[pred])
       Detect Image Letter
imgA
Out[77]:
In [78]: imgA=image.load_img("../../../data collection/conversation engine for deaf and dumb/Dataset/test_set/A/50.png")
       detect(imgA)
       1/1 [======] - 0s 28ms/step
       THE PREDICTED LETTER IS A
imgB
Out[79]:
In [80]: imgB=image.load_img("../../../data collection/conversation engine for deaf and dumb/Dataset/test_set/B/50.png")
       detect(imgB)
       1/1 [======= ] - 0s 36ms/step
       THE PREDICTED LETTER IS B
```

```
In [81]: imgC = image.load_img('...../.../data collection/conversation engine for deaf and dumb/Dataset/test_set/C/50.png',
                      target_size = (100,100))
       imgC
Out[81]:
In [82]: imgC=image.load_img("../../data collection/conversation engine for deaf and dumb/Dataset/test_set/C/50.png")
       detect(imgC)
       THE PREDICTED LETTER IS C
imgD
Out[83]:
In [84]: imgD=image.load_img("../../data collection/conversation engine for deaf and dumb/Dataset/test_set/D/50.png")
       detect(imgD)
       1/1 [======] - 0s 32ms/step
       THE PREDICTED LETTER IS D
In [85]: imgE = image.load_img('../../../data collection/conversation engine for deaf and dumb/Dataset/test_set/E/50.png',
                       target_size = (100,100))
       imgE
Out[85]:
In [86]: imgE=image.load_img("../../../data collection/conversation engine for deaf and dumb/Dataset/test_set/E/50.png")
       detect(imgE)
       1/1 [======] - 0s 29ms/step
       THE PREDICTED LETTER IS E
Out[87]:
In [88]: imgF=image.load_img("../../../data collection/conversation engine for deaf and dumb/Dataset/test_set/F/50.png")
       detect(imgF)
       1/1 [=======
                  ====== 1 - 0s 33ms/step
       THE PREDICTED LETTER IS F
```

#### 7.4 FLASK APPLICATION.

## **Loading The Required Packages.**

```
import numpy as np
import cv2
import os
from tensorflow.keras.models import load model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.backend import set_session
from flask import Flask, render_template, Response
import tensorflow as tf
from gtts import gTTS
global graph
global writer
from skimage.transform import resize
```

# Video Feed From HTML Page

```
@app.route('/video_feed')
def video_feed():
    return Response(gen(),mimetype='multipart/x-mixed-replace; boundary=frame')
if __name__ == '__main__':
    app.run()
```

#### 7.5 HTML PAGE.

```
rice control large enhanced content middle device width, initial scale 1.0, shrink to fit to the content middle device width, initial scale 1.0, shrink to fit to the content middle device width, initial scale 1.0, shrink to fit to the content middle device width, initial scale 1.0, shrink to fit to the content middle device width in the content middle width in the content width
```

#### 8.TESTING

Testing is the process of evaluating and verifying that a software product or application does what it is supposed to do. The benefits of testing include preventing bugs, reducing development costs and improving performance.

Test Case ID	Test Scenario	Steps to Execute	Expected Result	Actual Result
1	Verify if user is	1. Enter URL	Camera is On.	Working as
	able to providecamera access.	and clickgo. 2. Give CameraA ccess.		expected.

2	Verify if user is	1. Enter URL	Alphabet is	Working as
	able to get the	and clickgo.	predicted for	expected.
	desirable	2. Give	the gesture.	
	prediction for	CameraA		
	the gesture.	ccess. 3.		
		Make		
		Gesture		
		in front ofcamera.		

# **8.2.USER ACCEPTANCE TESTING**

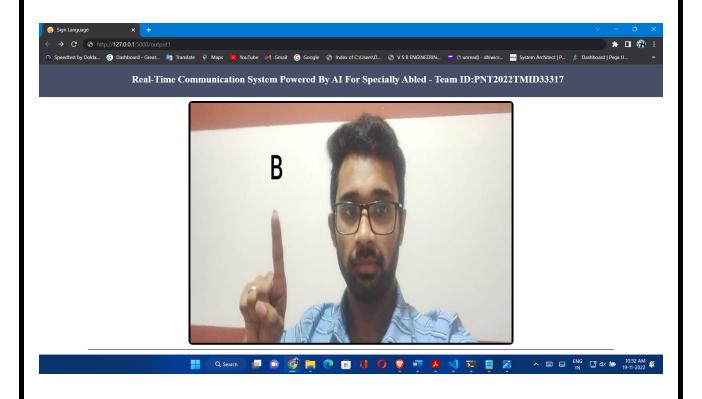
# Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	0	12	1	1	14
External	5	0	0	0	5
Fixed	11	3	2	2	18
Skipped	0	0	2	0	2
Won't Fix	4	0	0	0	4
Totals	20	15	5	3	43

# Test Case Analysis

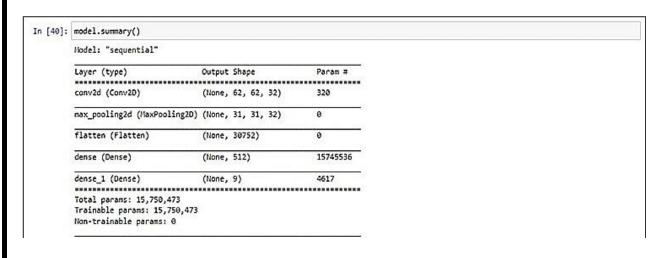
Section	Total Cases	Not Tested	Fail	Pass
Client Application	5	1	0	5
Security	2	0	0	2
Exception Reporting	2	0	0	2
Final Report Output	9	0	0	9

## **SAMPLE RESULTS**



# 9.RESULTS

# 9.1 Performance Metrics

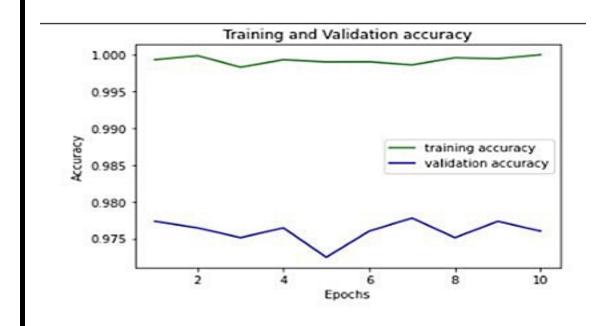


# 9.2 Classification Report

```
Confusion Matrix
[[38 31 33 26 29 22 31 19 21]
[31 28 25 27 26 26 33 26 28]
[22 18 28 34 30 36 33 21 28]
[32 21 23 34 30 24 42 22 22]
[29 23 29 18 25 30 32 30 34]
[20 29 27 26 32 25 32 22 37]
[27 30 26 32 21 31 33 26 24]
[26 41 25 26 24 26 30 25 27]
[25 29 33 28 33 30 29 14 29]]
```

Classification	n Report			
	precision recall		f1-score	support
A	0.15	0.15	0.15	250
В	0.11	0.11	0.11	250
<b>C</b>	0.11	0.11	0.11	250
D	0.14	0.14	0.14	250
E	0.10	0.10	0.10	250
F	0.10	0.10	0.10	250
G	0.11	0.13	0.12	250
н	0.12	0.10	0.11	250
I	0.12	0.12	0.12	250
accuracy			0.12	2250
macro avg	0.12	0.12	0.12	2250
weighted avg	0.12	0.12	0.12	2250

# 9.3Accuracy



#### 10.ADVANTAGES AND DISADVANATGES.

#### 10.1 ADVANTAGES.

- 1. To convey their information using signs which get converted to humanunderstandable language and speech is given as output.
- 2. Easiest Way To get the Results from those people.

#### 10.2 DISADVANTAGES

- 1. The dataset in limited. The alphabets only range from 'A' to 'J'.
- 2. As of now, only static gestures are converted.

#### 11. CONCLUSION

The main objective of this project is to develop gesture recognition so that the deaf can communicate with normal individuals. One of the crucial tasks is the extraction of features, and various gestures should yield various, effectively distinguishable characteristics. To identify the character from the gestureimages, we used a trained dataset for the CNN algorithm. These features combinedwith a labelled data enable accurate real- time ASL alphabet recognition. Our analysis found that accuracy is influenced by a variety of elements, including the camera, dataset, and approach. The accuracy drastically declines in low light and noisy backgrounds.

#### 12.FUTURE SCOPE

The proposed system can be translated into multiple languages, enhancing its dependability and effectiveness. In the near future, it might only be accessible through mobile devices, making the system more convenient and portable. This system is unable to detect gestures made with both hands. Therefore, detecting gestures done with both hands could be a future project.

```
13.APPENDIX.
     13.1 SOURCE CODE
1.app.py
     from flask import Flask, render_template, Response
import tensorflow as tf
import numpy as np
import trainlist
import cv2
model=tf.keras.models.load_model("./Model/sign_1.h5")
image=tf.keras.preprocessing.image
#print(model.summary())
fl_img='./Data/Test/G/Image_1667714982.6115465.jpg'
img=image.load_img(fl_img,target_size=(224,224))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=trainlist.dataset
ans=op[pred]
print("\n\t"+ans+"\n")
app = Flask(__name__)
print("[INFO] accessing video stream...")
camera = cv2.VideoCapture(1)
camera.set(cv2.CAP PROP FRAME WIDTH, 1280)
```

```
camera.set(cv2.CAP_PROP_FRAME_HEIGHT, 720)
pred=""
@app.route('/')
def index():
  return render_template('index.html')
def detect(frame):
  global pred
  global sess
  global graph
  img = resize(frame,(64,64,1))
  x = image.img_to_array(img)
  x = np.expand_dims(x,axis=0)
  #if(np.max(x)>1):
  # img = img/255.0
  with graph.as_default():
    set_session(sess)
    predictions = model.predict_classes(x)
  print(predictions)
  pred=vals[predictions[0]]
  print(pred)
def gen():
  while True:
    success, frame = camera.read()
    frame = cv2.resize(frame,(640,480))
```

```
detect(frame)
        frame = cv2.putText(frame, 'Prediction: '+pred,
(00,435), cv2.FONT_HERSHEY_SIMPLEX, 1,(0,0,255),
2, cv2.LINE_AA, False)
    ret, buffer = cv2.imencode('.jpg', frame)
    frame = buffer.tobytes()
    yield (b'--frame\r\n'
          b'Content-Type: image/jpeg\r\n\r\n' + frame +
b'\r\n')
@app.route('/video_feed')
def video_feed():
   return Response(gen(),mimetype='multipart/x-mixed-
replace; boundary=frame')
if __name__=='__main__':
  app.run()
2.main.py
     import tensorflow as tf
import numpy as np
import trainlist
import cv2
model=tf.keras.models.load_model("./Model/sign_1.h5")
image=tf.keras.preprocessing.image
#print(model.summary())
```

```
fl_img='./Data/Test/G/Image_1667714982.6115465.jpg'
img=image.load_img(fl_img,target_size=(224,224))
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
pred=np.argmax(model.predict(x))
op=trainlist.dataset
ans=op[pred]
print("\n\t"+ans+"\n")
3.view.py
       import cv2 as cv
from cvzone.HandTrackingModule import HandDetector
import numpy as np
import math
from cvzone.ClassificationModule import Classifier
import trainlist
cap = cv.VideoCapture(0)
detector = HandDetector(maxHands=1)
offset = 20
img_size = 300
classifier
                    Classifier("./Model/keras_model.h5",
"./Model/labels.txt")
labels = trainlist.dataset
def display():
  list = [" "]
  count = 0
```

```
while True:
    ret, img = cap.read()
    img_out = img.copy()
    hands, img = detector.findHands(img)
    if hands:
      hand = hands[0]
      x, y, w, h = hand['bbox']
      # Image empty
       img_bg = np.ones((img_size, img_size, 3), np.uint8)
* 255
          croped_img = img[y - offset; y + h + offset, x -
offset:x + w + offset1
       aspect_ratio = h / w
       if aspect_ratio > 1:
         k = img_size / h
         wCal = math.ceil(k * w)
               img_resize = cv.resize(croped_img, (wCal,
img_size))
         wGap = math.ceil((img_size - wCal) / 2)
         img_bg[:, wGap:wCal + wGap] = img_resize
                                    prediction, index =
classifier.getPrediction(img_bg)
         print(labels[index])
       else:
         k = img_size / w
         hCal = math.ceil(k * h)
            img_resize = cv.resize(croped_img, (img_size,
```

```
hCal))
         hGap = math.ceil((img_size - hCal) / 2)
         img_bg[hGap:hCal + hGap, :] = img_resize
                                   prediction, index =
classifier.getPrediction(img_bg)
         print(labels[index])
           cv.putText(img_out, labels[index], (x, y - 20),
cv.FONT_HERSHEY_COMPLEX, 2, (255, 255, 255), 2)
      cv.imshow("Image_croped", croped_img)
      cv.imshow("Image_bg", img_bg)
      gesture = labels[index]
      count += 1
      if count == 30:
         if gesture != list[-1]:
           list.append(gesture)
         count = count - 30
      print(list)
    cv.imshow("Image", img_out)
    key = cv.waitKey(1)
    if key == ord('q'):
      break
  cap.release()
  cv.destroyAllWindows()
display()
```

4.train.py
import tensorflow as tf
import trainlist
import os

TRAIN\_DIR="./Data/Train"
VALIDATE\_DIR="./Data/Test"
dataset=trainlist.dataset

def train\_model():

train\_datagen=tf.keras.preprocessing.image.ImageDataG enerator(rescale=1./255,shear\_range=0.2,zoom\_range=0.2,horizontal\_flip=True)

train\_generator=train\_datagen.flow\_from\_directory(TR AIN\_DIR,target\_size=(224,224),class\_mode="categorical",batch\_size=300)

validate\_datagen=tf.keras.preprocessing.image.ImageDat aGenerator(rescale=1./255,shear\_range=0.2,zoom\_range= 0.2,horizontal\_flip=True)

validate\_generator=validate\_datagen.flow\_from\_director y(VALIDATE\_DIR,target\_size=(224,224),class\_mode="categorical",batch\_size=300)

```
model=tf.keras.Sequential([
tf.keras.layers.Conv2D(64,(3,3),activation="relu",input_s
hape=(224,224,3)),
    tf.keras.layers.MaxPooling2D(2,2),
tf.keras.layers.Conv2D(128,(3,3),activation="relu",input_
shape=(112,112)),
    tf.keras.layers.MaxPooling2D(2,2),
tf.keras.layers.Conv2D(256,(3,3),activation="relu",input_
shape=(56,156)),
    tf.keras.layers.MaxPooling2D(2,2),
tf.keras.layers.Conv2D(512,(3,3),activation="relu",input_
shape=(28,28)),
    tf.keras.layers.MaxPooling2D(2,2),
tf.keras.layers.Conv2D(512,(3,3),activation="relu",input_
shape=(14,14)),
    tf.keras.layers.MaxPooling2D(2,2),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dropout(0.5),
    tf.keras.layers.Dense(256,activation="relu"),
    tf.keras.layers.Dense(10,activation="softmax")
  1)
model.compile(loss="categorical_crossentropy",optimizer
```

```
="adam",metrics=["accuracy"])
model.fit_generator(train_generator,epochs=10,validation
_data=validate_generator,verbose=1,validation_steps=10,
steps_per_epoch=20)
  model.save("sign_1.h5")
  print("Model Trained Sucessfully...")
def train_list(dataset):
  f=open("labels_1.txt","w+")
  for i in range(len(dataset)):
    f.write(str(i)+" "+dataset[i]+"\n")
  f.close()
  print("Dataset list as been sucessfully created")
train_model()
train_list(dataset)
```

```
5.opencv.py
        import cv2 as cv
from cvzone.HandTrackingModule import HandDetector
import numpy as np
import math
from cvzone.ClassificationModule import Classifier
import trainlist
cap=cv.VideoCapture(0)
detector = HandDetector(maxHands=1)
offset=20
img_size=300
classifier=Classifier("./Model/keras_model.h5","./Model/l
abels.txt")
labels=trainlist.dataset
def get_frame():
  count=0
  index l=-1
  ret,img=cap.read()
  img_out=img.copy()
  hands,img=detector.findHands(img)
  if hands:
    hand=hands[0]
    x,y,w,h=hand['bbox']
    #Image empty
    img_bg=np.ones((img_size,img_size,3), np.uint8)*255
        croped_img=img[y-offset:y+ h+offset;x+
w+offset1
```

```
aspect_ratio=h/w
    if aspect_ratio>1:
      k=img_size/h
      wCal= math.ceil(k*w)
      img_resize=cv.resize(croped_img,(wCal,img_size))
      wGap =math.ceil((img_size-wCal)/2)
      img_bg[:,wGap:wCal+wGap] = img_resize
      prediction,index=classifier.getPrediction(img_bg)
      # print(labels[index])
    else:
      k=img size/w
      hCal= math.ceil(k*h)
      img_resize=cv.resize(croped_img,(img_size,hCal))
      hGap =math.ceil((img_size-hCal)/2)
      img_bg[hGap:hCal+hGap,:] = img_resize
      prediction,index=classifier.getPrediction(img_bg)
      # print(labels[index])
                   cv.putText(img_out,labels[index],(x,y-
20),cv.FONT_HERSHEY_COMPLEX,2,(255,255,255),2)
    # cv.imshow("Image_croped",croped_img)
    # cv.imshow("Image_bg",img_bg)
    index l=index
  if ret:
    ret,jpeg=cv.imencode('.jpg',img_out)
```

```
return jpeg.tobytes(),index_l
  else:
    return None
6.trainlist.py
       dataset=[
  'A',
  'B',
  'C',
  'D',
  'E',
  'F',
  'G',
  'H',
  'I',
  'J'
7.ibmcloud.py
            from ibm_watson_machine_learning import
APIClient
web_cred={
   "apikey": "6PcwxslwN5BT5dP8C4oKx62Vsz661Sxw-
KY3oVAygalC",
     "url": "https://eu-gb.ml.cloud.ibm.com"
}
client=APIClient(web_cred)
spaceID="e4ef5efc-e11a-41cc-9c1e-b45c6a510aeb"
```

```
x=client.set.default_space(spaceID)
print(x)
8.ibm_upload.py
           from ibm_watson_machine_learning import
APIClient
web_cred={
   "apikey": "6PcwxslwN5BT5dP8C4oKx62Vsz661Sxw-
KY3oVAygalC",
    "url": "https://ef-gh.mh.cloud.ibm.com"
}
client=APIClient(web cred)
spaceID="**************************
****** #Confidential
x=client.set.default_space(spaceID)
X
'SUCCESS'
sw_id=client.software_specifications.get_uid_by_name("t
ensorflow_rt22.1-py3.9")
sw id
'acd9c798-6974-5d2f-a657-ce06e986df4d'
!tar -zcvf sign_lang.tgz keras_model.h5
a keras model.h5
model_details=client.repository.store_model(model="sign
_lang.tgz",meta_props={
             client.repository.ModelMetaNames.NAME:
"CNN_sign_lang",
              client.repository.ModelMetaNames.TYPE:
```

```
"tensorflow_2.7",
client.repository.ModelMetaNames.SOFTWARE_SPEC_
UID:sw id
})
model details
{'entity': {'hybrid_pipeline_software_specs': [],
     'software_spec': {'id': 'acd9c798-6974-5d2f-a657-
ce06e986df4d',
 'name': 'tensorflow_rt22.1-py3.9'},
 'type': 'tensorflow_2.7'},
'metadata': {'created at': '2022-11-07T04:58:57.379Z',
 'id': 'e85e52c1-6ab2-4fa5-a56e-5610b7368292'.
 'modified_at': '2022-11-07T04:59:02.593Z',
 'name': 'CNN_sign_lang',
 'owner': 'IBMid-668000CNQ0',
          'resource_key': 'd767170e-5545-4e10-9c54-
687fed2e8128'.
 'space_id': 'e4ef5efc-e11a-41cc-9c1e-b45c6a510aeb'},
'system': {'warnings': []}}
model_id=client.repository.get_model_id(model_details)
model id
'e85e52c1-6ab2-4fa5-a56e-5610b7368292'
client.repository.list()
                              NAME
GUID
                                            CREATED
                  TYPE
FRAMEWORK
e85e52c1-6ab2-4fa5-a56e-5610b7368292 CNN_sign_lang
2022-11-07T04:58:57.002Z tensorflow 2.7 model
```

```
8.datacollect.py
         import cv2 as cv
from cvzone.HandTrackingModule import HandDetector
import numpy as np
import math
import time
import trainlist
import os
def collectData(save_folder):
  cap=cv.VideoCapture(0)
  detector = HandDetector(maxHands=1)
  offset=20
  img_size=300
  counter=0
  while counter<100:
    ret,img=cap.read()
    hands,img=detector.findHands(img)
    if hands:
      hand=hands[0]
      x,y,w,h=hand['bbox']
      #Image empty
                  img_bg=np.ones((img_size,img_size,3),
np.uint8)*255
        croped_img=img[y-offset:y+ h+offset;x+
w+offset]
      aspect_ratio=h/w
```

```
if aspect_ratio>1:
        k=img_size/h
        wCal= math.ceil(k*w)
img_resize=cv.resize(croped_img,(wCal,img_size))
        wGap =math.ceil((img_size-wCal)/2)
        img_bg[:,wGap:wCal+wGap] = img_resize
      else:
        k=img_size/w
        hCal= math.ceil(k*h)
img_resize=cv.resize(croped_img,(img_size,hCal))
        hGap =math.ceil((img_size-hCal)/2)
        img_bg[hGap:hCal+hGap,:] = img_resize
      cv.imshow("Image_croped",croped_img)
#img_bw=cv.cvtColor(img_bg,cv.COLOR_BAYER_BG2
GRAY)
      cv.imshow("Image_bg",img_bg)
    cv.imshow("Image",img)
    key=cv.waitKey(1)
    if key==ord("s"):
      counter +=1
cv.imwrite(f"{save_folder}/Image_{time.time()}.jpg",img
_bg)
```

```
print(counter)
save_folder="Data/Train_2/"
dataset=trainlist.dataset
for data in dataset:
  data=save folder+data
  print("\nStarting to Collect "+data)
  try:
    os.mkdir(data)
    collectData(data)
  except:
    continue
  print(data)
10.ibmdownload.py
from ibm_watson_machine_learning import APIClient
import tarfile
web_cred={
   "apikey": "6PcwxslwN5BT5dP8C4oKx62Vsz661Sxw-
KY3oVAygalC",
    "url": "https://ef-gh.mh.cloud.ibm.com"
}
client=APIClient(web_cred)
spaceID="***************************
***" #Confidential
```

```
client.set.default_space(spaceID)
'SUCCESS'
model id="******************************
****** #Confidential
Running cells with 'Python 3.10.7 64-bit' requires
ipykernel package.
Run the following command to install 'ipykernel' into the
Python environment.
Command:
'c:/Users/HP/AppData/Local/Programs/Python/Python31
0/python.exe -m pip install ipykernel -U --user --force-
reinstall'
client.repository.download(model_id,'Model/sign.tgz')
Successfully saved model content to file: 'Model/sign.tgz'
'c:\\Users\\Deva\\Documents\\PROGRAMMING\\Project/
Model/sign.tgz'
!tar
                      Model/sign.tgz
                                           --directory
"/Users/srinath/Documents/PROGRAMMING/Project/M
odel/"
x keras_model.h5
11.apikey.json
  {
     "name": "Realtime_SignLanguage",
     "description": "Real-Time Communication System
Powered by AI for Specially Abled",
     "createdAt": "2022-11-08T09:29+0000",
```

```
"apikey":
"6PcwxslwN5BT5dP8C4oKx62Vsz661Sxw-
KY3oVAygalC"
}
12.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>Sign Language</title>
                               link
                                            rel="icon"
href="C:\Users\DHIWICSHEN\Desktop\IBM\Coding\N
ew folder\img\sign.png" type="image/png">
                           link
                                      rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/c
ss/bootstrap.min.css">
                           link
                                      rel="stylesheet"
href="https://use.fontawesome.com/releases/v5.12.0/css/al
l.css">
       k rel="stylesheet" href="static/css/Banner-
Heading-Image.css">
       k rel="stylesheet" href="static/css/Navbar-
Centered-Brand.css">
  k rel="stylesheet" href="static/css/styles.css">
</head>
<body>
```

```
<nav class="navbar navbar-light navbar-expand-md py-
3" style="background:#474E68;">
    <div class="container">
        <div></div><a class="navbar-brand d-flex align-
items-center" href="#"><h4 style="color: #ffffff; font-
             New roman;
style:Times
                              text-align: center;font-
family:Times
                       Roman"><strong>
                                            Real-Time
               New
Communication
             System Powered By AI  For Specially
Abled
                                                 Team
ID:PNT2022TMID33317</strong></h4></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: 800px;height: 600px;margin:
10px;min-height: 480px;min-width: 640px;border-radius:
10px;border: 5px groove #000000;">
                 <img src="{{ url_for('video_feed') }}"
style="width:
                                          100%:color:
                     100%; height:
rgb(255,255,255);text-align: center;font-size: 20px;"
           alt="Camera Access Not Provided!">
      </div>
    </div>
  </section>
<section>
```

```
<div class="container">
        <div class="accordion text-white" role="tablist"
id="accordion-1">
          <div class="accordion-item" style="font-style:</pre>
Times new Roman; background: #429691;">
             </div>
           </div>
         </div>
      </div>
    </div>
  </section>
   <div class="modal fade" role="dialog" tabindex="-1"
id="modal-1">
    <div class="modal-dialog" role="document">
      <div class="modal-content">
         <div class="modal-header">
                <h4 class="modal-title">American Sign
Language - Alphabets</h4><button type="button"
             class="btn-close" data-bs-dismiss="modal"
aria-label="Close"></button>
         </div>
                <div class="modal-body"><img src="{{
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>
13.finaloutput.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>Sign Language</title>
                                link
                                             rel="icon"
href="C:\Users\DHIWICSHEN\Desktop\IBM\Coding\N
ew folder\img\sign.png" type="image/png">
                            link
                                        rel="stylesheet"
href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/c
ss/bootstrap.min.css">
                            link
                                        rel="stylesheet"
href="https://use.fontawesome.com/releases/v5.12.0/css/al
l.css">
        link rel="stylesheet" href="static/css/Banner-
Heading-Image.css">
        <link rel="stylesheet" href="static/css/Navbar-</pre>
```

```
Centered-Brand.css">
  <link rel="stylesheet" href="static/css/styles.css">
  <style>
    img{
             width:500px; height:240px; display: block;
margin-left: auto; margin-top: 189px;
      margin-right: auto;
    }
    .dcont {
 display: flex;
.dcont > div {
 background-color: #f1f1;
 margin: 10px;
 padding: 20px;
font-size: 30px;
}
  </style>
</head>
<body>
<nav class="navbar navbar-light navbar-expand-md py-
3" style="background:#474E68;">
    <div class="container">
        <div></div><a class="navbar-brand d-flex align-
items-center" href="#"><h4 style="color: #ffffff; font-
style: oblique; text-align: center;font-family: Times New
Roman "><strong> Real-Time Communication
```

```
System Powered By AI For Specially
Abled
                               Team
                                                ID:
PNT2022TMID33317</strong></h4></a>
      <div></div>
    </div>
  </nav>
    <div class="dcont">
        <div>
<h1 style="
 padding: 0px 0px 0px 150px;
">SignLanguagePrediction</h1>
Sign languages are languages that use the visual-
manual modality to convey meaning, instead of just
spoken words. Sign languages are expressed through
manual articulation in combination with non-manual
markers.
<img
                                        class="imgi"
src="C:\Users\DHIWICSHEN\Desktop\IBM\Coding\New
folder\img\ppl.jpg" >
        </div>
        <div id="div-video-feed"
            style="width: 800px;height: 600px;margin:
10px;min-height: 480px;min-width: 640px;border-radius:
10px;border: 5px groove #000000;">
```

```
<video height="256" loop="true"
autoplay="autoplay"
                        controls="controls"
                                               id="vid"
muted>
                             <source type="video/mp4"</pre>
src="C:\Users\DHIWICSHEN\Desktop\IBM\Coding\New
folder\img\Video.mp4"></source>
        </video>
  </video>
         </div>
      <!-- </div> -->
    </div>
<section>
    <div class="container">
         <div class="accordion text-white" role="tablist"</pre>
id="accordion-1">
           <div class="accordion-item" style="font-style:</pre>
oblique; background:#474E68;">
            <div class="accordion-collapse collapse item-
2" role="tabpanel" data-bs-parent="#accordion-1">
             <div class="accordion-body">
             </div>
           </div>
         </div>
       </div>
```

```
</div>
  </section>
   <div class="modal fade" role="dialog" tabindex="-1"
id="modal-1">
    <div class="modal-dialog" role="document">
      <div class="modal-content">
         <div class="modal-header">
                <h4 class="modal-title">American Sign
Language - Alphabets</h4><button type="button"
             class="btn-close" data-bs-dismiss="modal"
aria-label="Close"></button>
        </div>
                <div class="modal-body"><img src="{{
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>
```

# 13.2 GITHUB AND PROJECT DEMO LINK 13.2.1.GITHUB LINK. https://github.com/IBM-EPBL/IBM-Project-39875-1660558366 13.2.2 PROJECT DEMO LINK https://youtu.be/-FM6qPP32k0