

# Real-Time Communication System Powered by AI for Specially Abled

Submitted By:-

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## **Project Report Format**

### **1. INTRODUCTION**

- 1.1. Project Overview
- 1.2. Purpose

### **2. LITERATURE SURVEY**

- 2.1. Existing problem
- 2.2. References
- 2.3. Problem Statement Definition

### **3. IDEATION & PROPOSED SOLUTION**

- 3.1. Empathy Map Canvas
- 3.2. Ideation & Brainstorming
- 3.3. Proposed Solution
- 3.4. Problem Solution fit

### **4. REQUIREMENT ANALYSIS**

- 4.1. Functional requirement
- 4.2. Non-Functional requirements

### **5. PROJECT DESIGN**

- 5.1. Data Flow Diagrams
- 5.2. Solution & Technical Architecture
- 5.3. User Stories

### **6. PROJECT PLANNING & SCHEDULING**

- 6.1. Sprint Planning & Estimation
- 6.2. Sprint Delivery Schedule
- 6.3. Reports from JIRA

### **7. CODING & SOLUTIONING (Explain the features added in the project along with code)**

- 7.1. Feature 1
- 7.2. Feature 2
- 7.3. Database Schema (if Applicable)

### **8. TESTING**

- 8.1. Test Cases
- 8.2. User Acceptance Testing

### **9. RESULTS**

- 9.1. Performance Metrics

### **10. ADVANTAGES & DISADVANTAGES**

### **11. CONCLUSION**

### **12. FUTURE SCOPE**

### **13. APPENDIX**

Source Code, GitHub & Project Demo Link

## 1. **INTRODUCTION**

### **1.1 Project Overview**

Real-time communications (RTC) are any mode of telecommunications in which all users can exchange information instantly. Communication plays a significant role in making the world better place. It creates a bonding and relations among the people. People get to know one another by sharing their ideas, thoughts, and experiences with those around them. There are numerous ways to accomplish this, the best of which is the gift of "Speech." Everyone can very convincingly transfer their thoughts and understand each other through speech. It will be unjust if we overlook those who are denied this priceless gift: the deaf and dumb. In such cases, the human hand has remained the preferred method of communication.

### **1.2 Purpose**

The Project's purpose is to create a system that translates sign language into a human understandable language so that ordinary people may understand it. In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. Since normal people are not trained on hand sign language. In emergency times conveying their message is very difficult. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used. Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation between a normal person and an impaired person in any language. The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb. We are making use of a convolution neural network to create a model that is trained on different hand gestures. An app is built which uses this model. This app enables deaf and dumb people to convey their information using signs which get converted to human-understandable language and speech is given as output.

## 2. LITERATURE SURVEY

A literature review is **a comprehensive summary of previous research on a topic**. The literature review surveys scholarly articles, books, and other sources relevant to a area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research.

In our project, We have taken the literature survey on IEEE papers. An intelligent communication device is developed to assist nonverbal, motor-disabled persons in the generation of written and spoken messages. The device is centered on knowledge base of the grammatical rules and message elements. A belief reasoning scheme based on both the information from external sources and the embedded knowledge issued to optimize the process of message search

### 2.1 Existing problem

Some of the existing solutions for solving this problem are:

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.

#### **Technology**

One of the easiest ways to communicate is through technology such as a phone or laptop. A deaf person can type out what they want to say and a person who is blind or has low vision can use a screen reader to read the text out loud.

A blind person can also use voice recognition software to convert what they are saying in to text so that a person who is Deaf can then read it.

#### **Interpreter**

If a sign language interpreter is available, this facilitates easy communication if the person who is deaf is fluent in sign language. The deaf person and person who is blind can communicate with each other via the interpreter. The deaf person can use sign language and the interpreter can speak what has been said to the person who is blind and then translate anything spoken by the blind person into sign language for the deaf person.

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

## 2.2References

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2. Lotti, F., Tiezzi, P., Vassura, G., Biagiotti, L., and Melchiorri, C., "UBH 3: an anthropomorphic hand with simplified endo-skeletal structure and soft continuous fingerpads", In Proceedings IEEE International Conference on Robotics and Automation, 2004 (ICRA'04), Vol.5, pp. 4736-474, IEEE, 2004.
3. Rajamohan, A., Hemavathy, R., and Dhanalakshmi, M., "Deaf-Mute Communication Interpreter", International Journal of Scientific Engineering and Technology, Vol.2, No.5, pp.336-341, 2013.

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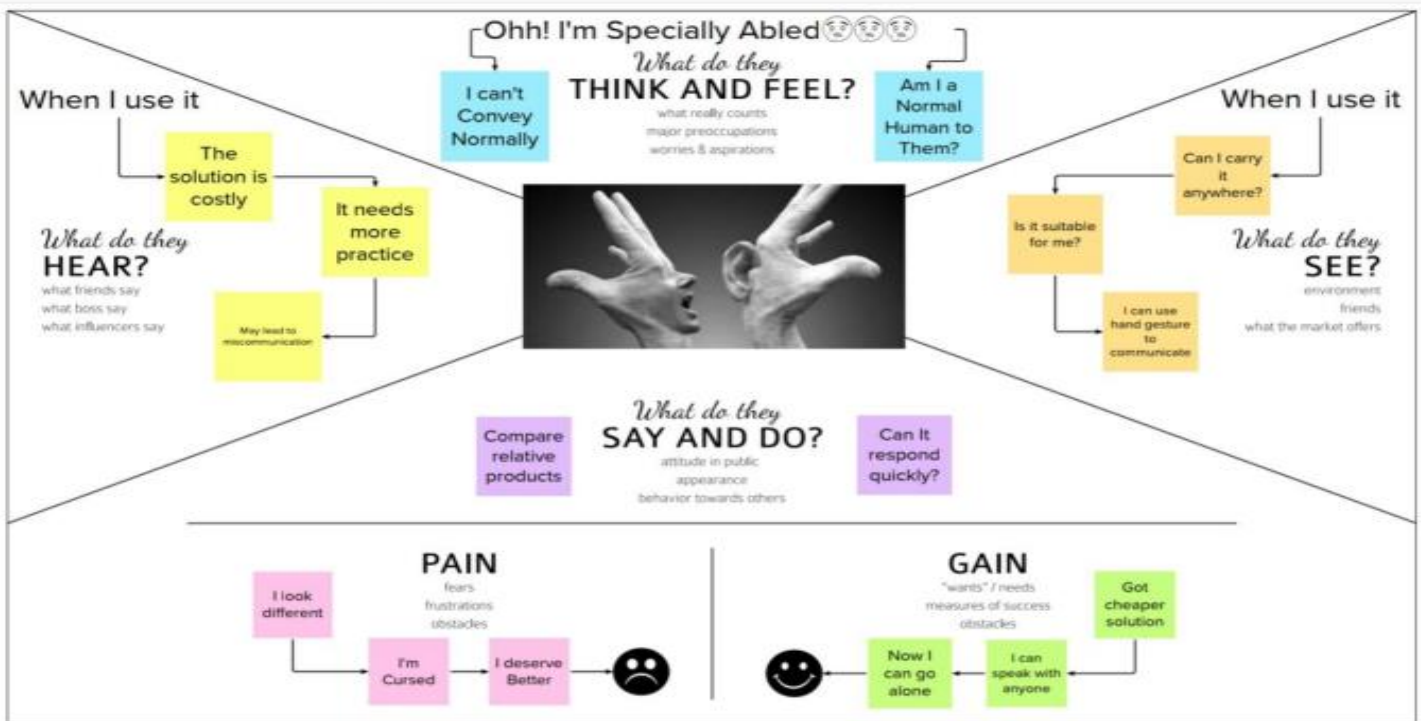
## 2.3Problem statement definition

Only specially abled people are taught sign language and the common person is unaware its working causing a communication gap. Under emergency situations, it is even more difficult for specially abled people to get help. Non-Emergency normal environments can also be hard for them to navigate needing special assistance. In this project we have designed and developed a system which lowers the communication gap between speech hearing impaired people and normal people that is we have built a system that enables communications between deaf-dumb person and a normal person. A convolution neural network is being used to develop a model that is trained on various hand movements. This model is used to create an app. This program allows deaf and hard of hearing persons to communicate using signs that are then translated into human readable text.

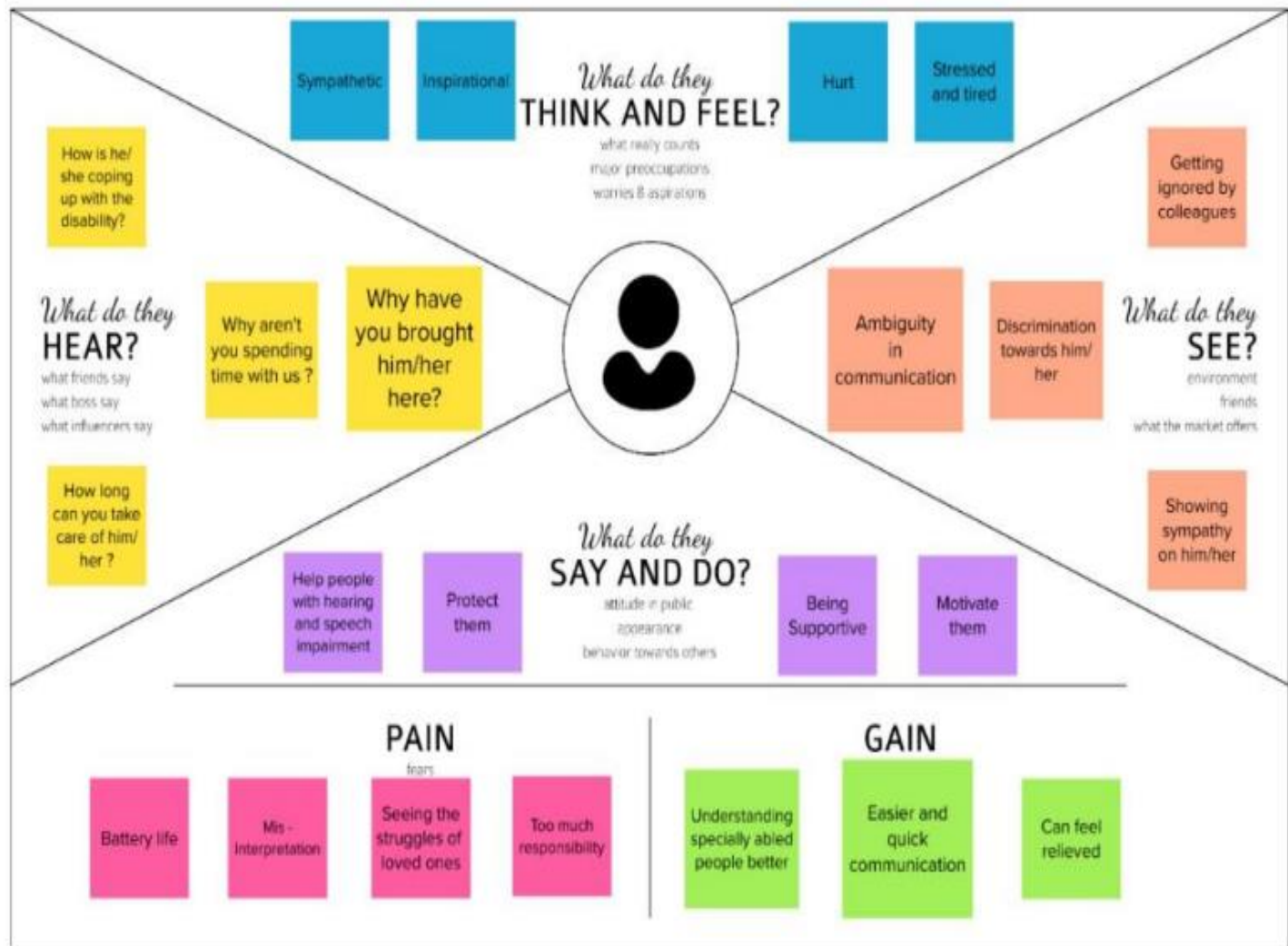
### 3. IDEATION AND PROPOSED SOLUTION

Ideation is the process where you generate ideas and solutions through techniques such as Empathy Map Canvas, Brainstorming. Ideation is also the third stage in the Design Thinking Process.

#### 3.1 Empathy map canvas



User1 (someone with a speech and hearing disability)



User2 Person without any impairments (parent/friend/relative/colleague)

### 3.2 Ideation & Brainstorming

#### Mridula

Communication should be universal without any barriers or limitations.

Communication is an important right. Sometimes people with disabilities have the need for supports due to complex communication needs.

supported to develop an effective, efficient and reliable means of independent communication

speak directly to the person rather than the person with them

#### Srimathi

only refer to the person's disability if necessary or relevant

avoid saying anything that implies the person with disability is superhuman, courageous or special

Research institutions and medical facilities are using the ability to analyse massive data sets to sequence the human genome

develop new forms of treatment, accelerate and improve patient care, and better manage electronic

#### Muruganandham

In emergency times conveying their message is very difficult.

Since normal people are not trained on hand sign language.

It is very difficult for mute people to convey their message to normal people.

AI technology can apply to any type of disability profile.

#### Mulla Sarfaraz

Communication should be universal without any barriers or limitations.

Our objective is to blend deaf and dumb within society and make them able to use their personal computers more effectively and efficiently

Developing an app will support this vulnerable society of impaired people and enhance communication among people.

Neural networks can solve somewhat complicated issues at a much easier level concerning the complexity of algorithms



### Web Interface

Sign-in and  
Sign-up  
options.

Dashboard.

Community  
page and  
chat box.

Emergency  
options in-  
built.

Speech  
control  
options.

Dynamic  
system.

### Machine Learning

Suggestion  
mechanism  
using history  
of  
translations.

Sign to  
Audio.

Audio to  
Sign.

Memory of  
frequently  
used  
sentences or  
phrases.

Recorded  
call to sign.

### APIs

Geolocation  
for  
emergencies.

Option for  
female and  
male voices.

Recording  
converted  
audio.

Translation to  
various  
languages  
and vice  
versa..

### Data Analytics

Use of ISL.



### 3.3 Proposed Solution

#### Proposed Solution Template:

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Sign Language is a visual means of communicating using gestures, facial expressions, and body language with specially abled. Since normal people are not trained in sign language, in times of emergency conveying their message is very difficult. Hence, there is a need for a system that recognizes different signs and empowers them in communicating with normal people
2.	Idea / Solution description	The idea is to create an end-end application that predicts the ISL signs from a live video and translates the same to voice such that conversing is at ease
3.	Novelty / Uniqueness	We are making use of a convolution neural network to create a model that is trained on different hand gestures.
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"><li>• Communication is achieved without the help of additional human intervention.</li><li>• No additional hardware support is needed to use the application</li><li>• Improve their career opportunities in the industry</li><li>• Can provide instant results to users</li></ul>
5.	Business Model (Revenue Model)	This business model truly revolutionizes accessibility and people with disabilities can drastically improve their everyday lives. We can associate the application with organizations to provide support for the specially abled. Creating an association with other medical applications to utilize our product in their app.
6.	Scalability of the Solution	This is an application people can access the application from any device (Mobile, Desktop, laptop, etc.), and used by everyone across the world. As it is hosted in IBM Cloud, it could be scaled up and down as per demand

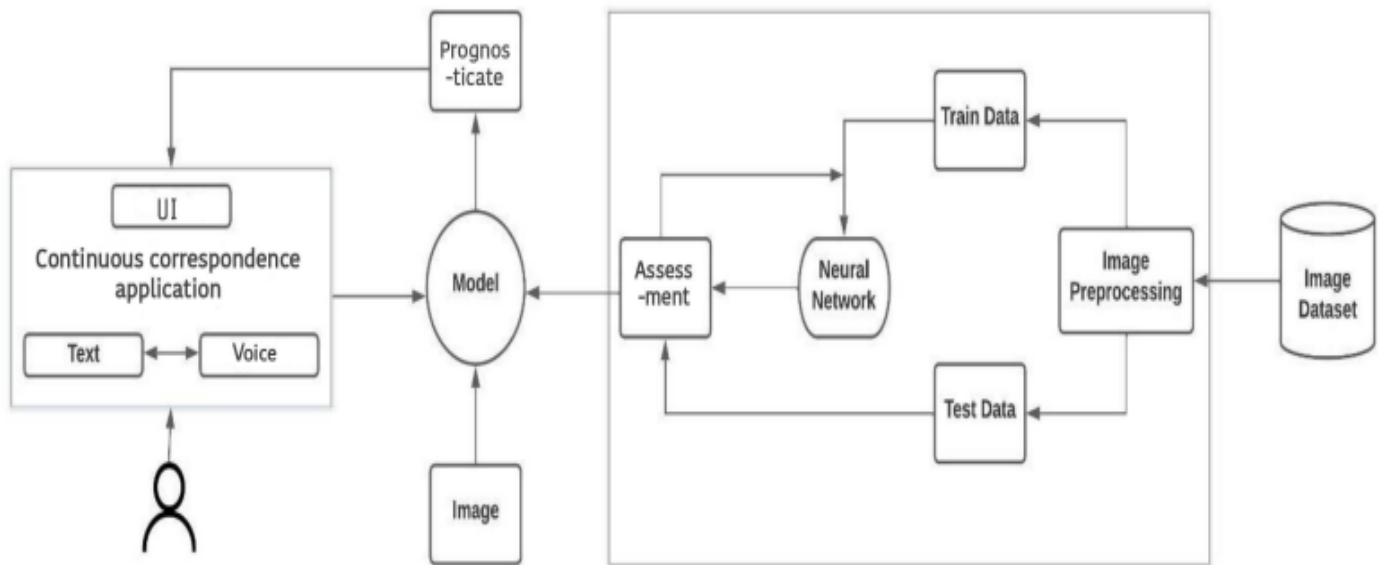
The Problem-Solution Fit is based on the principles of Lean Startup and User Experience design. It helps us to identify behavioral patterns and recognize what would work and why. It is used to identify solutions with higher chances of solution adoption, reduce time spent on testing.

### 3.4 Problem solution fit:

Define CS, fit into CC	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span> <ul style="list-style-type: none"> <li>- Specially-abled people</li> <li>- Teachers</li> <li>- Family</li> <li>- Colleagues</li> <li>- Friends</li> </ul>	<b>6. CUSTOMER CONSTRAINTS</b> <span>CC</span> <p>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.</p> <p>The specially-abled people find difficulties in communication with others. This makes them reluctant to encounter new environment and people.</p>	<b>5. AVAILABLE SOLUTIONS</b> <span>AS</span> <p>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What price &amp; costs do these solutions have? i.e. pen and paper is an alternative to digital notetaking.</p> <p>Deaf and dumb tend to write or text in order to communicate which is found unviable in absence of necessary materials. They also make use of lip-reading, gestures and pointers to communicate.</p>	Explore AS, differentiate
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span> <ul style="list-style-type: none"> <li>- There is a need to develop a system to convert sign language to speech and vice versa.</li> <li>- There should be an application to convey the information.</li> </ul>	<b>9. PROBLEM ROOT CAUSE</b> <span>RC</span> <p>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</p> <p>Normal people don't take any effort to learn sign language which makes the communication with the specially-abled difficult.</p>	<b>7. BEHAVIOUR</b> <span>BE</span> <p>What does your customer do to address the problem and get the job done? i.e. directly related: find the right water panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</p> <p>They seek for interpreters and mobile applications to build communication with normal people.</p>	

Identify strong TR & EM	<b>3. TRIGGERS</b> <span>TR</span> <ul style="list-style-type: none"> <li>- Seeing people being bullied and isolated.</li> <li>- Inability to convey their thoughts during emergencies.</li> <li>- Frustration upon missing opportunities.</li> <li>- Wish to lead a normal life.</li> </ul>	<b>10. YOUR SOLUTION</b> <span>SL</span> <p>If you are looking at an existing business, write down your current solution first, fit it in the canvas, and check how much it fits really. If you are writing on a new business proposition, then keep it blank until you fit in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</p> <p>To develop a web-based application to facilitate the communication between the normal and the specially-abled people using advanced deep learning algorithm.</p>	<b>8. CHANNELS of BEHAVIOR</b> <span>CH</span> <p><b>8.1 ONLINE</b> Video calls for distant communication involving either sign language or lip reading.</p> <p><b>8.2 OFFLINE</b> Dependent on a person for communication assistance.</p>
	<b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span> <p><b>Before</b></p> <ul style="list-style-type: none"> <li>- Socially secluded</li> <li>- Dependent</li> <li>- Hurt</li> </ul> <p><b>After</b></p> <ul style="list-style-type: none"> <li>- Feel equal</li> <li>- Confident</li> <li>- Relieved</li> </ul>		

## Solution Architecture Diagram:



Real-Time Communication System Powered by AI for Specially Abled

#### 4. REQUIREMENT ANALYSIS

##### 4.1 Functional requirement:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Verification	The user should receive a verification e-mail which they have to confirm to complete the registration.
FR-4	Compliance to rules or laws	Terms and conditions, Privacy policy, End user licensing agreement.
FR-5	Authorization levels	There are two levels of authorization namely standard access level and advanced access level.
FR-6	Legal Requirements	Medical Certificate is produced

##### 4.2 Non Functional requirement:

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

FR No.	Non-Functional Requirement	Description
NF R- 1	<b>Usability</b>	The designed system is easy to use for speciallyabled persons as it is portable and platform independent.
NF R- 2	<b>Security</b>	Converted information using signs into speech is accessed only by the user.
NF R- 3	<b>Reliability</b>	System is tested with large number of data and Providesinsight into issues.
NF R- 4	<b>Performance</b>	Quick Launch time of application and faster in converting signs into speech
NF R- 5	<b>Availability</b>	Provides automatic recovery and User access.
NF R- 6	<b>Scalability</b>	Standard network condition the device should convert information within second.

## 5. PROJECT DESIGN

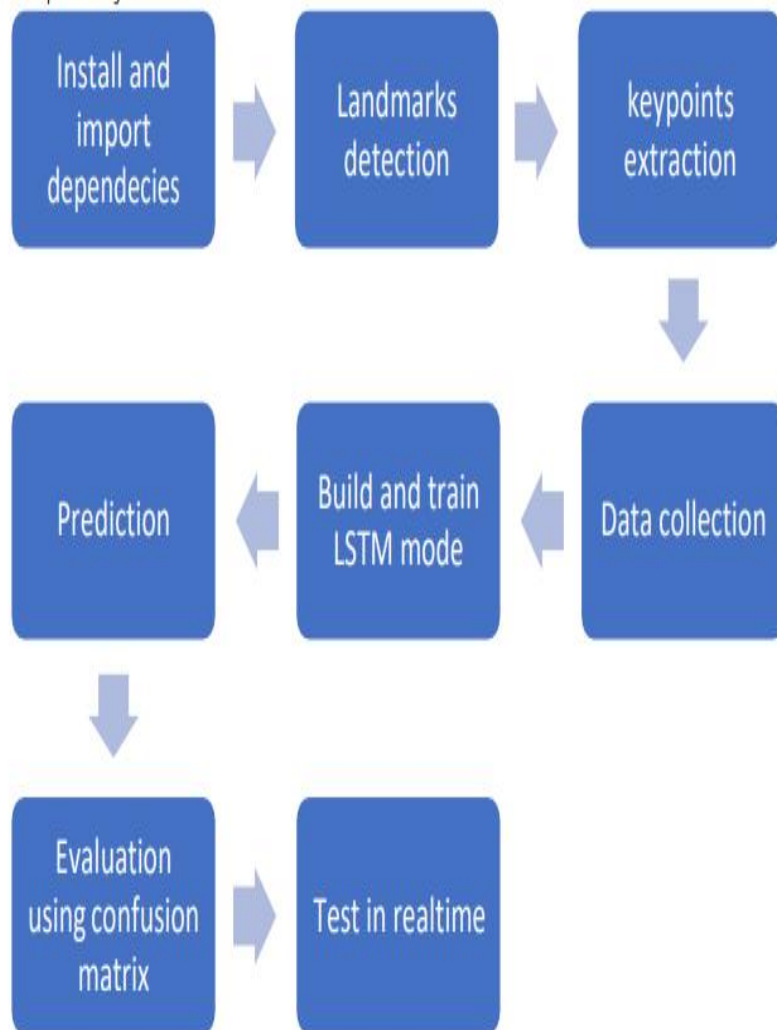
Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

### 5.1 Data Flow Diagrams

A data flow diagram is a traditional visual representation of the information flow within a system. It shows how data enters and leaves the system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination.

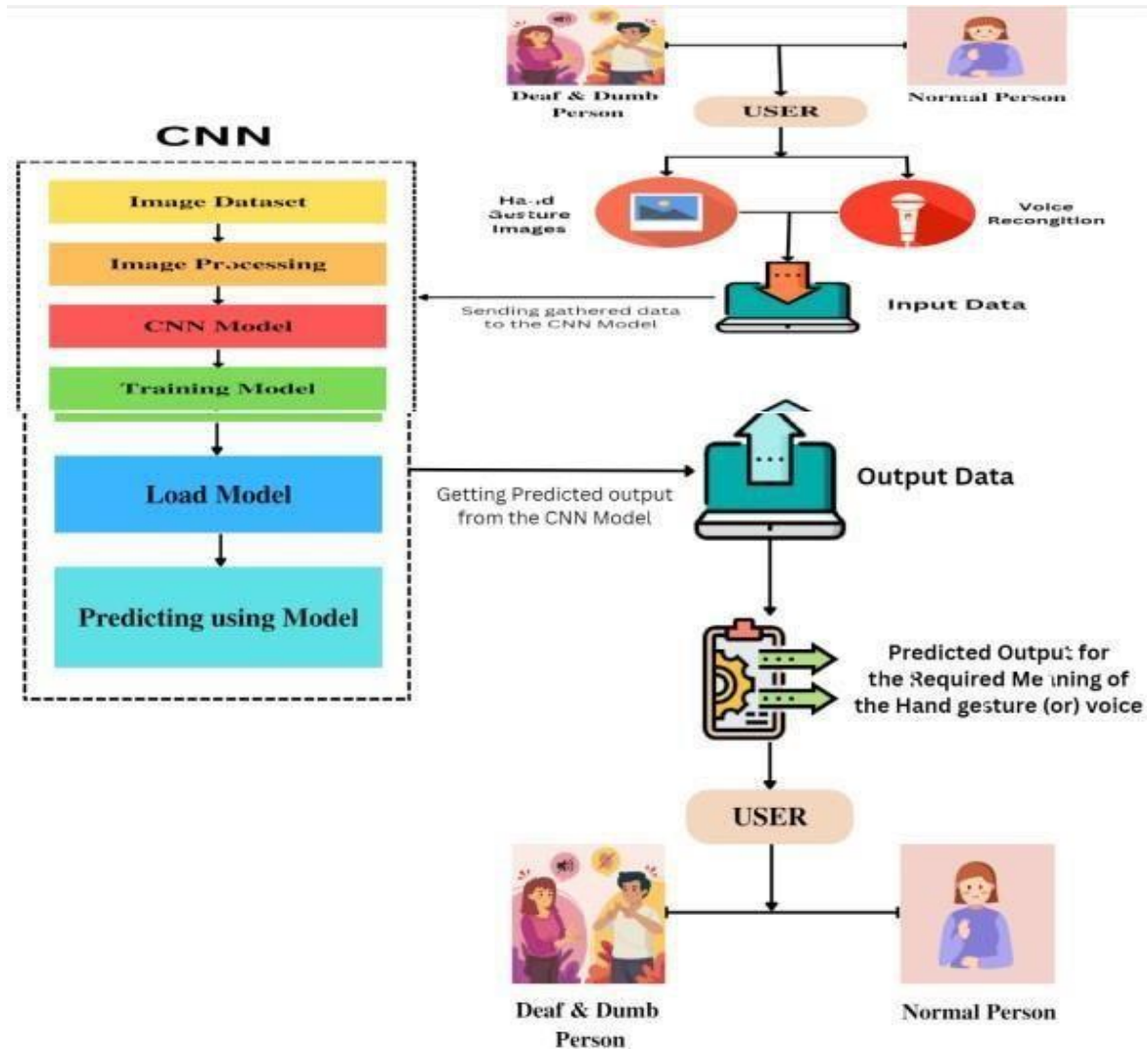
#### Data Flow Diagram:

A data flow diagram (DFD) is a conventional visual portrayal of the data streams inside a framework. A slick and clear DFD can portray the perfect proportion of the framework necessity graphically. It shows how information enters and leaves the framework, what changes the data, and where information is put away.



## 5.2 Solution Architecture & Technical Architecture

Solution Architecture:

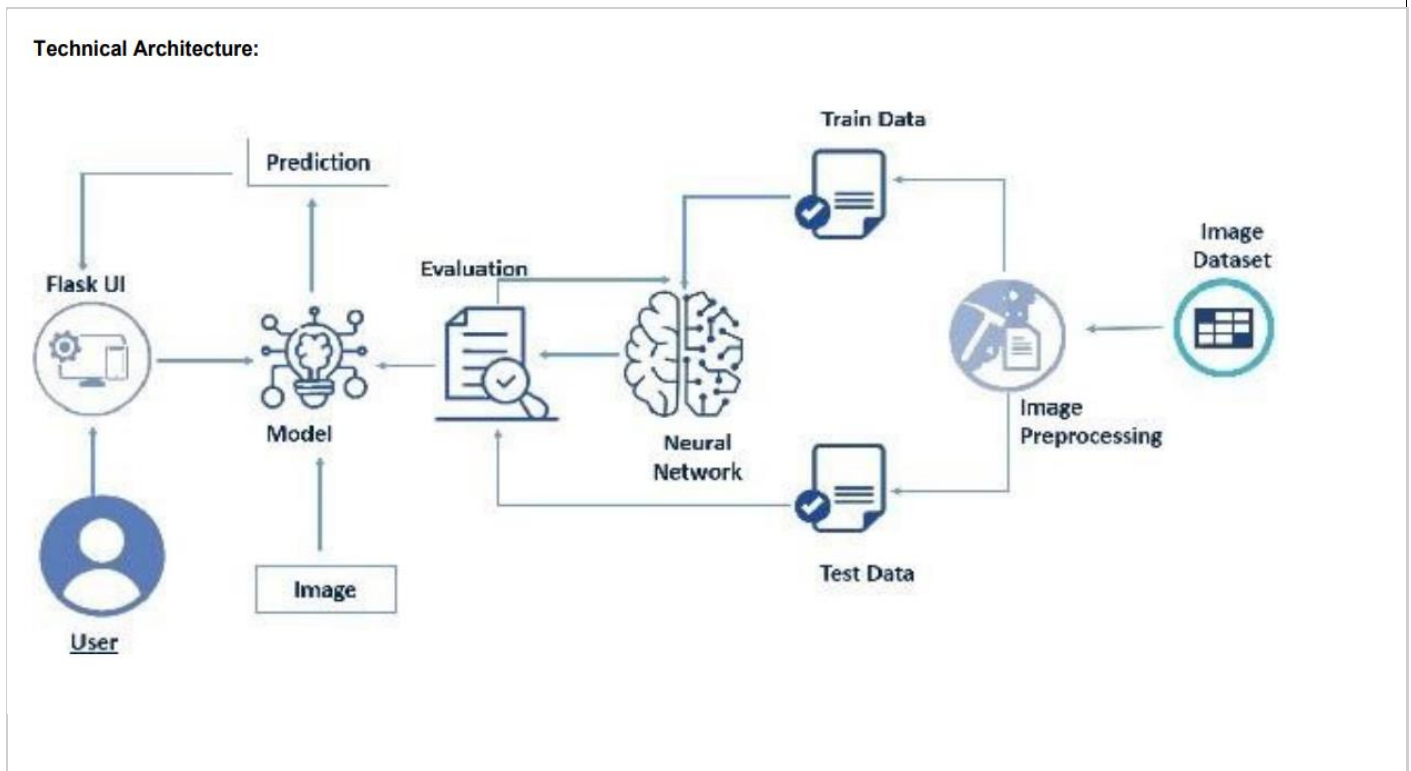


Solution architecture is the process of developing solutions based on predefined processes, guidelines and best practices with the objective that the developed solution fits within the enterprise architecture in terms of information architecture, system portfolios, integration requirements and many more.



 <b>Steps</b> What does the person (or group) typically experience?	<div>Checking for updates</div> <div>Searching for solutions</div> <div>A person checking for any security updates or messages for staff or during people</div> <div>Customers also can use the app to check status for the status for technology for help from a connection</div>	<div>For faster accessibility</div> <div>For robustness</div> <div>It operates 24x7 without interruption</div>	<div>Start using the application information provided</div> <div>They communicate with the app using Chat and that connects them into voice</div> <div>As they talk to voice about the app they will using the standard business rules app data</div> <div>As they talk to voice about the app they will using the standard business rules app data</div> <div>Good interaction between the user and the application takes place</div> <div>As they get location continuously from the app they get location only</div>	<div>They get online updates in the application as they use the app continuously</div> <div>They also get knowledge about the app from the app when using the app continuously</div>	<div>To facilitate a sense of togetherness</div> <div>To help those who are in need similar to them</div>
 <b>Interactions</b> What interactions do they have at each step along the way? <ul style="list-style-type: none"> <li>People: Who do they see or talk to?</li> <li>Places: Where are they?</li> <li>Things: What digital touchpoints or physical objects would they use?</li> </ul>	<div>They keep interacting with technology using a people</div> <div>They go to places which provide the information or messages that helps them people</div> <div>They try to create new things by their situation</div>	<div>Clear instruction</div> <div>Secured data and user information</div>	<div>As they get the app continuously with each other with the connectivity</div> <div>They make connections with each other and they interact by their connectivity</div>	<div>After usage they suggest the type of app to nearby friends</div>	<div>For accurate prediction</div> <div>Friendly environment</div>
 <b>Goals &amp; motivations</b> At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")	<div>During this step the motivation of the person is to use better technological facility</div>	<div>Through simple voice command</div> <div>Google</div> <div>Face recognition</div>	<div>To experience the advanced features of the application and make use of the system efficiently</div>	<div>They have a choice to click this to their comparison</div>	<div>Data sharing platform</div> <div>Social Media</div>
 <b>Positive moments</b> What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	<div>They get good ideas and information regarding advanced technologies</div>	<div>They will come to know about the features and start using the benefits of the application</div>	<div>They will enjoy the advanced features of the application and forget about their situations</div>	<div>They try to do greater level thinking by suggesting the application to their friends</div>	
 <b>Negative moments</b> What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?	<div>They get more information which will get them confused</div>	<div>They may get disappointed due to its limited facilities</div>	<div>They may even get addicted to this type of applications</div>	<div>They may even get addicted to this type of applications</div>	
 <b>Areas of opportunity</b> How might we make each step better? What ideas do we have? What have others suggested?	<div>They get good ideas and information regarding advanced technologies</div> <div>They get more suggestions from different people</div>	<div>They may have an idea of using the application for good deeds</div>	<div>Making use for this advancement may make the person more confident and smart</div>	<div>They may even get addicted to this type of applications</div>	

## Technical Architecture:



Technical Architecture is a form of Information Technology(IT) architecture that is used to design a system. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system- relevant requirements are met.

**Table-1: Components & Technologies:**

S.No	Component	Description	Technology
1.	User Interface	Chat bot user interface	HTML, CSS, Python.
2.	Application Logic	Logic for a process in the application	Python
3.	Application Logic	Logic for a process in the application	IBM Watson STT service & TTS service
4.	Cloud Database	Database Service on Cloud	IBM Cloudant
5.	File Storage	File storage requirements	Local File system

6.	Machine Learning Model	Neural Networks –CNN model, ANN model	Object Recognition Model – CNNmodel
7.	Infrastructure (Server / Cloud)	Application Deployment on Local System	Local, Cloud Foundry, Kubernetes.
8.	External Interfaces	Any interface that is transmitting information from the product to a third- party may contain informationthat is useful for an attack	Operating System - Windows, Mac, Linux; CPU & GPU (for training), WebCam, Scanners, Speaker s and PC

**Table-2: Application Characteristics:**

S.N	Characteristics Technology o	Description	
1.	Open-Source Frameworks	Numpy, Pandas , Keras, Tensorflow, NLTK, Sonnet.	Python framework
2.	Security Implementations	Security access controls , Use of 256 firewalls	SHA-
3.	Scalable Architecture	Scalable AI	SEI Digital library IBM Cloud
4.	Availability	Use of Cloud, Virtual assistant	IBM Watson Assistant
5.	Performance	Image pre-processing and CNN	Python

**User Stories:**

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Normal people and Deaf-mute people	Registration	USN-1	As a user, I can register for the application by entering my email, and password, and confirming my password	I can access my account/ dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the	I can receive confirmation email & click	High	Sprint-1

Normal people		USN-3	Give access to camera to recognize the gestures  Give access to microphone to give our message through voice	I can access messages given by the Deaf-mute people	High	Sprint-1
Deaf- mute people			Give access to display to view the message sent by normal people.	I can access messages given by the Normal people	High	Sprint-1
Administrator		USN-4	Admin side in the company should take care	all the requirements are there.	High	Sprint 1
Sign up		USN-5	Need to sign up to use it.	Need valid credentials.	High	Sprint-1
Wish list		USN-6	Before availing the service can be kept aside.	As a user can review and use the service.	Low	Sprint-2

A user story is an informal, general explanation of a design feature written from the perspective of the end user. Its purpose is to articulate how a design will provide value to the end user. A key component of agile software development is putting people first, and a user story puts end users at the center of the conversation. These stories use non-technical language to provide context for the development team and their efforts.

## 6 PROJECT PLANNING & SCHEDULING

Planning and scheduling are distinct but inseparable aspects of managing the successful project. The process of planning primarily deals with selecting the appropriate policies and procedures in order to achieve the objectives of the project. Scheduling converts the project action plans for scope, time cost and quality into an operating timetable.

### 6.1 Sprint Planning & Estimation

To create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Logesh Lingakumar
Sprint-1	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Balaji Harish
Sprint-2	Registration	USN-3	As a user, I can register for the application through phone number	2	Medium	Lingakumar
Sprint-2	User interface	USN-4	Professional responsible for user requirements & needs	2	Medium	Balaji Harish
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Logesh
Sprint-3	Dashboard	USN-6	As a user, I must receive any updates or pop ups in my dashboard	2	High	Lingakumar Balaji
Sprint-4	Details	USN-7	As a user, I should get notification about the progress and any updates via email or sms	1	Medium	Harish
Sprint-4	Privacy	USN-8	The developed application should be secure for the users	2	High	Lingakumar Logesh

Sprint planning & Estimation is the process for estimating the effort required to complete a prioritized task in the product backlog. This effort is usually measured with respect to the time it will take to complete that task, which, in turn, leads to accurate sprint planning.

## Product Backlog, Sprint Schedule, and Estimation

Use the below template to create product backlog and sprint schedule

Team Lead: **Mridula S**

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect Dataset .	10	High	Srimathi Mullasarfaraz Muruganandham
Sprint-1		USN-2	Image preprocessing	8	Medium	Srimathi Mullasarfaraz Muruganandham
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model	10	High	Srimathi Mullasarfaraz Muruganandham
Sprint-2		USN-4	Training the image classification model using CNN	7	Medium	Srimathi Mullasarfaraz Muruganandham
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	Srimathi Mullasarfaraz Muruganandham
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	8	Medium	Srimathi Mullasarfaraz Muruganandham



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

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

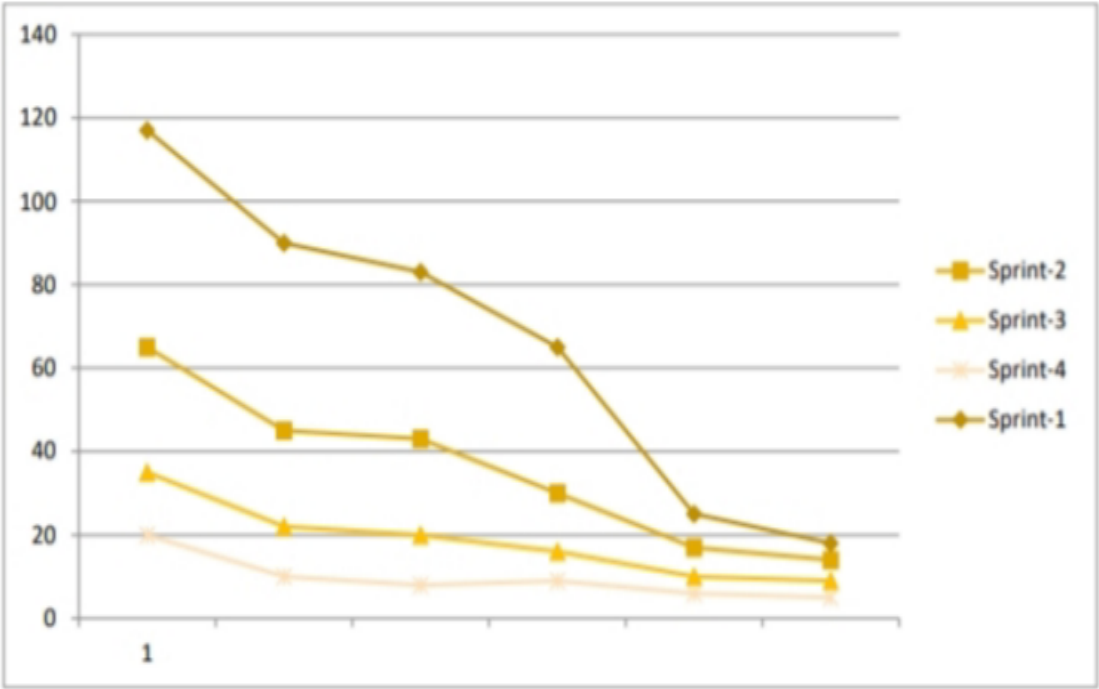
#### Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 05 (points per sprint). Let's calculate the team's (AV) per iteration unit (story points per day)

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

$$AV = 5/10 = 0.5$$

Burndown chart:



### SPRINT BURNDOWN CHART:



This are the final reports that is been generated from the jira software.  
Initially with the help of the jira software we have made a plan for the sprint delivery. By using it so we are getting the four phase sprint report with roadmap.

## 7 CODING & SOLUTIONING

In order to design website that covertns sign language into English alphabets we need to develop the website. For developing the website, primarily we need a platform that is uesful for developing the code. Coding is nothing that which are the applications developed by the developers in a certain computer language. Here we are using Python language for developing the website.

### Feature 1

Image Preprocessing

```
In [1]: from tensorflow.keras.preprocessing.image import ImageDataGenerator

In [2]: train_datagen=ImageDataGenerator(rescale=1./255, horizontal_flip=True, vertical_flip=True, zoom_range=0.2)

In [3]: test_datagen=ImageDataGenerator(rescale=1./255)

In [6]: x_train = train_datagen.flow_from_directory(r"/content/drive/MyDrive/IBM project/training_set", target_size=(64, 64), class_mode="categorical", batch_size=32)
Found 15130 images belonging to 9 classes.

In [7]: x_test = test_datagen.flow_from_directory(r"/content/drive/MyDrive/IBM project/test_set", target_size=(64, 64), class_mode="categorical", batch_size=32)
Found 1035 images belonging to 9 classes.
```

Model Building

```
In [8]: 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

In [20]: model.fit(x_train, epochs=10, validation_data=x_test, steps_per_epoch=len(x_train)//10, validation_steps=len(x_test))

Epoch 1/10
50/50 [=====] - 407s 8s/step - loss: 0.1036 - accuracy: 0.9707 - val_loss: 0.1421 - val_accuracy: 0.9362
Epoch 2/10
50/50 [=====] - 75s 1s/step - loss: 0.0937 - accuracy: 0.9767 - val_loss: 0.0786 - val_accuracy: 0.9768
Epoch 3/10
50/50 [=====] - 74s 1s/step - loss: 0.0833 - accuracy: 0.9740 - val_loss: 0.0380 - val_accuracy: 0.9894
Epoch 4/10
50/50 [=====] - 65s 1s/step - loss: 0.0493 - accuracy: 0.9853 - val_loss: 0.0354 - val_accuracy: 0.9913
Epoch 5/10
50/50 [=====] - 56s 1s/step - loss: 0.0514 - accuracy: 0.9851 - val_loss: 0.0484 - val_accuracy: 0.9913
Epoch 6/10
50/50 [=====] - 58s 1s/step - loss: 0.0661 - accuracy: 0.9813 - val_loss: 0.0597 - val_accuracy: 0.9894
Epoch 7/10
50/50 [=====] - 50s 1s/step - loss: 0.0488 - accuracy: 0.9872 - val_loss: 0.0888 - val_accuracy: 0.9662
Epoch 8/10
50/50 [=====] - 48s 958ms/step - loss: 0.0492 - accuracy: 0.9820 - val_loss: 0.0670 - val_accuracy: 0.9874
Epoch 9/10
50/50 [=====] - 35s 709ms/step - loss: 0.0599 - accuracy: 0.9820 - val_loss: 0.0129 - val_accuracy: 0.9971
Epoch 10/10
50/50 [=====] - 39s 770ms/step - loss: 0.0582 - accuracy: 0.9770 - val_loss: 0.1378 - val_accuracy: 0.9314

Out[20]:

In [21]: model.save("aslpng.h5")
```

## Feature 2

Testing the model

```
In [22]: from keras.models import load_model
import numpy as np
import cv2
```

```
In [23]: from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import numpy as np
```

```
In [34]: model=load_model("as1png.h5")
img = image.load_img(r"/content/drive/MyDrive/IBM project/test_set/D/10.png",target_size=(64,64))
img
```



```
In [35]: x = image.img_to_array(img)
x
```

```
Out[35]: array([[0., 0., 0.],
               [0., 0., 0.],
               [0., 0., 0.],
               ...,
               [0., 0., 0.],
               [0., 0., 0.],
               [0., 0., 0.]])
```

```
[[0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.],
 ...,
 [0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.]])
```

```
[[0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.],
 ...,
 [0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.]])
```

```
...,
```

```
[[0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.],
 ...,
 [0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.]])
```

```
[[0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.],
 ...,
 [0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.]])
```

```
[[0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.],
 ...,
 [0., 0., 0.],
 [0., 0., 0.],
 [0., 0., 0.]])
```

```
In [36]: x.shape
```

```
Out[36]: (64, 64, 3)
```

```
In [37]: x = np.expand_dims(x,axis=0)
x.shape
```

```
Out[37]: (1, 64, 64, 3)
```

```
In [38]: pred = model.predict(x)
```

```
1/1 [=====] ~ 0s 63ms/step
```

```
In [39]: pred
```

```
Out[39]: array([[0., 0., 0., 1., 0., 0., 0., 0.]])
```

```
In [45]: class_name=["A","B","C","D","E","F","G","H","I"]
pred_id = pred.argmax(axis=1)[0]
pred_id
```

```
Out[45]: 3
```

## 8. TESTING

A Test report is an organized summary of testing objectives, activities, and results. Test Report is a document which contains a summary of all test activities and final test results of a design. Test report is an assessment of how well the Testing is performed. Based on the test report, we understand the designs quality and its performance.

### 8.1 Test cases

				Date	12 Nov-22								
				Team ID	PM/2022/MD01158								
				Project Name	Project: Real time communication system powered by AI for specially abled								
				Maintain Marks	Amrita								
TestcaseID	Feature Type	Component	Test Scenario	Pre-Requlite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Yes)	Bug ID	Executed By
LogiPage_TC_001	Functional	Home Page	Verify user is able to see the homepage	Mozilla Firefox Browser	Enter URL in browser and click go	<a href="http://172.8.0.1:5001">http://172.8.0.1:5001</a>	Homepage should be displayed	Working as expected	Pass	Steps are clear to follow	NO	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S
LogiPage_TC_002	UI	Home Page	Verify the UI elements in homepage	Mozilla Firefox Browser	1.Enter URL and click go 2.Verify homepage with given UI elements. Reference: camera access display instruction to project	<a href="http://172.8.0.1:5001">http://172.8.0.1:5001</a>	Application should show below UI elements: a) Reference b) camera access display c) instruction to project	Working as expected	Pass	Steps are clear to follow	NO	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S
LogiPage_TC_003	UI	Home Page	Verify whether reference page is working	Mozilla Firefox Browser	1.Enter URL( <a href="http://172.8.0.1:5000">http://172.8.0.1:5000</a> ) and click go 2.Click on reference button	<a href="http://172.8.0.1:5001">http://172.8.0.1:5001</a>	User should navigate to reference page where all data of images is displayed	Working as expected	Pass	Steps are clear to follow	Yes	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S
LogiPage_TC_004	Functional	Home Page	Verify Camera access	Mozilla Firefox Browser/ Web Camera	1.Enter URL( <a href="http://172.8.0.1:5000">http://172.8.0.1:5000</a> ) and click go 2.Click allow camera access	allow camera access	Camera access is allowed and image is displayed	Working as expected	Pass	Steps are clear to follow	Yes	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S
LogiPage_TC_004	Functional	Home Page	Gesture detection	Mozilla Firefox/ Chrome	1.Enter URL( <a href="http://172.8.0.1:5000">http://172.8.0.1:5000</a> ) and click go 2.Click camera access 3.Image displayed 4.Detection of gesture occurs	Detection of gestures	Hand gestures needs to be detected and predicted	Working as expected	Pass	Steps are clear to follow	Yes	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S
LogiPage_TC_005	Functional	Home page	Output prediction	Chrome/real model	1.Enter URL( <a href="http://172.8.0.1:5000">http://172.8.0.1:5000</a> ) and click go 2.Click camera access 3.Image displayed 4.Detection of gesture occurs 5.Output prediction	Predicted gestures	Hand gestures are detected and predicted ASL alphabets are displayed	Working as expected	Pass	Predicted output is displayed	Yes	NA	SHWINE A JAGA RANCHHE RUPENDRA MISHRA PRADHA S

A test case is nothing but a series of step executed on a design, using a predefined set of input data, expected to produce a pre-defined set of outputs, in a given environment. It describes “how” to implement those test cases.

### 8.2 User Acceptance Testing

User acceptance testing (UAT), also called application testing or end-user testing, is a phase of software development in which the software is tested in the real world by its intended audience.

#### 1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of project- Real Time Communication System Powered By AI For Specially Abled at the time of the release to User Acceptance Testing (UAT).

## 2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	0	0	0	2	2
Duplicate	1	0	0	0	1
External	0	0	1	0	1
Fixed	0	1	1	0	2
Not Reproduced	0	1	0	0	1
Skipped	0	0	0	0	0
Won't Fix	0	1	0	0	1
Totals	1	3	2	2	8

## 3 Test Case

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

Section	Total Cases	Not Tested	Fail	Pass
View Home Page	7	0	1	6
Click Reference	15	0	3	12
Image displayed	12	0	0	12
Allow camera access	11	0	2	9
PrintEngine	8	0	0	8
ClientApplication	49	0	0	49
Security	4	0	0	4
OutsourceShipping	4	0	0	4
ExceptionReporting	11	0	0	11
FinalReportOutput	2	0	0	2
VersionControl	1	0	0	1

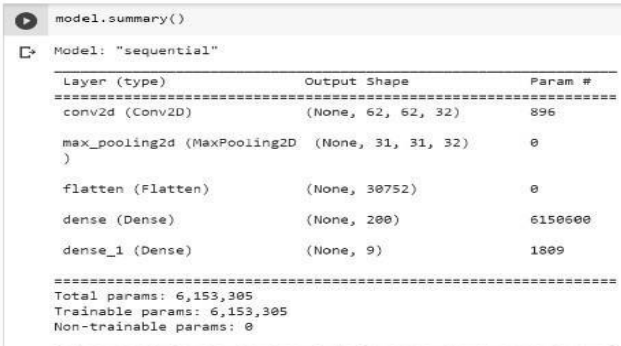
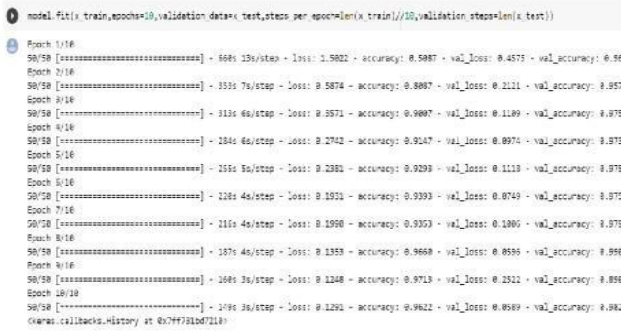
## 9. RESULT

Finally we got the output for the desired input.our ultimate aim is to covert sign language into English alphanets.We have created the user interface for impleting it so.Thus the website was created successfully.As a result both the deaf and dump alongwith normal people can able to understand the desired language that is required for them.

### 9.1 Performance metrics

#### Model Performance Testing:

Project team shall fill the following information in model performance testing template.

S.No.	Parameter	Values	Screenshot
1.	Model Summary	Model - Sequential model Layers: Conv2D-(None,62,62,32) MaxPooling2D-(None,31,31,32) Flatten-(None,30752) Dense-(None,200) Dense_1 -(None,9)	
2.	Accuracy	Training Accuracy - 0.9622 Validation Accuracy -0.9826	
3	Confidence Score	Class Detected – N/A Confidence Score -N/A	N/A

The proposed procedure was implemented and tested with set of images. The set of 15750 images of Alphabets from “A” to “I” are used for training database and a set of 2250 images of Alphabets from “A” to “I” are used for testing database. Once the gesture is recognize the equivalent Alphabet is shown on the screen.



## 10. **ADVANTAGES & DISADVANTAGES**

### **Advantages:**

1. Create a mobile application to bridge the communication gap between deaf and dumb persons and the general public.
2. Sign language standards exist, their dataset can be added, and the user can choose which sign language to read.

### **Disadvantages:**

1. Model only works from alphabets A to I.
2. Absence of gesture recognition, alphabets from J cannot be identified.
3. As the quantity/quality of images in the dataset is low, the accuracy is not great.

## 11. **CONCLUSION**

Sign language is a useful tool for facilitating communication between deaf and hearing people. Because it allows for two-way communication, the system aims to bridge the communication gap between deaf people and the rest of society. The proposed methodology translates language into English alphabets that are understandable to humans. This system sends hand gestures to the model, who recognises them and displays the equivalent Alphabet on the screen. Deaf-mute people can use their hands to perform sign language, which will then be converted into alphabets, thanks to this project.

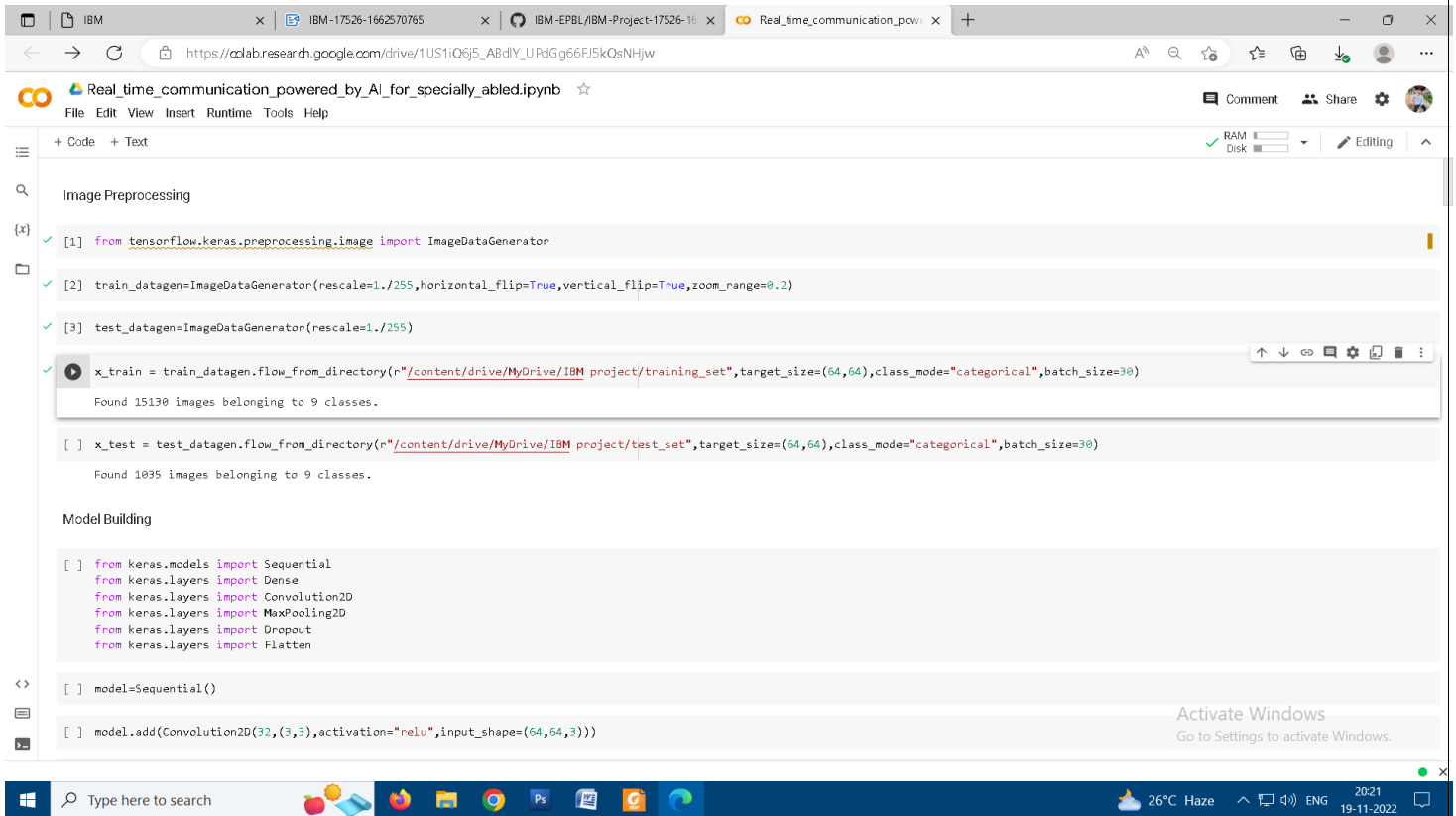
## 12. **FUTURE SCOPE**

Having a technology that can translate hand sign language to its corresponding alphabet is a game changer in the field of communication and AI for the specially abled people such as deaf and dumb. With introduction of gesture recognition, the web app can easily be expanded to recognize letters beyond 'I', digits and other symbols plus gesture recognition can also allow controlling of software/hardware interfaces.

We can develop a model for ISL word and sentence level recognition. This will require a system that can detect changes with respect to the temporal space. We can also develop a complete product that will help the speech and hearing-impaired people, and thereby reduce the communication gap.

### 13. APPENDIX

## Source Code for Model Training and Saving:



The screenshot shows a Jupyter Notebook titled "Real\_time\_communication\_powered\_by\_AI\_for\_specially\_abled.ipynb". The code is divided into two sections: "Image Preprocessing" and "Model Building".

```
[1] from tensorflow.keras.preprocessing.image import ImageDataGenerator

[2] train_datagen=ImageDataGenerator(rescale=1./255,horizontal_flip=True,vertical_flip=True,zoom_range=0.2)

[3] test_datagen=ImageDataGenerator(rescale=1./255)

x_train = train_datagen.flow_from_directory(r"/content/drive/MyDrive/IBM project/training_set",target_size=(64,64),class_mode="categorical",batch_size=30)

Found 15130 images belonging to 9 classes.

[ ] x_test = test_datagen.flow_from_directory(r"/content/drive/MyDrive/IBM project/test_set",target_size=(64,64),class_mode="categorical",batch_size=30)

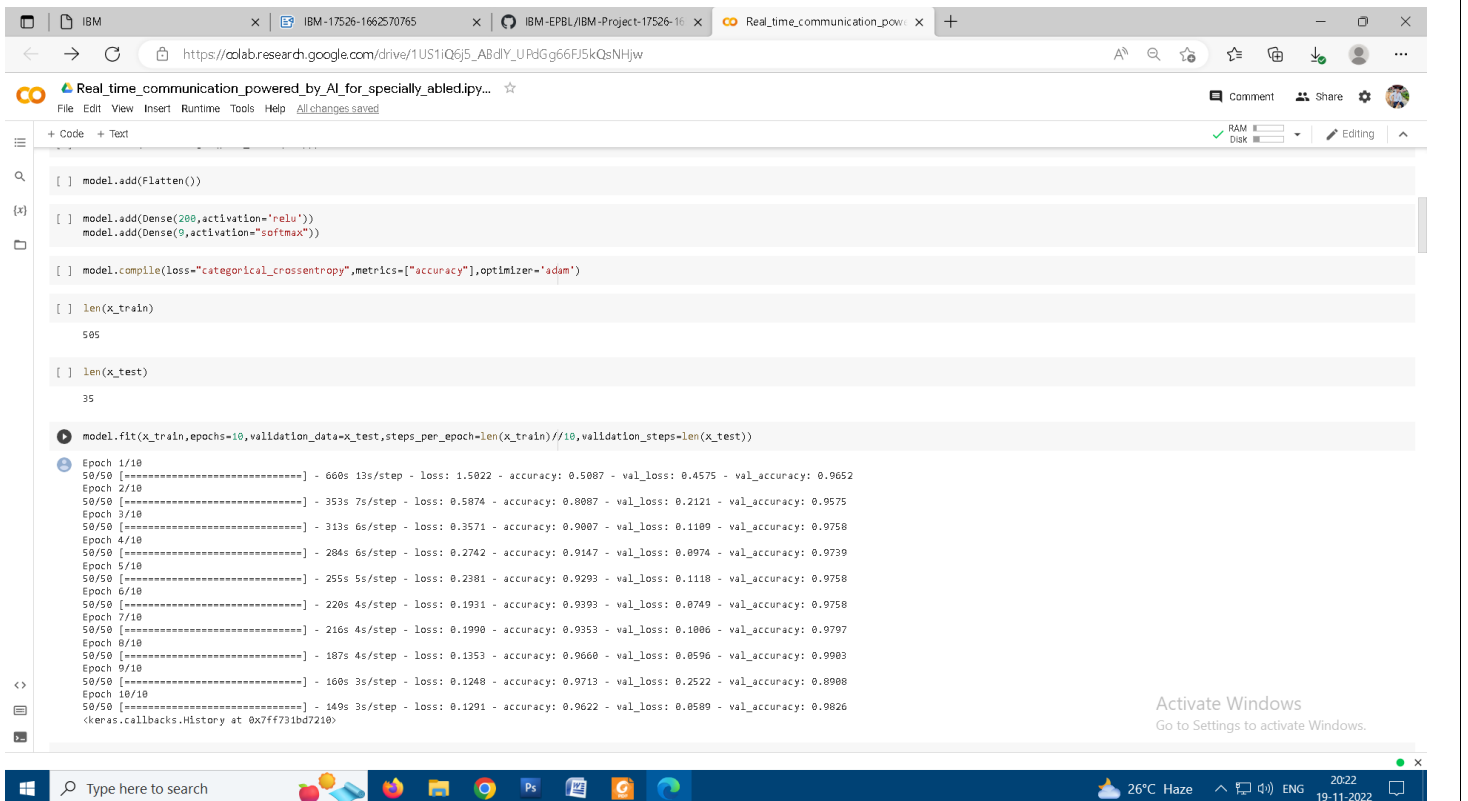
Found 1095 images belonging to 9 classes.

Model Building

[ ] 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

[ ] model=Sequential()

[ ] model.add(Convolution2D(32,(3,3),activation="relu",input_shape=(64,64,3)))
```



The screenshot shows the continuation of the Jupyter Notebook code, focusing on model compilation, training, and the resulting output.

```
[ ] model.add(Flatten())

[ ] model.add(Dense(200,activation='relu'))
    model.add(Dense(9,activation='softmax'))

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

[ ] len(x_train)

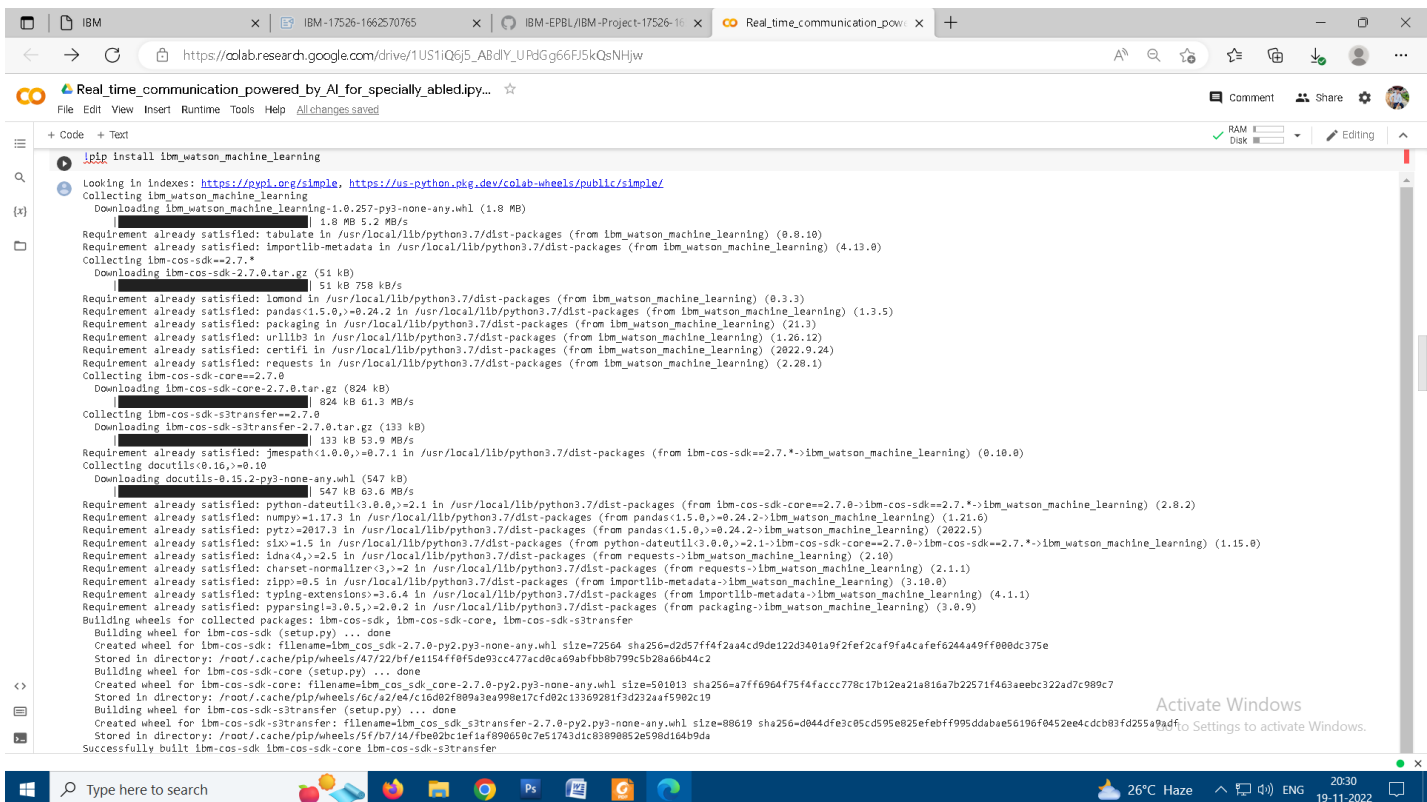
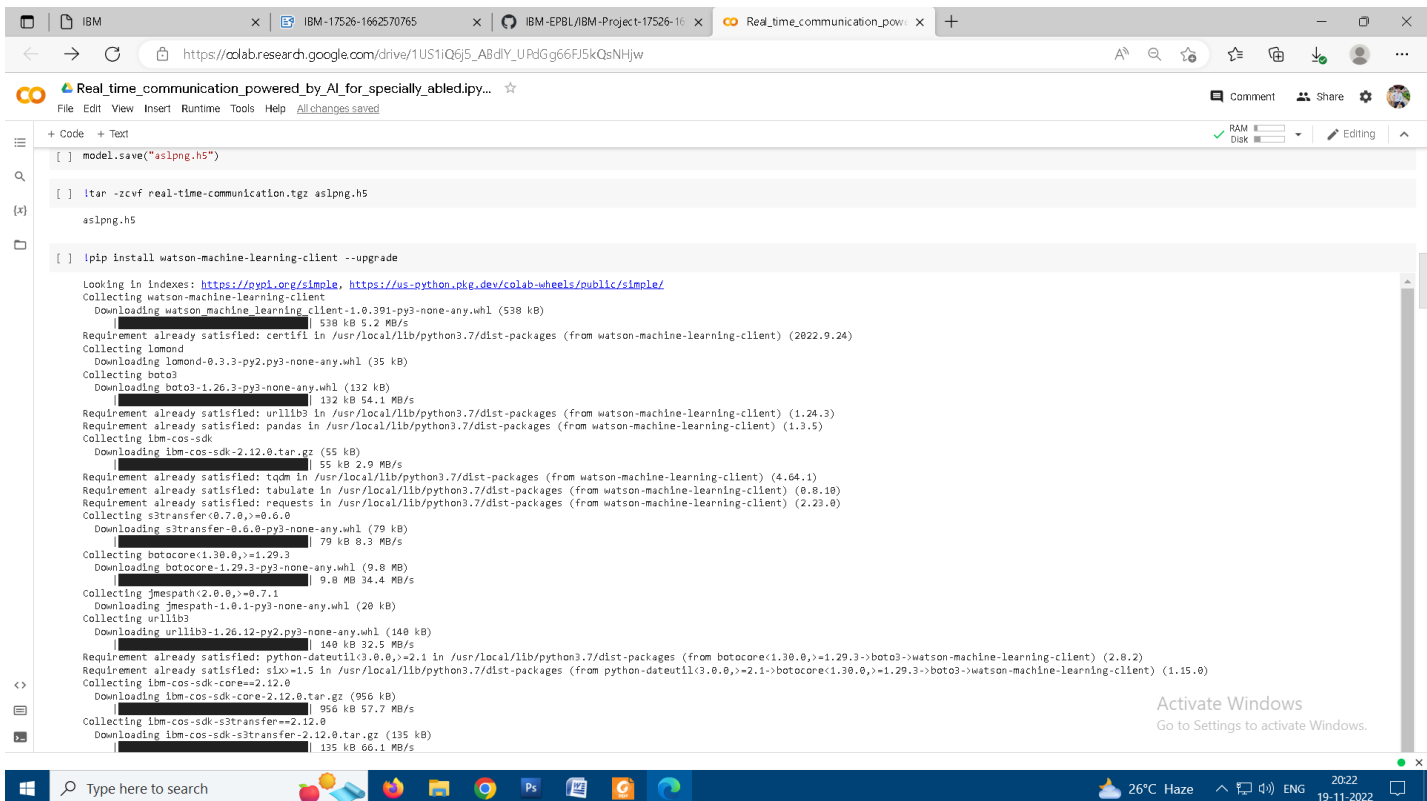
505

[ ] len(x_test)

35

model.fit(x_train,epochs=10,validation_data=x_test,steps_per_epoch=len(x_train)//10,validation_steps=len(x_test))

Epoch 1/10
50/50 [=====] - 660s 13s/step - loss: 1.5022 - accuracy: 0.5007 - val_loss: 0.4575 - val_accuracy: 0.9652
Epoch 2/10
50/50 [=====] - 353s 7s/step - loss: 0.5874 - accuracy: 0.8087 - val_loss: 0.2121 - val_accuracy: 0.9575
Epoch 3/10
50/50 [=====] - 313s 6s/step - loss: 0.3571 - accuracy: 0.9007 - val_loss: 0.1109 - val_accuracy: 0.9758
Epoch 4/10
50/50 [=====] - 284s 6s/step - loss: 0.2742 - accuracy: 0.9147 - val_loss: 0.0974 - val_accuracy: 0.9739
Epoch 5/10
50/50 [=====] - 255s 5s/step - loss: 0.2381 - accuracy: 0.9293 - val_loss: 0.1118 - val_accuracy: 0.9750
Epoch 6/10
50/50 [=====] - 220s 4s/step - loss: 0.1931 - accuracy: 0.9393 - val_loss: 0.0749 - val_accuracy: 0.9758
Epoch 7/10
50/50 [=====] - 216s 4s/step - loss: 0.1998 - accuracy: 0.9353 - val_loss: 0.1086 - val_accuracy: 0.9797
Epoch 8/10
50/50 [=====] - 187s 4s/step - loss: 0.1353 - accuracy: 0.9668 - val_loss: 0.0596 - val_accuracy: 0.9903
Epoch 9/10
50/50 [=====] - 160s 3s/step - loss: 0.1248 - accuracy: 0.9713 - val_loss: 0.2522 - val_accuracy: 0.8908
Epoch 10/10
50/50 [=====] - 149s 3s/step - loss: 0.1291 - accuracy: 0.9622 - val_loss: 0.0589 - val_accuracy: 0.9826
<keras.callbacks.History at 0x7ff731bd7210>
```



```

    item sets on me chnl e leer n'ng.r t ient .APT Cl\ient oA7+~6b7d7cBdb)

e client.spaces.get_aetatf(s)

{ "resource": [
  {
    "id": "bluemix:pubLLc:@-28:eu-de:a/b933ie Taedac4b7B4b99BBb9b8e434z:IN9d8bd2-b3dT-463b-848a-d88f4b26fcldy::",
    "api_key": "5tIhzR9qe45b_Vb_8YcAnclzn4Tn-HuMQbullyDe9Mc",
    "resource_key_cn": "crn:vl:bluemix:public:cloud-object-storage:global:a/b933iefaedac4670a69908b9b06e4341:920ea9cd-9efd-4270-a82b-07e13faac607::",
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    "url": "/v2/spaces/cff76553-4fb2-400c-9341-d2e9ac10faee"]}]

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"updated_at": "2022-11-06T10:34:06.965Z",
"url": "/v2/spaces/cff76553-4fb2-400c-9341-d2e9ac10faee"]}]

"resource_cn": "crn:vl:blw:in:public:cloud-obt-ct-star age:GLoba\\:a/b9a ta te'a edac# a7eas9eeb9beue4a#:I:9zeeagc d-9efd -a7e-a ebb-aze tata ac ae7::",
"updated_at": "2022-11-06T10:34:06.965Z",
"url": "/v2/spaces/cff76553-4fb2-400c-9341-d2e9ac10faee"]}]

```

Activate Windows

Go to 'e'tin9s to activate Windows.

DFea tme uommuncafou powered byAl TorspeGayabledipy... D

Comment Share Settings

```

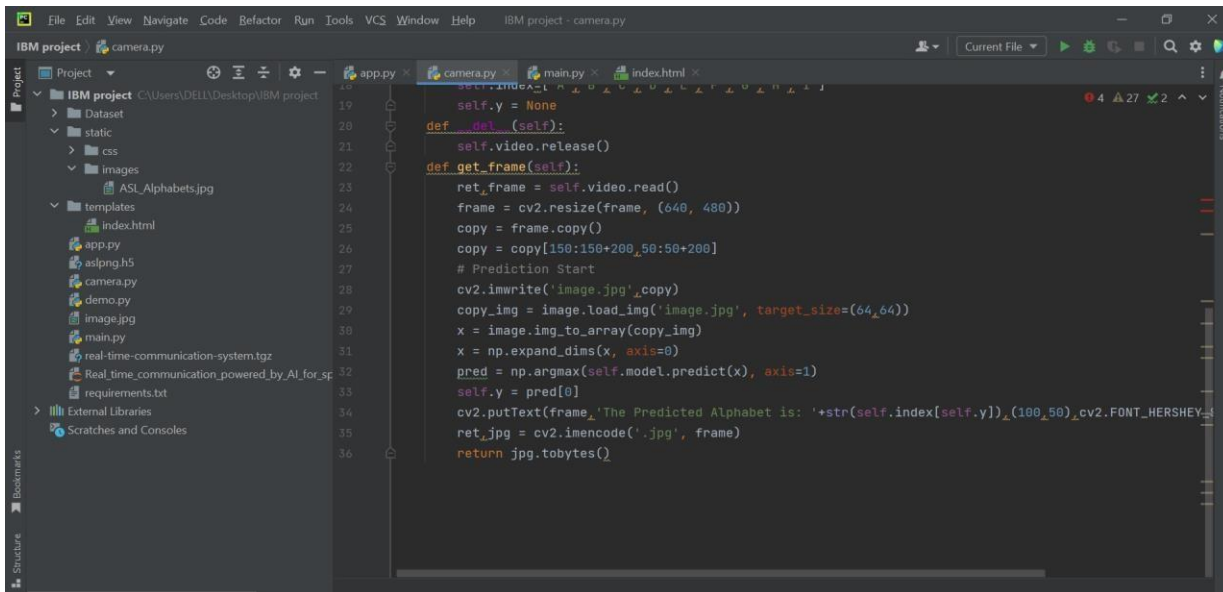
kernel-spark_2.4-scala_2.12      020919ca7-7ac1-566b-ca31-131606603585 base
pytorch-conv1_1-py3.7-mx1      909613c4-3346-475b-b513-401016122888 base
scikit-learn_0.20-py3.6        006a549c-9c1e-4d43-4344-ab70c65ff687 base
spark-mllib_3.0-scala_2.12     094cf4f6-09a7-5089-b56d-1ef34a0abde8 base
pytorch-conv1_x72_1-py3.9      0b040dd1-0061-5599-bae1-b5f6f0c66719 base
ai-function_0.1-py3.6           0c8df8e5-3376-474d-602d-3430c9949671 base
hw7_3.8                         060e78d7-875a-4726-8a9b-52d2c5248306 base
tensorflow_2.4-py3.7-hadoop    169253ca-397d-583c-0b2d-4677c6d3bf72 base
tensorflow_1.15-py3.6-ddl      11881b13-d62f-5422-5d82-6bf776828c47 base
nntime_22.1-py3.9             12b831d7-2408-5666-9807-8a03f1bf03c0 base
scikit-learn_0.22-py3.9       154810fa-5b3b-4ca1-82af-4d5ee5ab0b95 base
pytorch-conv1_1-py3.6         16c629ca-c7-07-5d6d-359c-38880dbd7f base
pytorch-conv1_3-py3.6         1095545a-f710-59dd-4028-0747a5cd5988 base
pytorch-conv1_x72_1-py3.9-odd 16c6218e-7105-485b-808c-a208e476f797 base
tensorflow_2.1-py3.6          20041772-0498-58c7-9f75-47192f055650 base
spark-mllib_2.1-py3.6         217c10f6-7387-586f-823a-31328265a4c9 base
tensorflow_2.4-py3.8-hadoop    26215f05-0833-4a41-41bb-d465306ce558 base
nntime_22.1-py3.6-cuda       2920548c-9a9f-5478-9b7a-79ca3561877b base
dw_py3.8                      2a8c9527-798f-5ae9-40ab-159c24705f base
autoai-ts_3.8-py3.8          20917700-b4eb-4b0d-06dc-5c6761310075 base
kernel-spark3_3-py3.9        2b7851e2-9b31-5a8c-4e01-4802a765803a base
snark-mllib_2.3              26f17700-b4eb-4b0d-06dc-5c6761310075 base

```

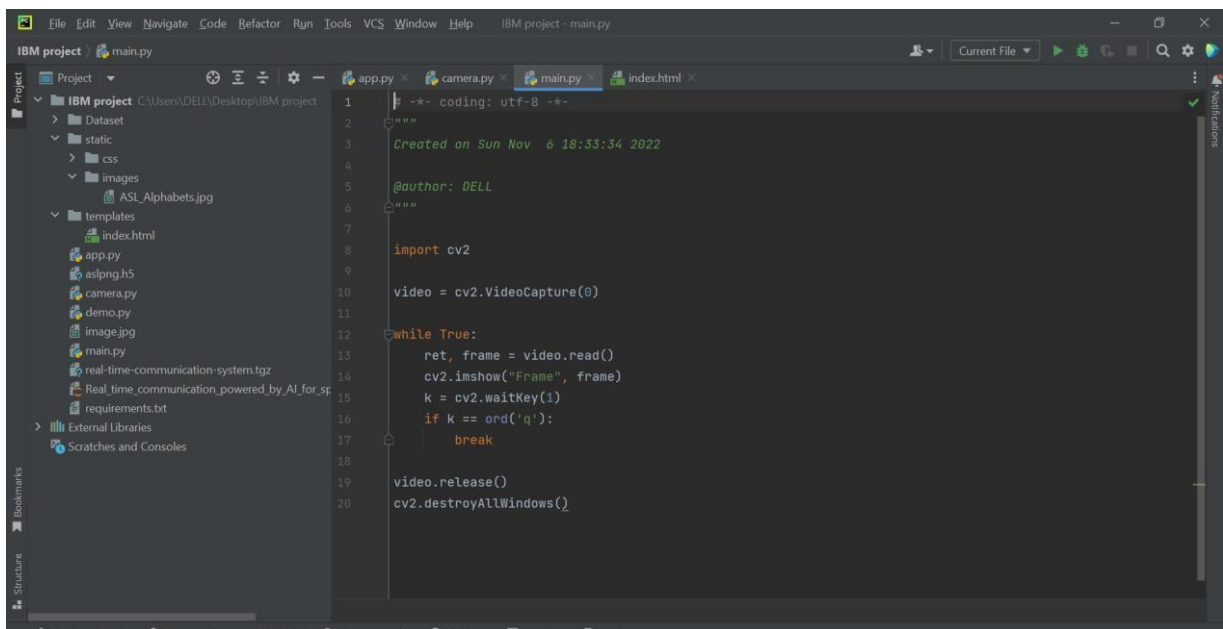
Activate Windows

```
File Edit View Navigate Code Refactor Run Tools VCS Window Help IBM project - app.py
IBM project
Project
  IBM project C:\Users\DELL\Desktop\IBM project
    Dataset
    static
    css
    images
      ASL_Alphabets.jpg
    templates
      index.html
      app.py
      aslpng.h5
      camera.py
      demo.py
      image.jpg
      main.py
      real-time-communication-system.tgz
      Real time communication powered by AI for sp
      requirements.txt
    External Libraries
    Scratches and Consoles
  Structure
  Bookmarks
  app.py x camera.py x main.py x index.html x
8 from flask import Flask, Response, render_template
9 from camera import Video
10
11 app = Flask(__name__)
12 @app.route('/')
13 def index():
14     return render_template('index.html')
15
16 def gen(camera):
17     while True:
18         frame = camera.get_frame()
19         yield(b'--frame\r\n'
20              b'Content-Type: image/jpeg\r\n\r\n' + frame +
21              b'\r\n\r\n')
22
23 @app.route('/video_feed')
24 def video_feed():
25     video = Video()
26     return Response(gen(video), mimetype='multipart/x-mixed-replace; boundary = frame')
27
28
29 if __name__ == '__main__':
30     app.run()
```

```
File Edit View Navigate Code Refactor Run Tools VCS Window Help IBM project - camera.py
IBM project
Project
  IBM project C:\Users\DELL\Desktop\IBM project
    Dataset
    static
    css
    images
      ASL_Alphabets.jpg
    templates
      index.html
      app.py
      aslpng.h5
      camera.py
      demo.py
      image.jpg
      main.py
      real-time-communication-system.tgz
      Real time communication powered by AI for sp
      requirements.txt
    External Libraries
    Scratches and Consoles
  Structure
  Bookmarks
  camera.py x
7 import cv2
8 import numpy as np
9 from tensorflow.keras.models import load_model
10 from tensorflow.keras.preprocessing import image
11
12 class Video(object):
13     def __init__(self):
14         self.video = cv2.VideoCapture(0)
15         self.roi_start = (50, 150)
16         self.roi_end = (250, 350)
17         self.model = load_model('aslpng.h5')
18         self.index = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I']
19         self.y = None
20     def __del__(self):
21         self.video.release()
22     def get_frame(self):
23         ret, frame = self.video.read()
24         frame = cv2.resize(frame, (640, 480))
25         copy = frame.copy()
26         copy = copy[150:150+200, 50:50+200]
27         # Prediction Start
28         cv2.imwrite('image.jpg', copy)
29         copy_img = image.load_img('image.jpg', target_size=(64, 64))
30         x = image.img_to_array(copy_img)
```



```
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20 def __del__(self):
21     self.video.release()
22 def get_frame(self):
23     ret, frame = self.video.read()
24     frame = cv2.resize(frame, (640, 480))
25     copy = frame.copy()
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27     # Prediction Start
28     cv2.imwrite('image.jpg', copy)
29     copy_img = image.load_img('image.jpg', target_size=(64, 64))
30     x = image.img_to_array(copy_img)
31     x = np.expand_dims(x, axis=0)
32     pred = np.argmax(self.model.predict(x), axis=1)
33     self.y = pred[0]
34     cv2.putText(frame, 'The Predicted Alphabet is: ' + str(self.index[self.y]) + '(100_50)', cv2.FONT_HERSHEY_SIMPLEX, 1, (0, 255, 0), 2)
35     ret, jpg = cv2.imencode('.jpg', frame)
36     return jpg.tobytes()
```



```
1 -*- coding: utf-8 -*-
2
3 Created on Sun Nov 6 18:33:34 2022
4
5 @author: DELL
6
7
8 import cv2
9
10 video = cv2.VideoCapture(0)
11
12 while True:
13     ret, frame = video.read()
14     cv2.imshow("Frame", frame)
15     k = cv2.waitKey(1)
16     if k == ord('q'):
17         break
18
19 video.release()
20 cv2.destroyAllWindows()
```

**GITHUB LINK - <https://github.com/IBM-EPBL/IBM-Project-26219-1660021655>**