

Real-Time Communication System Powered by AI for Specially Abled

Submitted By

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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 into 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).

2.2 References

1. Upendran, S., and Thamizharasi, A., "American Sign Language interpreter system for deaf and dumb individuals", In the Proceedings of the International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), pp. 1477- 1481, 2014
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.

<https://ieeexplore.ieee.org/document/8493808>

<https://ieeexplore.ieee.org/abstract/document/9396030>

<https://ieeexplore.ieee.org/document/8725244>

2.3 Problem 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.

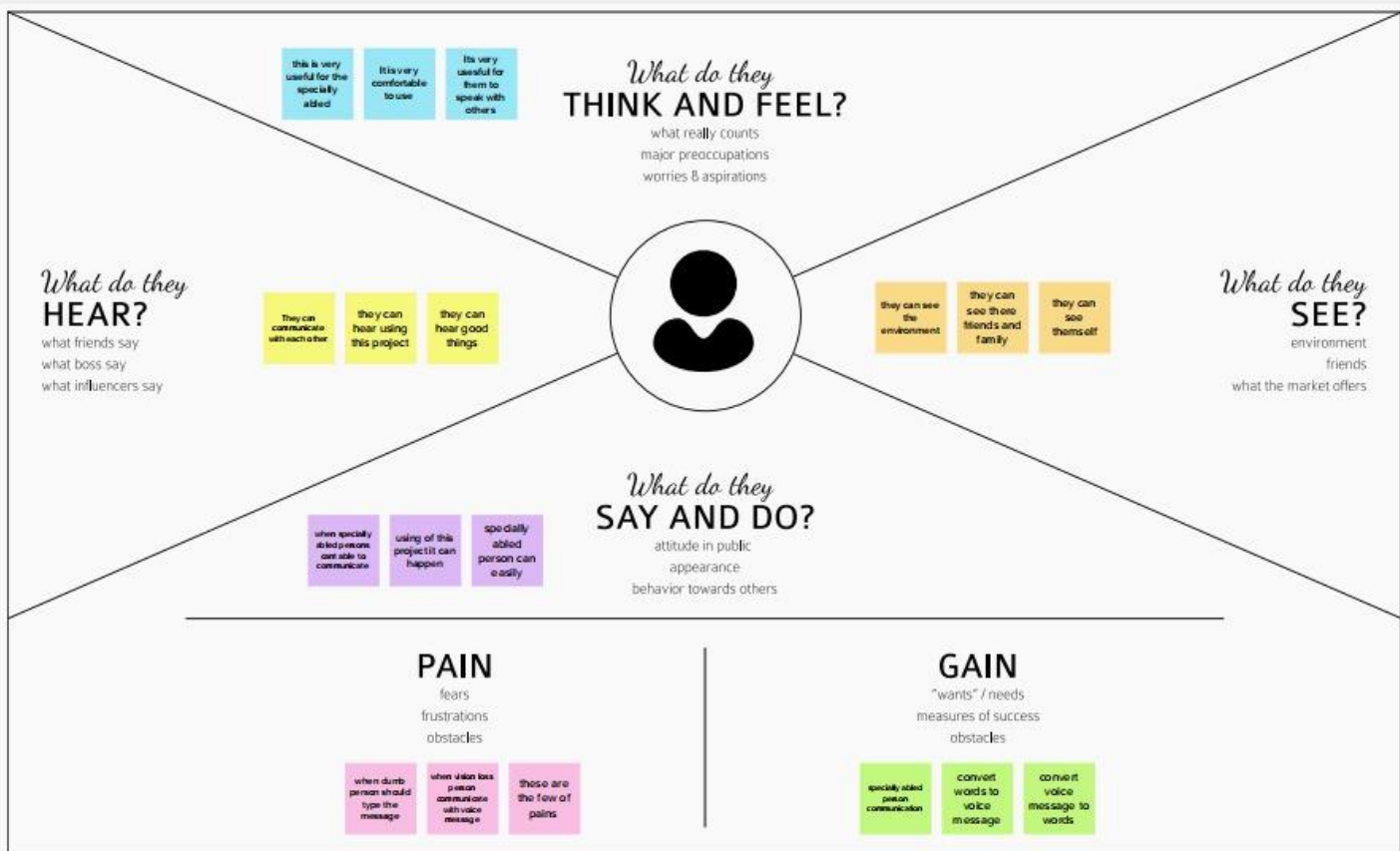
3.1 Empathy map canvas

Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1

Build empathy and keep your focus on the user by putting yourself in their shoes.



Share your feedback

3.2 Ideation & Brainstorming



USER INTERFACE

Design the application with Inclusivity to all types of people.

The App should be easily navigatable

APP EXPERIENCE

Creating an interactive and user-friendly dashboard.

The User Flow must be easy to understand by urban users too

Avoiding errors as far as possible

Step by step usage guide and FAQs are provided.

Language used in software is kept simple

FEATURES

Available to people of all age groups

A software that is accessible by all

Images taken and processed by web camera will avoid the background disturbance & Objects

As a coloured image has RGB layers, it would take a lot of time to process are planning... to Greyscale them

Chatbot For Help

A notification to remind them about their daily tasks to be done

An alarm button can be setup for any emergency uses for the specially abled person

Building a safe and secure software for user.

The dataset are collected to go optimum output

Accuracy in translation is a key point

DEVELOPMENT PROCESS

Collect various data necessary for training and testing

Making a modular software for quicker

Fault tolerant and handling the exceptions efficiently.

Avoiding errors as far as possible

Figure out if the user is showing a wrong sign and show error

A global community chat forum can be created so that people can share their thoughts

Translation should be faultless

It should follow the standard sign language regulations

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">● Communication is achieved without the help of additional human intervention.● No additional hardware support is needed to use the application● Improve their career opportunities in the industry● Can provide instant results to users
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 a 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

Proposed solution is the one in which we are making use of a convolution neural network to create a model that is trained on different hand gestures. A website is built which uses this model. The proposed solution section should offer the solution specifically, with enough detail so that the reader understands exactly what we're proposing.

3.4 Problem solution fit:

Maximum Marks: 2 Marks

PROBLEM SOLUTION FIT

Team ID: PNT2022TMID25445

Define CS, fit into CC	1.CUSTOMER SEGMENT(CS)	6.CUSTOMER CONSTRAINTS (CC)	5.AVAILABLE SOLUTIONS (AS)	Explore AS, differentiate
	Specially abled persons such as deaf and dumb people. The normal people who are trying to communicate with them are the customers	The sign language is not understandable to all. The difficulty in understanding the sign language by normal people	Using text type writers and AI Based devices i.e. Voice recognition.	
Focus on J&P, tap into BE, understand	2.JOBS-TO-BE-DONE/ PROBLEMS (J&P)	9.PROBLEM ROOT CAUSE (RC)	7.BEHAVIOUR (BE)	Focus on J&P, tap into BE, understand
	Create a communication link between deaf dumb and normal people Understanding inputs from the user may take a lot of efforts.	The communication barrier is the root cause. During emergency the specially abled people cannot contact or express their feelings to others (normal people). The feeling cannot be shared with other they feel stressed.	Customers try to find a device that helps in emergency situation.	
Identify strong TR & EM	3.TRIGGERS (TM)	10.YOUR SOLUTION (SL)	8.CHANNELS of BEHAVIOUR (CH)	Extract online & offline CH of BE
	An ability of the customers to communicate efficiently at serious and necessary situations. 4.EMOTIONS:BEFORE/AFTER (EM) After: Customer gain a better understanding of the needs of specially abled. They feel secured and it brings confidence in them. Before: Lacking of self-confidence. Feeling anxious of interacting with people.	This device helps in emergency situations to contact. The customer can share their feelings and also helps in expressing emotions and their motives.	ONLINE: Using online translation OFFLINE: They buy devices that helps in translating signed language to text and vice versa.	

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.

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.

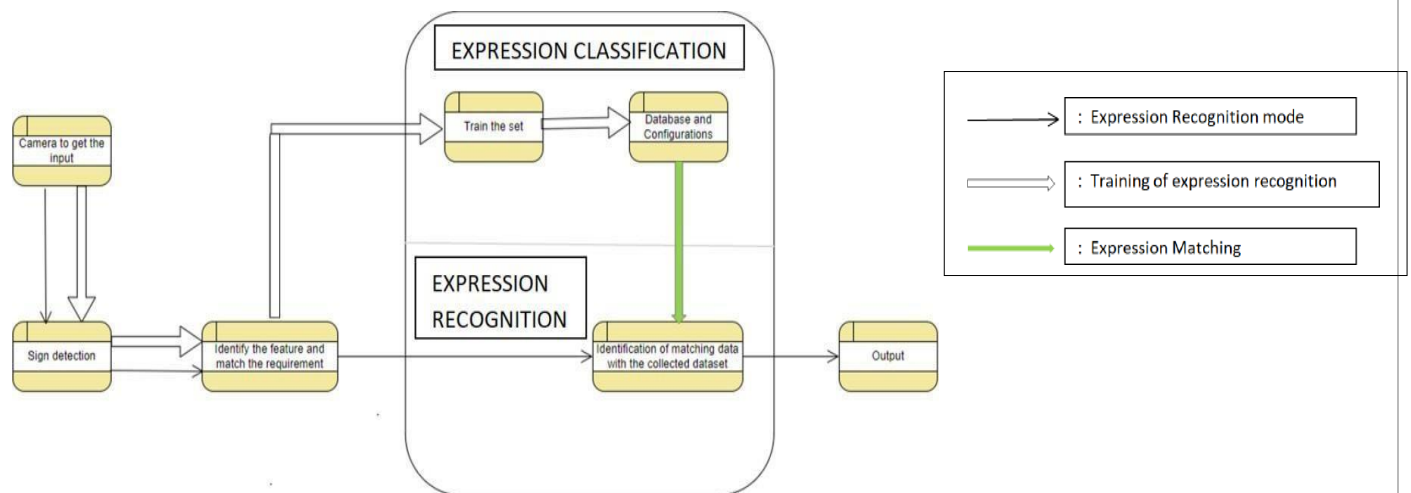
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The designed system is easy to use for speciallyabled persons as it is portable and platform independent.
NFR-2	Security	Converted information using signs into speech is accessed only by the user.
NFR-3	Reliability	System is tested with large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

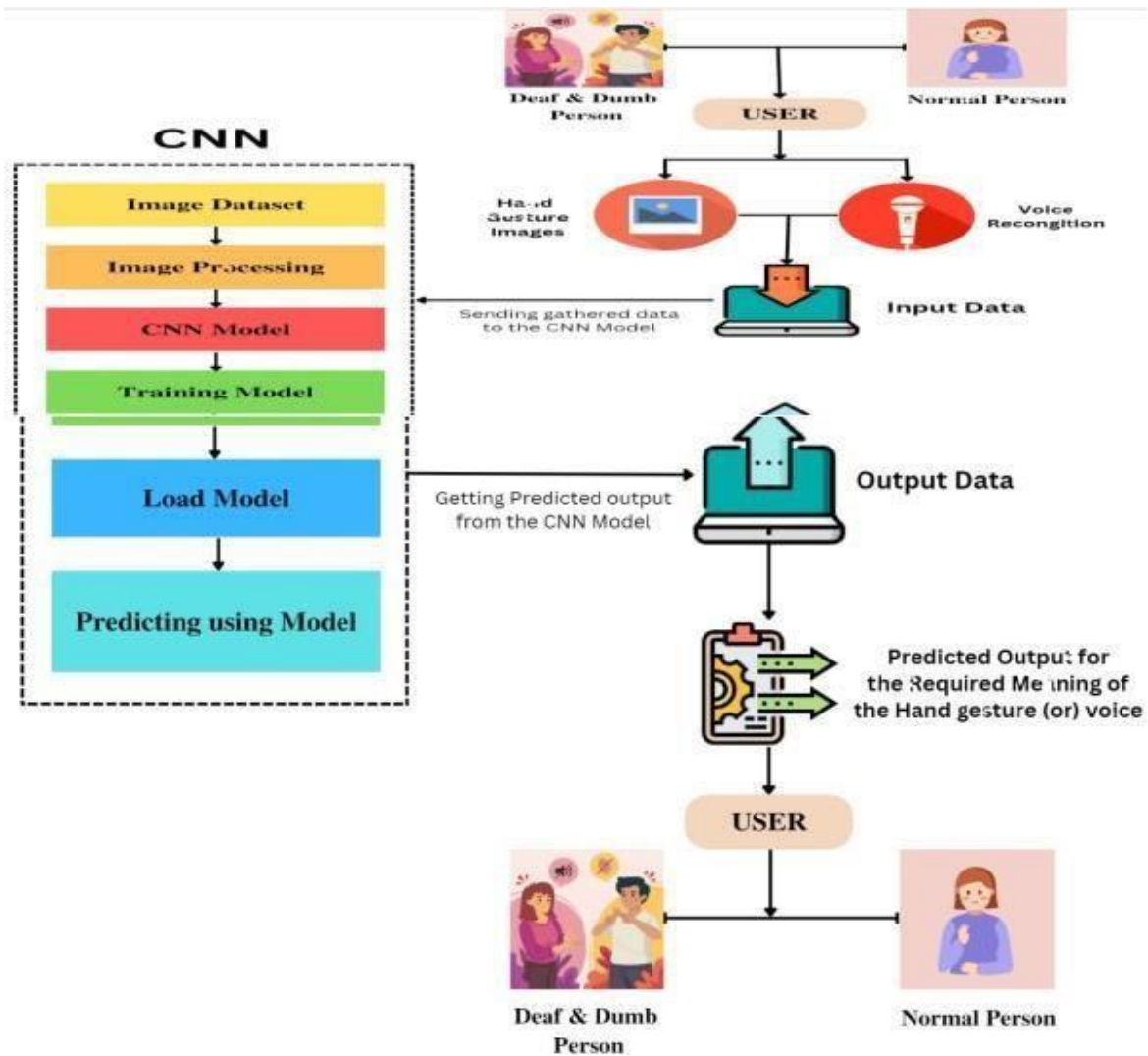
5.1 Data Flow Diagrams

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.



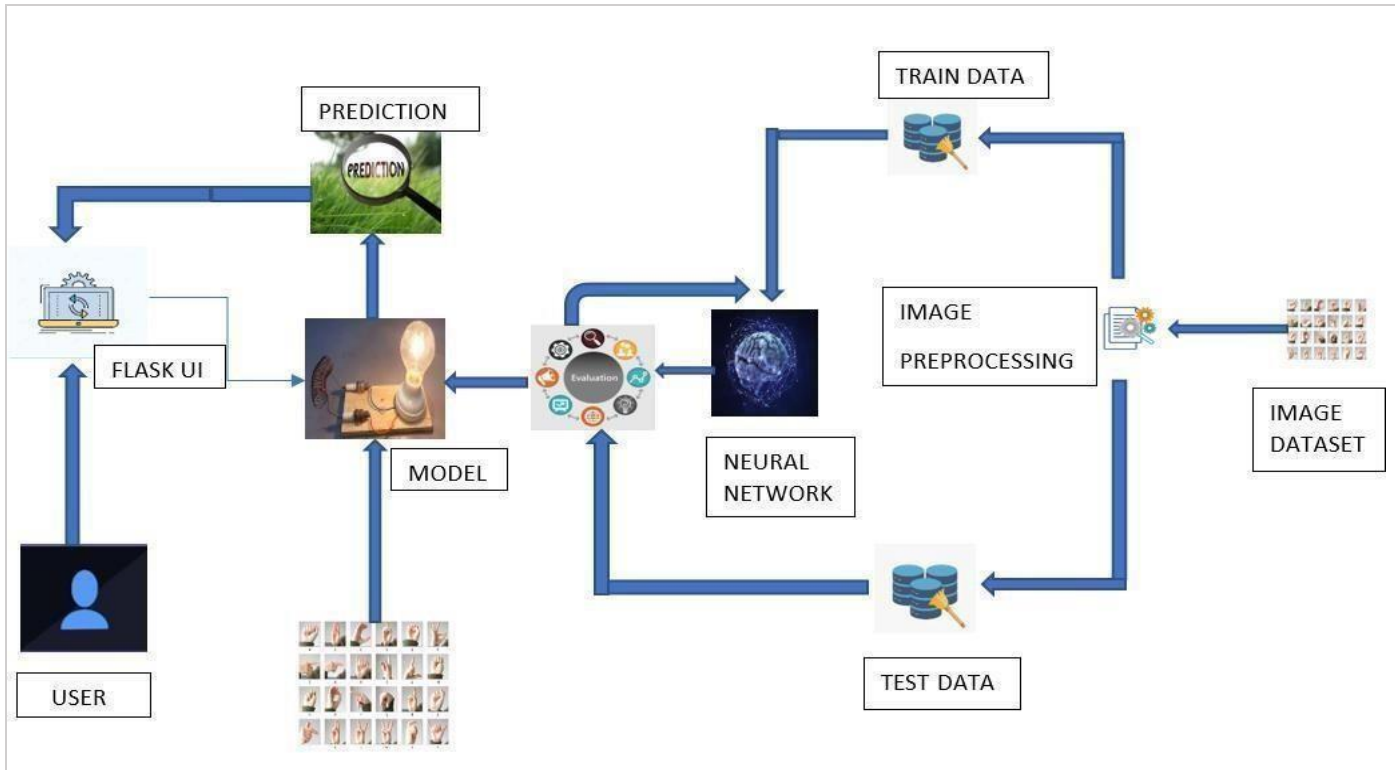
5.2 Solution Architecture & Technical Architecture

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.

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 information that is useful for an attack	Operating System - Windows, Mac, Linux; CPU & GPU (for training), WebCam, Scanners, Speakers and PC

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Numpy, Pandas , Keras, Tensorflow, NLTK, Sonnet.	Python framework
2.	Security Implementations	Security access controls ,Use of firewalls	SHA-256
3.	Scalable Architecture	Scalable AI	SEI Digital library
4.	Availability	Use of Cloud, Virtual assistant	IBM Cloud 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/ dash board	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive confirmation email & click confirm	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 S Dharshan Shiva
Sprint-1	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Bharanidaran Jaivignesh
Sprint-2	Registration	USN-3	As a user, I can register for the application through phone number	2	Medium	Logesh P
Sprint-2	User interface	USN-4	Professional responsible for user requirements & needs	2	Medium	Bharanidaran Jaivignesh
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Logesh S
Sprint-3	Dashboard	USN-6	As a user, I must receive any updates or pop ups in my dashboard	2	High	Logesh S Dharshan Shiva
Sprint-4	Details	USN-7	As a user, I should get notification about the progress and any updates via email or sms	1	Medium	Dharshan Shiva
Sprint-4	Privacy	USN-8	The developed application should be secure for the users	2	High	Logesh P Dharsahn shiva

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.

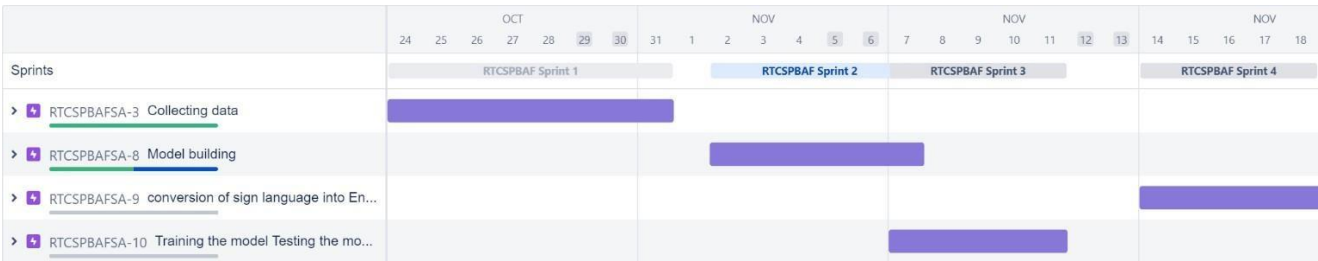
6.2 Sprint Delivery Schedule

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

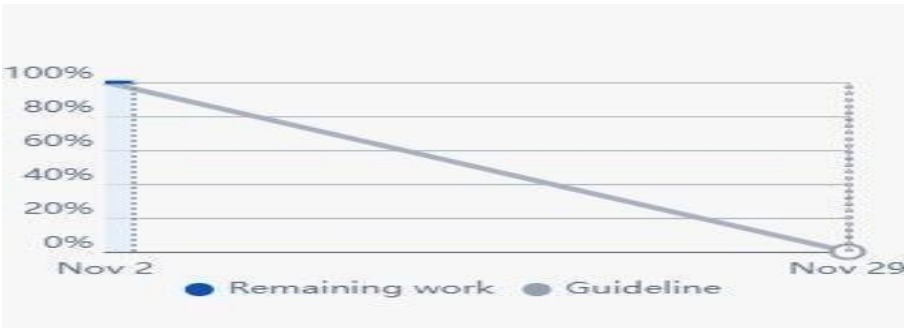
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	30 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	13 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	29 Nov 2022

Since sprints take place over a fixed period of time, it’s critical to avoid wasting time during planning and development.

6.3 Reports from JIRAROADMAP



Sprint-1



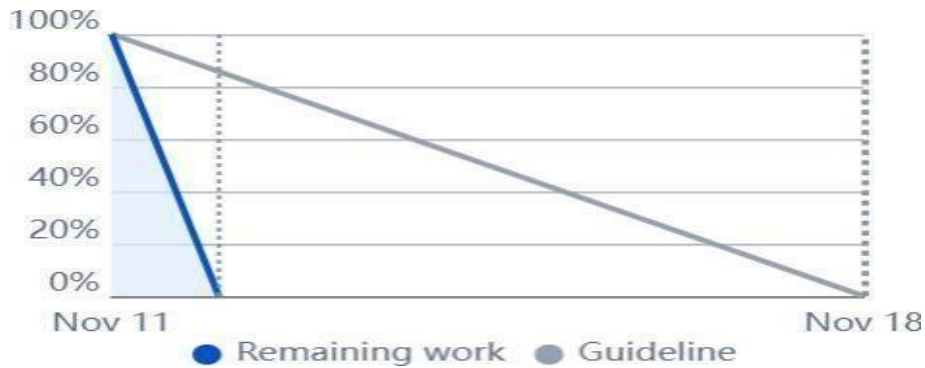
Sprint-2



Sprint-3



Sprint-4



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 coverts 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 950ms/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-23								
				Team ID	PNT-2022TM001158								
				Project Name	Project: Real time communication system powered by AI for specially abled								
				Document Name	Summary								
Testcase ID	Feature Type	Component	Test Scenario	Pre-Requirement	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC (or Automation) (Y/N)	Build ID	Executed By
LogInPage_TC_001	Functional	Home Page	Verify user is able to see the homepage	Mozilla Firefox Browser	Go to URL, in browser and click go	http://127.0.0.1:5000/	Homepage should be displayed	Working as expected	Pass	Steps are clear to follow	NO	NA	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.S
LogInPage_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 introduction to project	http://127.0.0.1:5000/	Application should show below UI elements: a. Reference b. camera access display c. Introduction to project	Working as expected	Pass	Steps are clear to follow	NO	NA	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.S
LogInPage_TC_003	UI	Home page	Verify whether reference page is working	Mozilla Firefox Browser	1. Enter URL(http://127.0.0.1:5000/) and click go 2. Click on reference button	http://127.0.0.1:5000/	Should show reference to reference page where all related images is displayed	working as expected	Pass	Steps are clear to follow	Yes	NA	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.S
LogInPage_TC_004	Functional	Home Page	Verify camera access	Mozilla Firefox Browser/ Web Camera	1. Enter URL(http://127.0.0.1:5000/) 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	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.S
LogInPage_TC_004	Functional	Home Page	Gesture detection	Mozilla Firefox/ Chrome	1. Enter URL(http://127.0.0.1:5000/) and click go 2. Click camera access 3. Image displayed 4. Detectional gesture occurs	Detectional gestures	Hand gestures needs to be detected and predicted	working as expected	Pass	Steps are clear to follow	Yes	NA	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.S
LogInPage_TC_005	Functional	Home page	Output prediction	Chrome/ trained model	1. Enter URL(http://127.0.0.1:5000/) and click go 2. Click camera access 3. Image displayed 4. Detectional 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	SHALINI A JAGA NANDINI R JINITHA ANISHKA PRASAD.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

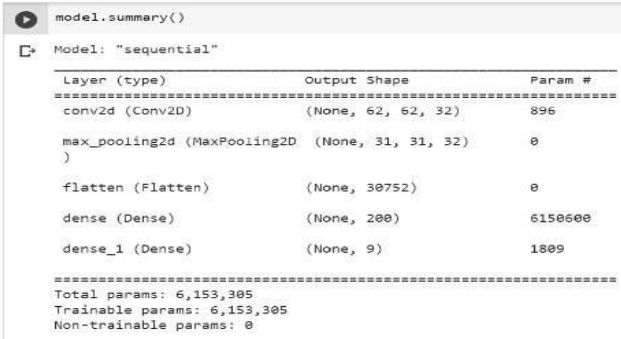
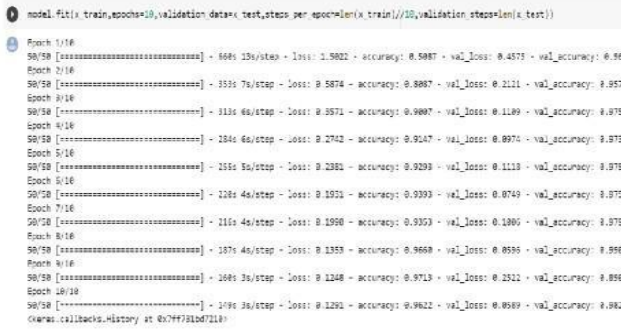
9. RESULT

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.

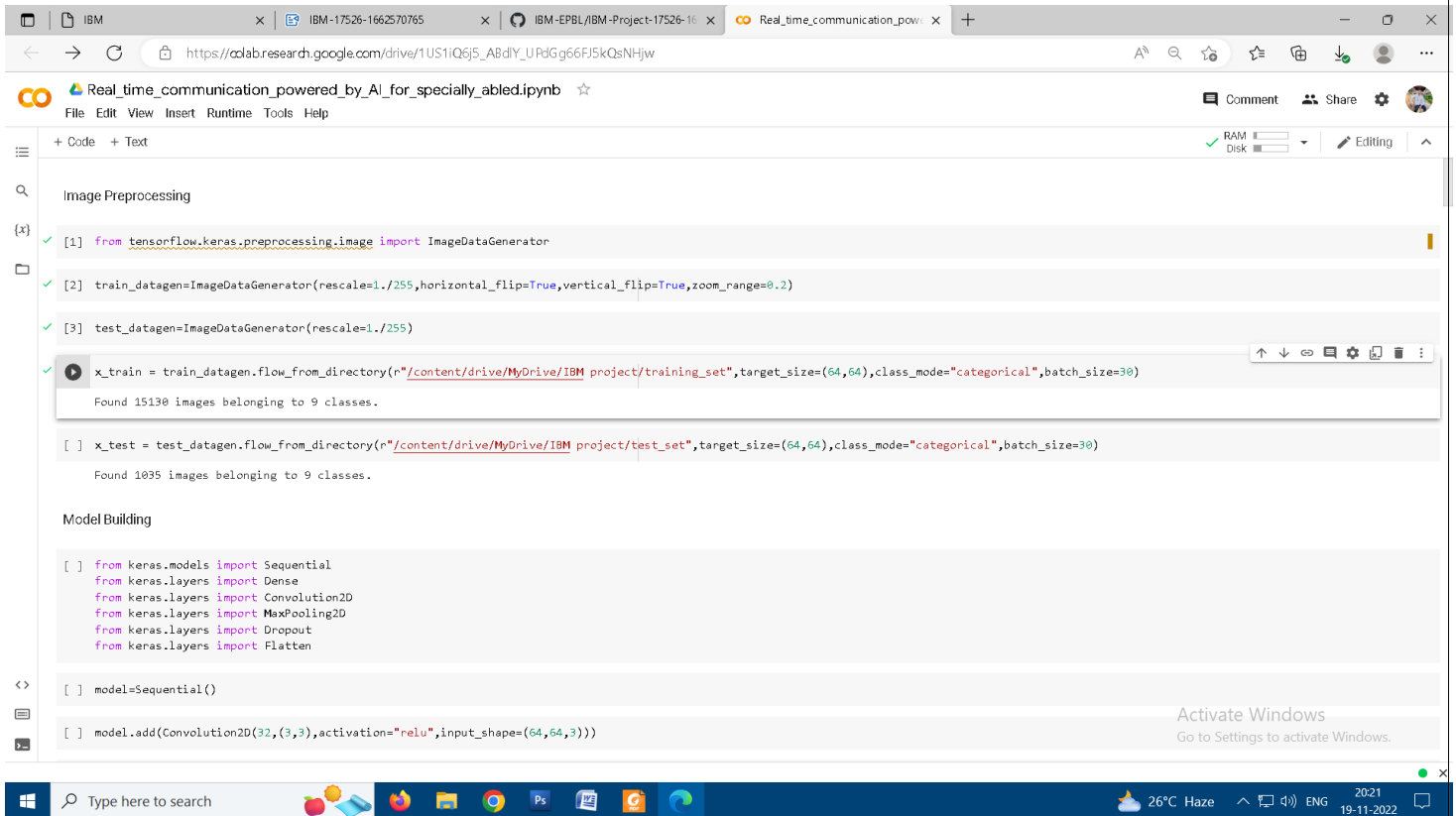
12. FUTURE SCOPE

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 notebook is open in a web browser with the URL https://colab.research.google.com/drive/1US1tQ6j5_ABdIY_UPdGg66FJ5kQsNHjw. The notebook contains 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)

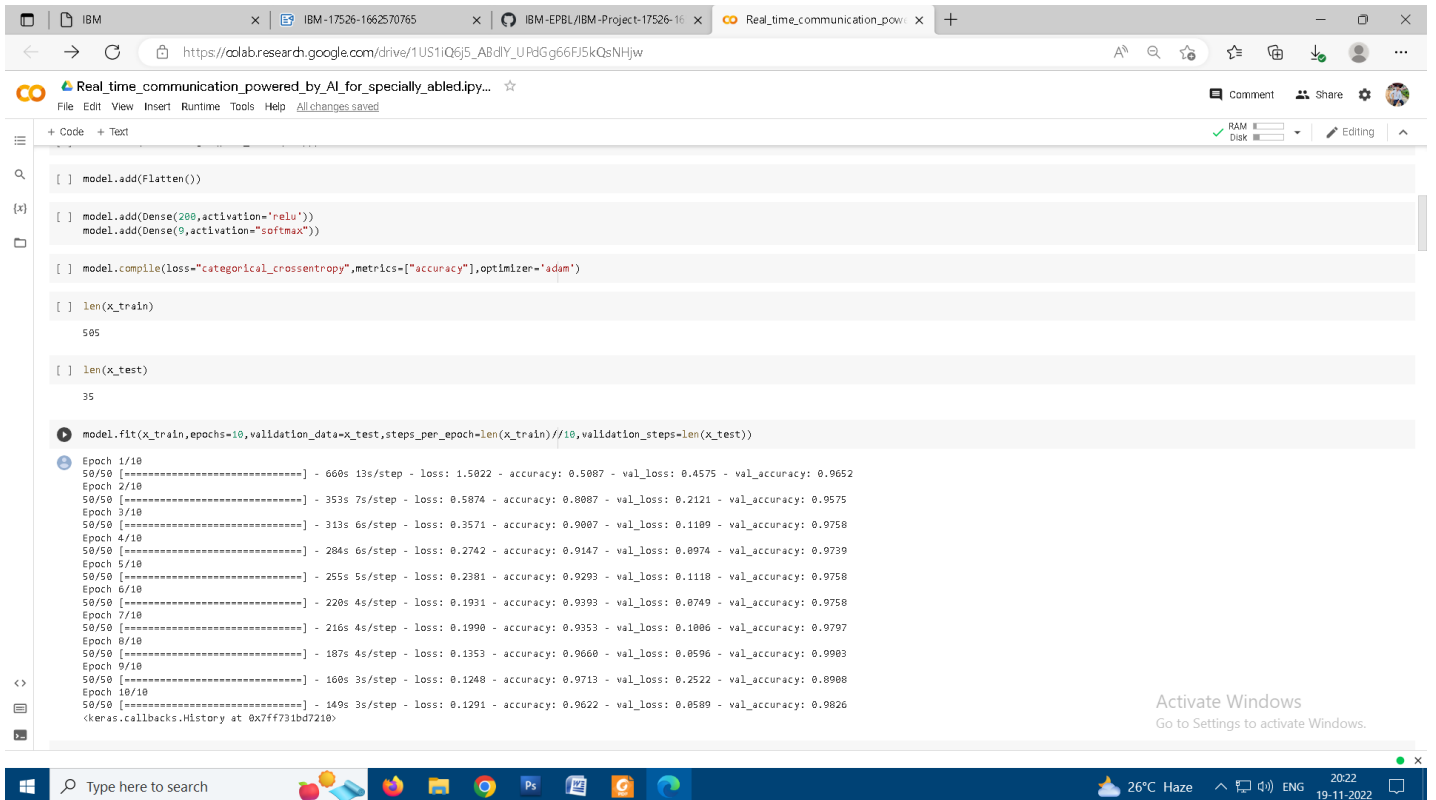
Found 1035 images belonging to 9 classes.

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. The code defines the model architecture, compiles it, and trains it for 10 epochs. The training progress is displayed in the output cell.

```
[ ] 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)

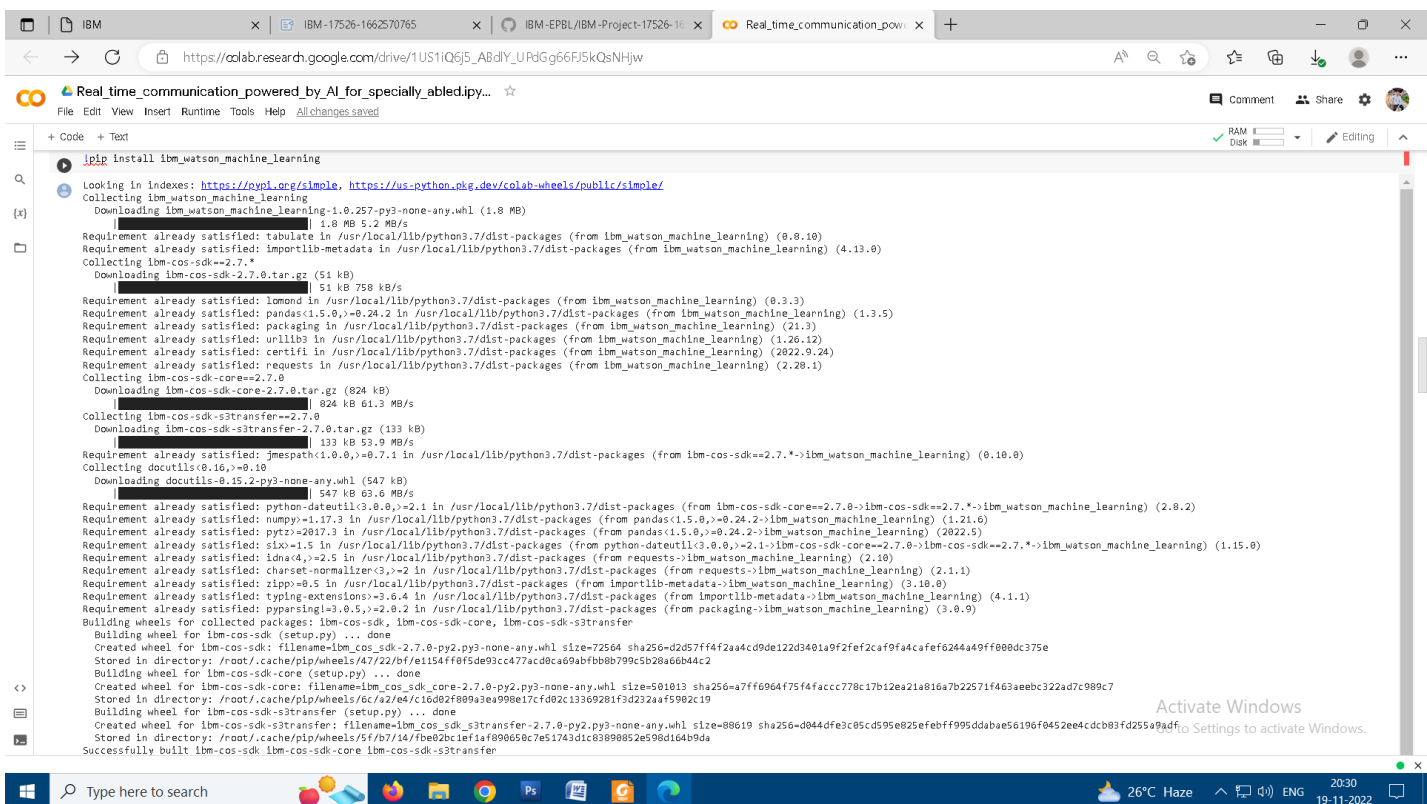
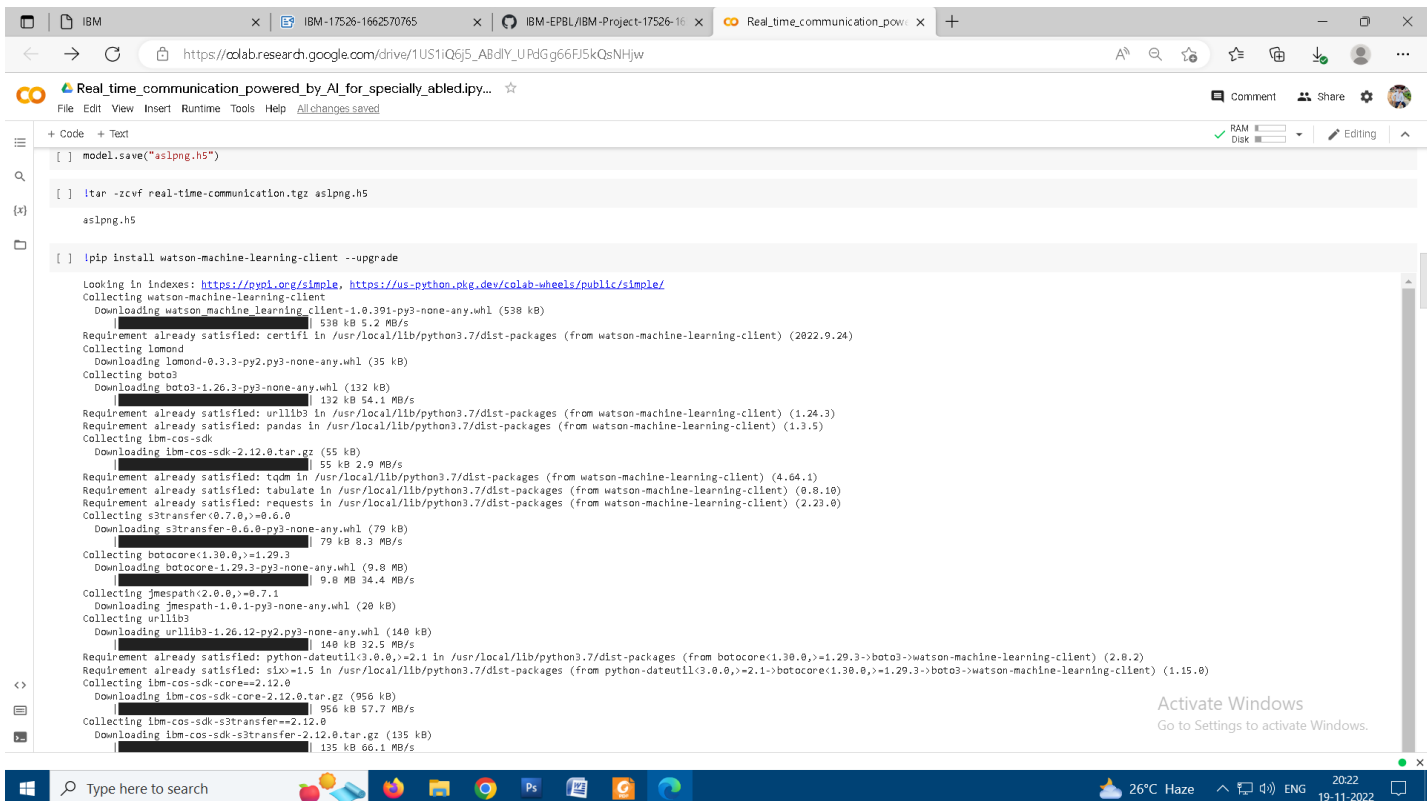
505

[ ] 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: 0.8007 - 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: 0.9758
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: 0.1990 - accuracy: 0.9353 - val_loss: 0.1006 - val_accuracy: 0.9797
Epoch 8/10
50/50 [=====] - 187s 4s/step - loss: 0.1353 - accuracy: 0.9660 - 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>
```



IBM-17526-1662570765 IBM-EPBL/IBM-Project-17526-16 Real_time_communication_pow...

https://colabresearch.google.com/drive/1U51tQ6j5_AbdlY_UPdGg66FJ5kQsNHjw

Real_time_communication_powered_by_AI_for_specially_abled.ipynb

Python 3.7 and 3.8 frameworks are deprecated and will be removed in a future release. Use Python 3.9 framework instead.

```
[ ] client

<ibm_watson_machine_learning.client.APIClient at 0x7ff6b7d7c8d0>

client.spaces.get_details()

{'resources': [{'entity': {'compute': {'crn': 'crn:v1:bluemix:public:pm-20:eu-de:a/b9331efaedac4670a69908b9b06e4341:150d8bd2-b3df-4636-848a-d80f4b26fcd1::',
    'guid': '150d8bd2-b3df-4636-848a-d80f4b26fcd1',
    'name': 'Watson Machine Learning-IN',
    'type': 'machine_learning'}},
    'description': '',
    'name': 'Real Time Communication Powered by AI for Specially Abled',
    'scope': {'bss_account_id': 'b9331efaedac4670a69908b9b06e4341'},
    'stage': {'production': False},
    'status': {'state': 'active'}},
    'storage': {'properties': {'bucket_name': '9f4f8465-6521-43e6-8b63-713a7c5aa38e',
    'bucket_region': 'eu-de-standard',
    'credentials': {'admin': {'access_key_id': '9066c3ab19204db3a12c6cd40a19070b',
    'api_key': 'oNhK0vE1075Uu1a8P0v5E2z0U5_AbdlY_UPdGg66FJ5kQsNHjw',
    'secret_access_key': '681fe49d3f45404ff41cb2f361afe58ddae9ae4ac3e5e31',
    'service_id': 'ServiceId-61c87d99-7dfc-491e-bdef-72cf589ac2e'},
    'editon': {'access_key_id': '89015f1ff44ce4aafaf06b126fcd0',
    'api_key': '5t1hzR0qoe45b_Vy_@CbAnc1zn4Tn-HuKqBULLYDe9Mc',
    'resource_key_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/b9331efaedac4670a69908b9b06e4341:920ea9cd-9efd-4270-a82b-87e13faac607::',
    'secret_access_key': 'e08ffcca8f3b1895f506231befe472d528c7b6efcc9b0b10',
    'service_id': 'ServiceId-34ca60b5-c426-493b-876f-45ad413fac13'},
    'viewer': {'access_key_id': 'f5a9f869485449cdebfc809e26fd3f42',
    'api_key': 'pu3-dUXor3-v7H7oo79UkQW3sF0520y6vVbsGu_Mgk7',
    'resource_key_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/b9331efaedac4670a69908b9b06e4341:920ea9cd-9efd-4270-a82b-87e13faac607::',
    'secret_access_key': 'eadbfb91ch0e606c0ce37879018580add7ed5b4f472ce',
    'service_id': 'ServiceId-5506b388-13e7-4bd1-b9a8-e645543et1c1'},
    'endpoint_url': 'https://s3.eu-de.cloud-object-storage.appdomain.cloud',
    'guid': '920ea9cd-9efd-4270-a82b-87e13faac607',
    'resource_crn': 'crn:v1:bluemix:public:cloud-object-storage:global:a/b9331efaedac4670a69908b9b06e4341:920ea9cd-9efd-4270-a82b-87e13faac607::',
    'type': 'bmcos_object_storage'}},
    'metadata': {'created_at': '2022-11-06T10:33:47.576Z',
    'creator_id': 'IBMLD-66200401QT',
    'id': 'cfff76553-4fb2-408c-9341-d2e9ac10faee',
    'updated_at': '2022-11-06T10:34:06.965Z',
    'url': '/v2/spaces/cfff76553-4fb2-408c-9341-d2e9ac10faee'}}]}
```

[] space_uid="cfff76553-4fb2-408c-9341-d2e9ac10faee"

Activate Windows
Go to Settings to activate Windows.

IBM-17526-1662570765 IBM-EPBL/IBM-Project-17526-16 Real_time_communication_pow...

https://colabresearch.google.com/drive/1U51tQ6j5_AbdlY_UPdGg66FJ5kQsNHjw

Real_time_communication_powered_by_AI_for_specially_abled.ipynb

Connecting with IBM

```
[ ] from tensorflow.keras.models import load_model

[ ] model = load_model('as1png.h5')

[ ] client.set_default_space(space_uid)

'SUCCESS'

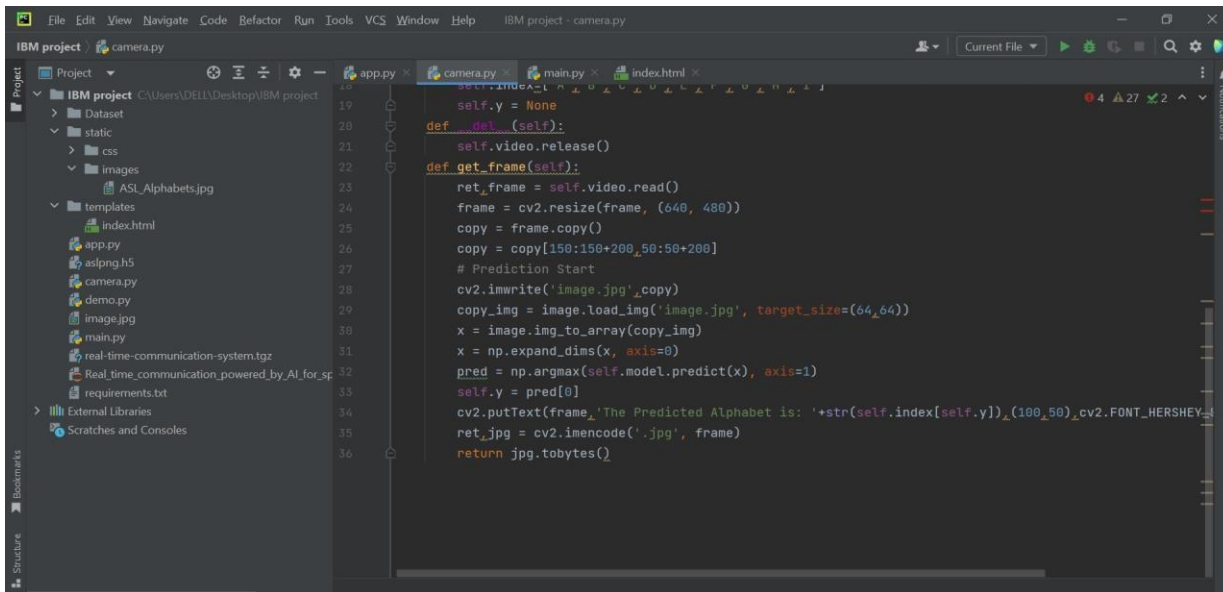
client.software_specifications.llst()

-----
NAME ASSET_ID TYPE
default_py3.6 0602b0c9-8b7d-44a8-9b09-46c416adcbd9 base
kernel-spark3.2-scala2.12 020d60ce-7ac1-5e68-ac1a-31189867356a base
pytorch-onnx_1.3-py3.7-edt 060ea134-3346-5748-b513-49120e15d280 base
scikit-learn_0.20-py3.6 09c5a1d0-0c1e-4473-a344-eb7b665ff607 base
spark-mllib_3.0-scala_2.12 09f4cf90-98a7-5099-b9ed-1ef348aebdee base
pytorch-onnx_rt22.1-py3.9 0b048dda-e681-5599-b641-b5f6fccc6471 base
ai-function_0.1-py3.6 0cd89f1e-5376-4f4d-92dd-da3b69aa9bda base
shiny-r3.6 0e6e79df-875e-4f24-8ae9-62dcd2148306 base
tensorflow_2.4-py3.7-horovod 1092590a-307d-563d-9b62-4eb7d64b3f22 base
pytorch_1.1-py3.6 10ac12d6-6b3b-4ccd-8392-3e922c096a92 base
tensorflow_1.15-py3.6-ddl 111e41b3-d62d-5422-44d6-bf7768284b7 base
runtime-22.1-py3.9 12b83a17-24d8-5082-908f-0ab31fbfd3cb base
scikit-learn_0.22-py3.6 154018fa-5b3b-4ac1-82af-4d5ee5abbc85 base
default_r3.6 1b70a0c3-ab34-4b07-8aa0-a4a3c8296a36 base
pytorch-onnx_1.3-py3.6 1bc6029a-cc97-56da-b9e0-39c3808dbb67 base
kernel-spark3.3-r3.6 1c9e454f-f216-50dd-a20e-474a5cdf5980 base
pytorch-onnx_rt22.1-py3.9-edt 1d362186-74d5-5b59-8b6c-9d80800de37f base
tensorflow_2.1-py3.6 1eb25b04-d6ed-5dde-b6a5-3fbdf1665666 base
spark-mllib_3.2 20047f72-0a98-58c7-9ff5-a77b012eb0f5 base
tensorflow_2.4-py3.8-horovod 217c16f6-178f-50bf-824a-b19f20564c49 base
runtime-22.1-py3.9-cuda 26215f05-08c3-5441-a1b0-d466306ce058 base
dt_py3.8 295a0d05-9ef9-547e-9b4f-92ae1563e720 base
autoai-ts_3.8-py3.8 2a0c932-708f-5ae9-abd6-15e0c2402fb5 base
tensorflow_1.15-py3.6 2b73a275-7c6f-420b-a912-eae7f436e0bc base
kernel-spark3.3-py3.9 2b7961e2-e3b1-5a8c-a491-402c8368839a base
pytorch_1.2-py3.6 2c8ef57d-2687-4b7d-acce-61f94976dad1 base
spark-mllib_2.3 2e51f708-bca8-4b6d-88dc-5c6791308075 base
```

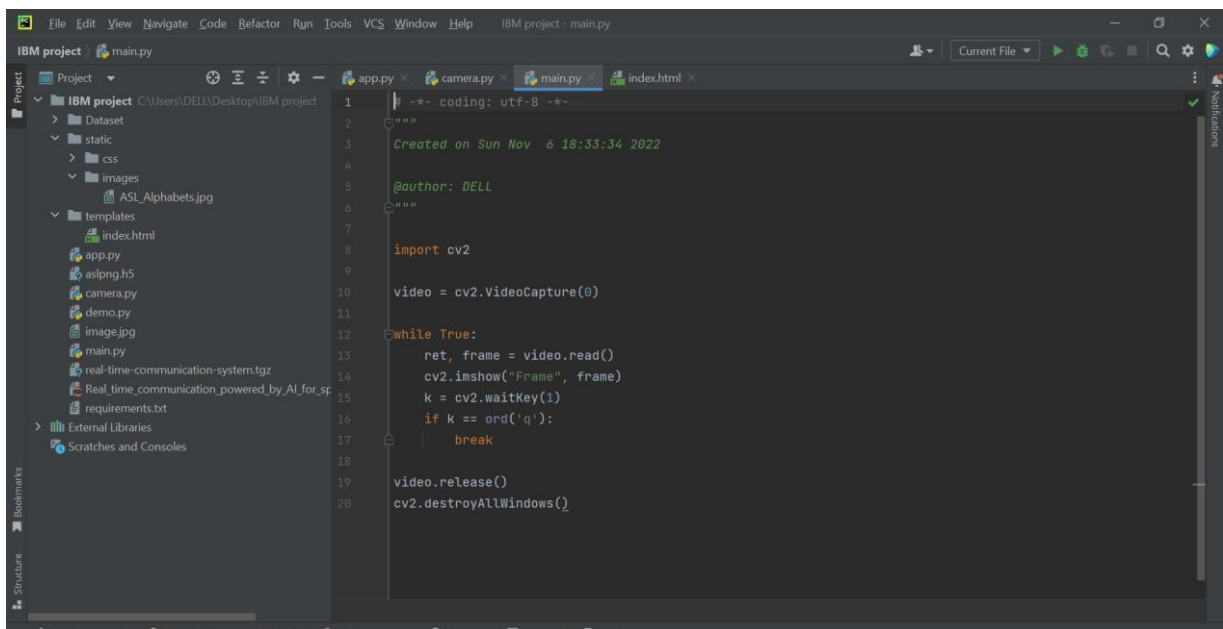
Activate Windows
Go to Settings to activate Windows.

```
IBM project - app.py
File Edit View Navigate Code Refactor Run Tools VCS Window Help
IBM project
Project
  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
  app.py
  camera.py
  main.py
  index.html
  6
  Current File
  Run
  Debug
  Test
  Search
  Settings
  Notifications
  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()
```

```
IBM project - camera.py
File Edit View Navigate Code Refactor Run Tools VCS Window Help
IBM project
Project
  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
  camera.py
  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)
```



```
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)
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-36398-1660294882>

DEMO LINK - <https://youtu.be/qHSBvxBFNx0>