

**UNIVERSITY COLLEGE OF ENGINEERING VILLUPURAM**

Kakkuppam, Villupuram-605103

**IBM - PROJECT - 28555-1660113610**

**REAL TIME COMMUNICATION SYSTEM POWERED BY AI  
FOR SPECIALLY ABLED**

**TEAM ID : PNT2022TMID29257**

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# **1. INTRODUCTION**

## **1.1 Project Overview**

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. 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. The human hand has remained a popular choice to convey information in situations where other forms like speech cannot be used.

## **1.2 Purpose**

This project enables a deaf and dumb people to convey their information using signs which get converted to human – understandable 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 signlanguage 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. Title:**

Portable Communication Aid for Specially Challenged : Conversion of Hand Gestures into Voice and Vice Versa

### **Author:**

T Meera Devi, K M Shravan Raju

### **Methodology:**

The work is to develop a portable device for the disabled people who are not able to communicate with the normal persons properly. There are various steps involved in recognising the feature distinguishing hand gesticulation. The collected gesticulation is trained using Neural Network. The hand movement pattern is separated from a continuous recording of gestures. Low-Level understanding for the feature pattern comprises the gestural segment.

**Advantage:**

This will be useful for the normal people to communicate with differently abled people and vice versa.

**Limitation:**

Separation of the hand movements from continuous hand gestures may result in accuracy issues.

**2. Title:**

Real-Time Two-Way Communication Approach for Hearing Impaired and Dumb Person Based on Image Processing.

**Author:**

Shweta. S. Shinde, Rajesh M. Autee, Vitthal K. Bhosale

**Methodology:**

Proposed system is based on vision-based hand recognition approach. The hand gestures are identified under varying illumination conditions. The proposed method performs background segmentation of the hand from the acquired data and then is assigned a particular gesture for different alphabets. It involves feature extraction methods to calculate peak calculation and angle calculation of hand gestures. Finally, the gestures are recognized by converting these gestures into speech and vice versa. For extracting the features of speech signal Mel-frequency cepstrum coefficients and dynamic time warping are used. The proposed system is based on MATLAB.

**Advantage:**

Two-way communication is possible enabling effective communication between normal people and physically impaired

**Limitations:**

Detected only limited hand gestures (From alphabets A to I)

Memory consumption is high as image processing is done using the built-in model of MATLAB.

### **3. Title:**

Hand Gesture Detection based Real-time American Sign Language Letters Recognition using Support Vector Machine

### **Authors:**

Xinyun Jiang, Wasim Ahmad

### **Methodology:**

Features extraction by Principal Component Analysis(PCA) SVM is used for mapping hand gestures.

### **Advantage:**

Principal Component Analysis used to select 8 features, reduces computational complexity and processing time.

### **Limitation:**

Reorientation stage- rotation angle of alphabets difficult to determine. Only static images are used.

### **4. Title:**

Sign Language Recognition Using Deep Learning on Custom Processed Static Gesture Images.

### **Authors:**

Aditya Das, Shantanu Gawde, Khyati Suratwala, Dhananjay Kalbande

### **Methodology:**

CNN to recognize sign language gestures, Transfer learning using Inception v3.

### **Advantage:**

Average around 90% is obtained.

### **Limitation:**

Dynamic hand gestures are not used. Only static finger spellings are used.



**5.Title:**

Machine Learning Model for Sign Language Interpretation using Webcam Images.

**Author:**

Kanchan Dabre, Surekha Dholay

**Advantage:**

Prediction using Haar Cascade Classifier integrated with SVM, Classification based on supervised feed forward backpropagation algorithm. Convergence rate is faster. Average recognition rate: 91.11 %

**Limitation:**

Haar Cascade Classifier compromises on precision.

**6. Title:**

MUDRAKSHARA - A Voice for Deaf/Dumb People

Author Dr.Yeresime Suresh, J Vaishnavi, M Vindhya, Mohammed Sadiq Afreed Meeran, Supritha Vemala

**Methodology:**

A system that recognizes hand gestures and performs the task same as translators is developed - MUDRAKSHARA. It identifies hand gestures in the images obtained from video that is captured by a web 'cam recorder and gives the meaning of signs made by hearing/speech disabled people thus making communication complete.

**Advantages:**

Provides the opportunity for common people to understand sign language thus bridging the communication gap between the deaf/dumb and the common people. High accuracy because of the highly trained CNN model.

**Limitation:**

The system does not respond to dynamic hand gestures. Compared to other latest algorithms, CNN is a bit slow.

**2.3 Problem statement definition**

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

The project aims to develop a system that converts the sign language into a human hearing voice in the desired language to convey a message to normal people, as well as convert speech into understandable sign language for the deaf and dumb. 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.

**Approach:**

Communication plays a significant role in making the world a better place. Most people communicate efficiently without any issues, but many cannot due to disability. They cannot hear or speak, which makes Earth a problematic place to live for them. Even simple basic

tasks become difficult for them. Disability is an emotive human condition, Being deaf and dumb pushes the subject to oblivion, highly introverted. How artificial intelligence is being used to help people who are unable to do what most people do in their everyday lives. Technology should create a platform or a world of equality despite the natural state of humans.

### Benefits:

To help people overcome physical and cognitive challenges.

### Problem Statement I



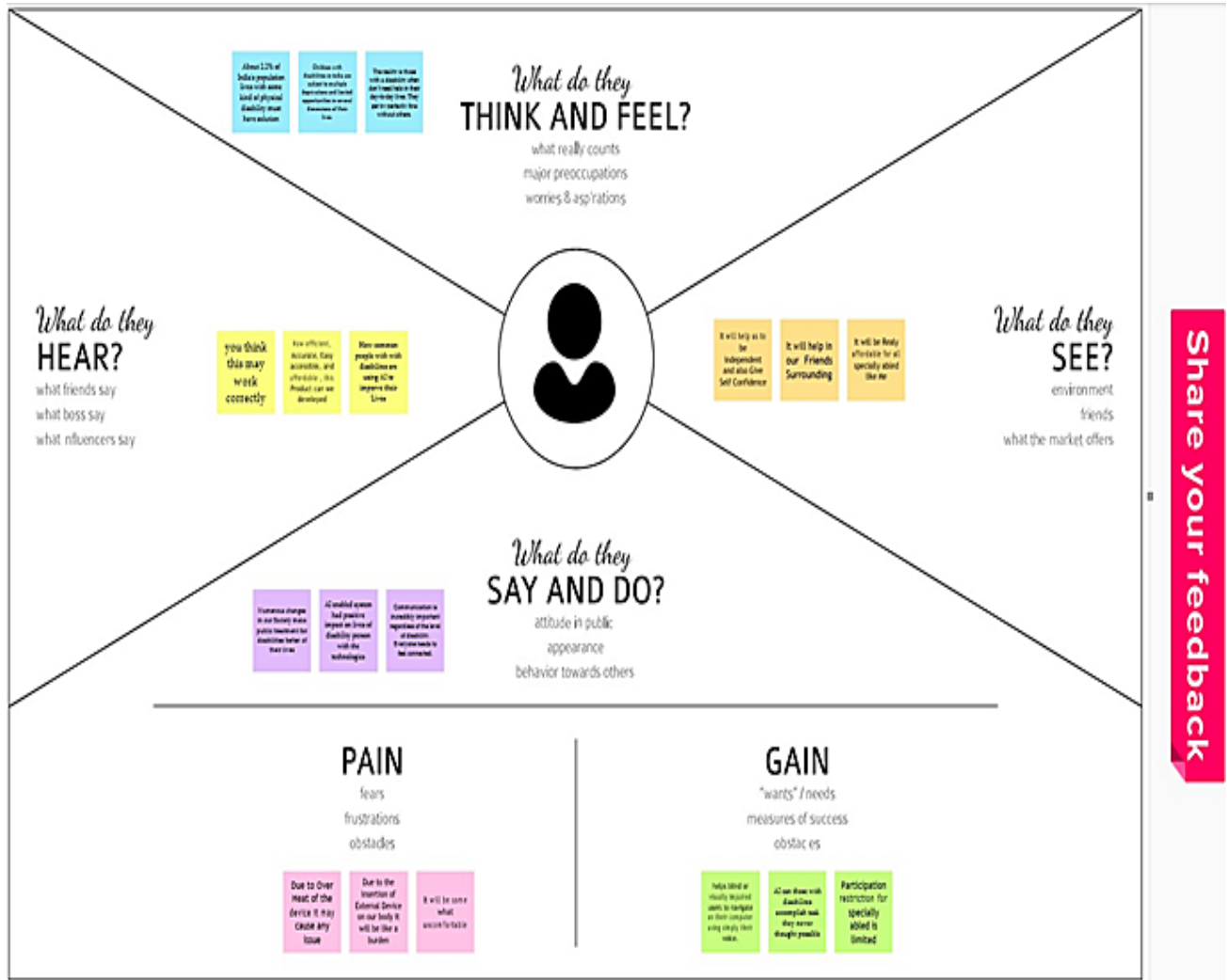
### Problem Statement II



### 3. IDEATION & PROPOSED SYSTEM

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 mapcanvas





### 3.3 Proposed Solution

#### Proposed Solution Template:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Communications between deaf-mute and a normal person.
2.	Idea / Solution description	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.
3.	Novelty / Uniqueness	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.
4.	Social Impact / Customer Satisfaction	An App is used that enables deaf-mute people to convey their information using signs which get converted to human Understandable language and speech.
5.	Business Model (Revenue Model)	An app is being built which uses this model.
6.	Scalability of the Solution	Can use both normal and deaf-mute people. Easy to handle. Produces rapid translations. Deliver the accurate content.

### 3.4 Problem solutionfit

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.

Problem-Solution fit canvas 2.0		Purpose / Vision	
<p>Project Title: Real-Time Communication System Powered by AI for Specially Abled</p> <p>Team id: PNT2022TMID29257</p>			
Define CS, fit into CC	<b>1. CUSTOMER SEGMENT(S)</b> <small>Who is your customer? i.e. working parents of 0-5 y.o. kids</small>  Deaf-mute and a normal person are the customers of this project.	<b>6. CUSTOMER CONSTRAINTS</b> <small>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.</small>  The network connection of the device should be stable to capture the voice or sign languages	<b>5. AVAILABLE SOLUTIONS</b> <small>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 pros &amp; cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking</small>  Nowadays Deaf Mute Communication Interpreter , Under Wearable communication method, there are Glove based system, Keypad method and Handicom Touchscreen.
	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <small>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</small>  Communication between the deaf and non-deaf has always been a very cumbersome task. This paper aims to cover the various prevailing methods of deaf-mute communication interpreter system. The two broad classification of the communication methodologies used by the deaf-mute people are Wearable Communication Device and Online Learning System.	<b>9. PROBLEM ROOT CAUSE</b> <small>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.</small>  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.	<b>7. BEHAVIOUR</b> <small>What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</small>  Easy to use . can be able to respond quickly. Able to produce absolute translation. Should consume less data. Requirement of internet speed.
Focus on J&P, tap into BE, understand RC	<b>3. TRIGGERS</b> <small>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</small>  If any specially abled people use this device for communication make the others to use this device.	<b>10. YOUR SOLUTION</b> <small>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</small>  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.	<b>8. CHANNELS of BEHAVIOUR</b> <b>8.1 ONLINE</b> <small>What kind of actions do customers take online? Extract online channels from #7</small>  The specially abled people need to access the device.
Identify strong TR & EM	<b>4. EMOTIONS: BEFORE / AFTER</b> <small>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure &gt; confident, in control - use it in your communication strategy &amp; design.</small>  It enables Specially abled people to convey their information using signs which get converted to human-understandable language and speech.	<b>8.2 OFFLINE</b> <small>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</small>  Store The datas and informations being transferred.	Extract online & offline CH of BE

## 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.

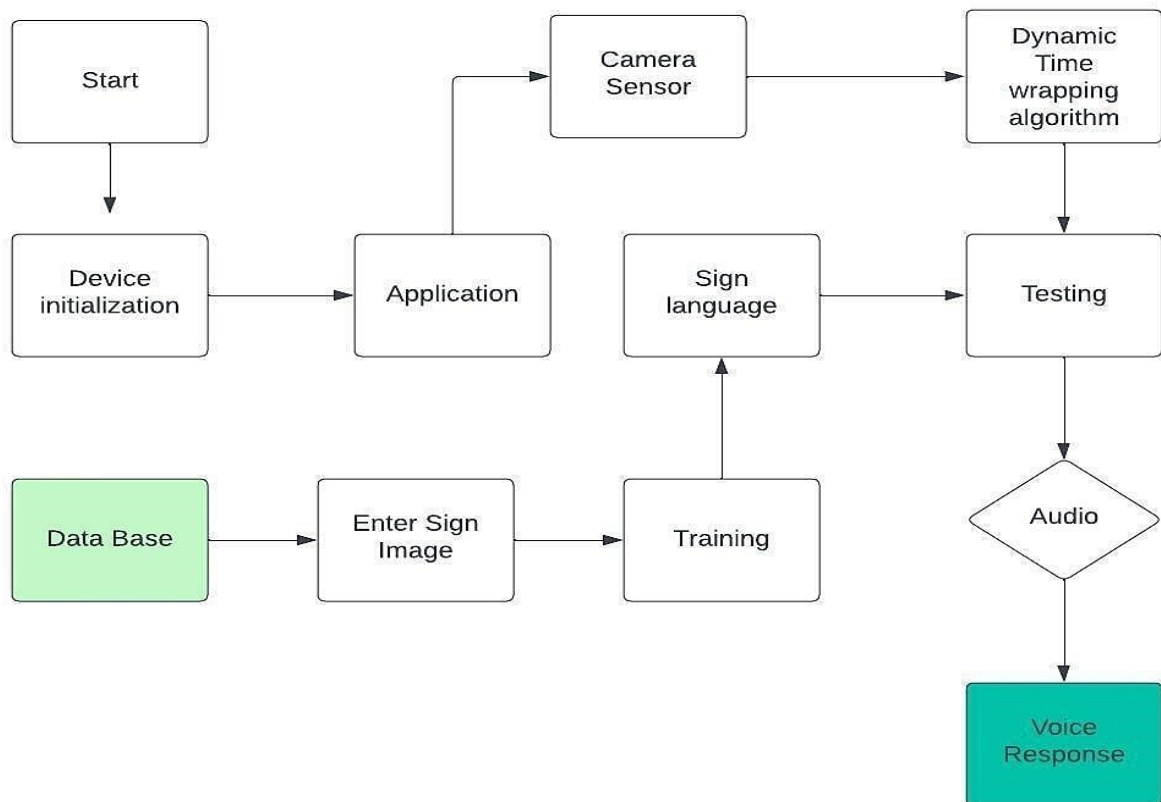
<b>FR No.</b>	<b>Non-Functional Requirement</b>	<b>Description</b>
NF R-1	<b>Usability</b>	The designed system is easy to use for speciallyabled personsas it is portable and platform independent.
NF R-2	<b>Security</b>	Converted information usingsigns into speechis accessed only by the user.
NF R-3	<b>Reliability</b>	System is testedwith large numberof 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 shouldconvert 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

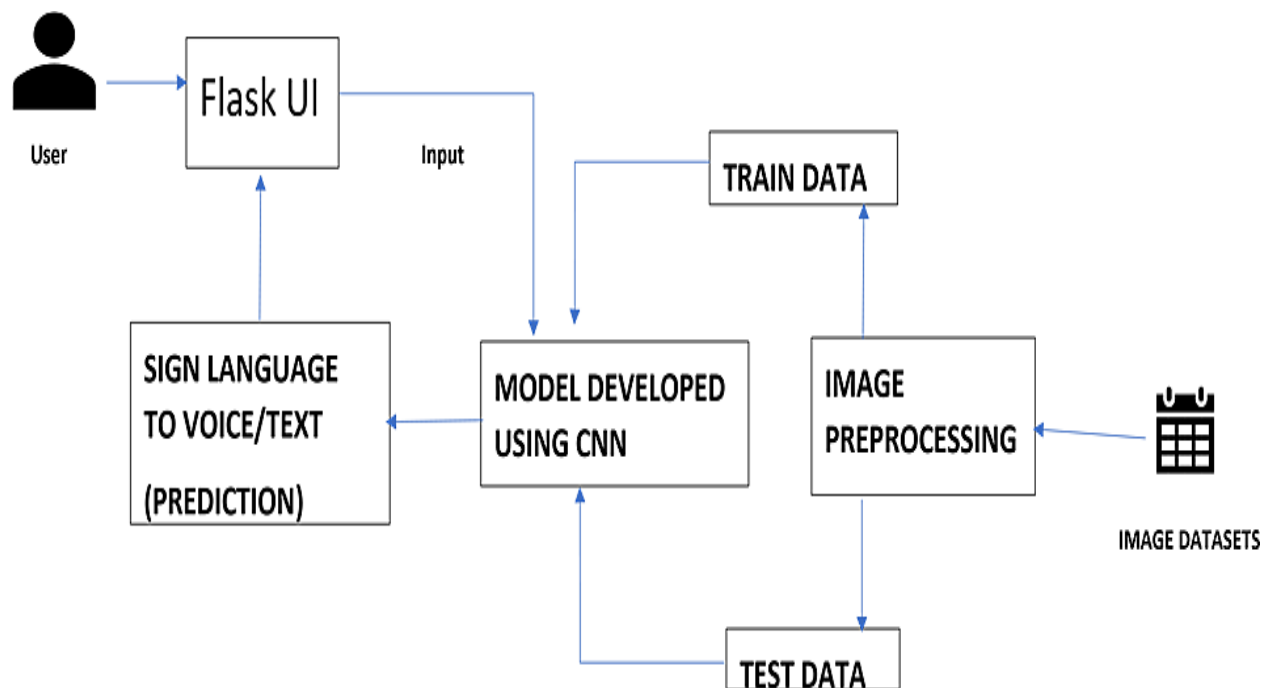
A data flow diagram is a traditional visual representation of the information flow within a system. It shows how data enters and leaves the system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between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



## 5.2 Solution Architecture & Technical Architecture

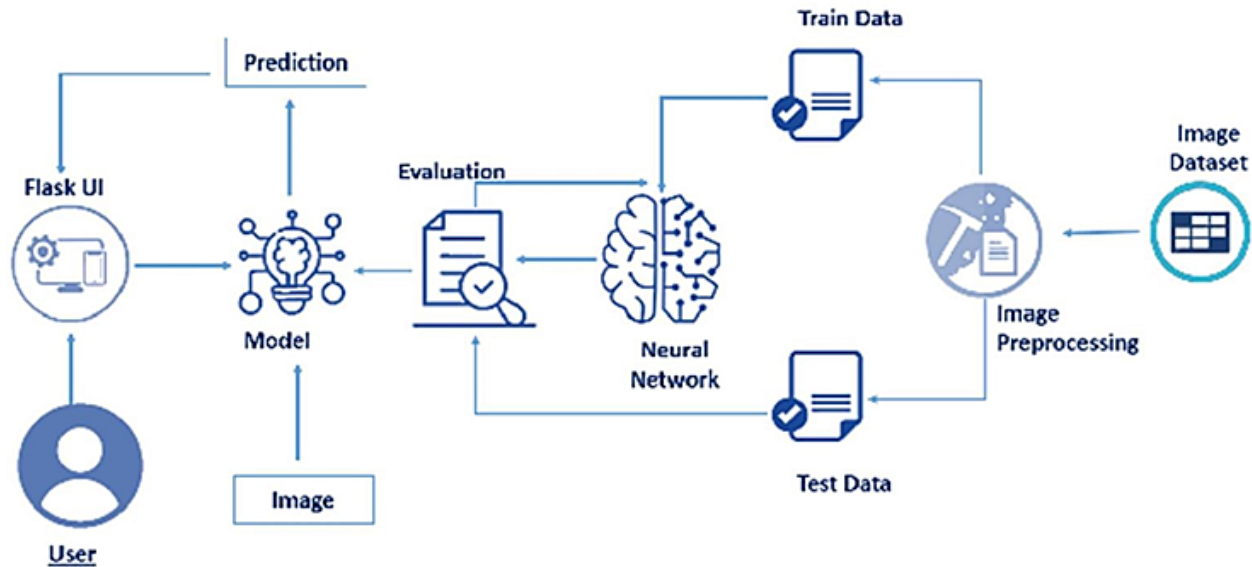
### Solution Architecture:

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	Deaf and dumb people willing to communicate efficiently, without any hassle with others in their surrounding environment	AI techniques
2.	Flask UI	The components of Flask's User Interface allow one to interact with clients that make use of your application and gather information.	Can be executed using existing cloud technologies
3.	Image Dataset	The initial prototype of this application is trained on a subset of the dataset containing 20 different signs adhering to the American Sign Language	AI techniques
4.	Image Preprocessing	The images in the dataset are preprocessed to increase the sharpness / clarity and remove any noise	ANN, CNN, OpenCV
5.	Training	SVM is run on the training dataset to extract attributes from the images	Scikit-learn, Natural Language Processing (NLP)

		which are then fed to the Neural Network in order to make the prediction	
6.	Testing	The trained model is then run on an additional untested 10-15 sign-language images and the performance parameters are evaluated and recorded	Scikit-learn, NLP
7.	Neural Network	The same neural network architecture is used for both top-view and bottom-view models; the only difference lies in the number of output units	ANN
8.	Evaluation	Records the generalization accuracy of the proposed model on future / unseen data	
9.	Model	ML algorithms like SVM (Support Vector Machine) are applied to classify the given image dataset	Machine Learning
10.	Prediction	The attributes extracted from the images are examined and predictions are made in order to convert the sign-language to the corresponding text	ANN, CNN

**Table-2: Application Characteristics:**

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Robots and various other AI tools have made it possible for people with disabilities to live comfortably	AI techniques like self-moving robots and other software systems
2.	Security Implementations	Users are authenticated based on their username/password pair and/or OTP sent to their given mobile numbers	SHA-1, Encryptions, IAM Controls

3.	Scalable Architecture	We implement a modular 3-tier client-server application architecture that improves scalability, availability, and performance. Individual tiers are containerized	Presentation layer, Application layer and Data Layer modularity, Docker
4.	Availability	The application has an extremely low downtime and load balancers forward request to other available machines in case of failures	Key performance indicators (KPI)
5.	Performance	The application performs efficiently under a heavy load of translation requests without any significant reduction in the conversion accuracy	Number of requests per minute, accuracy of translation (sign-language to speech & text to sign-language)

## 5.3 User Stories:

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.

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	<p>Give access to camera to recognize the gestures</p> <p>Give access to microphone to give our message through voice</p>	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



## 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.

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	Akshaya , Priya dharshini
Sprint-2		USN-2	As a user, I will receive confirmation email once I have registered	1	High	Abirami , Sushmitha

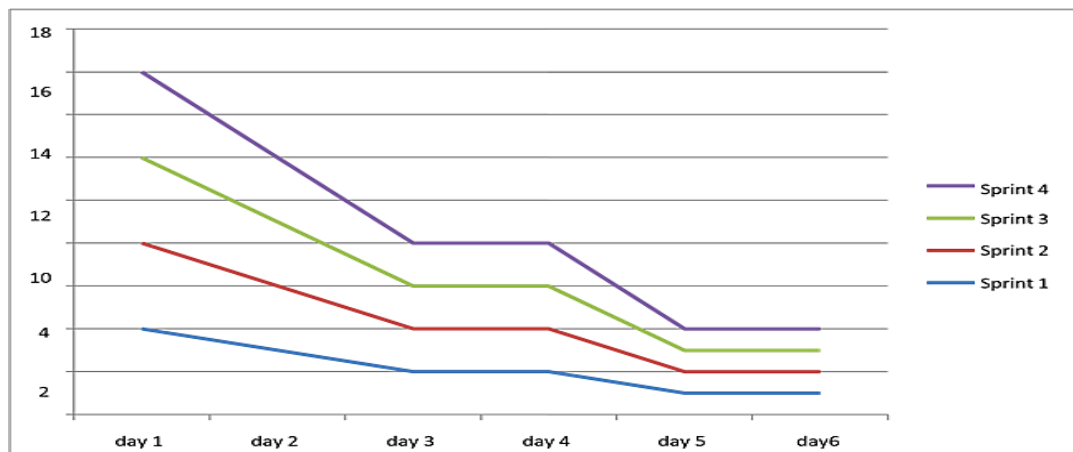
			for the application			
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password	1	Medium	akshaya, sushmitha
Sprint-2	Dashboard	USN-4	As a user, I can log into my account in a given Dashboard	1	High	Akshaya Abirami Priya dharshini Sushmitha
Sprint-1	User interface	USN-5	Professional responsible for user requirements & needs	1	High	Akshaya Abirami Sushmitha Priya dharshini
Sprint-3	Objective	USN-6	The goal is to describe all the inputs and outputs	1	High	Sushmitha Akshaya
Sprint-4	Privacy	USN-7	The developed application should be secure for the users	1	High	Priya dharshini Abirami

## 6.2 Sprint Delivery Schedule

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

## 6.3 Burndown Chart

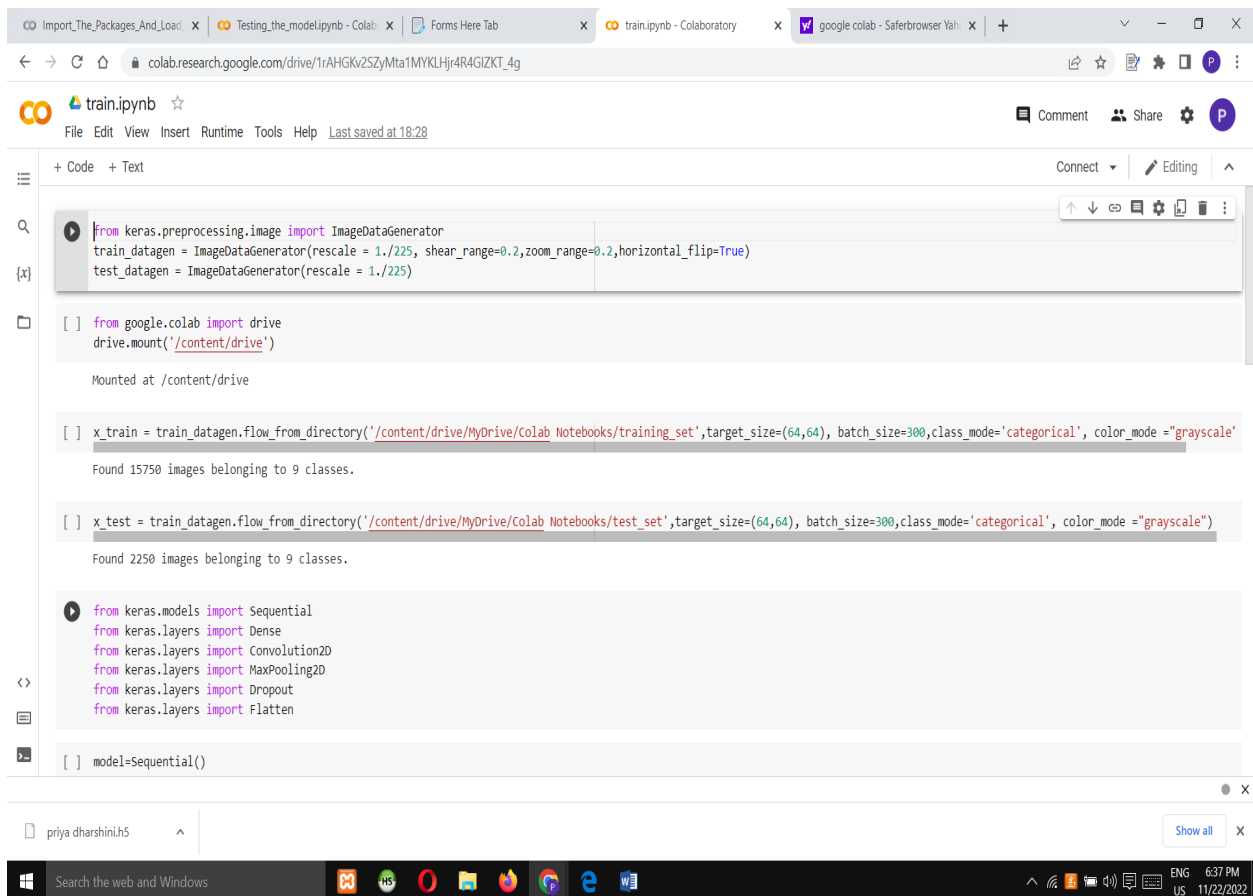
A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



## 7. CODING & SOLUTIONING

In order to design website that converts sign language into English alphabets we need to develop the website. For developing the website, primarily we need a platform that is useful 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.

### 7.1 Feature 1:



The screenshot displays a Google Colab notebook interface. The browser tabs at the top include 'Import\_The\_Packages\_And\_Load...', 'Testing\_the\_model.ipynb - Colab', 'Forms Here Tab', 'train.ipynb - Colaboratory', and 'google colab - Safetbrowser Yah...'. The address bar shows the Colab URL. The notebook's title bar is 'train.ipynb' with a star icon. The menu bar includes 'File', 'Edit', 'View', 'Insert', 'Runtime', 'Tools', 'Help', and 'Last saved at 18:28'. On the right, there are buttons for 'Comment', 'Share', and a settings gear. The main code area has a toolbar with icons for undo, redo, insert code, insert text, and a search icon. The code is as follows:

```
+ Code + Text
from keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator(rescale = 1./225, shear_range=0.2, zoom_range=0.2, horizontal_flip=True)
test_datagen = ImageDataGenerator(rescale = 1./225)

[ ] from google.colab import drive
drive.mount('/content/drive')

Mounted at /content/drive

[ ] x_train = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/training_set', target_size=(64,64), batch_size=300, class_mode='categorical', color_mode="grayscale")
Found 15750 images belonging to 9 classes.

[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/test_set', target_size=(64,64), batch_size=300, class_mode='categorical', color_mode="grayscale")
Found 2250 images belonging to 9 classes.

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()
```

The bottom of the notebook shows the user's name 'priya dharshinih5' and a 'Show all' button. The Windows taskbar at the very bottom shows the search bar and various application icons, with the system clock indicating 6:37 PM on 11/22/2022.

CO Import\_The\_Packages\_And\_Load x Testing\_the\_model.ipynb - Colab Forms Here Tab train.ipynb - Colaboratory google colab - Saferbrowser Yah

colab.research.google.com/drive/1rAHGKv2SZyMta1MYKLHjr4R4GIZKT\_4g

train.ipynb

File Edit View Insert Runtime Tools Help Last saved at 18:28

+ Code + Text

Connect Editing

```
[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/test_set',target_size=(64,64), batch_size=300,class_mode='categorical', color_mode="grayscale")

Found 2250 images belonging to 9 classes.

[ ] 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), input_shape=(64,64,1), activation = 'relu'))

[ ] model.add(MaxPooling2D(pool_size=(2,2)))

[ ] model.add(Flatten())

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

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

priya dharshini.h5

Show all

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CO Import\_The\_Packages\_And\_Load x Testing\_the\_model.ipynb - Colab Forms Here Tab train.ipynb - Colaboratory google colab - Saferbrowser Yah

colab.research.google.com/drive/1rAHGKv2SZyMta1MYKLHjr4R4GIZKT\_4g

train.ipynb

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```
[ ] model.fit_generator(generator=train_generator, steps_per_epoch=20, epochs=10, validation_data=(x_test, validation_steps=40))

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: 'Model.fit_generator' is deprecated and will be removed in a future version. Please use 'Model.fit', which
    """Entry point for launching an IPython kernel.

Epoch 1/10
24/24 [=====] - ETA: 0s - loss: 1.2858 - accuracy: 0.6470 WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or
24/24 [=====] - 3100s 130s/step - loss: 1.2858 - accuracy: 0.6470 - val_loss: 0.4954 - val_accuracy: 0.8693
Epoch 2/10
24/24 [=====] - 1177s 49s/step - loss: 0.2674 - accuracy: 0.9240
Epoch 3/10
24/24 [=====] - 618s 26s/step - loss: 0.1465 - accuracy: 0.9627
Epoch 4/10
24/24 [=====] - 349s 14s/step - loss: 0.0960 - accuracy: 0.9753
Epoch 5/10
24/24 [=====] - 193s 8s/step - loss: 0.0624 - accuracy: 0.9847
Epoch 6/10
24/24 [=====] - 101s 4s/step - loss: 0.0421 - accuracy: 0.9904
Epoch 7/10
24/24 [=====] - 65s 3s/step - loss: 0.0354 - accuracy: 0.9908
Epoch 8/10
24/24 [=====] - 48s 2s/step - loss: 0.0238 - accuracy: 0.9956
Epoch 9/10
24/24 [=====] - 40s 2s/step - loss: 0.0256 - accuracy: 0.9939
Epoch 10/10
24/24 [=====] - 40s 2s/step - loss: 0.0192 - accuracy: 0.9964
<keras.callbacks.History at 0x7f4c82eac9d0>

[ ] model.save('Priyadharshini.h5')
```

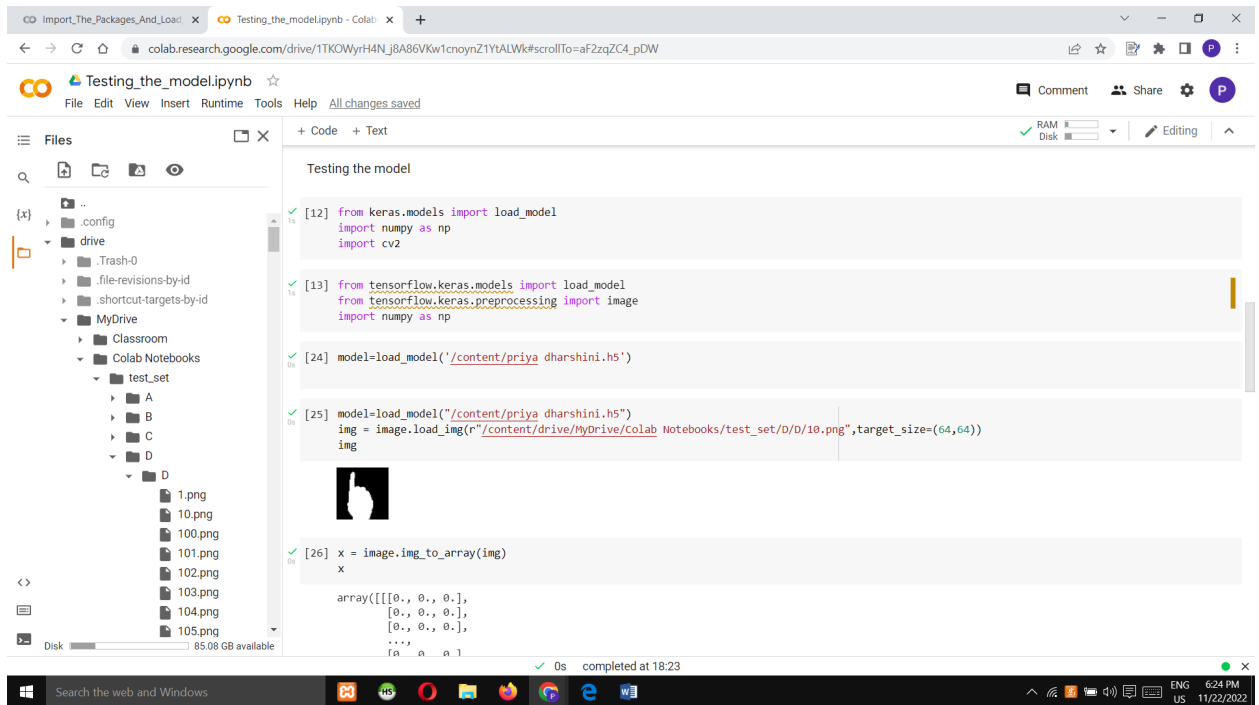
priya dharshini.h5

Show all

Search the web and Windows

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## 7.2 Feature 2:



This screenshot shows the first part of a Colab notebook. The file explorer on the left shows a directory structure with a 'test\_set' folder containing images 1.png through 105.png. The code cell [12] imports 'load\_model' from 'keras.models', 'numpy' as 'np', and 'cv2'. Cell [13] imports 'load\_model' from 'tensorflow.keras.models', 'image' from 'tensorflow.keras.preprocessing', and 'numpy' as 'np'. Cell [24] loads the model from a local file path. Cell [25] loads an image from a local path and displays it as a thumbs-up icon. Cell [26] converts the image to an array and prints its shape, which is (64, 64, 3).

```
[12] from keras.models import load_model
import numpy as np
import cv2

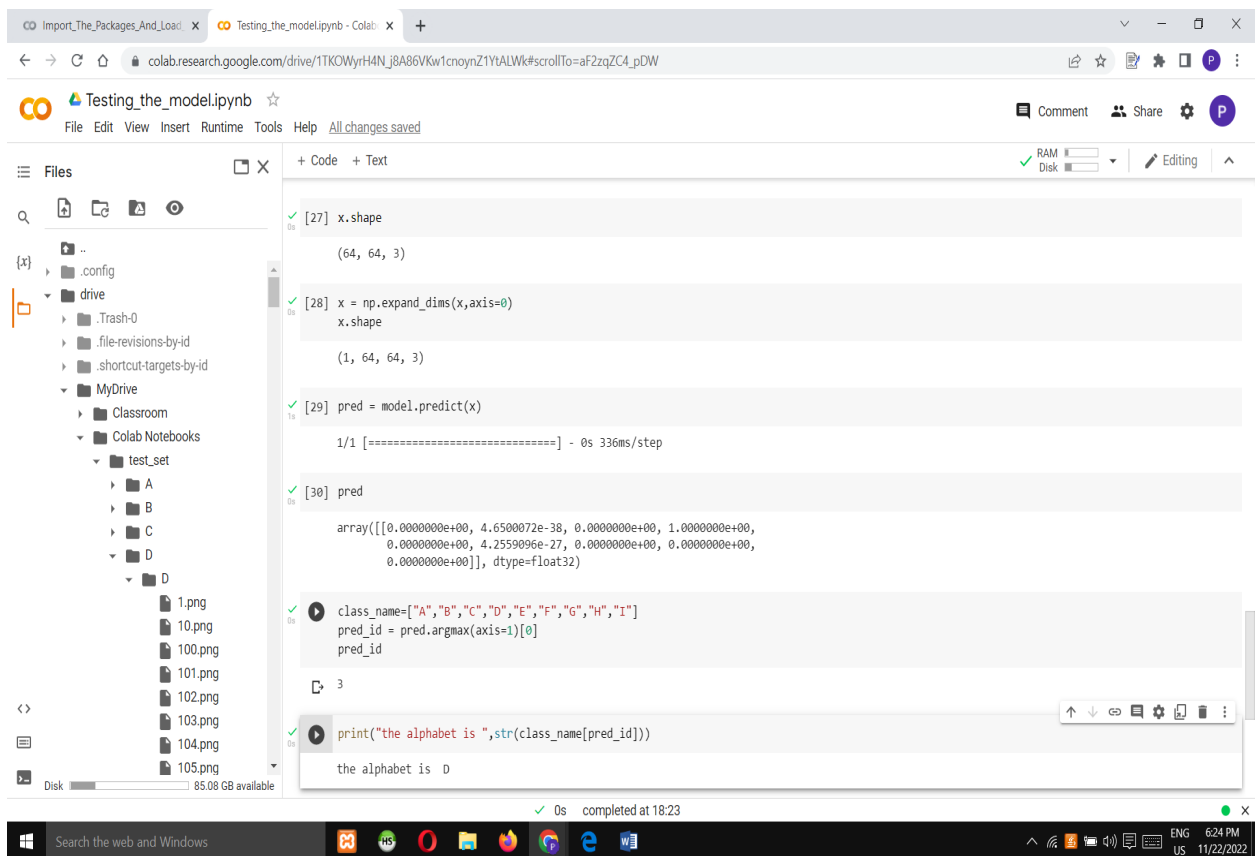
[13] from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import numpy as np

[24] model=load_model('/content/priya_dharshini.h5')

[25] model=load_model("/content/priya_dharshini.h5")
img = image.load_img(r"/content/drive/MyDrive/Colab Notebooks/test_set/D/10.png",target_size=(64,64))
img

[26] x = image.img_to_array(img)
x

array([[ [0., 0., 0.],
         [0., 0., 0.],
         [0., 0., 0.],
         ...,
         [0., 0., 0.] ]])
```



This screenshot shows the second part of the Colab notebook. Cell [27] prints the shape of 'x', which is (64, 64, 3). Cell [28] expands the dimensions of 'x' and prints the new shape, which is (1, 64, 64, 3). Cell [29] uses the model to predict the class of 'x' and prints the result, which is 1. Cell [30] prints the predicted class name, which is 'D'. Cell [31] prints the final result, which is 'the alphabet is D'.

```
[27] x.shape

(64, 64, 3)

[28] x = np.expand_dims(x,axis=0)
x.shape

(1, 64, 64, 3)

[29] pred = model.predict(x)

1/1 [=====] - 0s 336ms/step

[30] pred

array([[0.000000e+00, 4.650072e-38, 0.000000e+00, 1.000000e+00,
        0.000000e+00, 4.255909e-27, 0.000000e+00, 0.000000e+00,
        0.000000e+00]], dtype=float32)

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

3

[32] print("the alphabet is ",str(class_name[pred_id]))

the alphabet is D
```

## 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 design's quality and its performance.

## 8.1 Testcases

A test case is nothing but a series of steps 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.

						Date	17 Aug 21						
						Page ID	PMP-2021-0000119						
						Project Name	Project for new communication system powered by AI for sustainable global development						
						Version/Builds	version						
Test case ID	Feature Type	Component	Test Scenario	Pre-Condition	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	Pass/Fail	Executed By
LspcPage_TC_001	Functional	Home Page	Verify user can click to see the homepage	Mainly Firefox browser	Click URL, browser and click go	<a href="#">http://127.0.0.1:5000</a>	Homepage is visible displayed	Working as expected	Pass	Steps are clear to follow	No	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra
LspcPage_TC_002	UI	HomePage	Verify the title/content in homepage	Mainly Firefox browser	1. Click URL, browser and click go 2. Verify homepage with given elements - references,careers access & login/register button is present	<a href="#">http://127.0.0.1:5000</a>	App name should show below it & contents reference careers access & login/register button is present	Working as expected	Pass	Steps are clear to follow	No	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra
LspcPage_TC_003	UI	Home page	Verify whether all home page is working	Mainly Firefox browser	1. Click URL <a href="#">http://127.0.0.1:5000</a> and click go 2. Click on reference button	<a href="#">http://127.0.0.1:5000</a>	User should navigate to reference page where all related image is displayed	working as expected	Pass	Steps are clear to follow	Yes	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra
LspcPage_TC_004	Functional	Home Page	Verify Careers access	Mainly Firefox Browser with Chrome	1. Click URL <a href="#">http://127.0.0.1:5000</a> and click go 2. Click on view careers access	view careers access	Careers access is allowed and page is displayed	working as expected	Pass	Steps are clear to follow	Yes	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra
LspcPage_TC_004	Functional	Home Page	Gender detection	Visual studio Code	1. Click URL <a href="#">http://127.0.0.1:5000</a> and click go 2. Click careers access 3. Image displayed 4. Detection of gender occurs	Detection of genders	First genders result value detected and page load	working as expected	Pass	Steps are clear to follow	Yes	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra
LspcPage_TC_005	Functional	Home page	Output prediction	Online code editor	1. Click URL <a href="#">http://127.0.0.1:5000</a> and click go 2. Click careers access 3. Image displayed 4. Prediction of gender occurs 5. Output prediction	Predicted genders	First genders are detected and predicted All predictions are displayed	working as expected	Pass	Tested and output is correct	Yes	NA	Soumitra A Jaiswal Nikhil Chandra Mishra Ajay Kumar Mishra

## 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		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

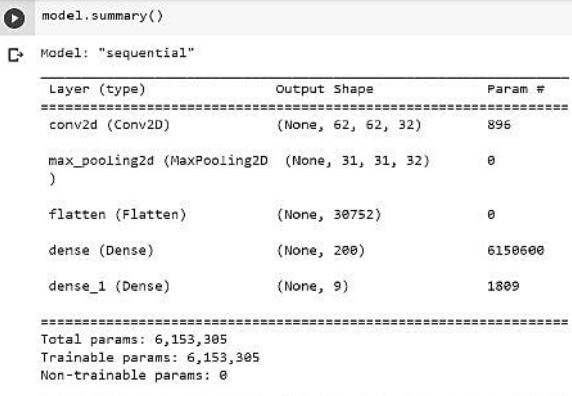
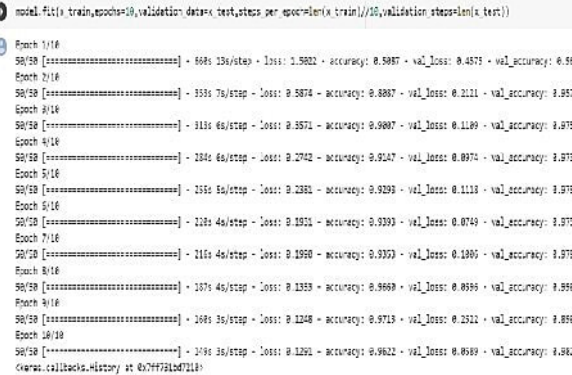
## 9. RESULT

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 interfacefor 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 languagethat 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)	 <pre> model.summary()  Model: "sequential" Layer (type)                Output Shape                Param # ----- conv2d (Conv2D)              (None, 62, 62, 32)         896 max_pooling2d (MaxPooling2D) (None, 31, 31, 32)         0 flatten (Flatten)             (None, 30752)              0 dense (Dense)                 (None, 200)                6150600 dense_1 (Dense)               (None, 9)                  1809 Total params: 6,153,305 Trainable params: 6,153,305 Non-trainable params: 0 </pre>
2.	Accuracy	Training Accuracy - 0.9622  Validation Accuracy -0.9826	 <pre> 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 [=====] - loss: 1.5802 - accuracy: 0.5987 - val_loss: 0.4573 - val_accuracy: 0.5652 Epoch 2/10 50/50 [=====] - loss: 0.5874 - accuracy: 0.8867 - val_loss: 0.2111 - val_accuracy: 0.8573 Epoch 3/10 50/50 [=====] - loss: 0.3571 - accuracy: 0.9087 - val_loss: 0.1189 - val_accuracy: 0.8758 Epoch 4/10 50/50 [=====] - loss: 0.2742 - accuracy: 0.9247 - val_loss: 0.0974 - val_accuracy: 0.8798 Epoch 5/10 50/50 [=====] - loss: 0.2381 - accuracy: 0.9289 - val_loss: 0.1133 - val_accuracy: 0.8758 Epoch 6/10 50/50 [=====] - loss: 0.1921 - accuracy: 0.9393 - val_loss: 0.0749 - val_accuracy: 0.8758 Epoch 7/10 50/50 [=====] - loss: 0.1990 - accuracy: 0.9353 - val_loss: 0.1005 - val_accuracy: 0.8797 Epoch 8/10 50/50 [=====] - loss: 0.1353 - accuracy: 0.9669 - val_loss: 0.0599 - val_accuracy: 0.8993 Epoch 9/10 50/50 [=====] - loss: 0.1248 - accuracy: 0.9713 - val_loss: 0.2321 - val_accuracy: 0.8998 Epoch 10/10 50/50 [=====] - loss: 0.1261 - accuracy: 0.9622 - val_loss: 0.0589 - val_accuracy: 0.9826 Overfit: callback.history at 0:707316d7118 </pre>
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:**

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

### **Disadvantages:**

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

## **11. CONCLUSION**

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

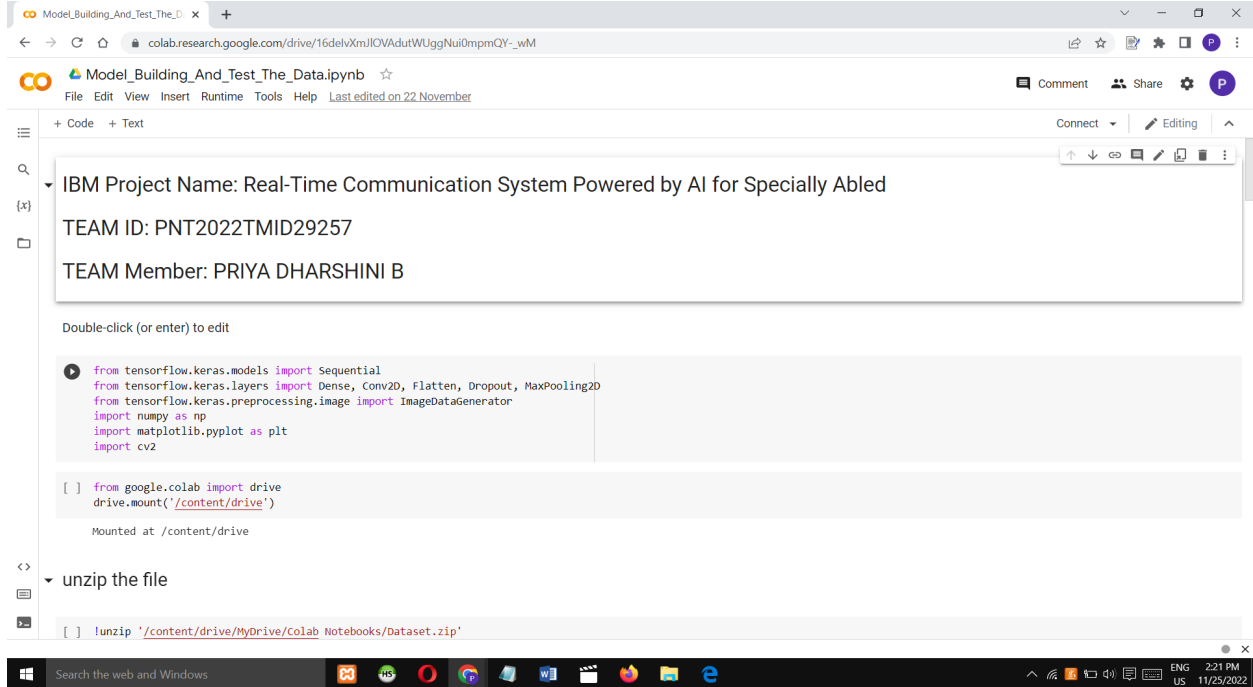
## **12. FUTURESCOPE**

Having a technology that can translate hand sign languageto its corresponding alphabet is a game changerin the field of communication and AI for the speciallyabledpeople such as deafand dumb. With introduction of gesture recognition, the web app can easilybe expanded to recognizeletters beyond 'I', digits and other symbolsplus 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 changeswith respect to the temporalspace. We can alsodevelop a complete productthat will help the speech and hearing-impaired people, and thereby reduce the communication gap.

# 11. APPENDIX

## Source Code for Model Training and Saving:

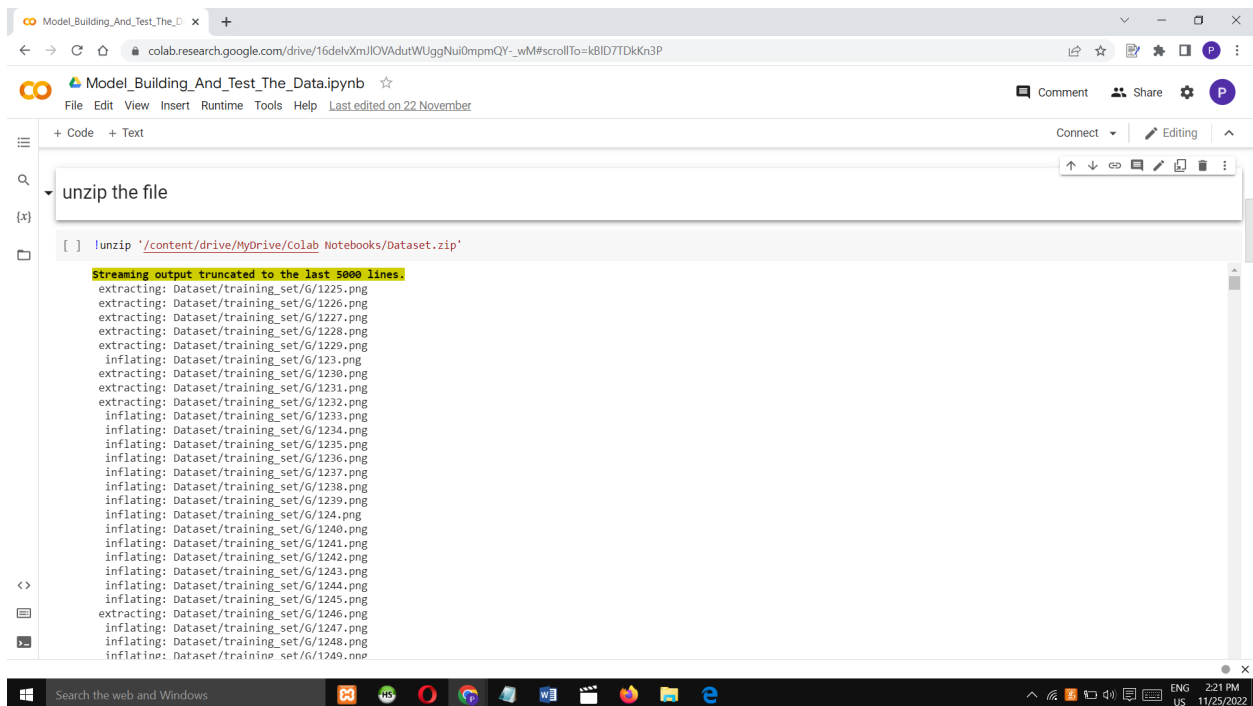


```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Conv2D, Flatten, Dropout, MaxPooling2D
from tensorflow.keras.preprocessing.image import ImageDataGenerator
import numpy as np
import matplotlib.pyplot as plt
import cv2

[ ] from google.colab import drive
drive.mount('/content/drive')

Mounted at /content/drive

!unzip '/content/drive/MyDrive/Colab Notebooks/Dataset.zip'
```



```
!unzip '/content/drive/MyDrive/Colab Notebooks/Dataset.zip'

Streaming output truncated to the last 5000 lines.
extracting: Dataset/training_set/g/1225.png
extracting: Dataset/training_set/g/1226.png
extracting: Dataset/training_set/g/1227.png
extracting: Dataset/training_set/g/1228.png
extracting: Dataset/training_set/g/1229.png
inflating: Dataset/training_set/g/123.png
extracting: Dataset/training_set/g/1230.png
extracting: Dataset/training_set/g/1231.png
extracting: Dataset/training_set/g/1232.png
inflating: Dataset/training_set/g/1233.png
inflating: Dataset/training_set/g/1234.png
inflating: Dataset/training_set/g/1235.png
inflating: Dataset/training_set/g/1236.png
inflating: Dataset/training_set/g/1237.png
inflating: Dataset/training_set/g/1238.png
inflating: Dataset/training_set/g/1239.png
inflating: Dataset/training_set/g/124.png
inflating: Dataset/training_set/g/1240.png
inflating: Dataset/training_set/g/1241.png
inflating: Dataset/training_set/g/1242.png
inflating: Dataset/training_set/g/1243.png
inflating: Dataset/training_set/g/1244.png
inflating: Dataset/training_set/g/1245.png
extracting: Dataset/training_set/g/1246.png
inflating: Dataset/training_set/g/1247.png
inflating: Dataset/training_set/g/1248.png
inflating: Dataset/training_set/g/1249.png
```

Model\_Building\_And\_Test\_The\_Data.ipynb

colab.research.google.com/drive/16dehXmJIOVAdutWUggNui0mpmQY\_-wM#scrollTo=kBID7TDkKn3P

Model\_Building\_And\_Test\_The\_Data.ipynb

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```
[ ] inflating: Dataset/training_set/6/1274.png
inflating: Dataset/training_set/6/1275.png
inflating: Dataset/training_set/6/1276.png
```

### DATA AUGMENTATION

```
[ ] from keras.preprocessing.image import ImageDataGenerator
train_datagen=ImageDataGenerator(rescale = 1./255, shear_range=0.2, zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
test_datagen = ImageDataGenerator(rescale=1./255)

[ ] x_train = train_datagen.flow_from_directory("/content/Dataset/training_set", target_size=(64,64),batch_size=100,
class_mode='categorical', color_mode ="grayscale")

Found 15750 images belonging to 9 classes.

[ ] x_test = test_datagen.flow_from_directory("/content/Dataset/test_set", target_size=(64,64),batch_size=100,
class_mode='categorical', color_mode ="grayscale")

Found 2250 images belonging to 9 classes.

[ ] len(x_train)

158

[ ] len(x_test)

23
```

Search the web and Windows

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Model\_Building\_And\_Test\_The\_Data.ipynb

colab.research.google.com/drive/16dehXmJIOVAdutWUggNui0mpmQY\_-wM#scrollTo=kBID7TDkKn3P

Model\_Building\_And\_Test\_The\_Data.ipynb

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### MODEL BUILDING

```
[ ] from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Convolution2D
from tensorflow.keras.layers import Conv2D, MaxPooling2D
from keras.layers import Dropout
from keras.layers import Flatten

[ ] #Creating the model
model=Sequential()
#Adding the layers
model.add(Convolution2D(32,(3,3), input_shape=(64,64,1), activation = 'relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())

#adding hidden layers
model.add(Dense(400, activation='relu'))
model.add(Dense(200, activation='relu'))
model.add(Dense(100, activation='relu'))

#Adding the output layer
model.add(Dense(9, activation='softmax'))

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

NameError
<ipython-input-1-609c21115e8e> in <module>
```

Search the web and Windows

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Model\_Building\_And\_Test\_The\_Data.ipynb

```
[ ] model.fit_generator(x_train, steps_per_epoch=30, epochs=10, validation_data=x_test, validation_steps=50)
```

/usr/local/lib/python3.7/dist-packages/ipykernel\_launcher.py:1: UserWarning: `Model.fit\_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which  
Entry point for launching an IPython kernel.

Epoch 1/10  
30/30 [=====] - ETA: 0s - loss: 1.0169 - accuracy: 0.6463WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or g  
30/30 [=====] - 19s 615ms/step - loss: 1.0169 - accuracy: 0.6463 - val\_loss: 0.5061 - val\_accuracy: 0.8356  
Epoch 2/10  
30/30 [=====] - 13s 425ms/step - loss: 0.3044 - accuracy: 0.9057  
Epoch 3/10  
30/30 [=====] - 13s 429ms/step - loss: 0.1901 - accuracy: 0.9407  
Epoch 4/10  
30/30 [=====] - 13s 420ms/step - loss: 0.1213 - accuracy: 0.9633  
Epoch 5/10  
30/30 [=====] - 13s 422ms/step - loss: 0.0777 - accuracy: 0.9753  
Epoch 6/10  
30/30 [=====] - 13s 421ms/step - loss: 0.0641 - accuracy: 0.9800  
Epoch 7/10  
30/30 [=====] - 15s 496ms/step - loss: 0.0559 - accuracy: 0.9830  
Epoch 8/10  
30/30 [=====] - 13s 426ms/step - loss: 0.0442 - accuracy: 0.9857  
Epoch 9/10  
30/30 [=====] - 13s 425ms/step - loss: 0.0262 - accuracy: 0.9920  
Epoch 10/10  
30/30 [=====] - 14s 453ms/step - loss: 0.0311 - accuracy: 0.9895  
<keras.callbacks.History at 0x7fd5a473e590>

```
[ ] model.save('Real_time.h5')
```


TEST THE MODEL

Model\_Building\_And\_Test\_The\_Data.ipynb

```
[ ] from tensorflow.keras.models import load_model  
from tensorflow.keras.preprocessing import image  
import numpy as np  
import cv2
```

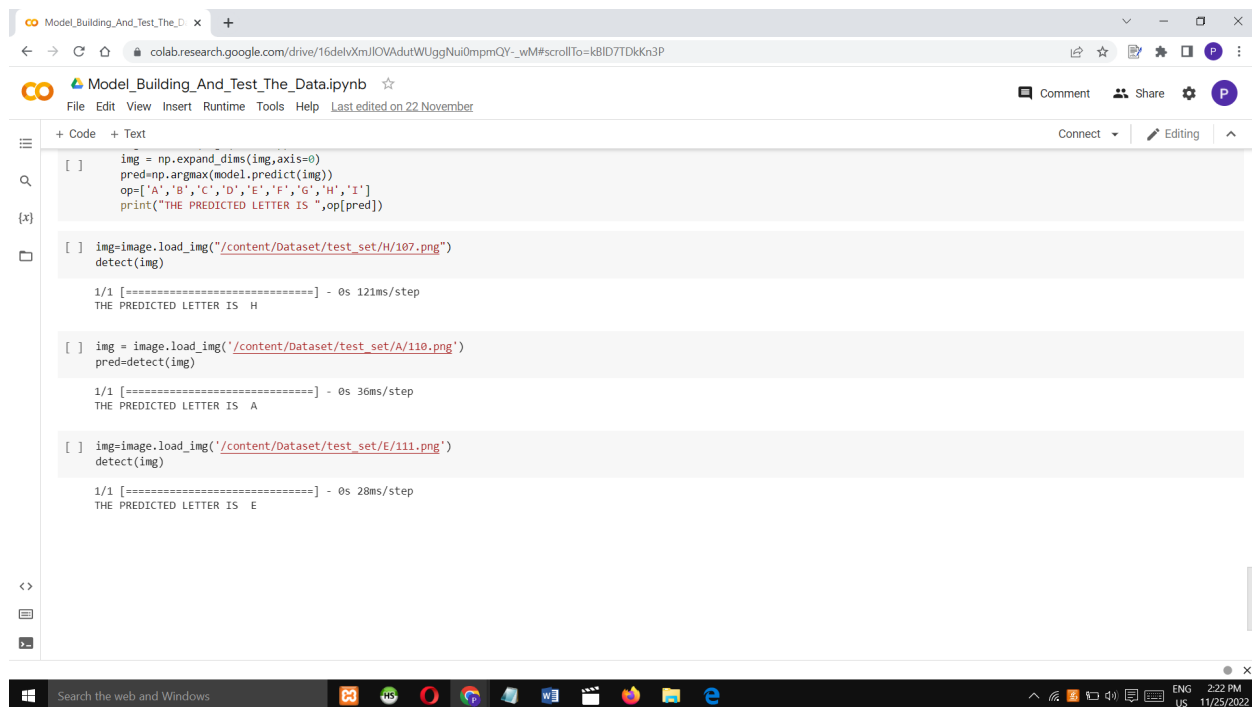
```
[ ] model = load_model('/content/Real_time.h5')
```

```
[ ] img = image.load_img('/content/Dataset/test_set/H/107.png', target_size = (100, 100))  
img
```



```
[ ] from skimage.transform import resize  
def detect(frame):  
    img = image.img_to_array(frame)  
    img = resize(img, (64, 64, 1))  
    img = np.expand_dims(img, axis=0)  
    pred = np.argmax(model.predict(img))  
    op = ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I']  
    print("THE PREDICTED LETTER IS ", op[pred])
```

```
[ ] img = image.load_img("/content/Dataset/test_set/H/107.png")
```



```
Model_Building_And_Test_The_Data.ipynb
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[ ] img = np.expand_dims(img,axis=0)
    pred=np.argmax(model.predict(img))
    ops=['A','B','C','D','E','F','G','H','I']
    print("THE PREDICTED LETTER IS ",ops[pred])

[ ] img=image.load_img('/content/Dataset/test_set/H/107.png')
    detect(img)

1/1 [=====] - 0s 121ms/step
THE PREDICTED LETTER IS  H

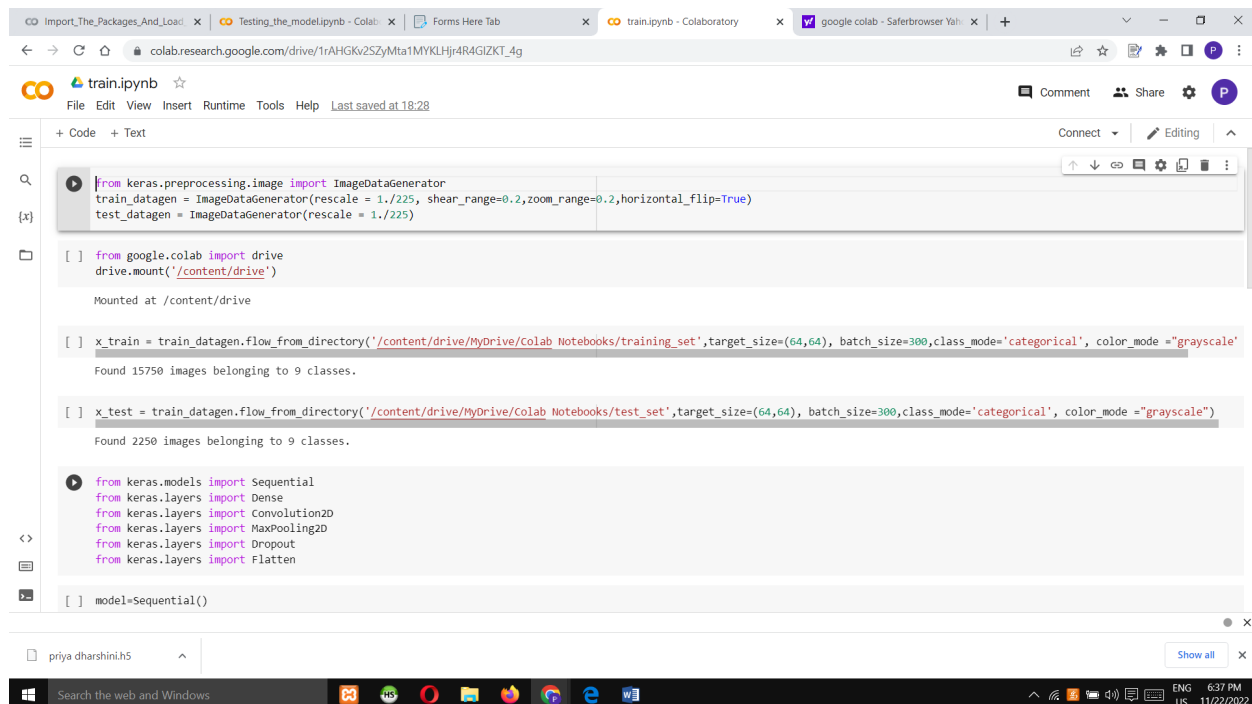
[ ] img = image.load_img('/content/Dataset/test_set/A/110.png')
    pred=detect(img)

1/1 [=====] - 0s 36ms/step
THE PREDICTED LETTER IS  A

[ ] img=image.load_img('/content/Dataset/test_set/E/111.png')
    detect(img)

1/1 [=====] - 0s 28ms/step
THE PREDICTED LETTER IS  E
```

## Training the model:



```
train.ipynb
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+ Code + Text
from keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator(rescale = 1./225, shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
test_datagen = ImageDataGenerator(rescale = 1./225)

[ ] from google.colab import drive
    drive.mount('/content/drive')

Mounted at /content/drive

[ ] x_train = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/training_set',target_size=(64,64), batch_size=300,class_mode='categorical', color_mode ="grayscale")
    Found 15750 images belonging to 9 classes.

[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/test_set',target_size=(64,64), batch_size=300,class_mode='categorical', color_mode ="grayscale")
    Found 2250 images belonging to 9 classes.

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()
```



Import\_The\_Packages\_And\_Load x Testing\_the\_model.ipynb - Colab x Forms Here Tab x train.ipynb - Colaboratory x google colab - Saferbrowser Yah x +

colab.research.google.com/drive/1rAHGKv2SZyMta1MYKLHjr4R4GIZKT\_4g

train.ipynb

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```
[ ] /usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which
    """Entry point for launching an IPython kernel.

Epoch 1/10
24/24 [=====] - ETA: 0s - loss: 1.2858 - accuracy: 0.6470 WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or
24/24 [=====] - 3100s 130s/step - loss: 1.2858 - accuracy: 0.6470 - val_loss: 0.4954 - val_accuracy: 0.8693
Epoch 2/10
24/24 [=====] - 1177s 49s/step - loss: 0.2674 - accuracy: 0.9240
Epoch 3/10
24/24 [=====] - 618s 26s/step - loss: 0.1465 - accuracy: 0.9627
Epoch 4/10
24/24 [=====] - 349s 14s/step - loss: 0.0960 - accuracy: 0.9753
Epoch 5/10
24/24 [=====] - 193s 8s/step - loss: 0.0624 - accuracy: 0.9847
Epoch 6/10
24/24 [=====] - 101s 4s/step - loss: 0.0421 - accuracy: 0.9904
Epoch 7/10
24/24 [=====] - 65s 3s/step - loss: 0.0354 - accuracy: 0.9908
Epoch 8/10
24/24 [=====] - 48s 2s/step - loss: 0.0238 - accuracy: 0.9956
Epoch 9/10
24/24 [=====] - 40s 2s/step - loss: 0.0256 - accuracy: 0.9939
Epoch 10/10
24/24 [=====] - 40s 2s/step - loss: 0.0192 - accuracy: 0.9964
<keras.callbacks.History at 0x7f4c82eac9d0>

model.save('Priyadarshini.h5')
```

priya dharshini.h5

Show all

Search the web and Windows

6:38 PM 11/22/2022

Import\_The\_Packages\_And\_Load x Testing\_the\_model.ipynb - Colab x Forms Here Tab x train.ipynb - Colaboratory x google colab - Saferbrowser Yah x +

colab.research.google.com/drive/1rAHGKv2SZyMta1MYKLHjr4R4GIZKT\_4g

train.ipynb

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Connect Editing

```
[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/test_set',target_size=(64,64), batch_size=300,class_mode='categorical', color_mode="grayscale")

Found 2250 images belonging to 9 classes.

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), input_shape=(64,64,1), activation = 'relu'))

[ ] model.add(MaxPooling2D(pool_size=(2,2)))

[ ] model.add(Flatten())

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

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

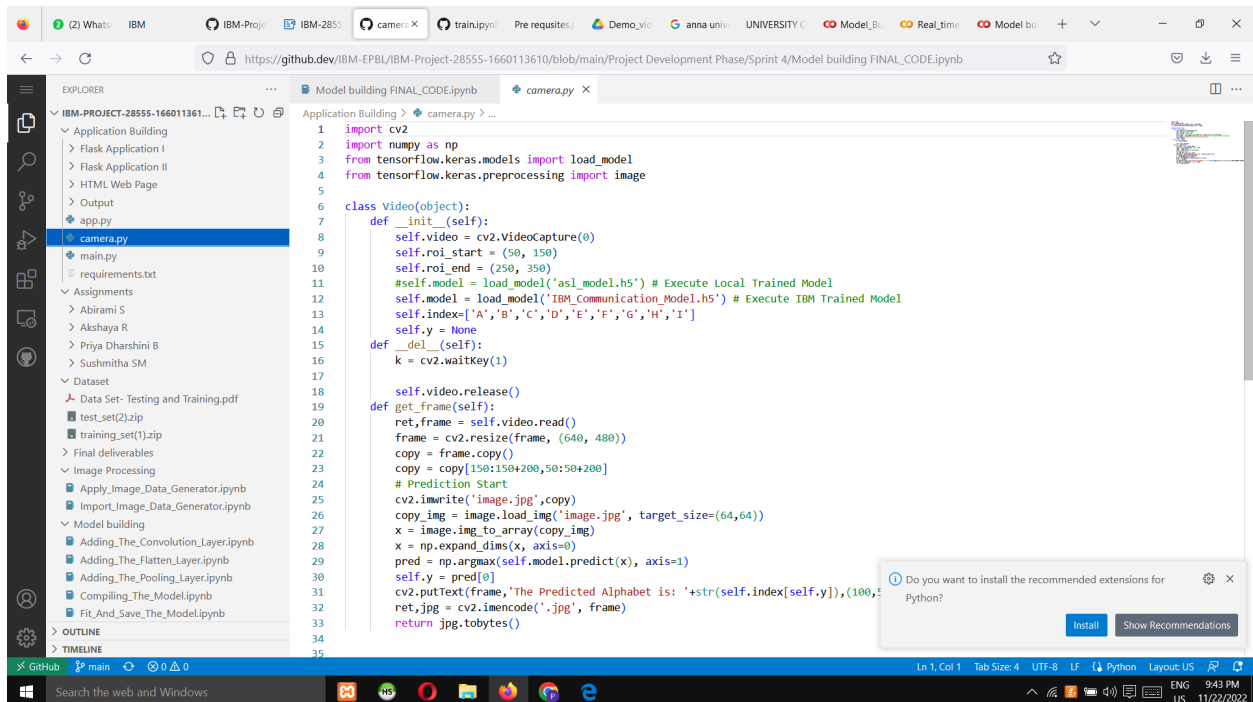
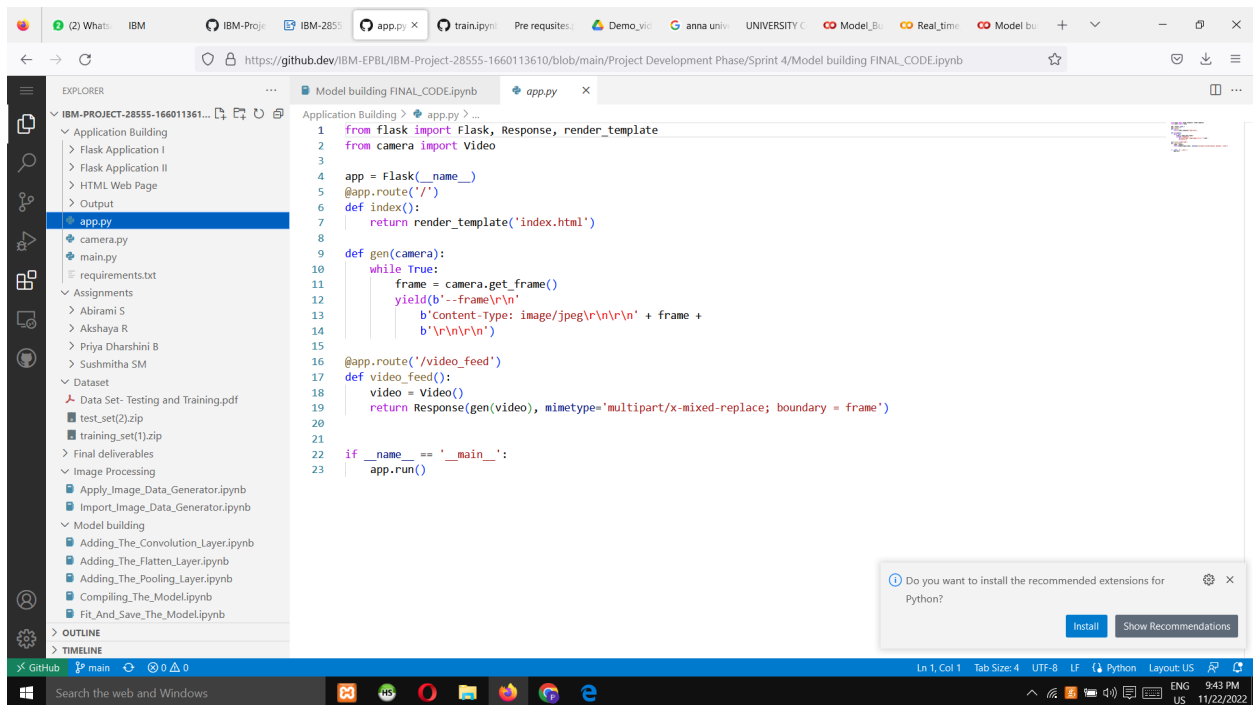
priya dharshini.h5

Show all

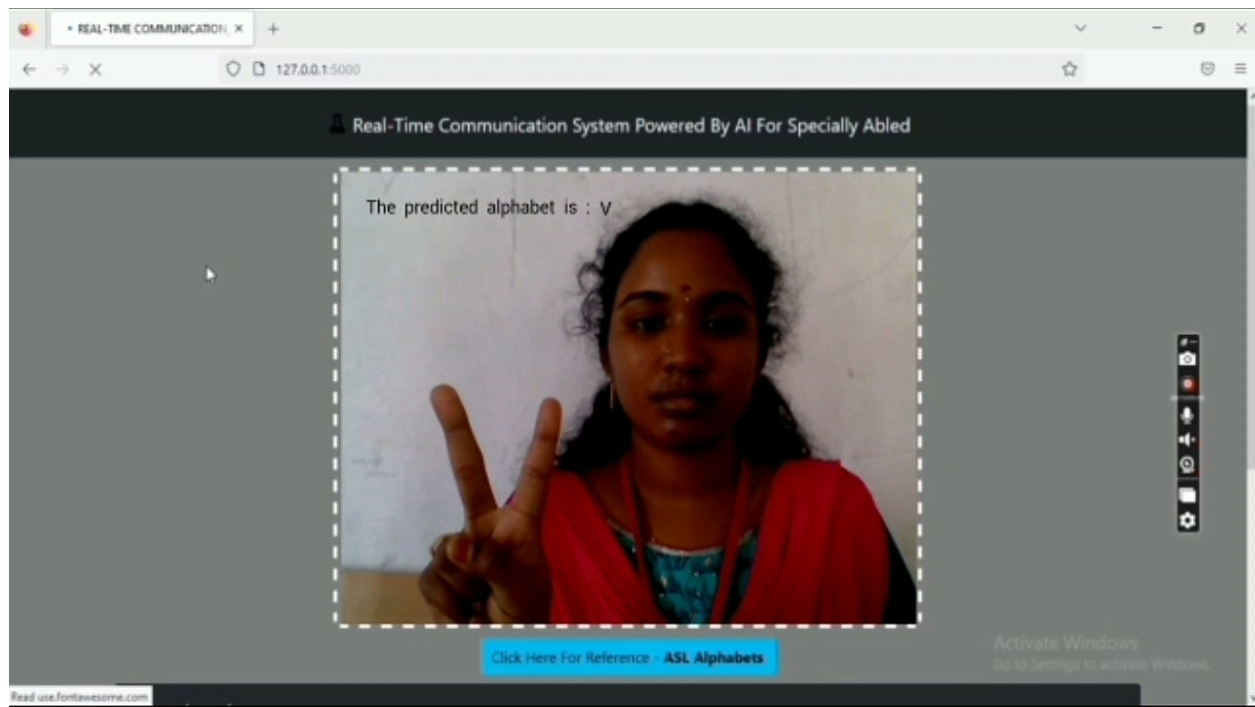
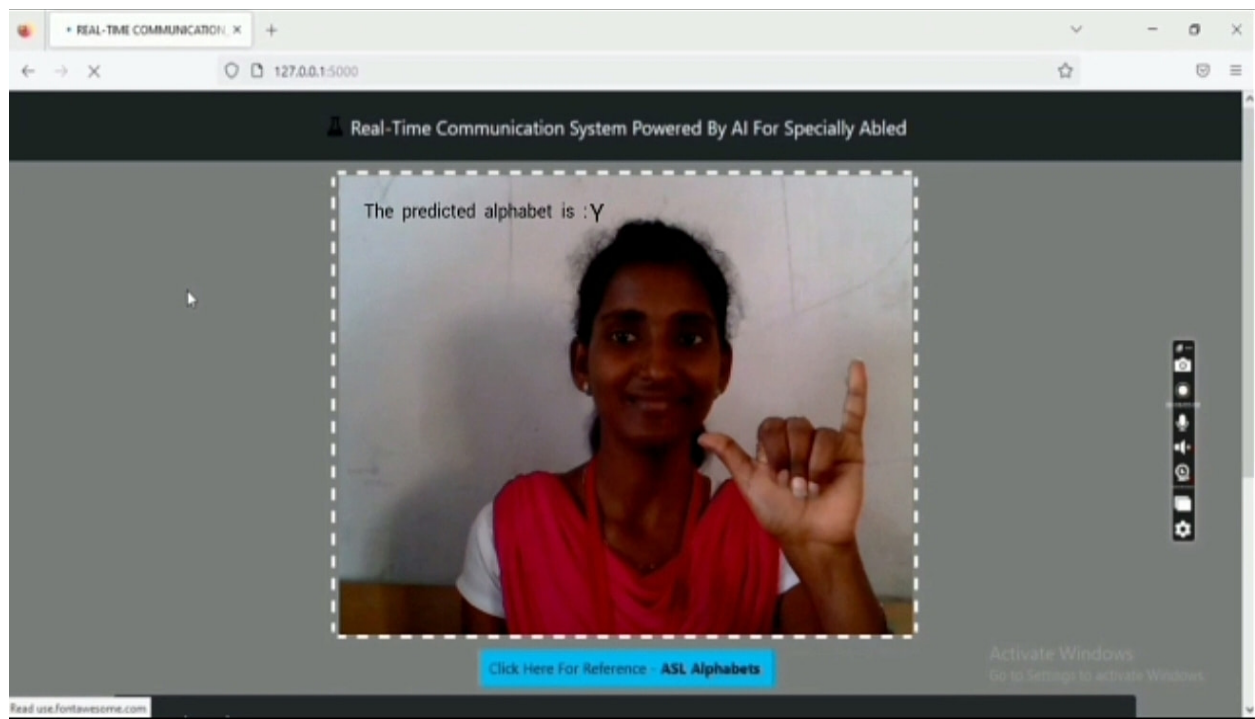
Search the web and Windows

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# web app:



## Output:





## Source code

### github link:

<https://github.com/IBM-EPBL/IBM-Project-28555-1660113610>

### Demo link:

[https://drive.google.com/file/d/1nqcXSNYeaLmnYvWW\\_vcWHxZ1jyE-s79m/view?usp=share\\_link](https://drive.google.com/file/d/1nqcXSNYeaLmnYvWW_vcWHxZ1jyE-s79m/view?usp=share_link)