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

Submitted By

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Dr.P.Arjun	Dr.K.Kavitha	Mrs.M.PheminaSelvi

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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 i f we overlook those who are denied this priceless gift: the deaf and dumb. The t echnology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf m ute 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 l ike speech cannot be used.

1.2 Purpose

This project enables a deaf and dumb people to convey their information you sing 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 writtenand spoken messages. The device is centered on knowledge base of the grammatical rules and messageelements. A beliefreasoning scheme based on both the information from external sourcesand the embedded knowledge issuedto optimize the process of message search.

2.1 Existing problem

Some of the existing solutions for solving this problem are:
Communications between deaf-muteand a normal person has always been a challenging task.It is very difficultfor mute peopleto 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 personcan type out what they want to say and a personwho is blind orhas low vision can use a screen readerto read the text out loud. A blind personcan alsouse voicerecognition software to convert what they are saying in to text so that a person who

is Deaf can then read it.

Interpreter:

If a signlanguage interpreter is available, thisfacilitates easy communication if the person who is deaf is fluent in sign language. The deaf person and personwho is blindcan communicate with each other via the interpreter. The deaf personcan use sign language and the interpreter can speak what has been said to the personwho is blind and then translate anything spoken by the blindperson 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 peopleand 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:

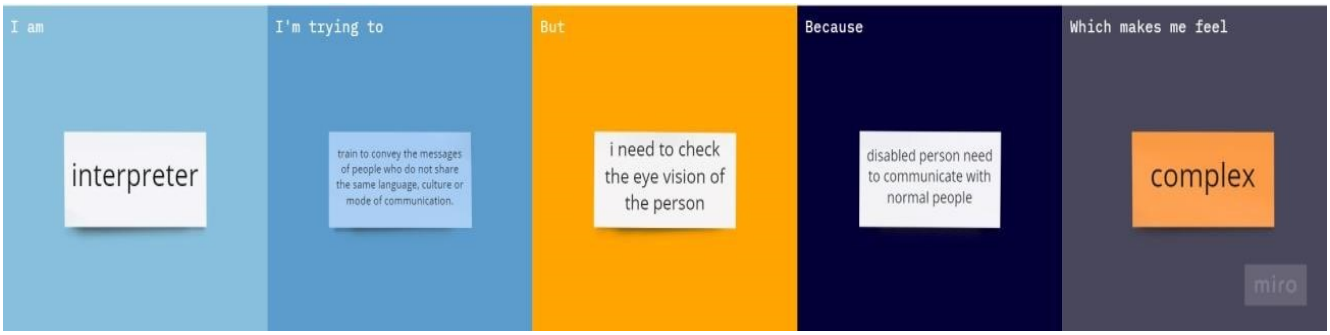
Communication plays a significant role in making the world a better place. Most people communicate efficiently without any issues, but many cannot due to disability. They cannot hear or speak, which makes Earth a problematic place to live for them. Even simple basic

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

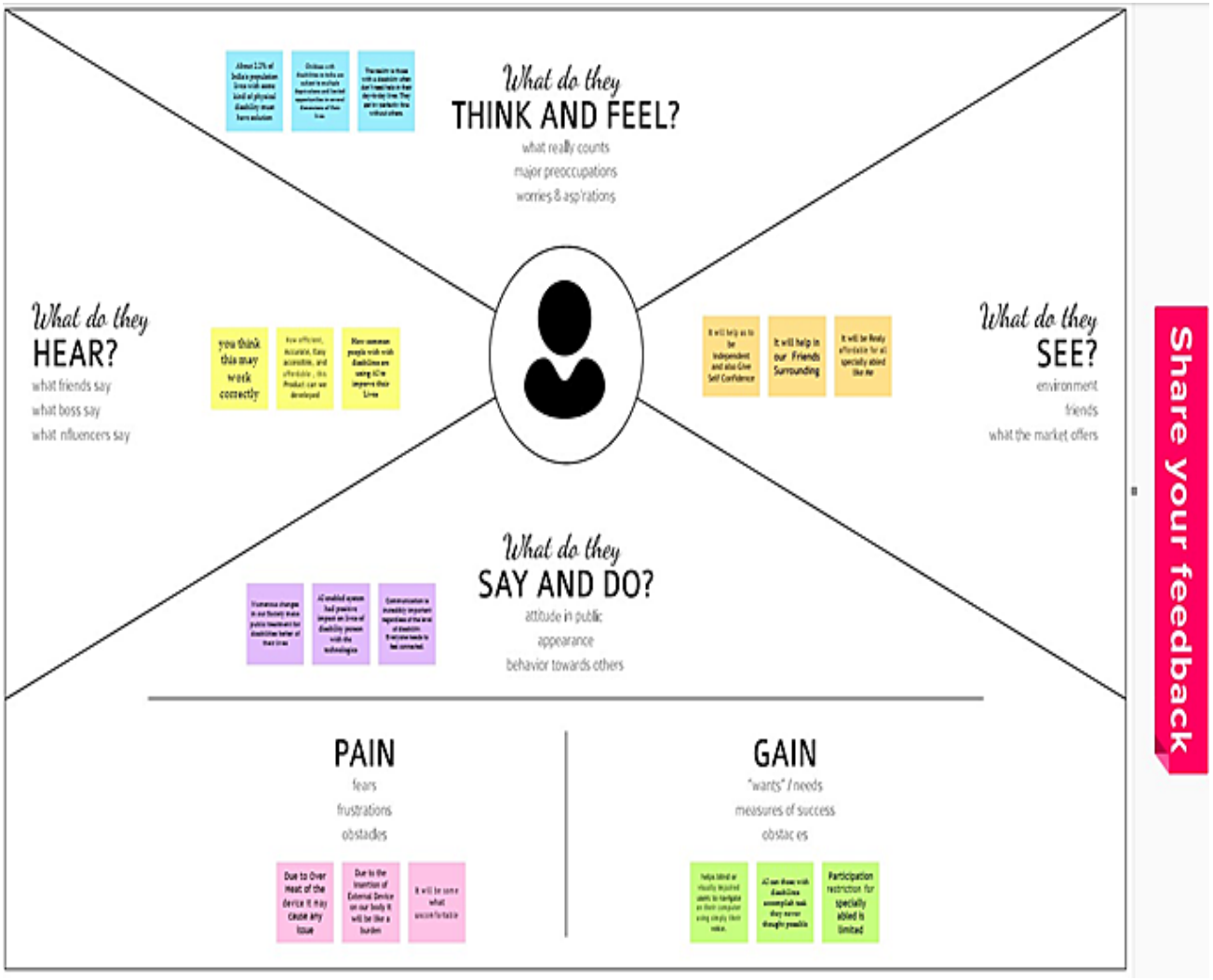


Problem Statement II

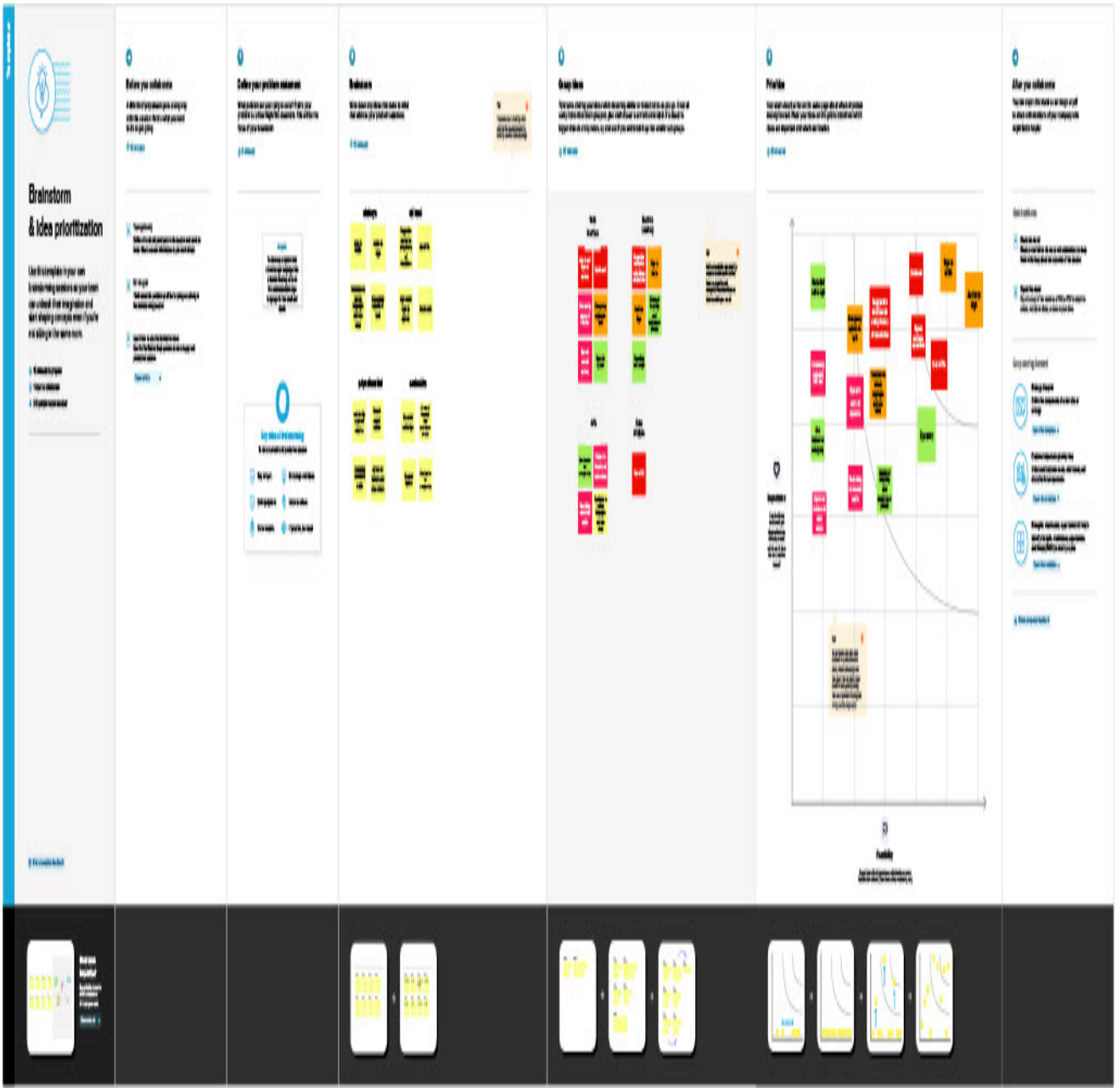
3. IDEATION & PROPOSED SYSTEM

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



3.2 Ideation&Brainstorming



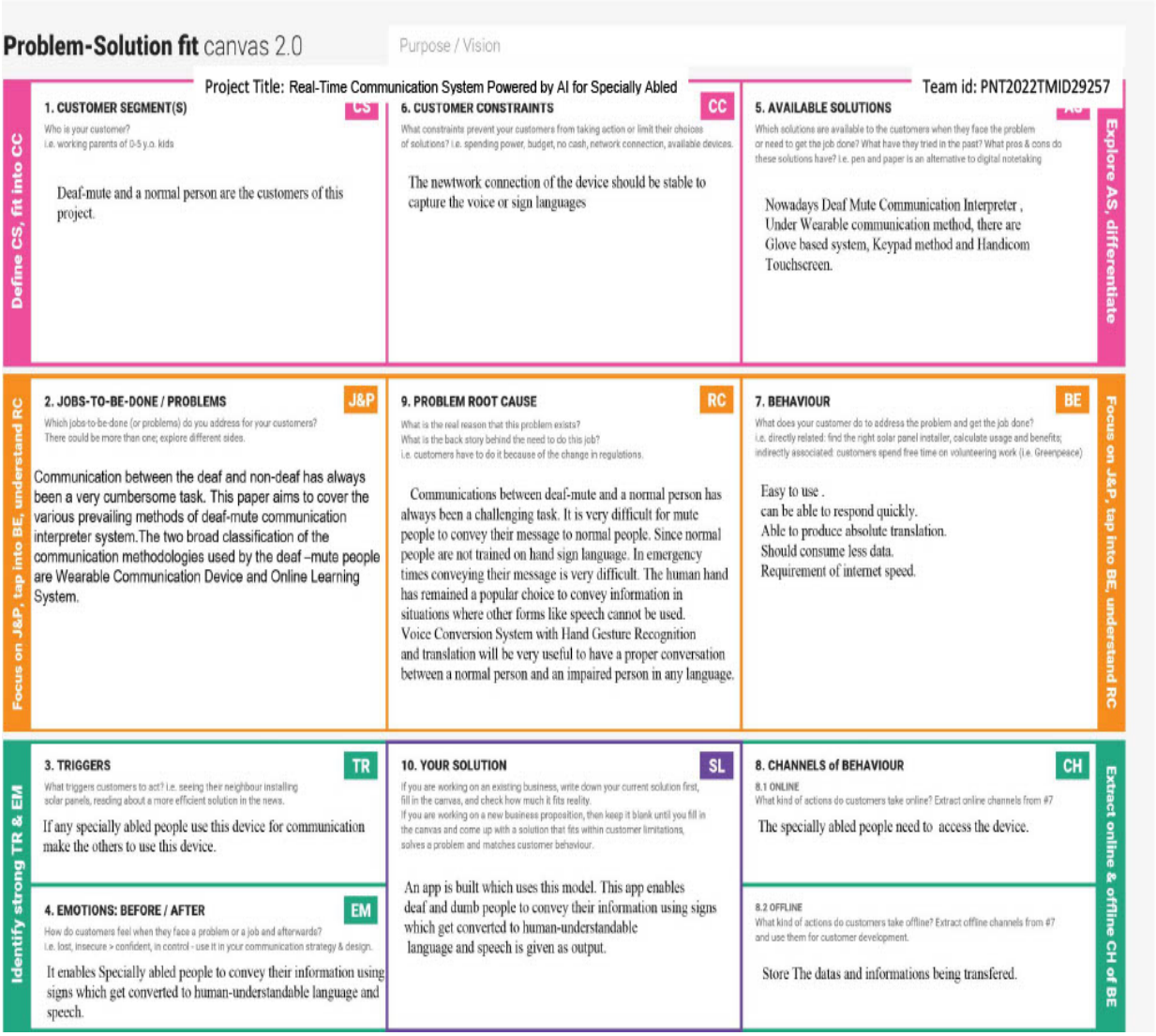
3.3 Proposed Solution

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 chancesof 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 theyhave to confirmto complete the registration.
FR-4	Compliance to rulesor laws	Terms and conditions, Privacy policy, End user licensing agreement.
FR-5	Authorization levels	There are two levels of authorization namely standard access level and advanced access level.
FR-6	Legal Requirements	Medical Certificate is produced

4.2 Non Functional requirement:

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

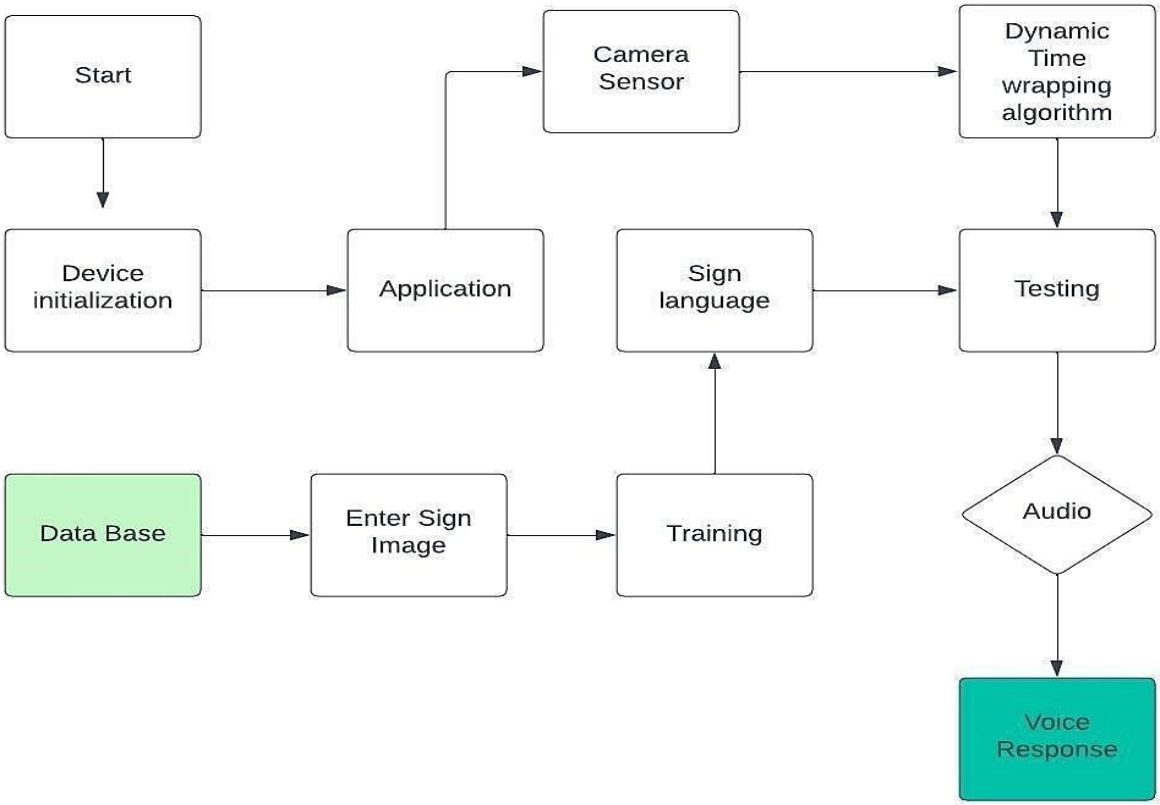
FR No.	Non-Functional Requirement	Description
NF R-1	**Usability**	The designed system is easy to use for speciallyabled personsas it is portable and platform independent.
NF R-2	**Security**	Converted information usingsigns into speechis accessed only by the user.
NF R-3	**Reliability**	System is testedwith large numberof data and Providesinsight into issues.
NF R-4	**Performance**	Quick Launch time of application and faster in converting signs into speech
NF R-5	**Availability**	Provides automatic recovery and User access.
NF R-6	**Scalability**	Standard network condition the device shouldconvert information within second.

5.PROJECT DESIGN

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

5.1 Data Flow Diagrams

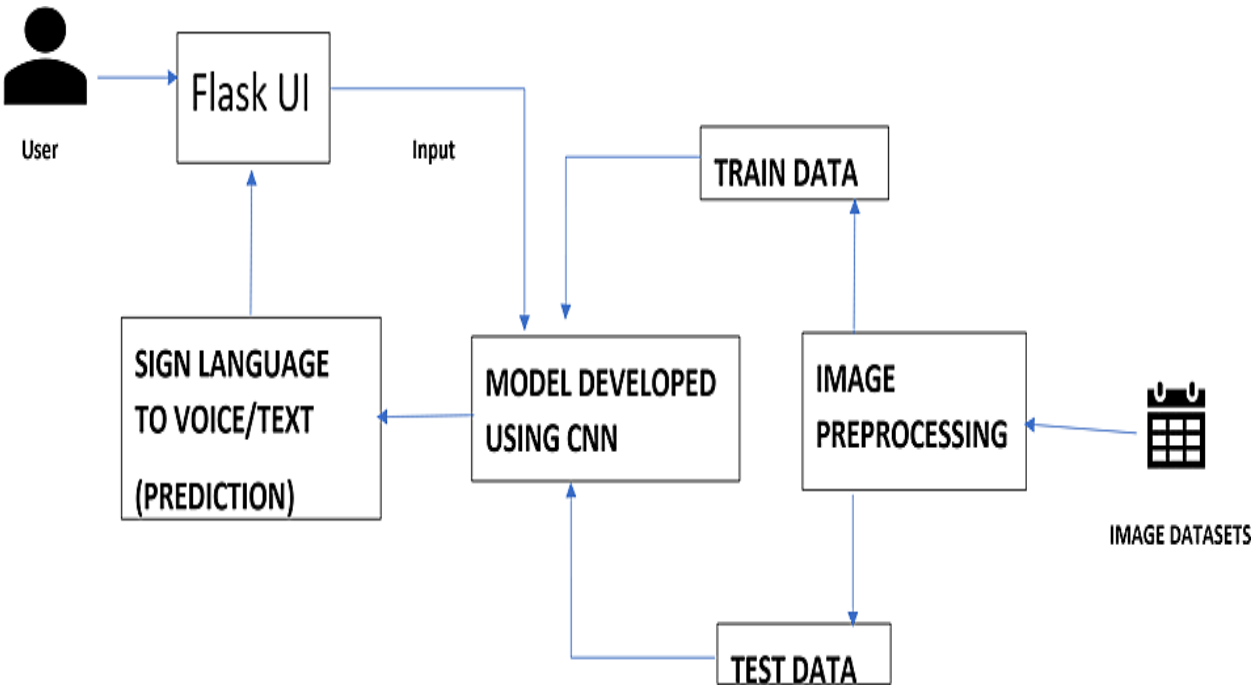
A data flow diagram is a traditional visual representation of the information flow within a system. It shows how data enters and leaves the system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between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

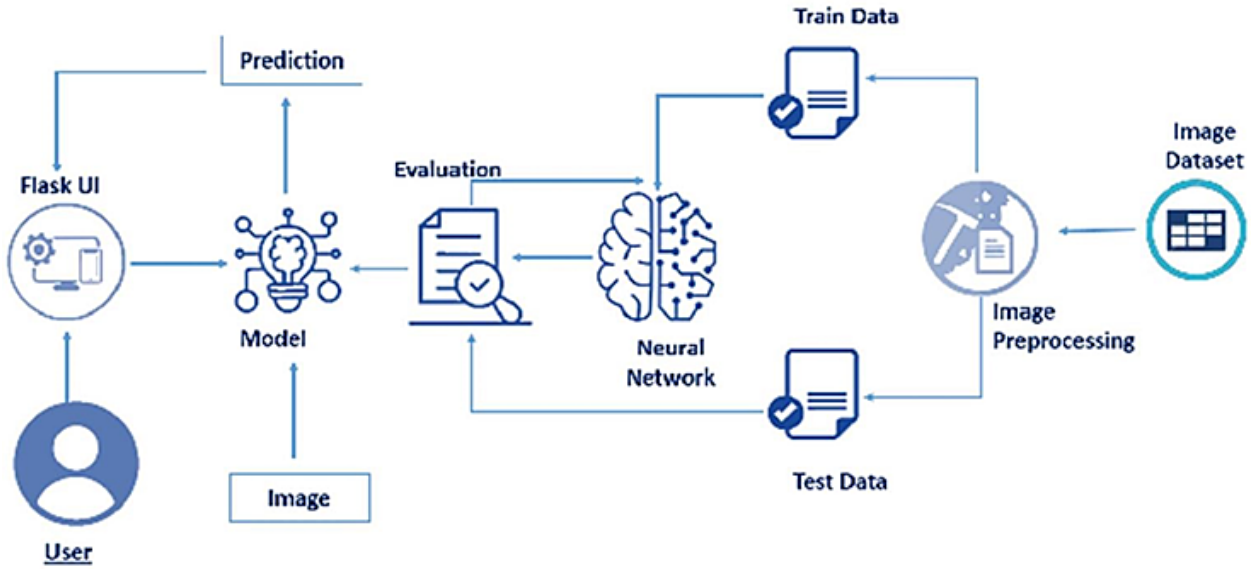


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User	Deaf and dumb people willing to communicateefficiently, 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 designfeature written from the perspective of the end user. Its purposeis to articulate how a design will provide value tothe end user. A key component of agile softwaredevelopment is puttingpeople first, and a user story puts end users at the centerof the conversation. These storiesuse non-technical language to provide contextfor the development team and their efforts.

User Type	Functional Requiremen t (Epic)	User Story Num ber	User Story / Task	Acceptan ce criteria	Prio ri ty	Relea se
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 boar d	Hi gh	Sprint-1
		USN-2	As a user,I will receive a confirmation email once I have registered for the application	I can receive confirmati on email & click confirm	Hi gh	Sprint-1

Normal people		USN-3	Give accessto 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	Hi gh	Sprin t-1
Deaf- mute people			Give access to display to view the message sent by normal people.	I can access messages given by the Norma l people	Hi gh	Sprin t-1
Administrator		USN-4	Admin side in the company should take care	all the requireme nts are there.	Hi gh	Sprint 1
Sign up		USN-5	Need to sign up to use it.	Need valid credential s.	Hi gh	Sprin t-1
Wish list		USN-6	Before availing the service can be kept aside.	As a user canreview anduse the service.	Low	Sprin t-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 intoanoperating 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 oncel have registered	1	High	Abirami , Sushmitha

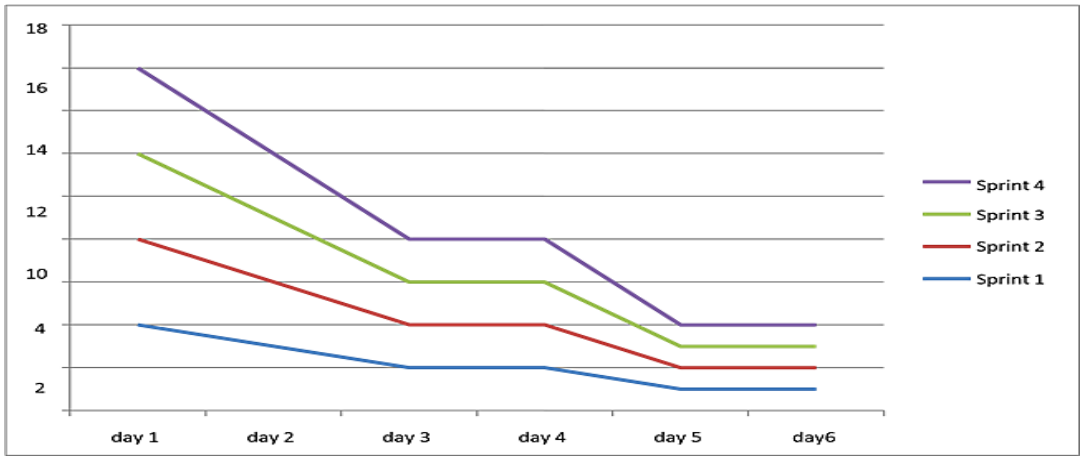
			for the application			
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password	1	Medium	akshaya, sushmitha
Sprint-2	Dashboard	USN-4	As a user, I can log into my account in a given Dashboard	1	High	Akshaya Abirami Priya dharshini Sushmitha
Sprint-1	User interface	USN-5	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

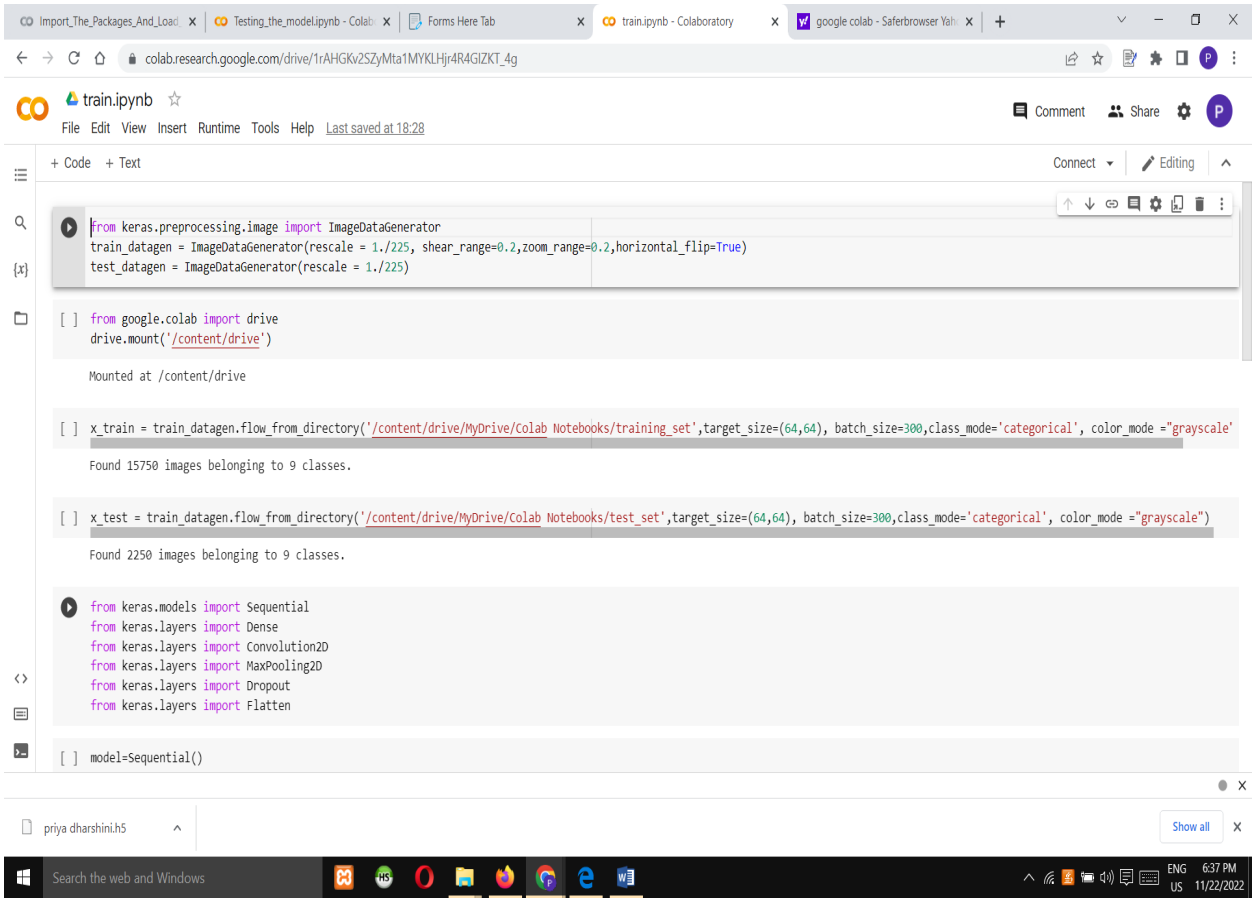
A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

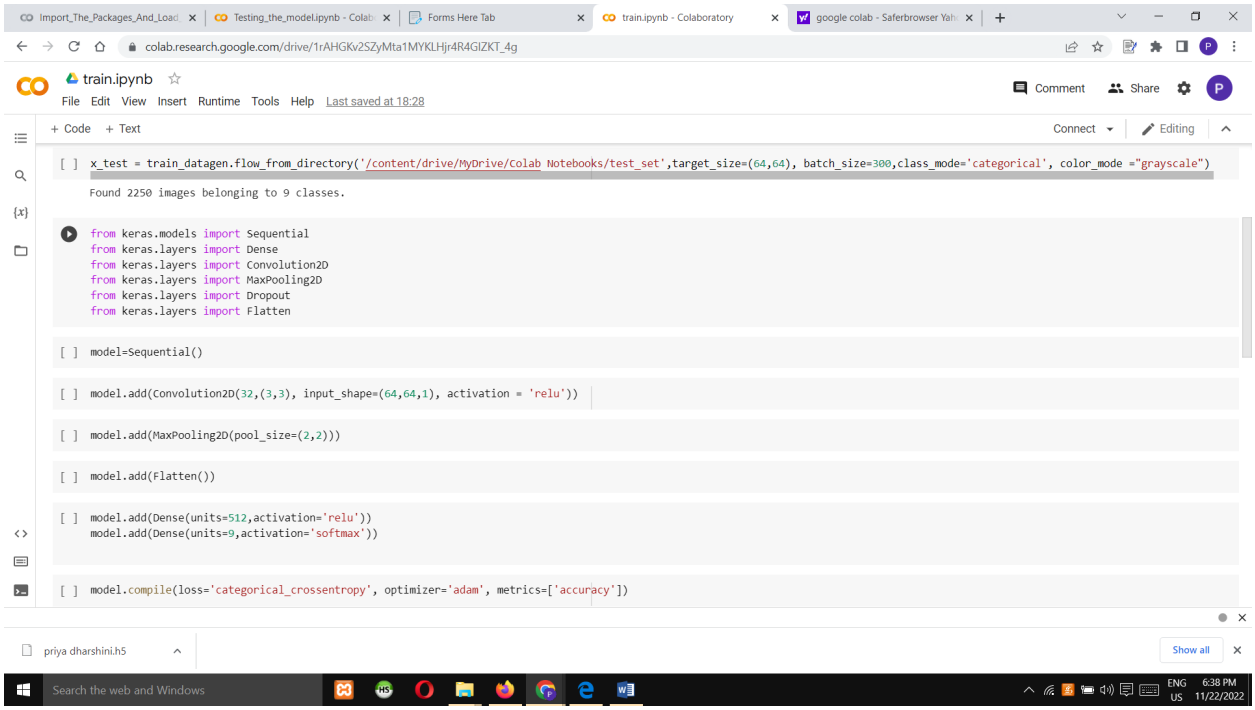


7. CODING & SOLUTIONING

In order to design websitethat coverts sign language into English alphabets we need to develop the website.For developing the website, primarly 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.

7.1 Feature 1:




Import_The_Packages_And_Load
Testing_the_model.ipynb - Colab
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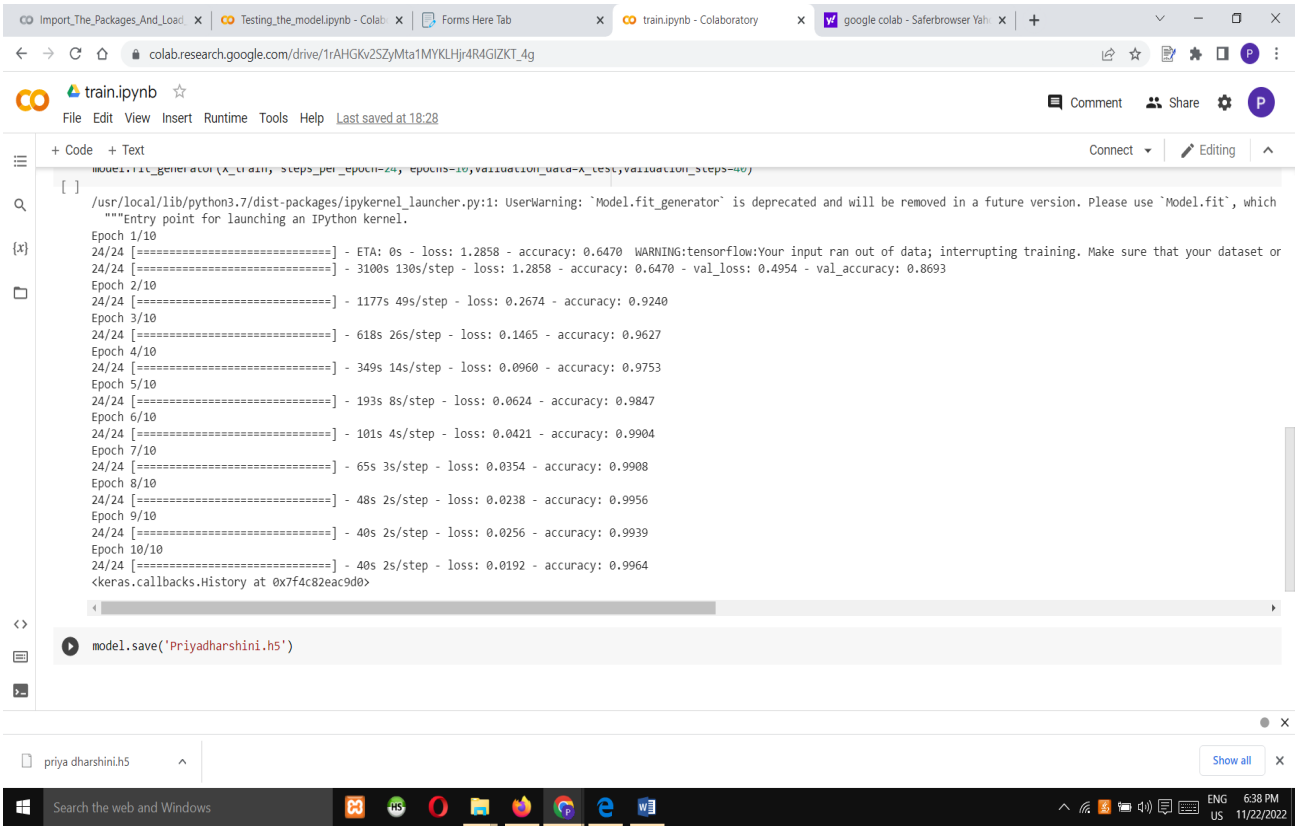
train.ipynb - Colaboratory
google colab - Saferbrowser Yah
colab.research.google.com/drive/1rAHGKv2SZyMta1MYKLHjr4R4GlZKT_4g
train.ipynb
File Edit View Insert Runtime Tools Help Last saved at 18:28
Comment
Share
+ Code + Text
Connect
Editing
[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab 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
Search the web and Windows
ENG US
6:38 PM
11/22/2022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train.ipynb
File Edit View Insert Runtime Tools Help Last saved at 18:28
Comment
Share
+ Code + Text
Connect
Editing
/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
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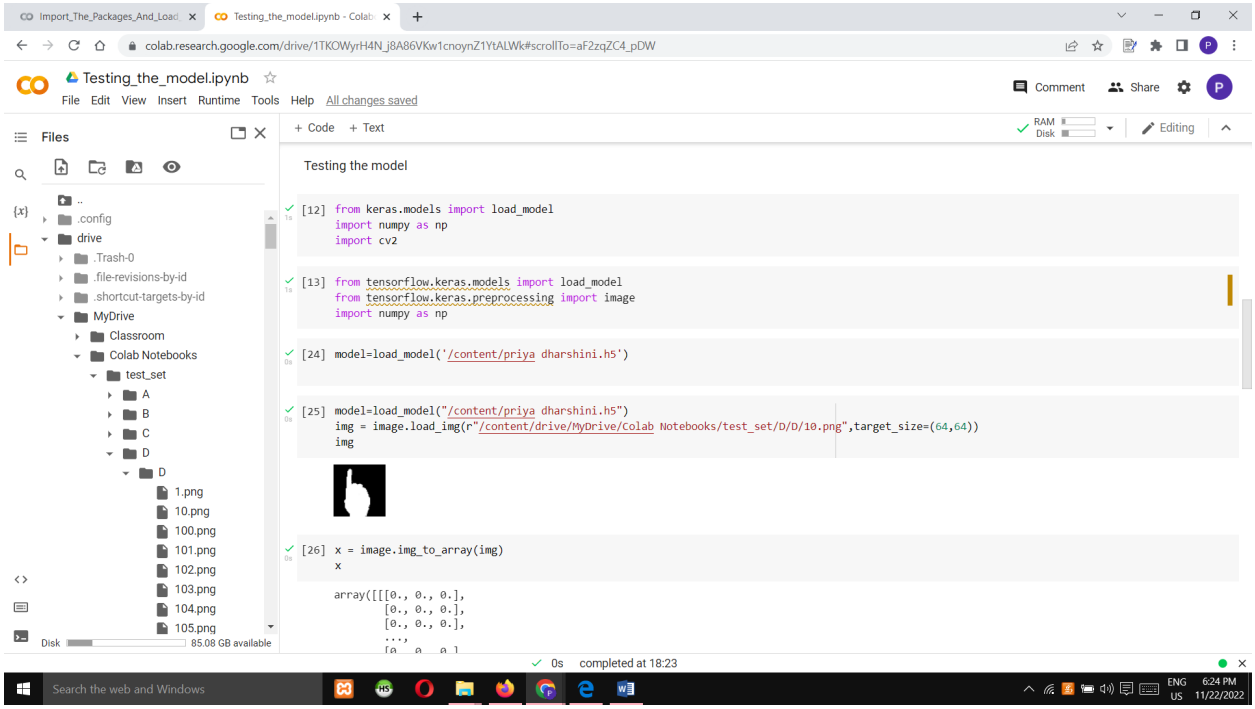
ENG US
6:38 PM
11/22/2022

7.2 Feature 2:


Testing_the_model.ipynb
Testing the model
[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/D/10.png",target_size=(64,64))
img
[26] x = image.img_to_array(img)
x
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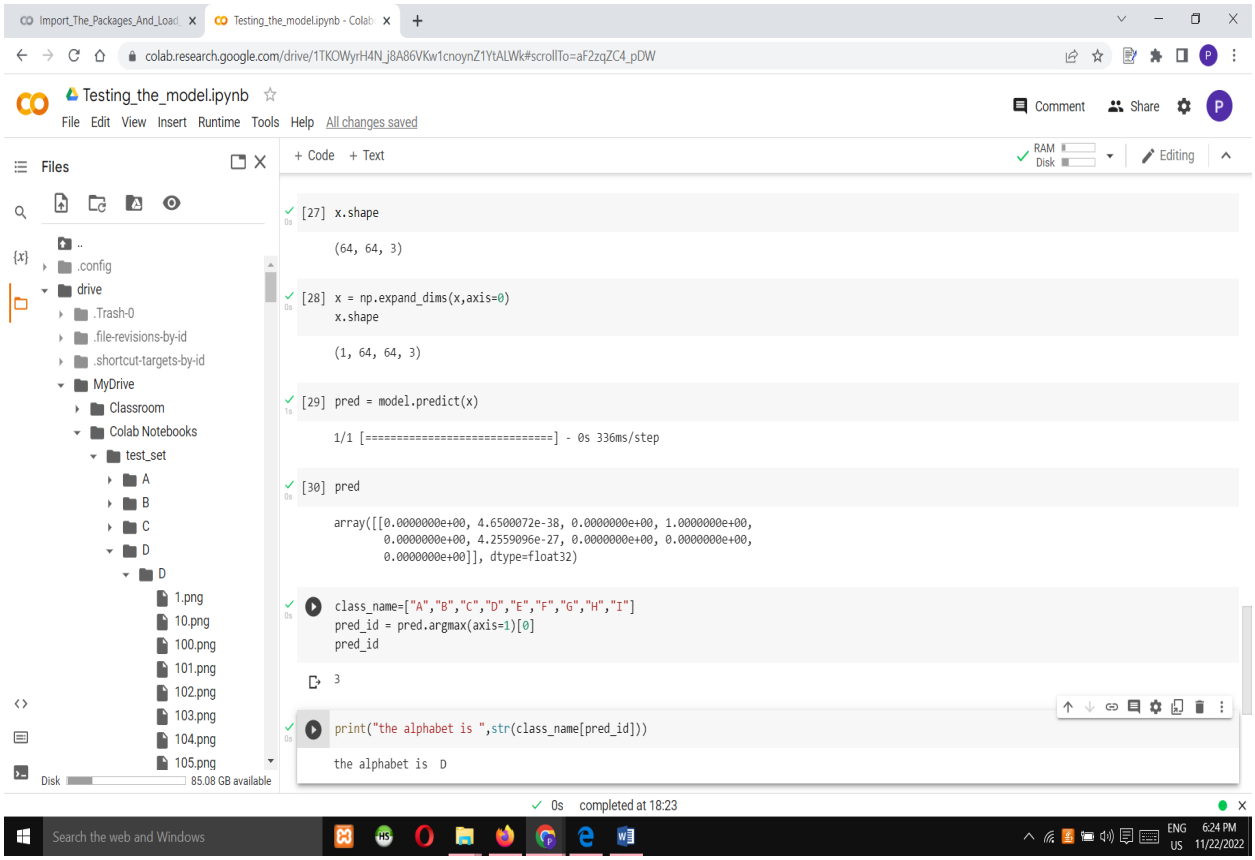
[0., 0., 0.],
[0., 0., 0.],
...,

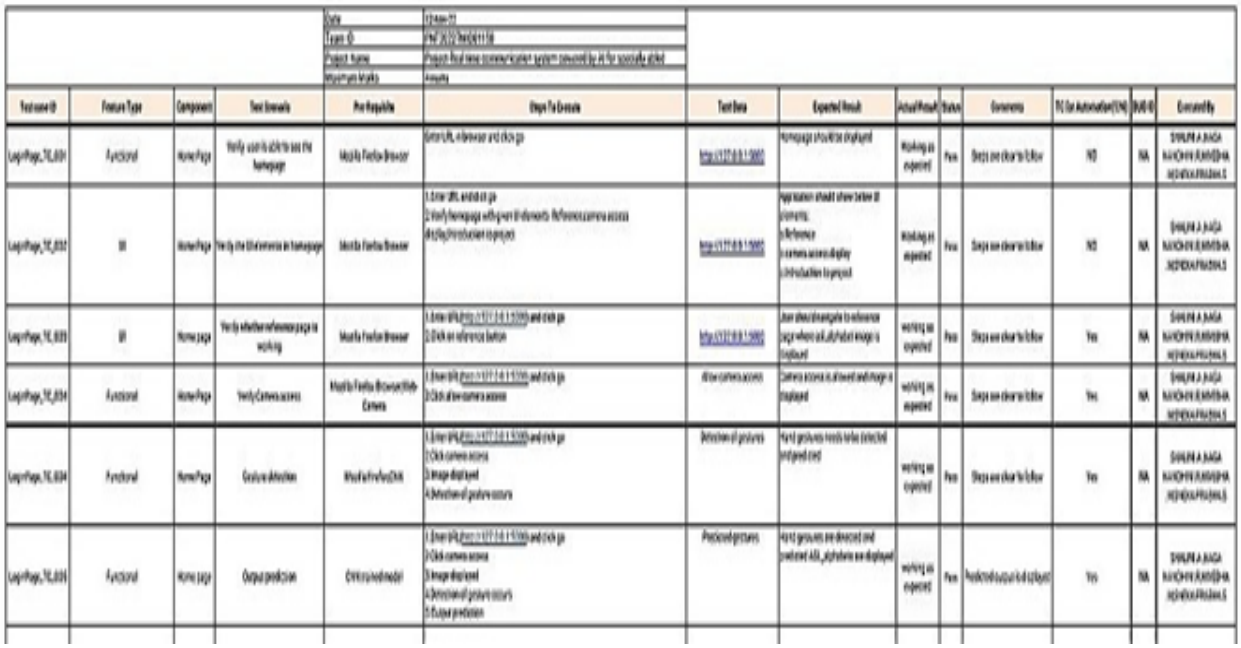

[27] x.shape
(64, 64, 3)
[28] x = np.expand_dims(x,axis=0)
x.shape
(1, 64, 64, 3)
[29] pred = model.predict(x)
1/1 [==============================] - 0s 336ms/step
[30] pred
array([[0.0000000e+00, 4.6500072e-38, 0.0000000e+00, 1.0000000e+00,
0.0000000e+00, 4.2559096e-27, 0.0000000e+00, 0.0000000e+00,
0.0000000e+00]], dtype=float32)
class_name=["A","B","C","D","E","F","G","H","I"]
pred_id = pred.argmax(axis=1)[0]
pred_id
3
print("the alphabet is ",str(class_name[pred_id]))
the alphabet is D

8. TESTING

A Test report is an organized summaryof testing objectives, activities, and results. Test Report is a documentwhich contains a summary of all testactivities and finaltest results of a design. Test report is an assessment of how well the Testingis performed. Based on the test report, we understand the designsquality and its performance.

8.1 Testcases

A test case is nothingbut 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 implementthose test cases.



8.2 User Acceptance Testing

User acceptance testing (UAT), also called application testing or end-user testing, is a phase of softwaredevelopment in whichthe 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

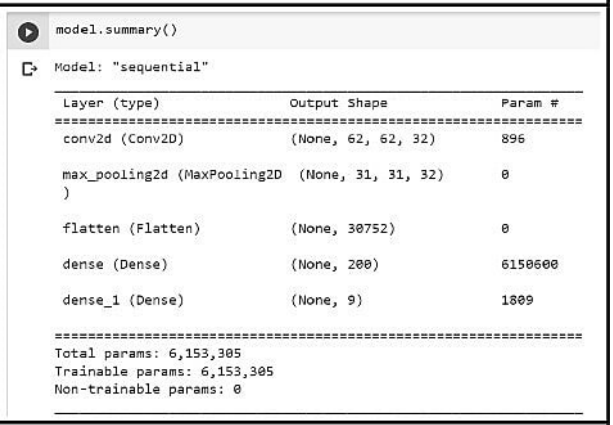
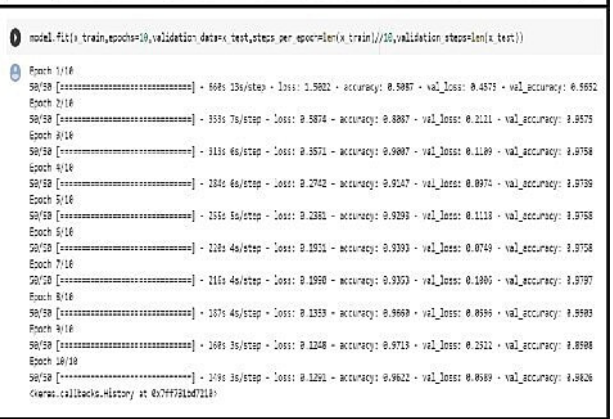
9. RESULT

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)	
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 of15750 images of Alphabets from “A” to “I” are used for training database and a set of 2250 imagesof Alphabets from “A” to “I” are used for testingdatabase. 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 datasetcan be added,and the usercanchoose which sign language to read.

Disadvantages:

- Model only works from alphabetsA to I.
- Absence of gesture recognition, alphabets from J cannot be identified.
- As the quantity/quality of images in the datasetis 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.

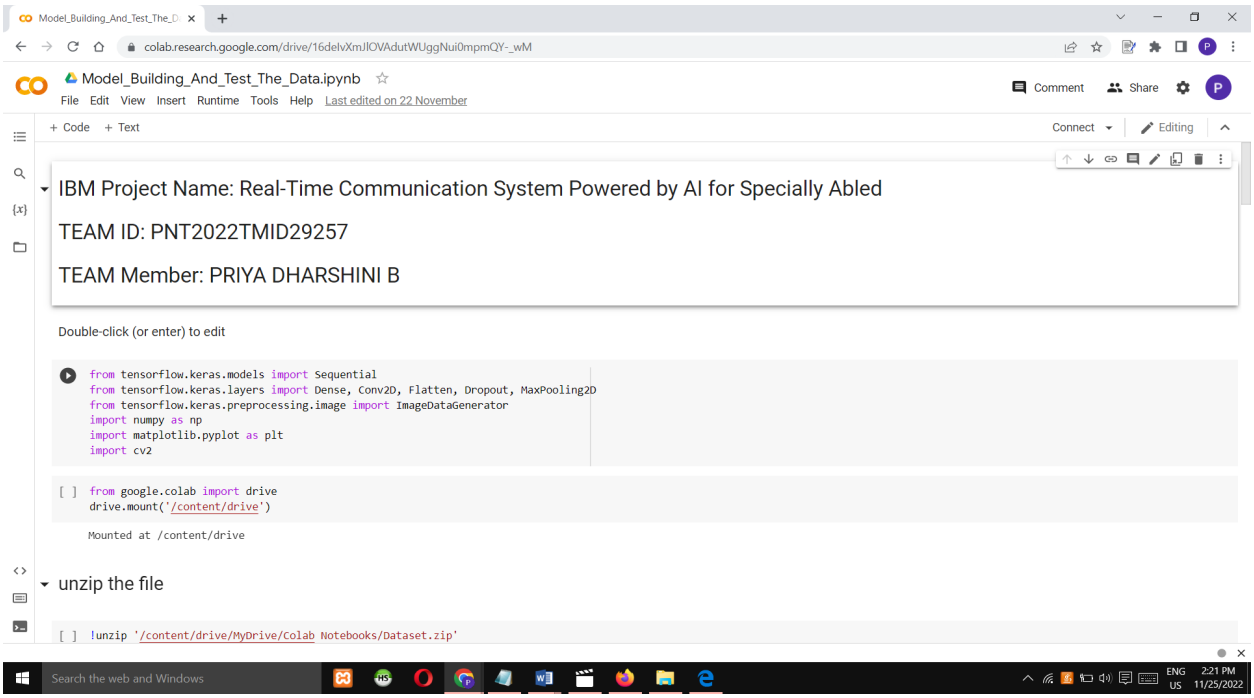
12. FUTURESCOPE

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:



Model_Building_And_Test_The_D

colab.research.google.com/drive/16delvXmJlOVAdutWUggNui0mpmQY-_wM

Model_Building_And_Test_The_Data.ipynb

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IBM Project Name: Real-Time Communication System Powered by AI for Specially Abled

TEAM ID: PNT2022TMID29257

TEAM Member: PRIYA DHARSHINI B

Double-click (or enter) to edit

```
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')
```

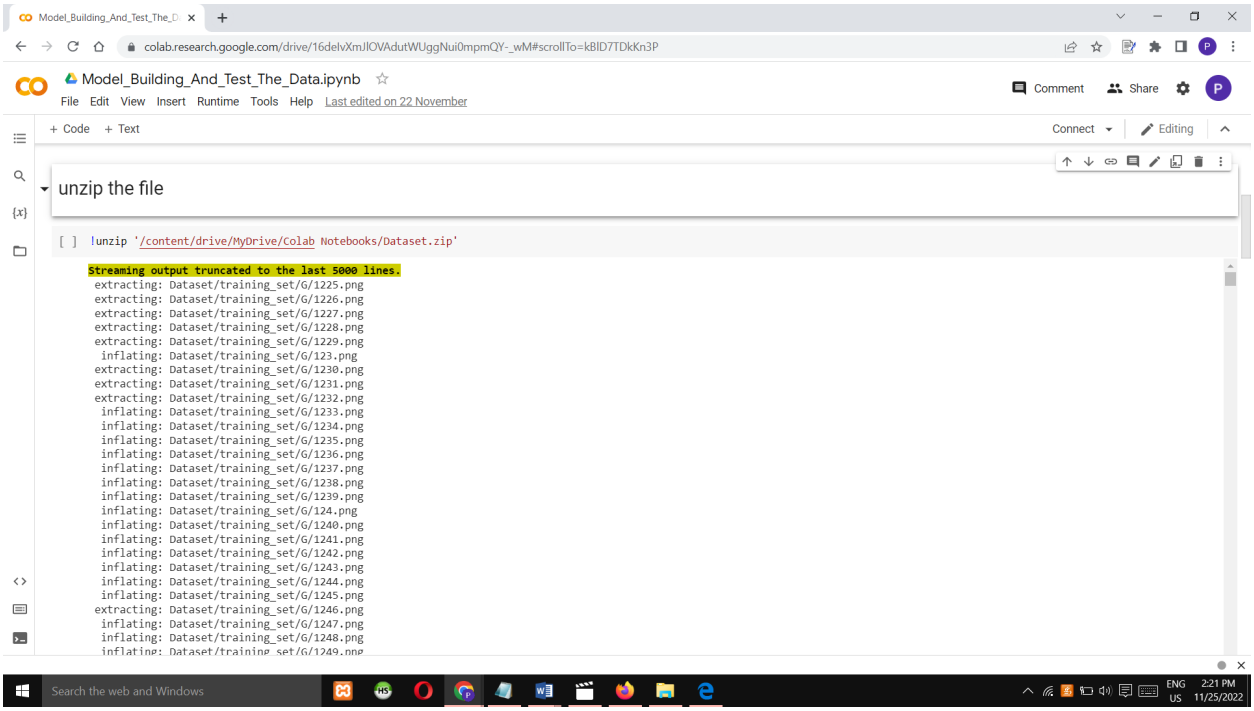
```
Mounted at /content/drive
```

unzip the file

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

Search the web and Windows

ENG US 2:21 PM 11/25/2022



Model_Building_And_Test_The_D

colab.research.google.com/drive/16delvXmJlOVAdutWUggNui0mpmQY-_wM#scrollTo=kBlD7TDkKn3P

Model_Building_And_Test_The_Data.ipynb

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unzip the file

```
[ ] !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
```

Search the web and Windows

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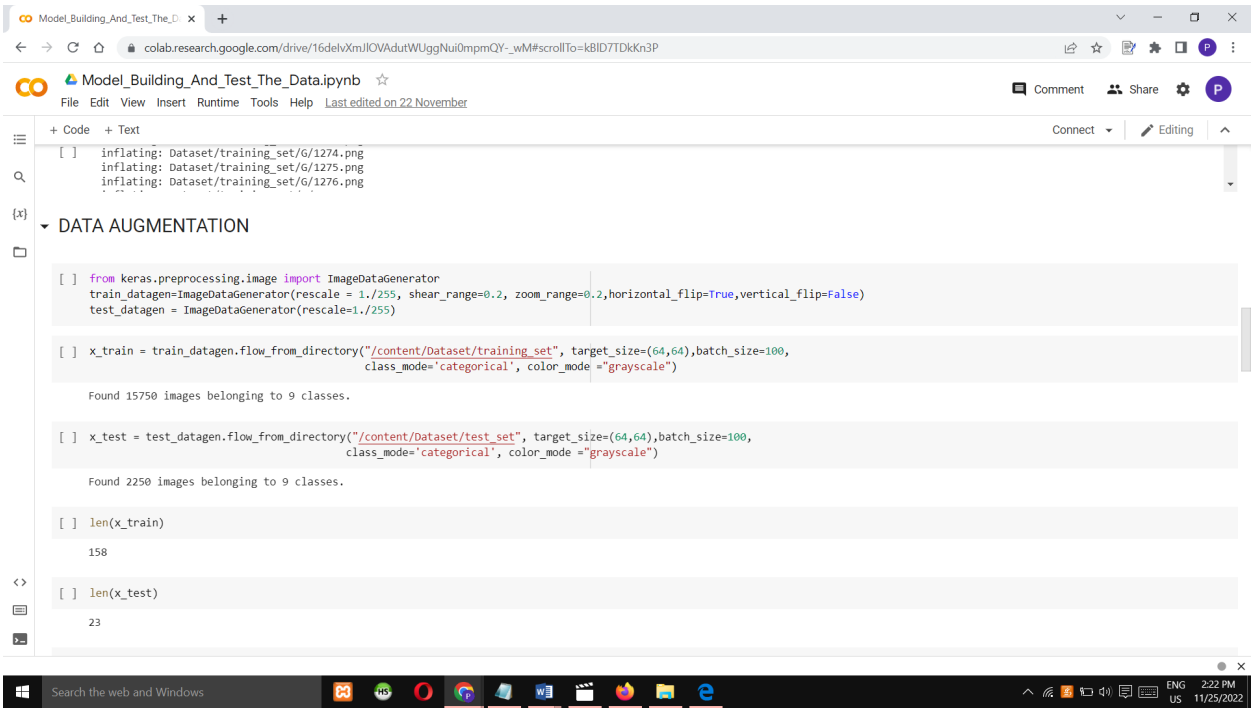
Model_Building_And_Test_The_D
colab.research.google.com/drive/16delvXmJlOVAdutWUggNui0mpmQY-_wM#scrollTo=kBlD7TDkKn3P
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inflating: Dataset/training_set/G/1274.png
inflating: Dataset/training_set/G/1275.png
inflating: Dataset/training_set/G/1276.png
DATA 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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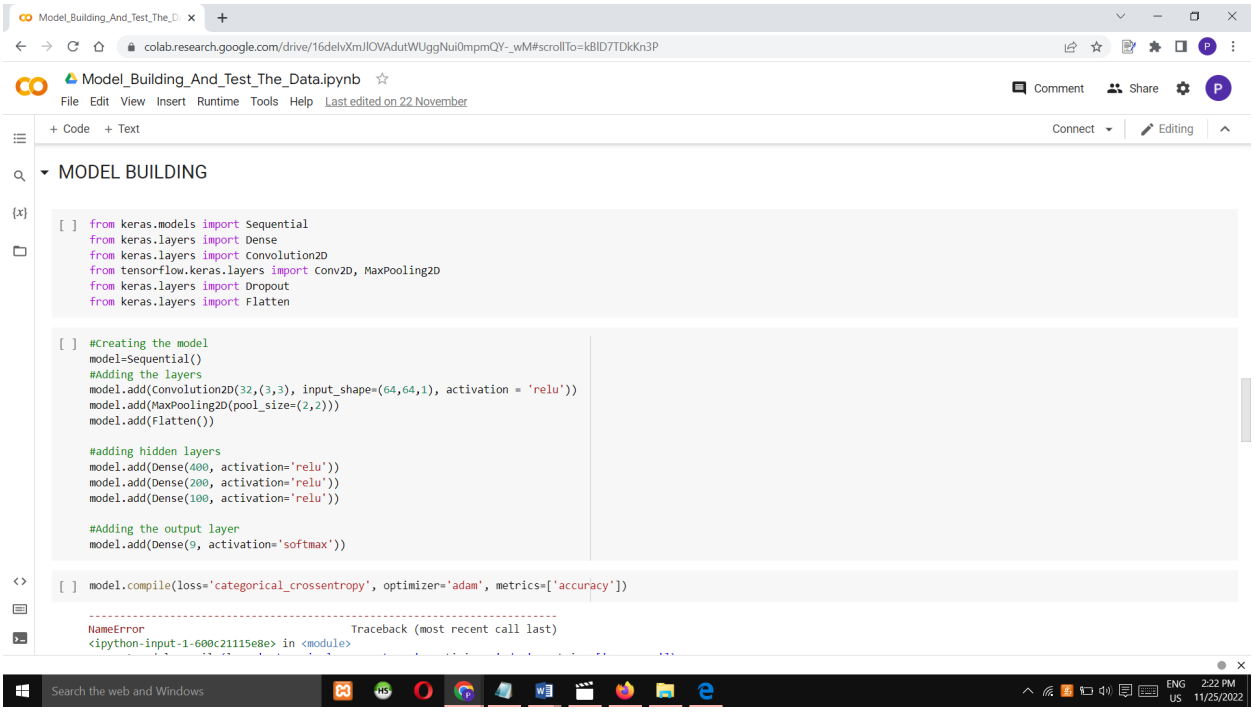
Model_Building_And_Test_The_D
colab.research.google.com/drive/16delvXmJlOVAdutWUggNui0mpmQY-_wM#scrollTo=kBlD7TDkKn3P
Model_Building_And_Test_The_Data.ipynb
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MODEL BUILDING
from keras.models import Sequential
from keras.layers import Dense
from keras.layers 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 Traceback (most recent call last)
<ipython-input-1-600c21115e8e> in <module>
Search the web and Windows
ENG US
2:22 PM 11/25/2022

Model_Building_And_Test_The_D

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Model_Building_And_Test_The_Data.ipynb

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SEARCH STACK OVERFLOW

```
[ ] 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

Search the web and Windows

ENG US 2:22 PM 11/25/2022

Model_Building_And_Test_The_D

colab.research.google.com/drive/16delvXmJlOVAdutWUggNui0mpmQY-_wM#scrollTo=kBlD7TDkKn3P

Model_Building_And_Test_The_Data.ipynb

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TEST THE MODEL

```
[ ] 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')
```

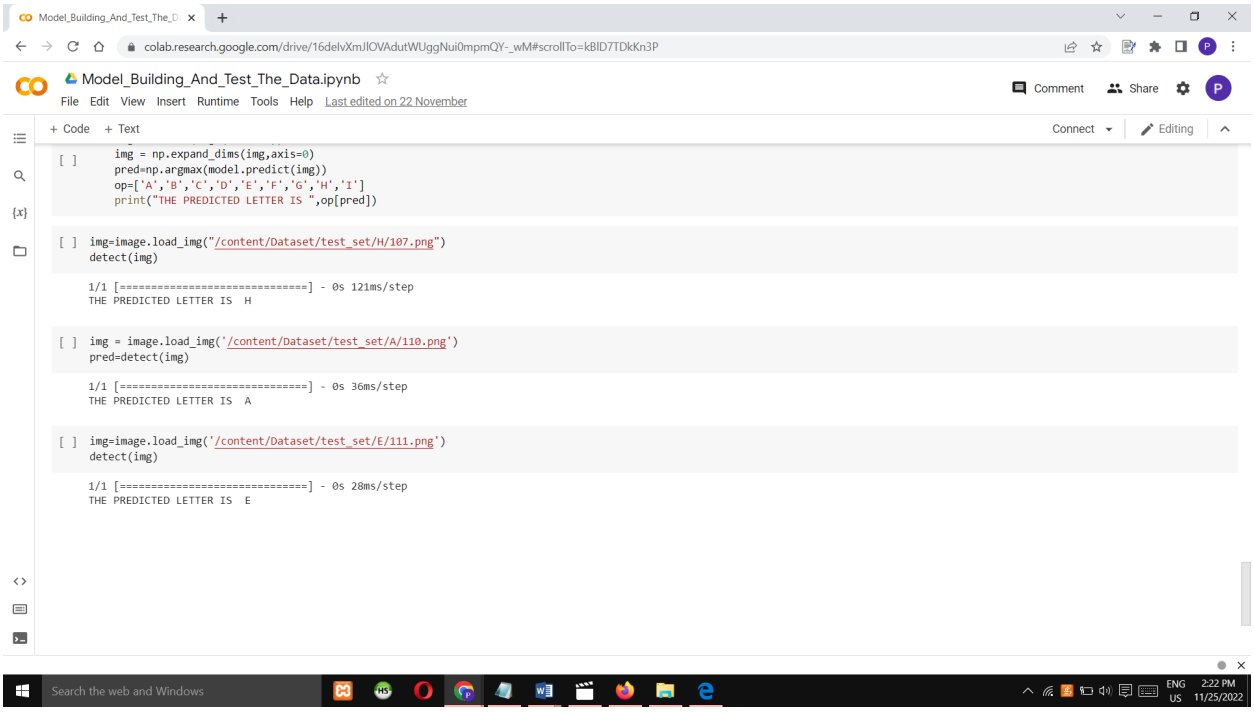
```
[ ] img = image.load_img('/content/Dataset/test_set/H/107.png',target_size = (100,100))
    img
```

```
[ ] 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])
```

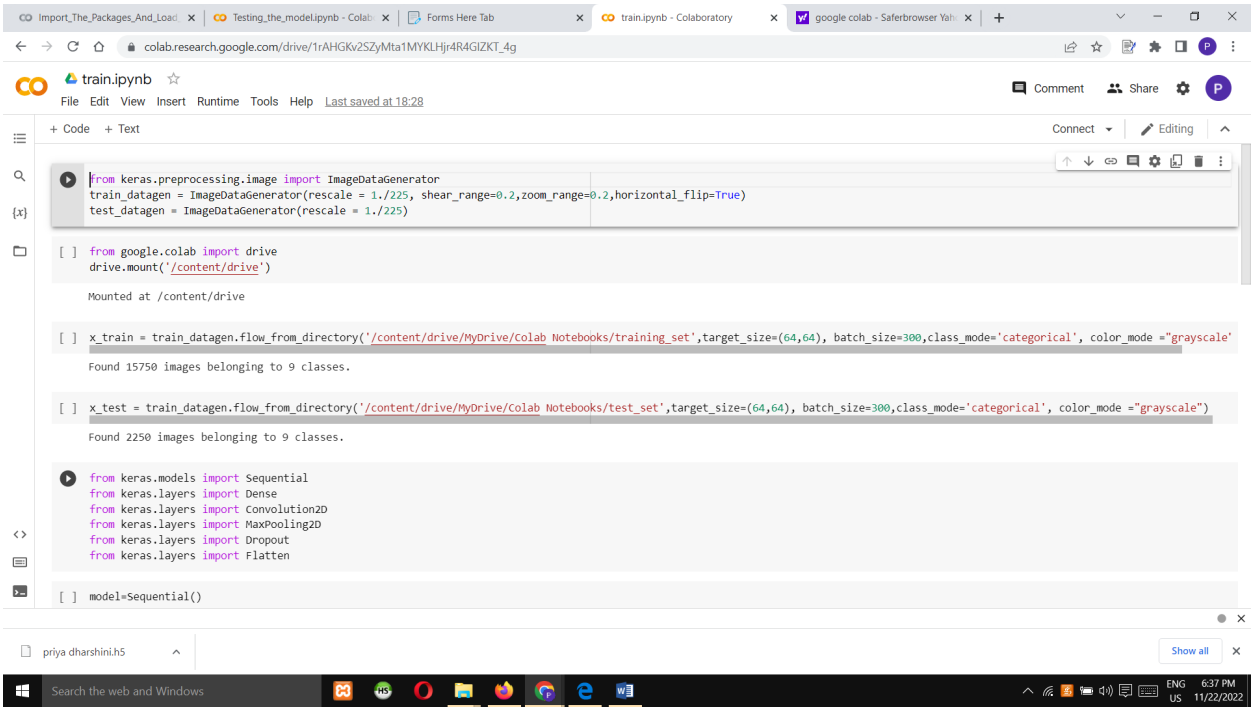
```
[ ] img=image.load_img("/content/Dataset/test_set/H/107.png")
```

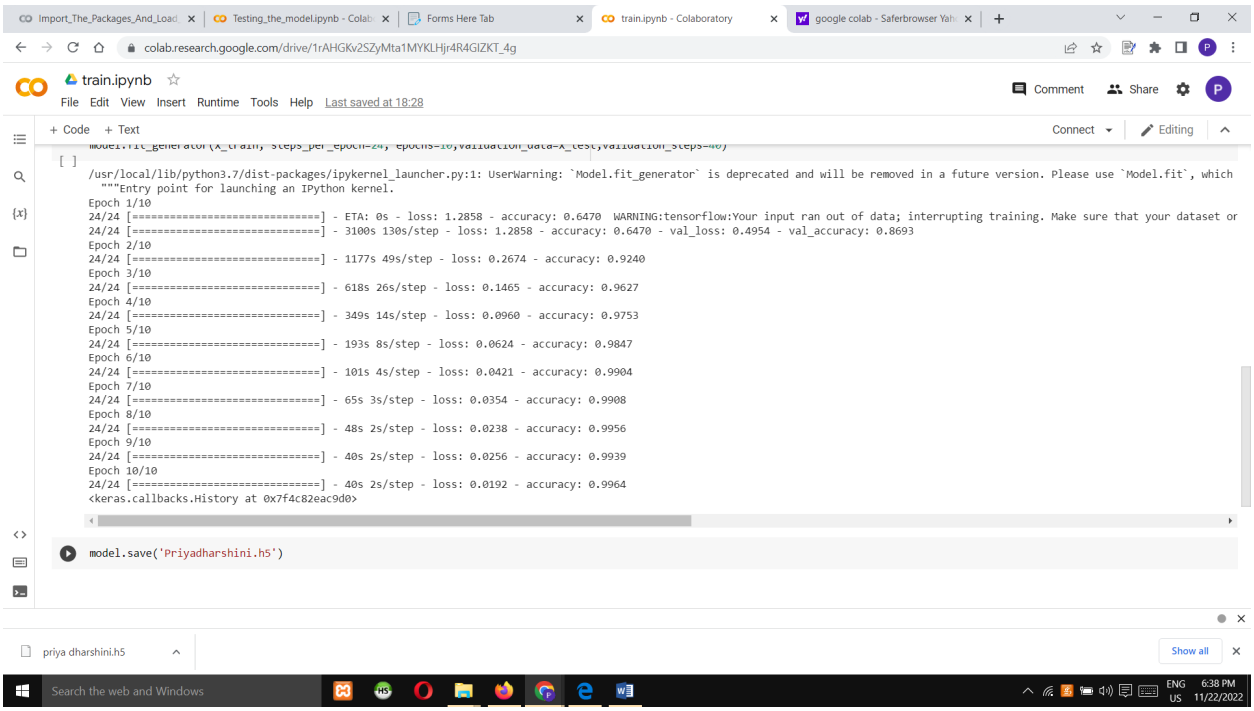
Search the web and Windows

ENG US 2:22 PM 11/25/2022



Training the model:




Import_The_Packages_And_Load
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
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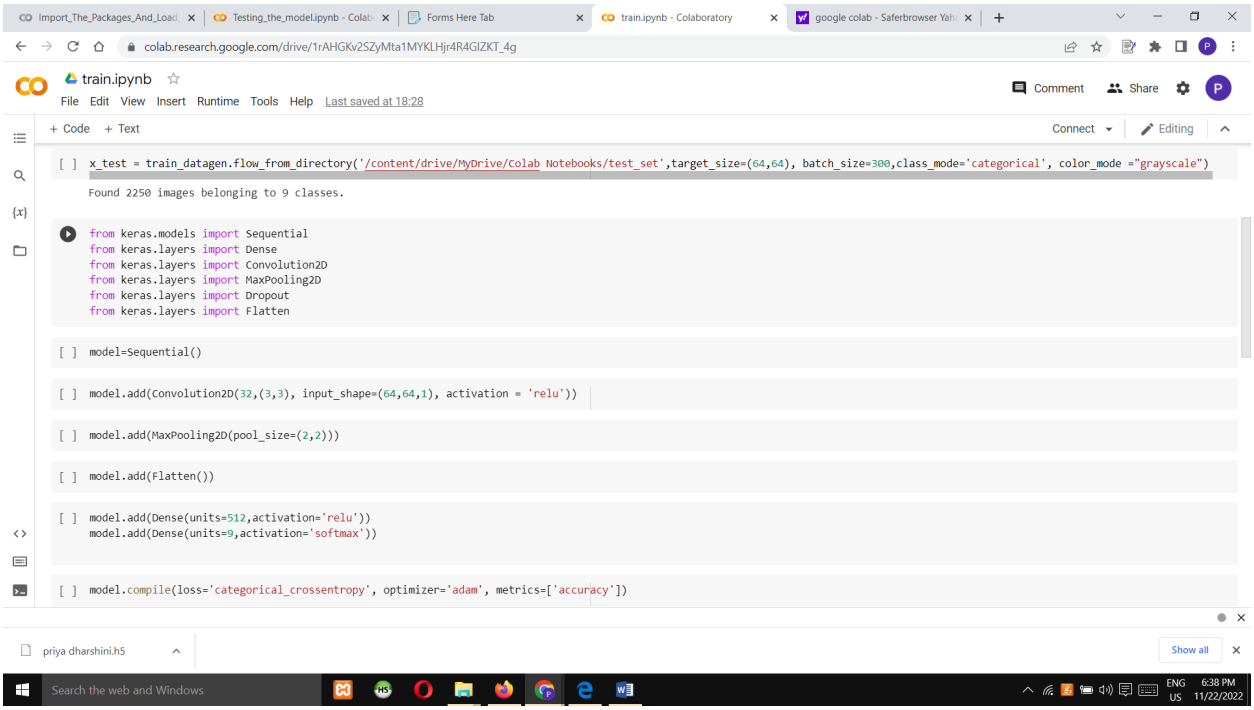
[ ]
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.fit`, which
"""Entry point for launching an IPython kernel.
Epoch 1/10
24/24 [==============================] - ETA: 0s - loss: 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('Priyadharshini.h5')
priya dharshini.h5
Show all
Search the web and Windows
ENG US
6:38 PM 11/22/2022


Import_The_Packages_And_Load
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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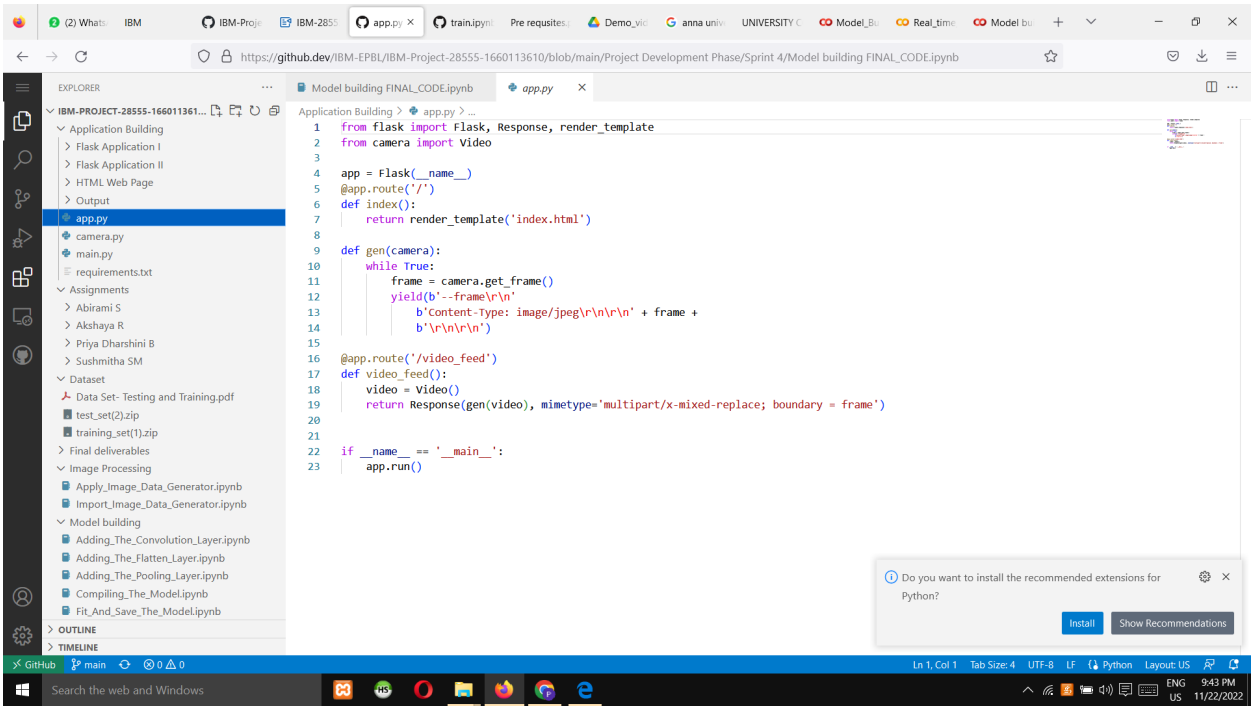
[ ] x_test = train_datagen.flow_from_directory('/content/drive/MyDrive/Colab Notebooks/test_set',target_size=(64,64), batch_size=300,class_mode='categorical', color_mode ="grayscale")
Found 2250 images belonging to 9 classes.
from keras.models import Sequential
from keras.layers import Dense
from keras.layers 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
ENG US
6:38 PM 11/22/2022

web app:



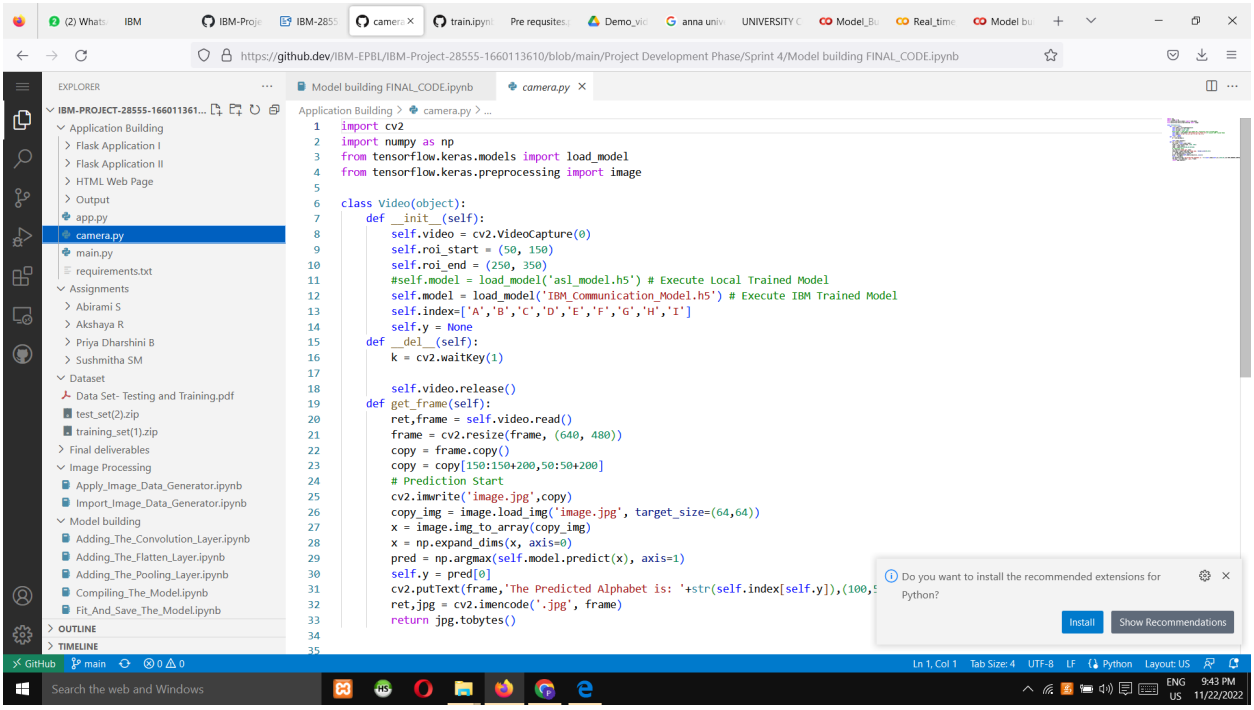
```
from flask import Flask, Response, render_template
from camera import Video

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

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

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


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

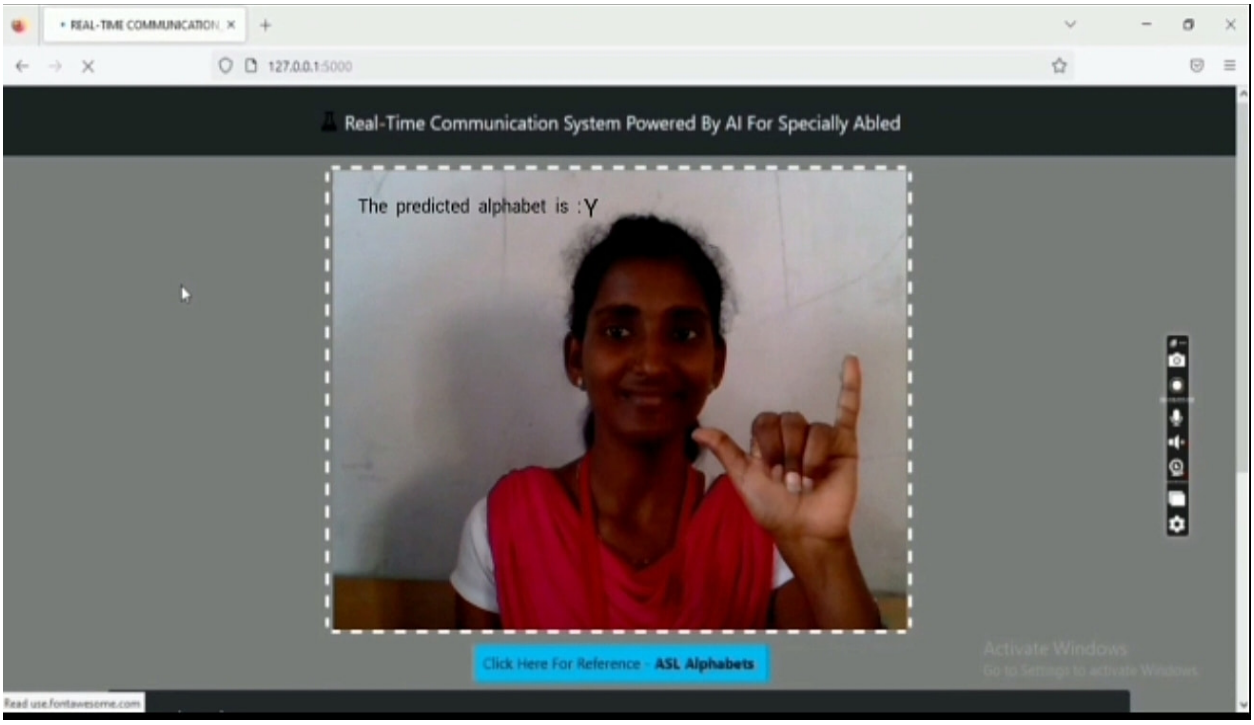


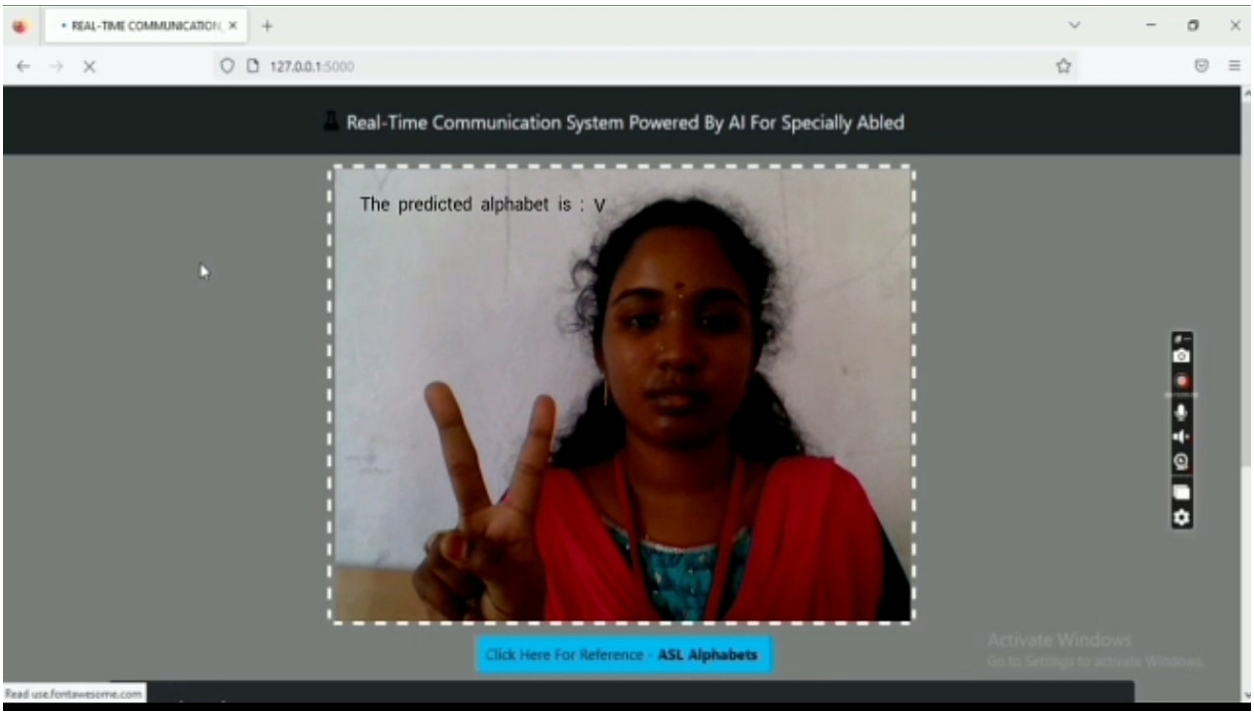
```
import cv2
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image

class Video(object):
    def __init__(self):
        self.video = cv2.VideoCapture(0)
        self.roi_start = (50, 150)
        self.roi_end = (250, 350)
        #self.model = load_model('asl_model.h5') # Execute Local Trained Model
        self.model = load_model('IBM_Communication_Model.h5') # Execute IBM Trained Model
        self.index=['A','B','C','D','E','F','G','H','I']
        self.y = None
    def __del__(self):
        k = cv2.waitKey(1)

        self.video.release()
    def get_frame(self):
        ret,frame = self.video.read()
        frame = cv2.resize(frame, (640, 480))
        copy = frame.copy()
        copy = copy[150:150+200,50:50+200]
        # Prediction Start
        cv2.imwrite('image.jpg',copy)
        copy_img = image.load_img('image.jpg', target_size=(64,64))
        x = image.img_to_array(copy_img)
        x = np.expand_dims(x, axis=0)
        pred = np.argmax(self.model.predict(x), axis=1)
        self.y = pred[0]
        cv2.putText(frame,'The Predicted Alphabet is: '+str(self.index[self.y]),(100,
        ret,jpg = cv2.imencode('.jpg', frame)
        return jpg.tobytes()
```

Output:


REAL-TIME COMMUNICATION
127.0.0.1:5000
Real-Time Communication System Powered By AI For Specially Abled
The predicted alphabet is : Y
Click Here For Reference - ASL Alphabets
Activate Windows
Read use.fontawesome.com


REAL-TIME COMMUNICATION
127.0.0.1:5000
Real-Time Communication System Powered By AI For Specially Abled
The predicted alphabet is : V
Click Here For Reference - ASL Alphabets
Activate Windows
Read use.fontawesome.com

Source code

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

Demo link:
https://drive.google.com/file/d/1XEEtTRY3oNFZJa_rIVdPXLQJrGTLhja8/view?usp=share_link