Government College of Technology

Coimbatore -641013

IBM - PROJECT - 3904-1658670533

REAL TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

TEAM ID : PNT2022TMID06853

Submitted By

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Ms. Divya

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1. INTRODUCTION

a. 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 deafmute and a normal person has always been a challenging task. It is very difficult for mute people to convey their message to normal people. The human hand has remained a popular choice to convey information in situations where other forms

like speech cannot be used.

b. Purpose

This project enables a deaf and dumb people to convey their information using signs which get converted to human – understandable language. So, the difference between the deaf and dumb people and ordinary people will not be happen. They all are same.

2. LITERATURE SURVEY

a. Existing Problem

Some of the existing solutions for solving this problem are:

Technology:

One of the easiest ways to communicate is through technology such as a smart phone or laptop. A deaf person can type out what they want to say and a person who is blind or has low vision can use a screen reader to read the text out loud. A blind person can also use voice recognition software to convert what they are saying in to text so that a person who is Deaf can then read it.

Interpreter:

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

Just Speaking:

Depending on the deaf person's level of hearing loss, they may be able to communicate with a blind person who is using speech. For example, a deaf person may have enough residual hearing (with or without the use of an assistive hearing device such as a hearing aid) to be able to decipher the speech of the person who is blind or has low vision. 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).

b. References

[1] AAWAAZ : A Communication System for Deaf and Dumb by Anchal Sood , Anju Mishra(2016)

The paper proposes a framework for recognizing hand gesture which would serve not only as a way of communication between deaf and dumb and mute people, but also, as an instructor. Deaf and dumb individuals lack in proper communication with normal people and find it difficult to properly express themselves. Thus, they are subjected to face many issues in this regard. The sign language is very popular among them and they use it to express themselves. Thus, there is a need of a proper translator. The deaf and dumb are not idle as past, they are working outside and doing great at it. So, an efficient system must be set up, to interact with them, to know their views and ideas.

Advantage :

· Early and accurate recognizing.

Disadvantage :

· Lack of proper communication.

[2] Full Duplex Communication System for Deaf & Dumb People by Shraddha R. Ghorpade, Surendra K. Waghamare (2015)

One of the important problems that our society faces is that people with disabilities are finding it hard to cope-up with the fast-growing technology. The access to communication technologies has become

essential for the handicapped people. Generally deaf and dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign.

Advantage :

· Fast Recogination.

Disadvantage :

· Difficulty in communicating with others who don't understand sign.

[3]Computer Technology Department, RTMNU, Nagpur, Maharashtra, India(2017)

An evolution of Information and Communication Technology has influenced every part of human life. It has modified the way we do the job, occupation, travel, acknowledge and convey. For the Deaf people group, the utilization ICT has enhance their personal satisfaction by creating frameworks that can help them discuss better with whatever remains of the world and among themselves. Gesture based communication is the essential method for correspondence in the almost totally impaired group.

Advantage :

· Deaf peoples has enhance to utilize personal satisfaction.

Disadvantage :

· The issue emerges when hard of hearing individuals attempt to convey what needs be to other individuals.

c. 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

Approach:-

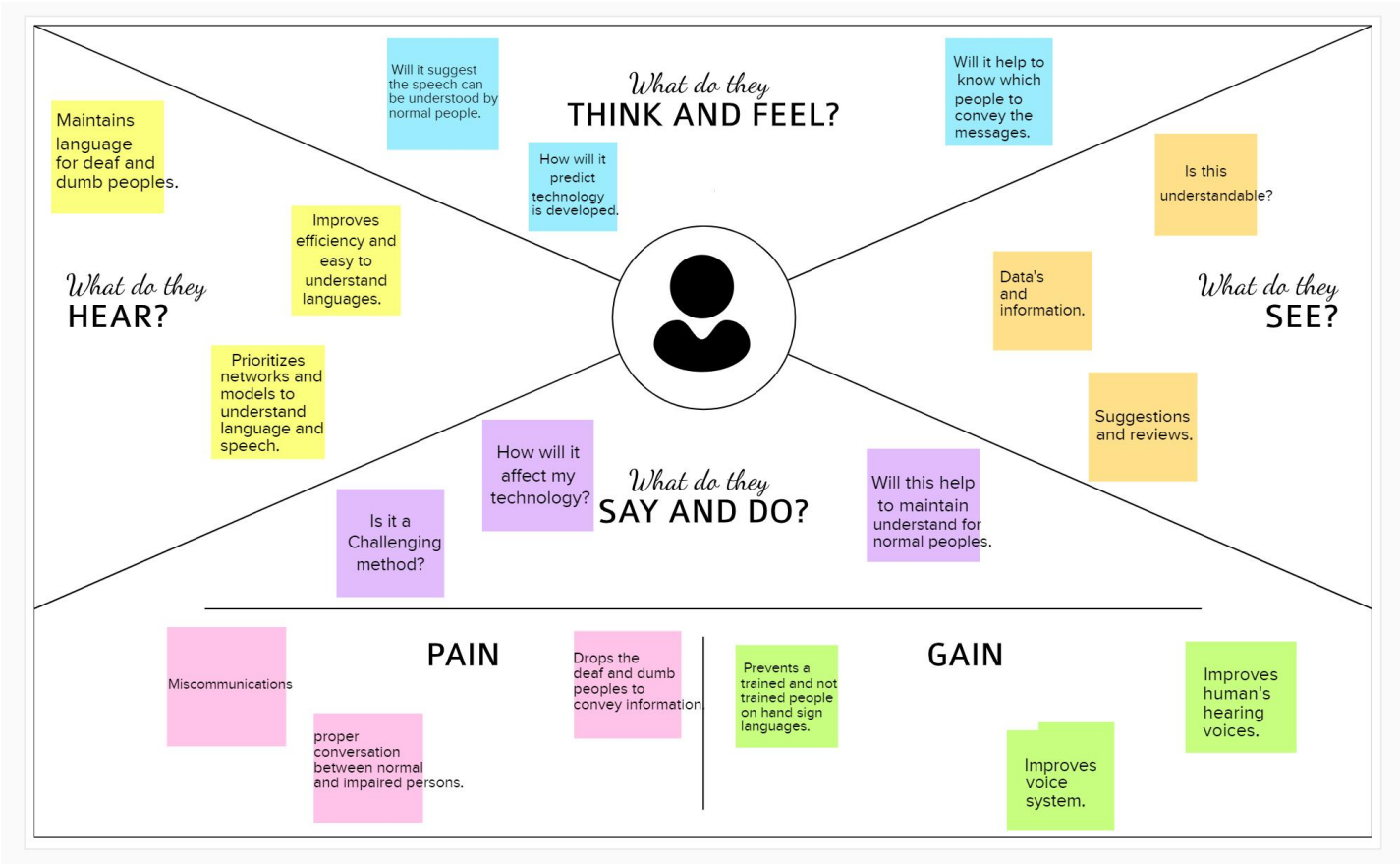
- Communication plays a significant role in making the world a better place. Most people communicate efficiently without any issues, but many cannot

due to disability.

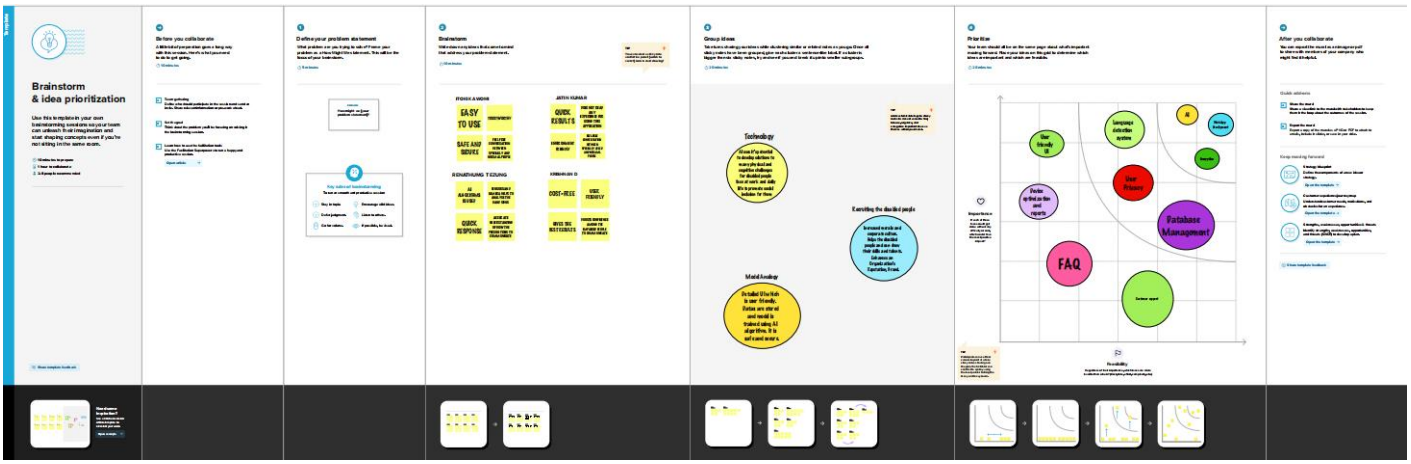
- They cannot hear or speak, which makes Earth a problematic place to live for them. Even simple basic tasks become difficult for them.

3.IDEATION & PROPOSED SYSTEM

a. Empathy Map Canvas



b. Ideation & Brainstorming



c. Proposed Solutions

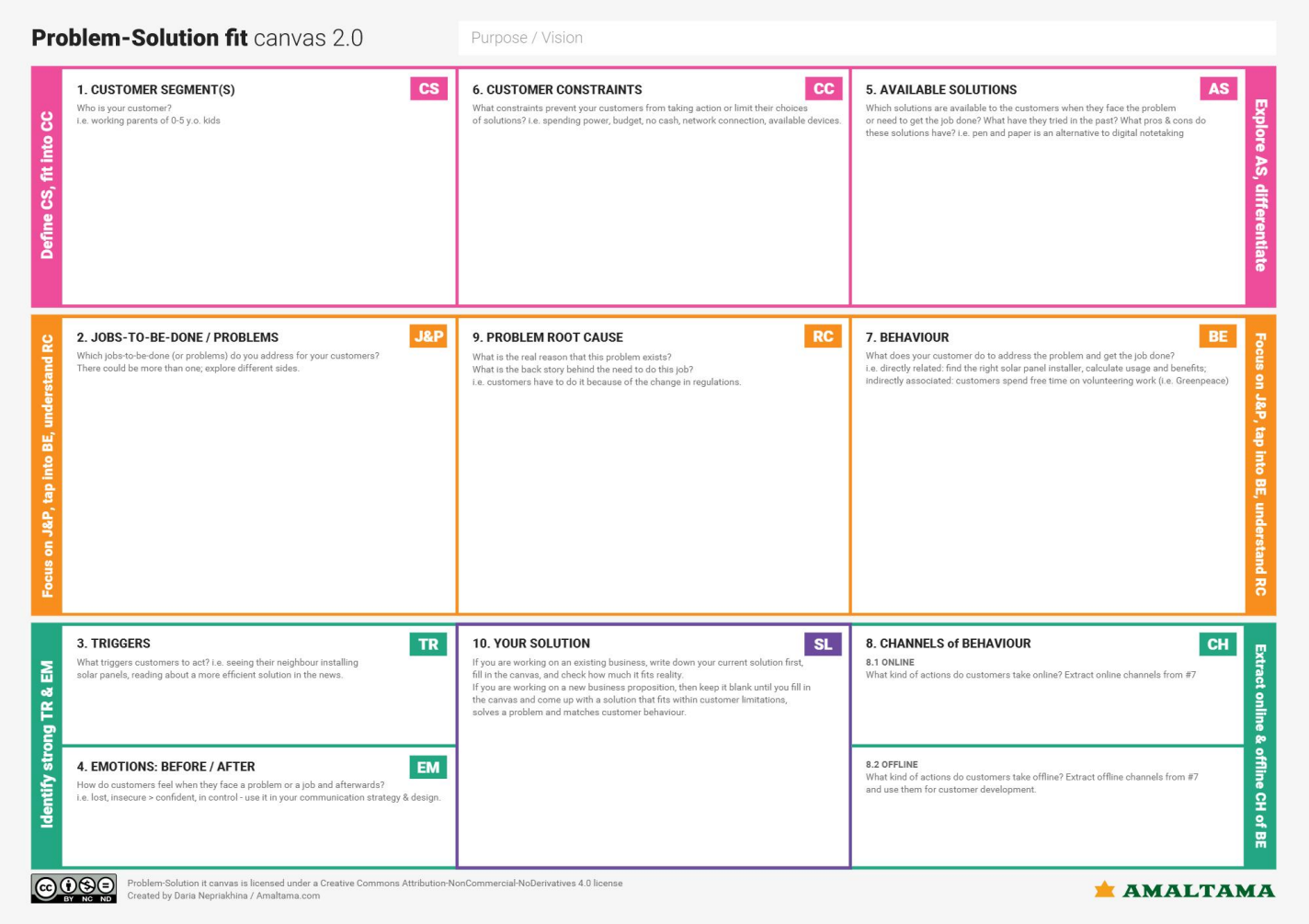
This paper describes the system that overcomes the problem faced by the speech and hearing impaired. The objectives of the research are as follow:

1. To design and develop a system which lowers the communication gap between speechhearing impaired and normal world.

2. To build a communication system that enables communications between deaf-dumb person and a normal person.

3. A convolution neural network is being used to develop a model that is trained on various hand movements. This model is used to create an app. This programme allows deaf and hard of hearing.

d. Problem Solution Fit



4. REQUIREMENT ANALYSIS

a. 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	**LOW VISION:** As a user who has trouble reading due to low vision, I want to be able to make the text larger on the screen so that I can read it.
FR-2	User Confirmation	**IMPAIRED USER:** As a user who is hearing -impaired, I want a turn on video captions so that I can understand what is being said in videos.
FR-3	User Registration	**COLOR BLINDNESS:** As a user who is color blind, I want to links to be distinguishable on the page so that I can find the links and navigate the site

b. Non–Functional requirement

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

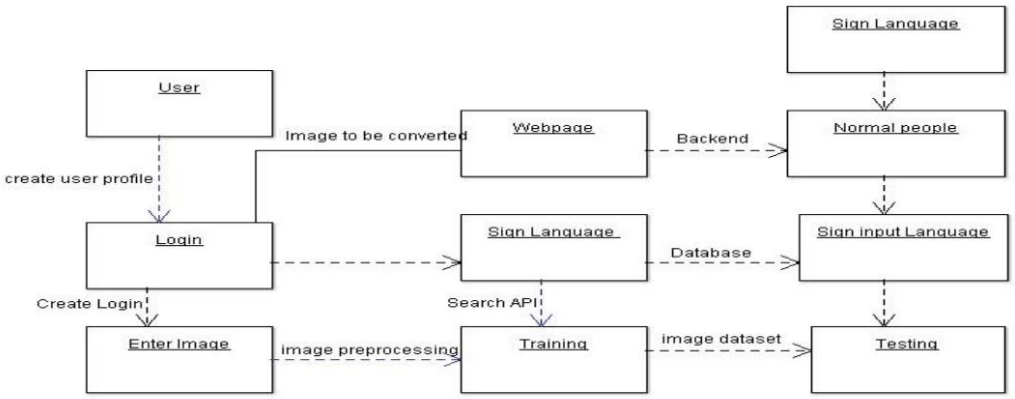
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	• Visual and Audio Help • Text size scaling • Reverse contrast
NFR-2	Security	Important information: • Walking in single file or in narrow space. • Steps, Stairs and Slope.
NFR-3	Reliability	To determine reliability measures are: • Test-Retest Repeatability • Individual Repeatability
NFR-4	Performance	To determine predictors of success in reading with low vision aids, in terms of reading acuity, optimum acuity reserve, and maximum reading speed, for observers with low vision for various causes
NFR-5	Availability	Lack of adequate low vision services and barriers to their provision and uptake impact negatively on efforts to prevent visual impairment and blindness
NFR-6	Scalability	There is a large selection of device to help people with low vision. Some are "Optical", glass lenses such as magnifying glasses and telescopes.

5. PROJECT DESIGN

a. Data Flow Diagram

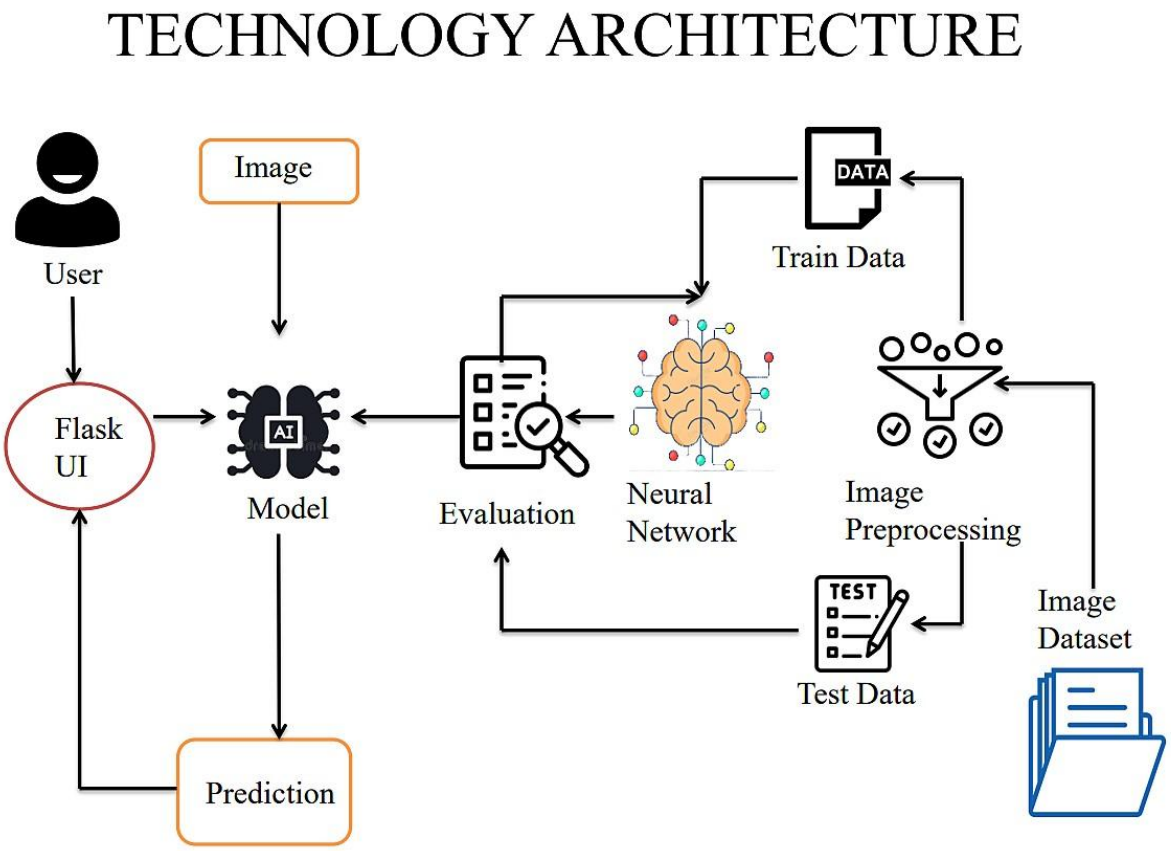
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information.

:



Dataflow Diagram

b. Solution & Technical Architecture



c. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Low vision)	Registration	USN-1	As a user, who has trouble reading due to low vision, I want to be able to make the text larger on the screen so that I can read it.	I can access my account / dashboard	High	Sprint-1
Customer (Color blindness)		USN-2	As a user, who is color blind ,I want to have access to information conveyed in color so that, I do not miss anything and I understand the content.	I can receive confirmation email & click confirm	High	Sprint-1
Customer (Impaired user)		USN-3	As a user, who is hearing-mpaired, Iwant a transcript of the spoken audio so that I can have access to all information provided in audio clips	I can register & access the dashboard with Facebook Login	Low	Sprint-2

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

Project Planning Phase

Project Planning (Product Backlog, Sprint Planning, Stories, Story points)

Date	22 October 2022
Team ID	PNT2022TMID06853
Project Name	Real-Time Communication System Powered by AI for Specially Abled
Maximum Marks	8 Marks

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect Dataset	2	High	ITOKI,JATIN, RENATHUNG, KRISHNAN
Sprint-1		USN-2	Collect Key points using Media Pipe Holistic	1	High	ITOKI,JATIN, RENATHUNG, KRISHNAN
Sprint-2	Build of the model	USN-3	Model initialisation with required layers	2	High	ITOKI,JATIN, RENATHUNG,KRISHNAN
Sprint-2		USN-4	Training model using LSTM from key points collected	2	Medium	ITOKI,JATIN, RENATHUNG, KRISHNAN
Sprint-3	Testing the model	USN-5	Testing the model's performance	10	High	ITOKI,JATIN, RENATHUNG,KRISHNAN
Sprint-4	Implementation of speech feature	USN-6	Converting text to speech using Google API(Any API)	10	Medium	ITOKI,JATIN, RENATHUNG,KRISHNAN

b. Sprint Delivery Schedule

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

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	10	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	5	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	6	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	6	19 Nov 2022

Velocity:

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

Average Velocity = 6/10 = 0.6

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.

BURNDOWN CHART			
Sprint	**Date**	**Estimated Effort**	**Actual Effort**
Sprint - 1	24 – Oct - 2022	20	20
	25 – Oct - 2022	19	20
	26 – Oct - 2022	18	19
	27 – Oct - 2022	17	19
	28 – Oct - 2022	17	18
Sprint - 2	29 – Oct - 2022	16	17
	30 – Oct - 2022	15	15

	[illegible]	[illegible]	[illegible]
	31 – Oct - 2022	14	13
	01 – Nov - 2022	13	12
	02 – Nov - 2022	12	11
	03 – Nov - 2022	11	11

Sprint - 3	04 – Nov - 2022	11	11
	05 – Nov - 2022	10	9
	06 – Nov - 2022	9	8
	07 – Nov - 2022	8	7
	08 – Nov - 2022	7	6

	08 – Nov - 2022	7	6
	09 – Nov - 2022	6	6
Sprint - 4	10 – Nov - 2022	5	5
	11 – Nov - 2022	5	5
	12 – Nov - 2022	5	4
	13 – Nov - 2022	4	3
	14 – Nov - 2022	3	2
	15 – Nov - 2022	2	2
	16 – Nov - 2022	1	2
	17– Nov - 2022	1	1
	18 – Nov - 2022	1	1

Burndown Chart:

c. Reports from JIRA

7. RESULTS

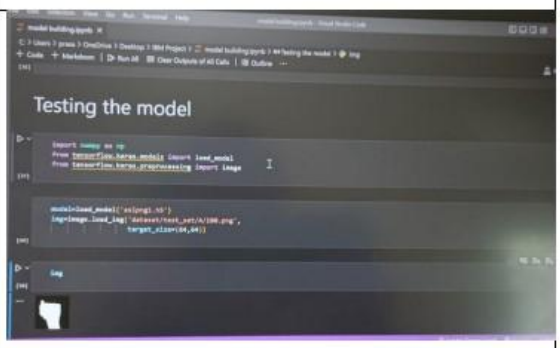
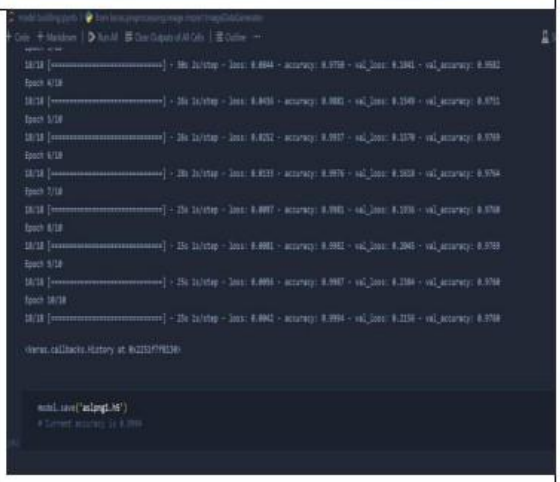
a. Performance Metrics

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 recognise the equivalent Alphabet is shown

on the screen.

Model Performance Testing:

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

S.No.	Parameter	Values	Screenshot
1.	Model Testing	-	
2.	Accuracy	Training Accuracy - Validation Accuracy -	

8.ADVANTAGES & DISADVANTAGES

Advantages:

1.It is possible to create a mobile application to bridge the communication gap between deaf and dumb persons and the general public.

2.As different sign language standards exist, their dataset can be added, and the user can choose which sign language to read.

Disadvantages:

1. The current model only works from alphabets A to I.

2.In absence of gesture recognition, alphabets from J cannot be identified as they require some kind of gesture input from the user.

3.As the quantity/quality of images in the dataset is low, the accuracy is not great, but that can easily be improved by change in dataset.

9.CONCLUSION

Sign language is a useful tool for facilitating communication between deaf and hearing people. Because it allows for two-way communication, the system aims to bridge the communication gap between deaf people and the rest of society. The proposed methodology translates language into English alphabets that are understandable to humans.

This system sends hand gestures to the model, who recognizes them and displays the equivalent Alphabet on the screen. Deaf and dumb people can use

their hands to perform sign language, which will then be converted into alphabets

it is easy to understand

10. FUTURE SCOPE

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

11. APPENDIX

Source Code for Model Training and Saving:

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

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

In [3]:
```
x_train = train_datagen.flow_from_directory('dataset/training_set',target_size=(64,64),batch_size=900, class_mode='categorical',
x_test = test_datagen.flow_from_directory('dataset/test_set',target_size=(64,64),batch_size=900, class_mode='categorical', color_
```

```
Found 15750 images belonging to 9 classes.
Found 2250 images belonging to 9 classes.
```

In [5]:
```
x_train.class_indices
```

Out[5]:
```
{'A': 0, 'B': 1, 'C': 2, 'D': 3, 'E': 4, 'F': 5, 'G': 6, 'H': 7, 'I': 8}
```

In [31]:
```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

In [32]:
```
# Creating Model
model=Sequential()
```

In [33]:
```
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,1)))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())

# Adding Hidden Layers
model.add(Dense(300,activation='relu'))
model.add(Dense(512,activation='relu'))

# Adding Output Layer
model.add(Dense(9,activation='softmax'))
```

In [34]:
```
# Compiling the Model
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

In [35]:
```
# Fitting the Model Generator
model.fit(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))
```

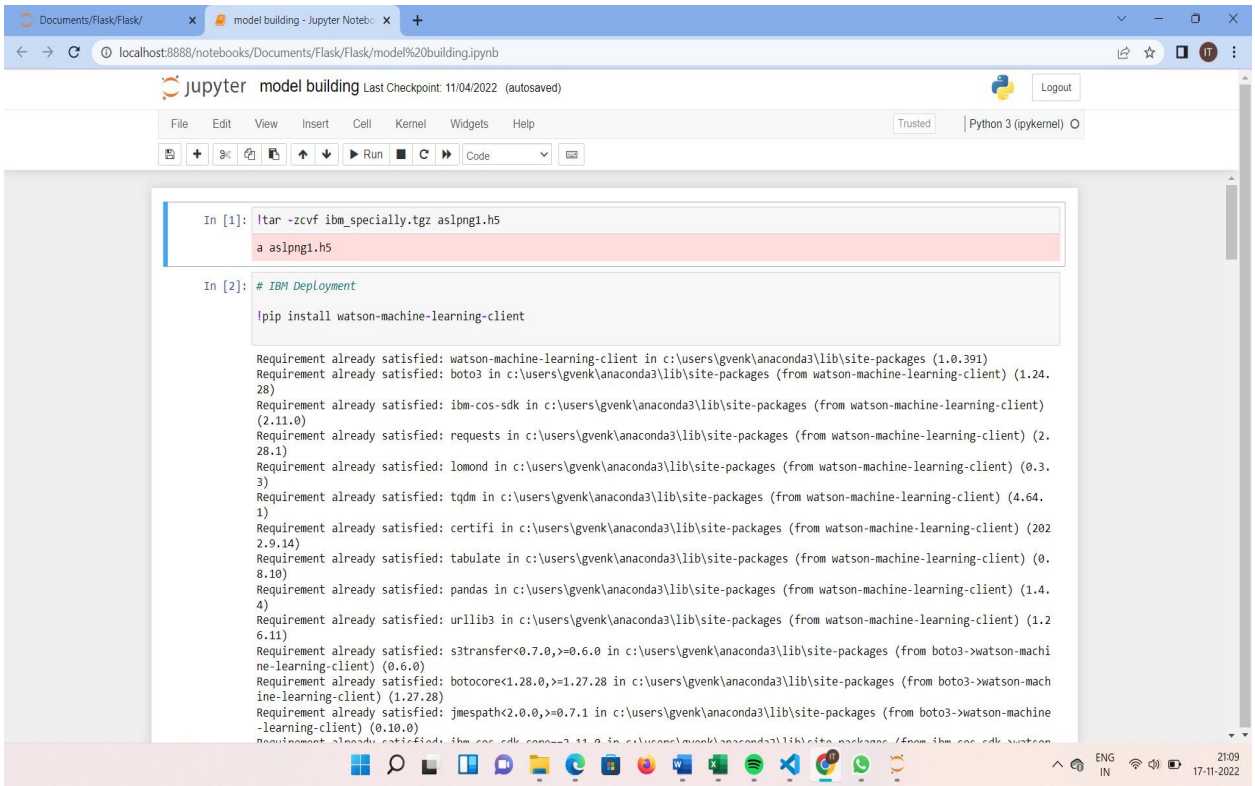
```
Epoch 1/10
18/18 [==============================] - 35s 2s/step - loss: 0.8970 - accuracy: 0.6950 - val_loss: 0.3145 - val_accuracy: 0.898
7
Epoch 2/10
18/18 [==============================] - 38s 2s/step - loss: 0.1944 - accuracy: 0.9416 - val_loss: 0.2033 - val_accuracy: 0.944
0
Epoch 3/10
18/18 [==============================] - 30s 2s/step - loss: 0.0844 - accuracy: 0.9750 - val_loss: 0.1841 - val_accuracy: 0.958
2
```

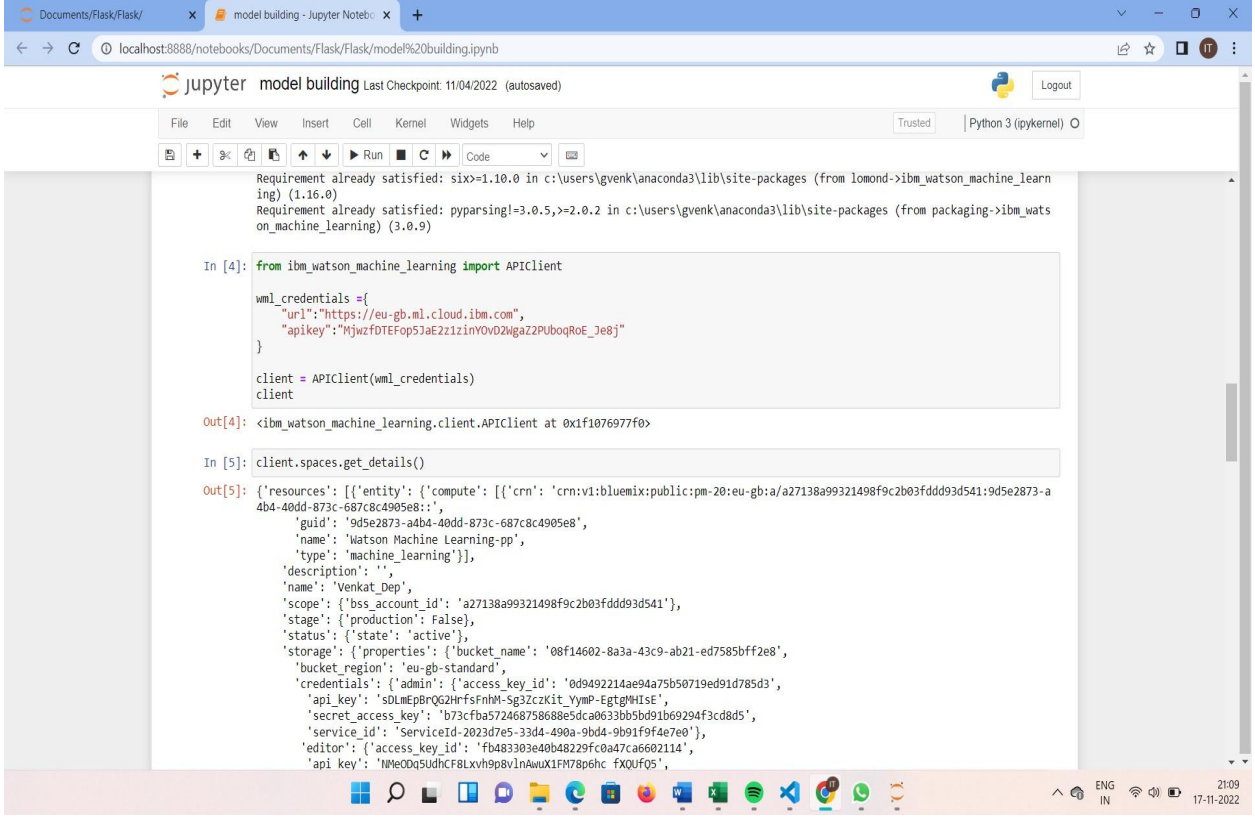
```
18/18 [==============================] - 38s 2s/step - loss: 0.1944 - accuracy: 0.9416 - val_loss: 0.2033 - val_accuracy: 0.944
0
Epoch 3/10
18/18 [==============================] - 30s 2s/step - loss: 0.0844 - accuracy: 0.9750 - val_loss: 0.1841 - val_accuracy: 0.958
2
Epoch 4/10
18/18 [==============================] - 26s 1s/step - loss: 0.0436 - accuracy: 0.9881 - val_loss: 0.1549 - val_accuracy: 0.975
1
Epoch 5/10
18/18 [==============================] - 26s 1s/step - loss: 0.0252 - accuracy: 0.9937 - val_loss: 0.1570 - val_accuracy: 0.976
9
Epoch 6/10
18/18 [==============================] - 28s 2s/step - loss: 0.0133 - accuracy: 0.9976 - val_loss: 0.1618 - val_accuracy: 0.976
4
Epoch 7/10
18/18 [==============================] - 25s 1s/step - loss: 0.0097 - accuracy: 0.9981 - val_loss: 0.1936 - val_accuracy: 0.976
0
Epoch 8/10
18/18 [==============================] - 25s 1s/step - loss: 0.0081 - accuracy: 0.9982 - val_loss: 0.2045 - val_accuracy: 0.976
9
Epoch 9/10
18/18 [==============================] - 25s 1s/step - loss: 0.0056 - accuracy: 0.9987 - val_loss: 0.2384 - val_accuracy: 0.976
0
Epoch 10/10
18/18 [==============================] - 25s 1s/step - loss: 0.0042 - accuracy: 0.9994 - val_loss: 0.2156 - val_accuracy: 0.976
0
```

Out[35]: <keras.callbacks.History at 0x2251f7f8130>

In [36]:
```
model.save('aslpng1.h5')
# Current accuracy is 0.9994
```

IBM Model Training & Download Code:




Documents/Flask/Flask/
model building - Jupyter Noteb
localhost:8888/notebooks/Documents/Flask/Flask/model%20building.ipynb
jupyter model building Last Checkpoint: 11/04/2022 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
Run
Code
Requirement already satisfied: six>=1.10.0 in c:\users\gvenk\anaconda3\lib\site-packages (from lomond->ibm_watson_machine_learning) (1.16.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in c:\users\gvenk\anaconda3\lib\site-packages (from packaging->ibm_watson_machine_learning) (3.0.9)
In [4]:
from ibm_watson_machine_learning import APIClient
wml_credentials ={
"url":"https://eu-gb.ml.cloud.ibm.com",
"apikey":"MjwzfDTEFop5JaE2z1zinYOvD2WgaZ2PUboqRoE_Je8j"
}
client = APIClient(wml_credentials)
client
Out[4]:
<ibm_watson_machine_learning.client.APIClient at 0x1f1076977f0>
In [5]:
client.spaces.get_details()
Out[5]:
{'resources': [{'entity': {'compute': [{'crn': 'crn:v1:bluemix:public:pm-20:eu-gb:a/a27138a99321498f9c2b03fddd93d541:9d5e2873-a4b4-40dd-873c-687c8c4905e8::',
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'type': 'machine_learning'}],
'description': '',
'name': 'Venkat_Dep',
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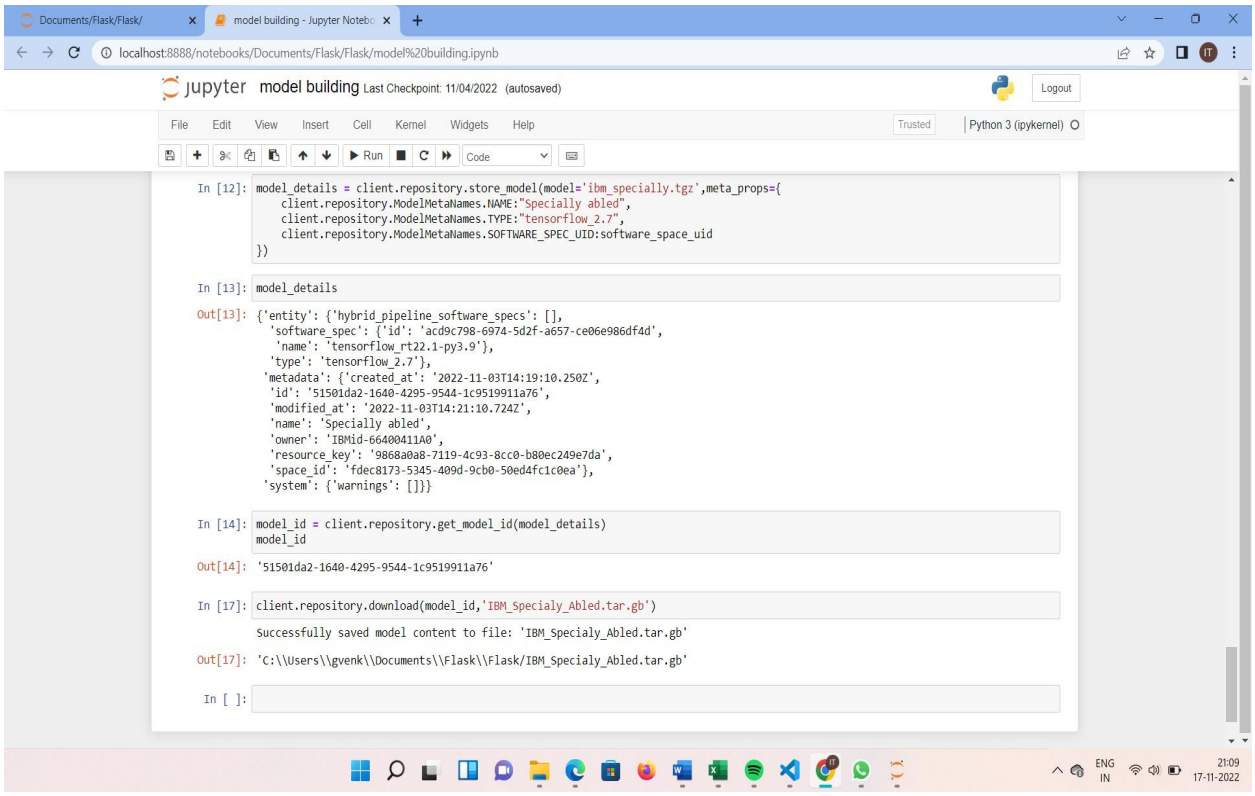
ENG IN
21:09
17-11-2022


Documents/Flask/Flask/
model building - Jupyter Noteb
localhost:8888/notebooks/Documents/Flask/Flask/model%20building.ipynb
jupyter model building Last Checkpoint: 11/04/2022 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
Run
Code
In [12]:
model_details = client.repository.store_model(model='ibm_specially.tgz',meta_props={
client.repository.ModelMetaNames.NAME:"Specially abled",
client.repository.ModelMetaNames.TYPE:"tensorflow_2.7",
client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_space_uid
})
In [13]:
model_details
Out[13]:
{'entity': {'hybrid_pipeline_software_specs': [],
'software_spec': {'id': 'acd9c798-6974-5d2f-a657-ce06e986df4d',
'name': 'tensorflow_rt22.1-py3.9'},
'type': 'tensorflow_2.7'},
'metadata': {'created_at': '2022-11-03T14:19:10.250Z',
'id': '51501da2-1640-4295-9544-1c9519911a76',
'modified_at': '2022-11-03T14:21:10.724Z',
'name': 'Specially abled',
'owner': 'IBMid-66400411A0',
'resource_key': '9868a0a8-7119-4c93-8cc0-b80ec249e7da',
'space_id': 'fdec8173-5345-409d-9cb0-50ed4fc1c0ea'},
'system': {'warnings': []}}
In [14]:
model_id = client.repository.get_model_id(model_details)
model_id
Out[14]:
'51501da2-1640-4295-9544-1c9519911a76'
In [17]:
client.repository.download(model_id,'IBM_Specialy_Abled.tar.gb')
Successfully saved model content to file: 'IBM_Specialy_Abled.tar.gb'
Out[17]:
'C:\\Users\\gvenk\\Documents\\Flask\\Flask/IBM_Specialy_Abled.tar.gb'
In [ ]:
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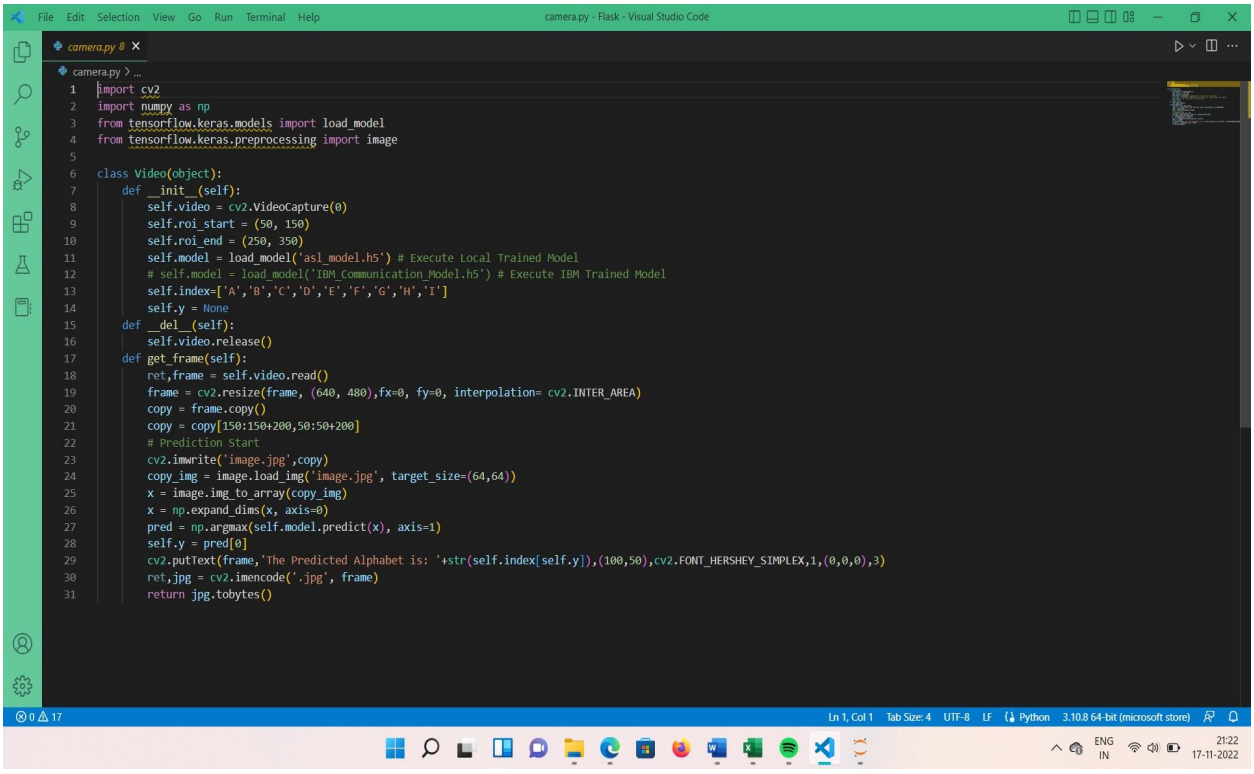
Web app Code:


File Edit Selection View Go Run Terminal Help
camera.py - Flask - Visual Studio Code
camera.py 8
camera.py > ...
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):
self.video.release()
def get_frame(self):
ret,frame = self.video.read()
frame = cv2.resize(frame, (640, 480),fx=0, fy=0, interpolation= cv2.INTER_AREA)
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]),(100,50),cv2.FONT_HERSHEY_SIMPLEX,1,(0,0,0),3)
ret,jpg = cv2.imencode('.jpg', frame)
return jpg.tobytes()
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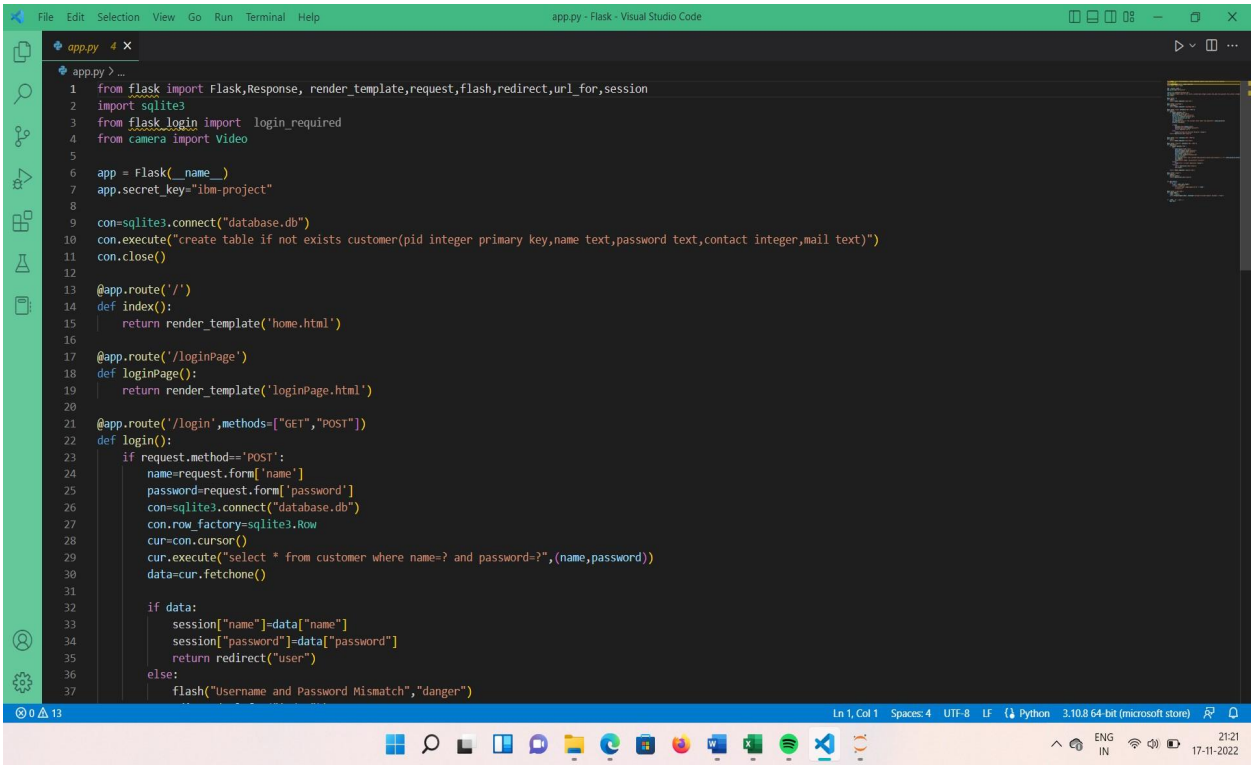
File Edit Selection View Go Run Terminal Help
app.py - Flask - Visual Studio Code
app.py 4
app.py > ...
from flask import Flask,Response, render_template,request,flash,redirect,url_for,session
import sqlite3
from flask_login import login_required
from camera import Video
app = Flask(__name__)
app.secret_key="ibm-project"
con=sqlite3.connect("database.db")
con.execute("create table if not exists customer(pid integer primary key,name text,password text,contact integer,mail text)")
con.close()
@app.route('/')
def index():
return render_template('home.html')
@app.route('/loginPage')
def loginPage():
return render_template('loginPage.html')
@app.route('/login',methods=["GET","POST"])
def login():
if request.method=='POST':
name=request.form['name']
password=request.form['password']
con=sqlite3.connect("database.db")
con.row_factory=sqlite3.Row
cur=con.cursor()
cur.execute("select * from customer where name=? and password=?",(name,password))
data=cur.fetchone()
if data:
session["name"]=data["name"]
session["password"]=data["password"]
return redirect("user")
else:
flash("Username and Password Mismatch","danger")
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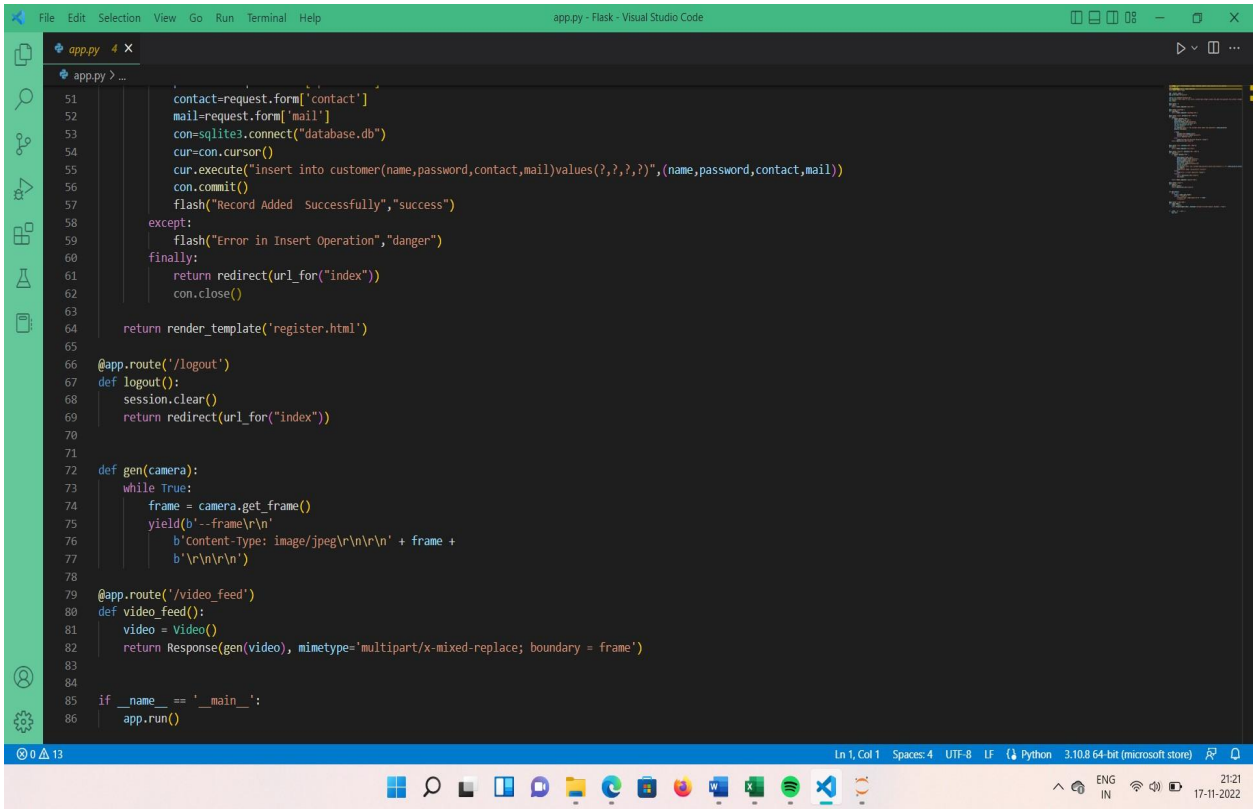

Github link : https://github.com/IBM-EPBL/IBM-Project-3904-1658670533

Video link : https://drive.google.com/drive/folders/1PStlIT2rO0_VoLJM-Do_rciUVj-zhKww?usp=sharing