Real-Time Communication System Powered by AI for Specially Abled

Submitted By

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Team Member 4:Zoe Saral D

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1. INTRODUCTION

1.1-Overview

Despite the prevalence of persons with disabilities in our society and the ongoing advancement of technology, not much is being done to make their lives better. It has never been easy to converse with a deaf-mute person. Since hand sign language is not taught to the general population, it might be difficult for silent people to communicate with non-mute people. They find it difficult to communicate during emergencies. The human hand has continued to be a popular alternative for information transfer in situations where voice or other modes of communication are impractical. A conversion system with hand gesture recognition and translation will enable effective communication between a normal person and a person with a disability in any language.

1.2-Purpose

Sharing opinions, ideas, and experiences with those around them helps people get to know one another. The goal of the project is to develop a system that converts sign language into a language that can be understood by humans so that everyone can use it.

Our project intends to create a system that can translate speech into acceptable sign language for the deaf and dumb as well as translate sign language into a human hearing voice in the desired language to communicate a message to normal people. A convolution neural network is being used to build a model that is trained on various hand motions. On the basis of this model, an app is created. With the help of this app, persons who are deaf or dumb can communicate using signs that are translated into languages that can be understood by others and then output as images.

2. LITERATURE SURVEY

2.1-Existing problem

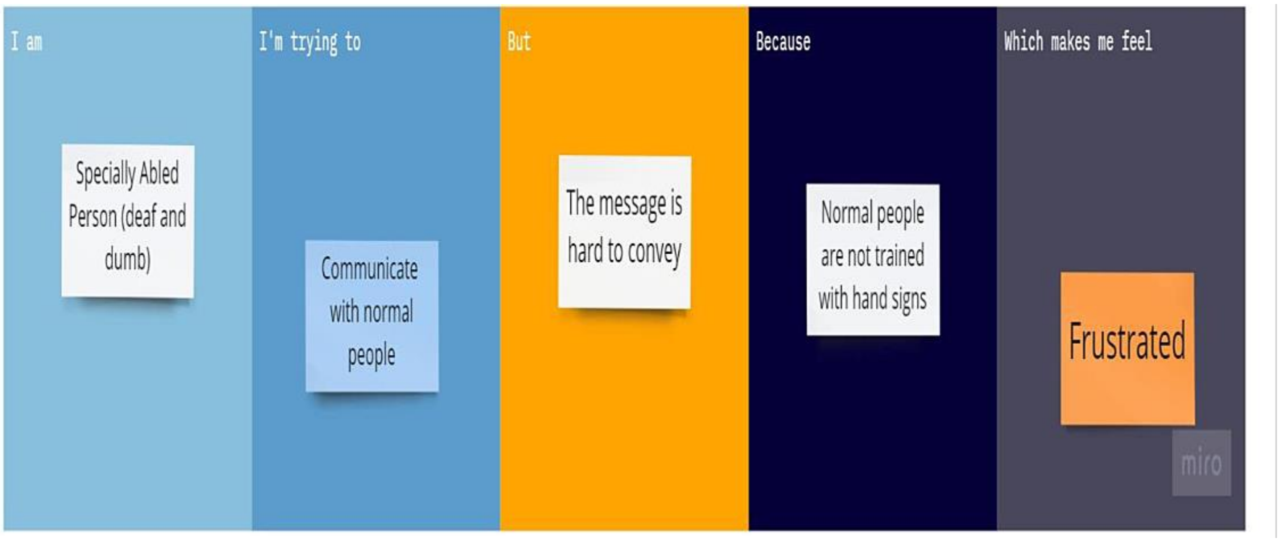
Every day, millions of people with hearing and speech disabilities use sign languages to communicate. Similar to how voice recognition is for other people, gesture recognition is a natural means of communication for hearing-impaired people. However, there is a problem with translating or translating sign language to text, and a better approach based on machine learning techniques is not available.

Wired gloves use light pulses that, when the fingers are bent, allow light to escape through the tiny crack and cause a loss of light to be detected. This technology is very expensive. The type and level of resolution utilised in the camera to collect sign language has an overall impact on the model created for translation, which is another major downside that contributes to lack of robustness. The technology that was built in many scenarios could only recognize a small number of languages, such as British, German, French, and Greek.

2.2-References

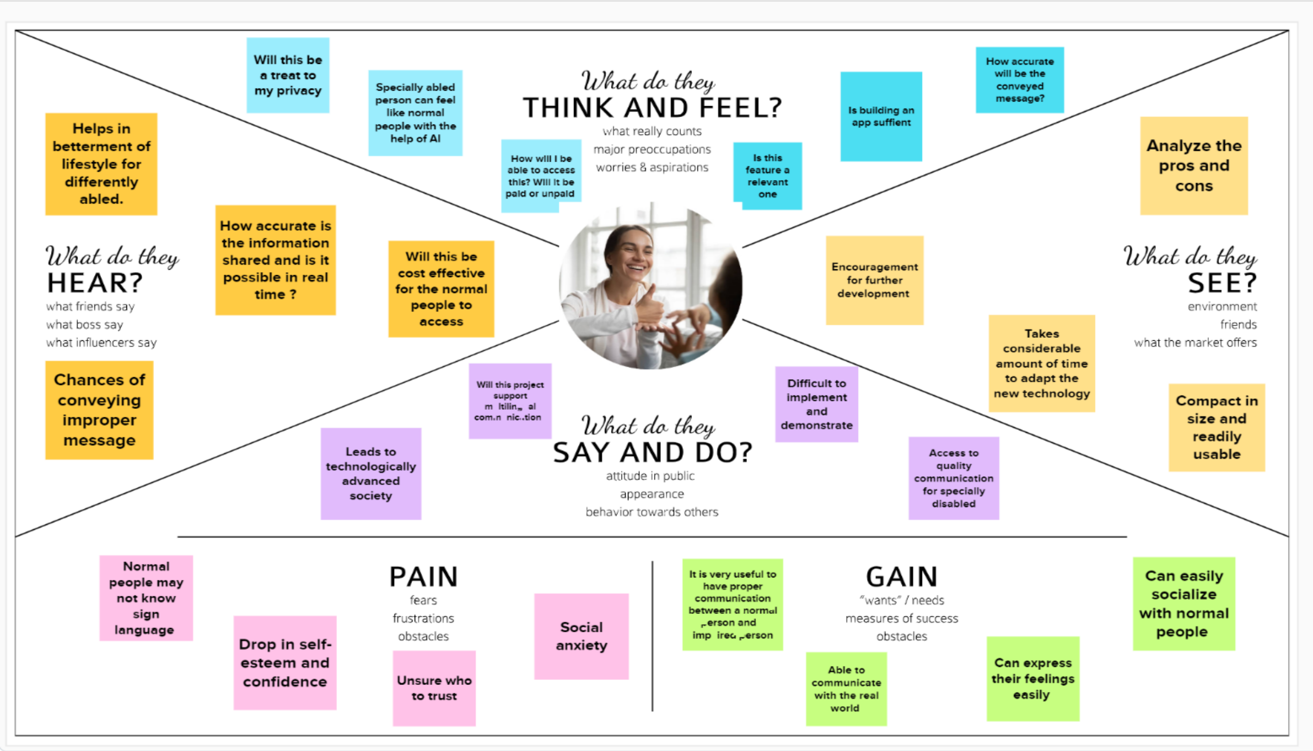
- Real-time sign language fingerspelling recognition using convolutional neural networks from depth map- Byeongkeun Kang, Truong Q. Nguyen, Subarna Tripathi.
- Sign Language Recognition using Deep Learning- Dhruv Sood
- Sign Language to Text and Speech Translation in Real Time Using Convolutional Neural Network- Ankit Ojha, Ayush Pandey, Shubham Maurya, Abhishek Thakur, Dr. Dayananda P.
- Sign Language Translator Using Deep Learning Techniques- Supriya Krishnamurthi, Indiramma M.

2.3 -Problem Statement Definition

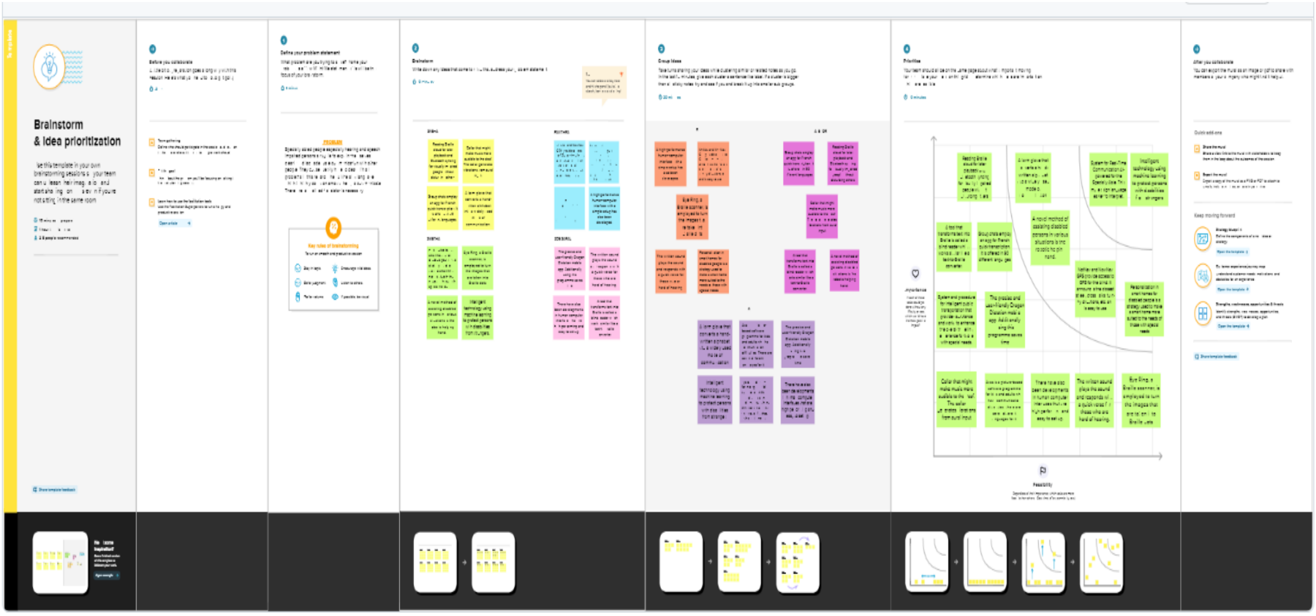

I am
Specially Abled Person (deaf and dumb)
I'm trying to
Communicate with normal people
But
The message is hard to convey
Because
Normal people are not trained with hand signs
Which makes me feel
Frustrated
miro

3. IDEATION & PROPOSED SOLUTION

3.1-Empathy Map Canvas


What do they
THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations
Will this be a treat to my privacy
Specially abled person can feel like normal people with the help of AI
How will I be able to access this? Will it be paid or unpaid
Is this feature a relevant one
Is building an app suffient
How accurate will be the conveyed message?
What do they
HEAR?
what friends say
what boss say
what influencers say
Helps in betterment of lifestyle for differently abled.
How accurate is the information shared and is it possible in real time ?
Will this be cost effective for the normal people to access
Chances of conveying improper message
What do they
SEE?
environment
friends
what the market offers
Analyze the pros and cons
Encouragement for further development
Takes considerable amount of time to adapt the new technology
Compact in size and readily usable
What do they
SAY AND DO?
attitude in public
appearance
behavior towards others
Will this project support multilingual communication
Leads to technologically advanced society
Difficult to implement and demonstrate
Access to quality communication for specially disabled
PAIN
fears
frustrations
obstacles
Normal people may not know sign language
Drop in self-esteem and confidence
Unsure who to trust
Social anxiety
GAIN
"wants" / needs
measures of success
obstacles
It is very useful to have proper communication between a normal person and impaired person
Able to communicate with the real world
Can express their feelings easily
Can easily socialize with normal people

3.2- Ideation & Brainstorming

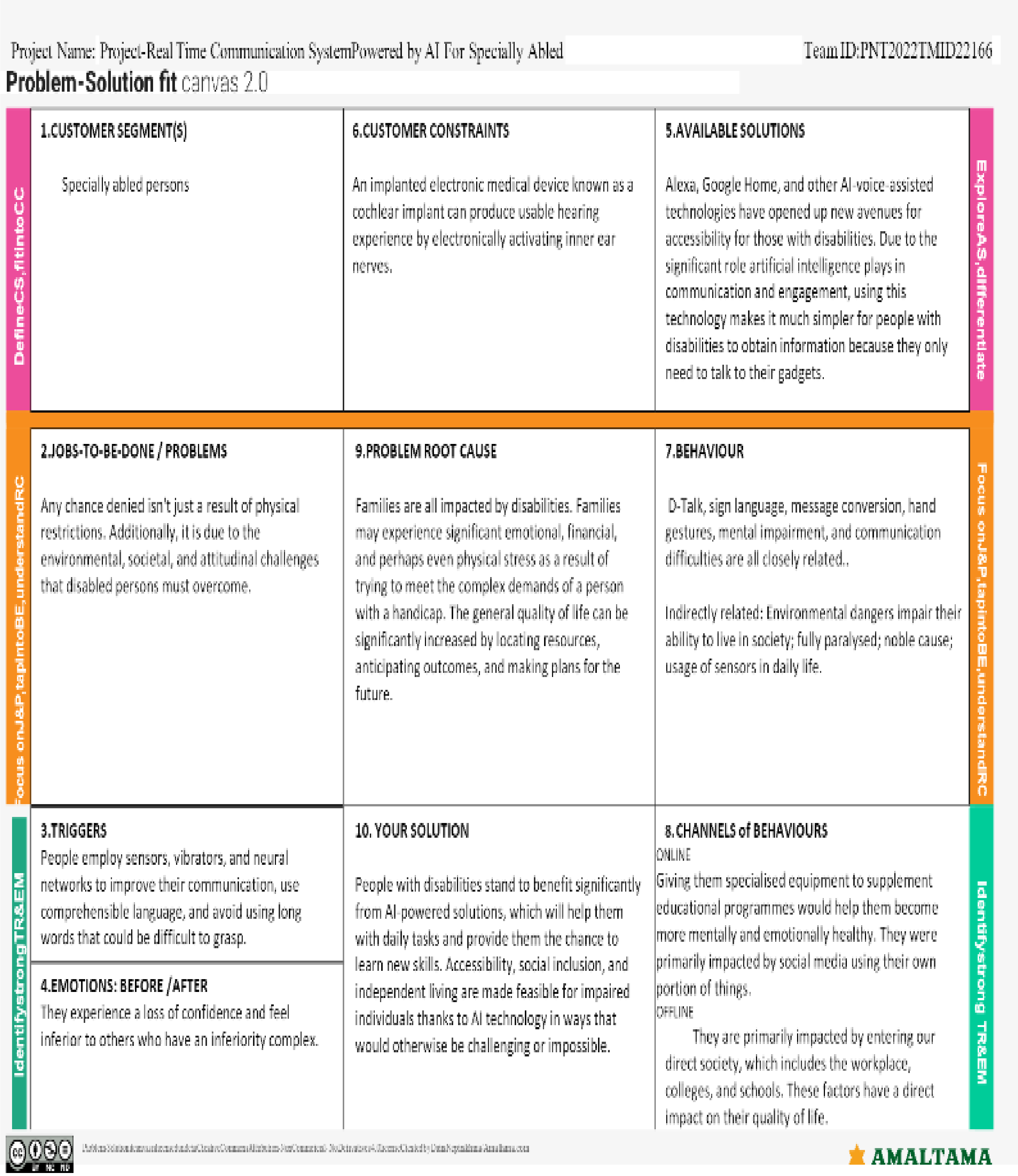


3.3 -Proposed Solution

S.No	Parameter	Description
1	Problem Statement (Problem to be solved)	Individuals with intellectual disabilities have different communication philosophies. Others employ non-verbal communication techniques including gestures, vocalisations, or even eye movements in addition to spoken or sign language. However, there may be difficulties with general communication between you and the individual with the intellectual disability as a health care provider. It is quite challenging for silent persons to communicate with non-mute people. Given that the average person is not trained in hand sign language. It might be quite challenging for them to communicate at times of crisis
2	Idea / Solution description	This initiative enables those who are deaf or dumb to use sign language to interact with the rest of the world. It also turns speech into understandable sign language for the deaf and dumb, converting sign language into a human hearing voice in the chosen language to communicate a message to ordinary people. Web cameras are used to capture the signs.A convolution neural network is being used to build a model that is trained on various hand motions. With the help of this

		app, persons who are deaf or dumb can communicate using signs that are translated into speech and human-understandable words.
3.	Novelty / Uniqueness	This software is specifically created for anyone to comprehend sign language, enabling them to assist those who are incapacitated in an emergency. In order to help persons who are deaf or hard of hearing in an emergency, this software is specifically made for those who wish to comprehend sign language.
4.	Social Impact / Customer Satisfaction	Disability-related social marginalisation results in a lack of social integration in a particular setting. A person with a disability could have trouble connecting with family members, coworkers at work, and students. The result of exclusion is that a person with a disability may not have the social support they need or the social skills they need to deal with their impairment, such as communication. We created a path for the deaf person to effortlessly use this application. . Using signs that are translated into speech and understandable language, it allows persons who are deaf or dumb to communicate. supplied as a result
5.	Business Model (Revenue Model)	The financial advantages of this project include a few methodologies, such as the chance for risk sharing, reducing the debt capacity, releasing free cash flow, and maintaining a competitive advantage in a market that is competitive. This project also offers an improved facility for making things more simple, effective, and efficient.
6.	Scalability of the Solution	The functional needs and how they affect society are addressed by the scalability of a solution. The project's potential to grow depends on how well it can adapt to changes in application and system processing requirements in terms of cost and performance.

3.4- Problem Solution fit



Project Name: Project-Real Time Communication SystemPowered by AI For Specially Abled

Team ID:PNT2022TMID22166

Problem-Solution fit canvas 2.0

DefineCS,fitintoCC

1.CUSTOMER SEGMENT(S)

Specially abled persons

6.CUSTOMER CONSTRAINTS

An implanted electronic medical device known as a cochlear implant can produce usable hearing experience by electronically activating inner ear nerves.

5.AVAILABLE SOLUTIONS

Alexa, Google Home, and other AI-voice-assisted technologies have opened up new avenues for accessibility for those with disabilities. Due to the significant role artificial intelligence plays in communication and engagement, using this technology makes it much simpler for people with disabilities to obtain information because they only need to talk to their gadgets.

ExploreAS,differentiate

Focus onJ&P,tapintoBE,understandRC

2.JOBS-TO-BE-DONE / PROBLEMS

Any chance denied isn't just a result of physical restrictions. Additionally, it is due to the environmental, societal, and attitudinal challenges that disabled persons must overcome.

9.PROBLEM ROOT CAUSE

Families are all impacted by disabilities. Families may experience significant emotional, financial, and perhaps even physical stress as a result of trying to meet the complex demands of a person with a handicap. The general quality of life can be significantly increased by locating resources, anticipating outcomes, and making plans for the future.

7.BEHAVIOUR

D-Talk, sign language, message conversion, hand gestures, mental impairment, and communication difficulties are all closely related..

Indirectly related: Environmental dangers impair their ability to live in society; fully paralysed; noble cause; usage of sensors in daily life.

Focus onJ&P,tapintoBE,understandRC

IdentifystrongTR&EM

3.TRIGGERS

People employ sensors, vibrators, and neural networks to improve their communication, use comprehensible language, and avoid using long words that could be difficult to grasp.

4.EMOTIONS: BEFORE /AFTER

They experience a loss of confidence and feel inferior to others who have an inferiority complex.

10. YOUR SOLUTION

People with disabilities stand to benefit significantly from AI-powered solutions, which will help them with daily tasks and provide them the chance to learn new skills. Accessibility, social inclusion, and independent living are made feasible for impaired individuals thanks to AI technology in ways that would otherwise be challenging or impossible.

8.CHANNELS of BEHAVIOURS

ONLINE

Giving them specialised equipment to supplement educational programmes would help them become more mentally and emotionally healthy. They were primarily impacted by social media using their own portion of things.

OFFLINE

They are primarily impacted by entering our direct society, which includes the workplace, colleges, and schools. These factors have a direct impact on their quality of life.

Identifystrong TR&EM

AMALTAMA

4. REQUIREMENT ANALYSIS

4.1- Functional requirement

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	Authorization levels	There are two levels of authorization namely standard access level and advanced access level.
FR-4	External interface	Ethernet, FireWire, USB.
FR-5	Reporting	Any problems with the application will automatically be reported to the developer.
FR-6	Compliance to rules or laws	Terms and conditions, Privacy policy, End user licensing agreement.

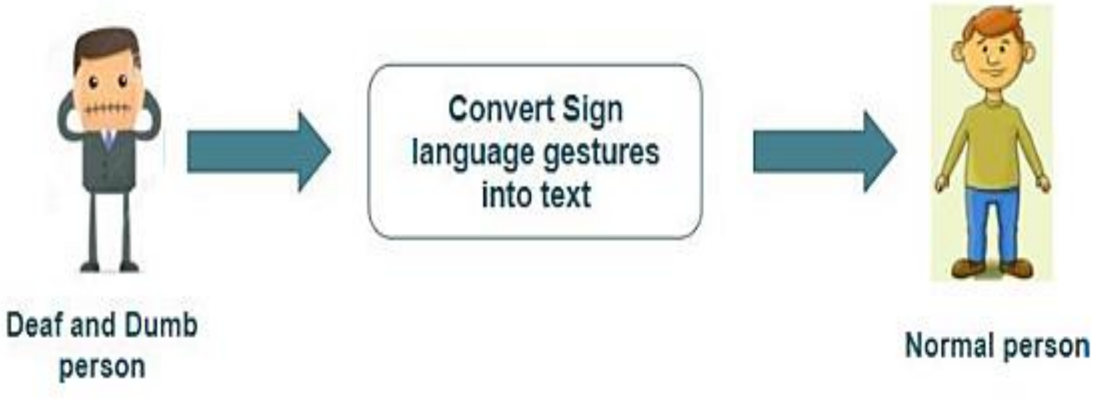
4.2- Non-Functional requirements

FR No	**Non-Functional Requirement (Epic)**	***Description***
FR-1	Usability	People with disabilities must be able to use the product
FR-2	Security	Only the user has access to information that has been translated from signs into voice.
FR-3	Reliability	Provides insight into potential problems with desktop applications on controlled devices.
FR-4	Performance	App's launch time is quicker when converting signs into speech
FR-5	Scalability	Provides automatic recovery as much as possible
FR-6	Scalability	The app's response time is quick enough to support 20,000 users at a time.

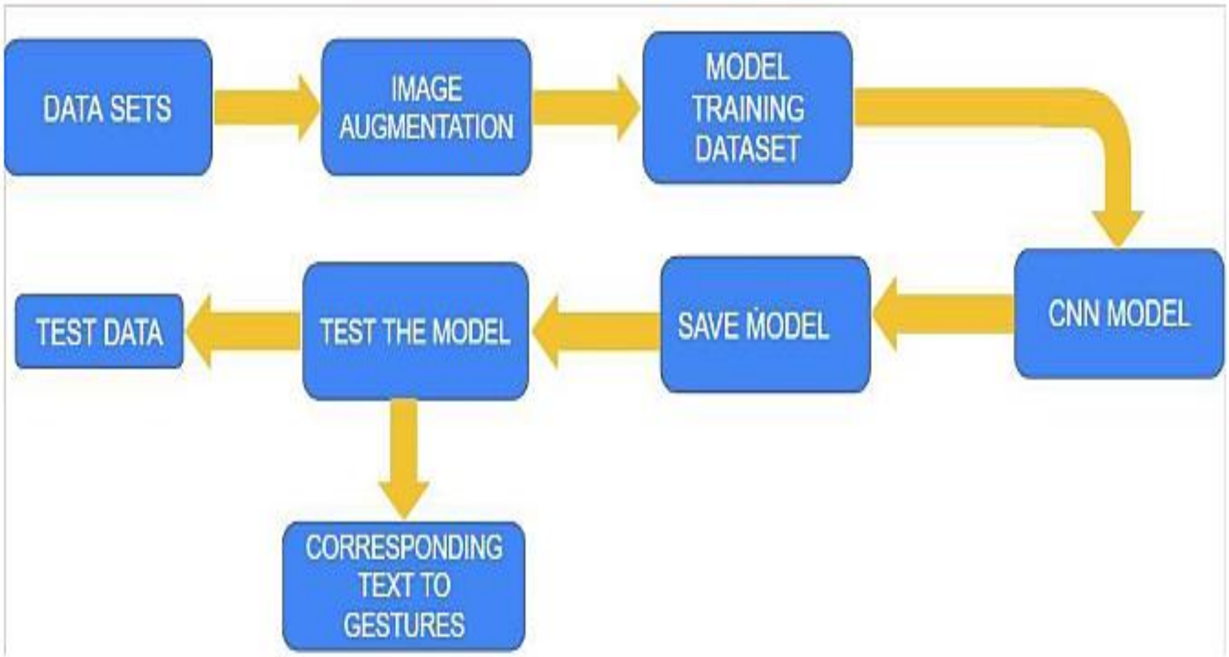
5. PROJECT DESIGN

5.1-Data Flow Diagrams

Level 0-DFD

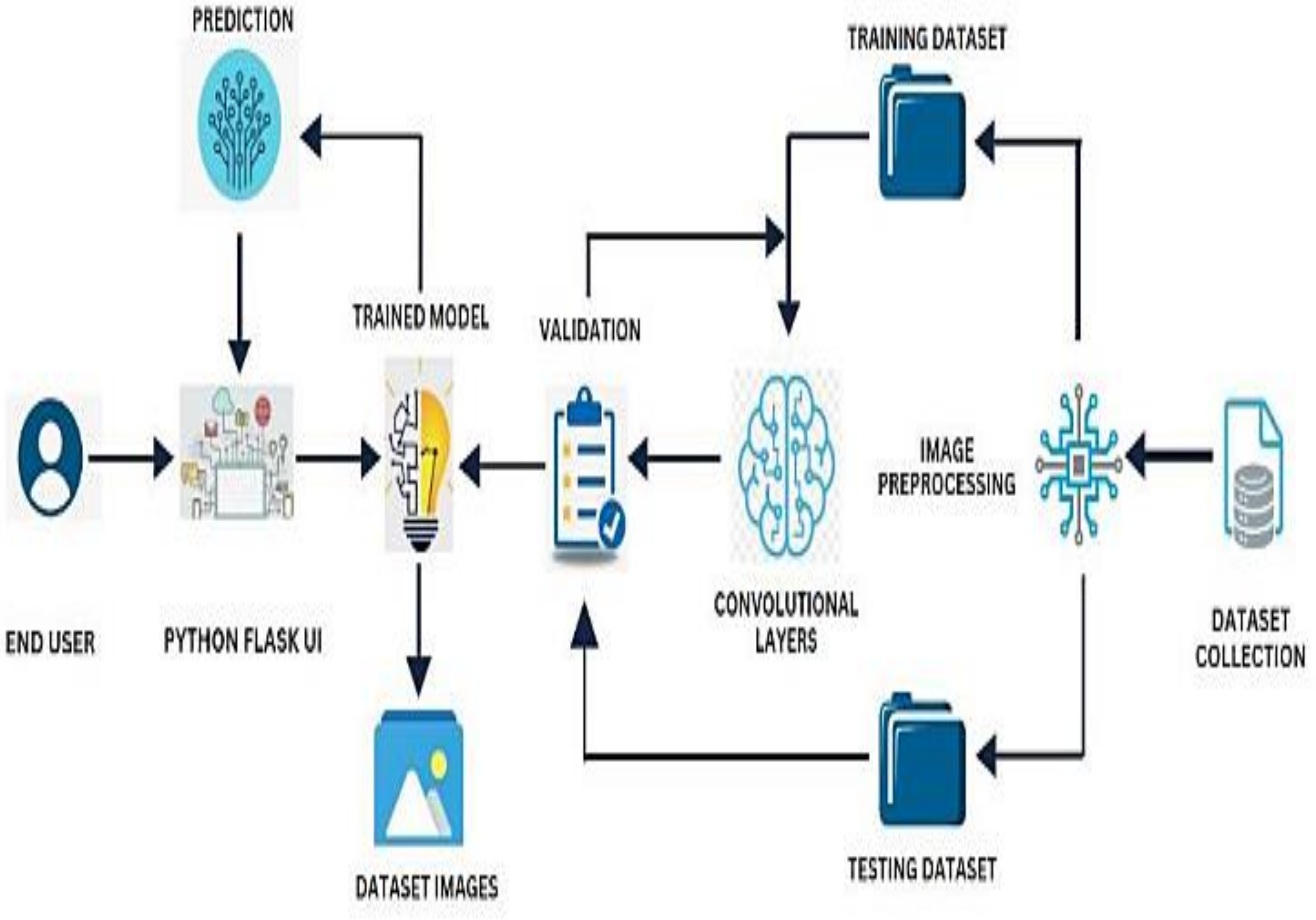


Level 1-DFD

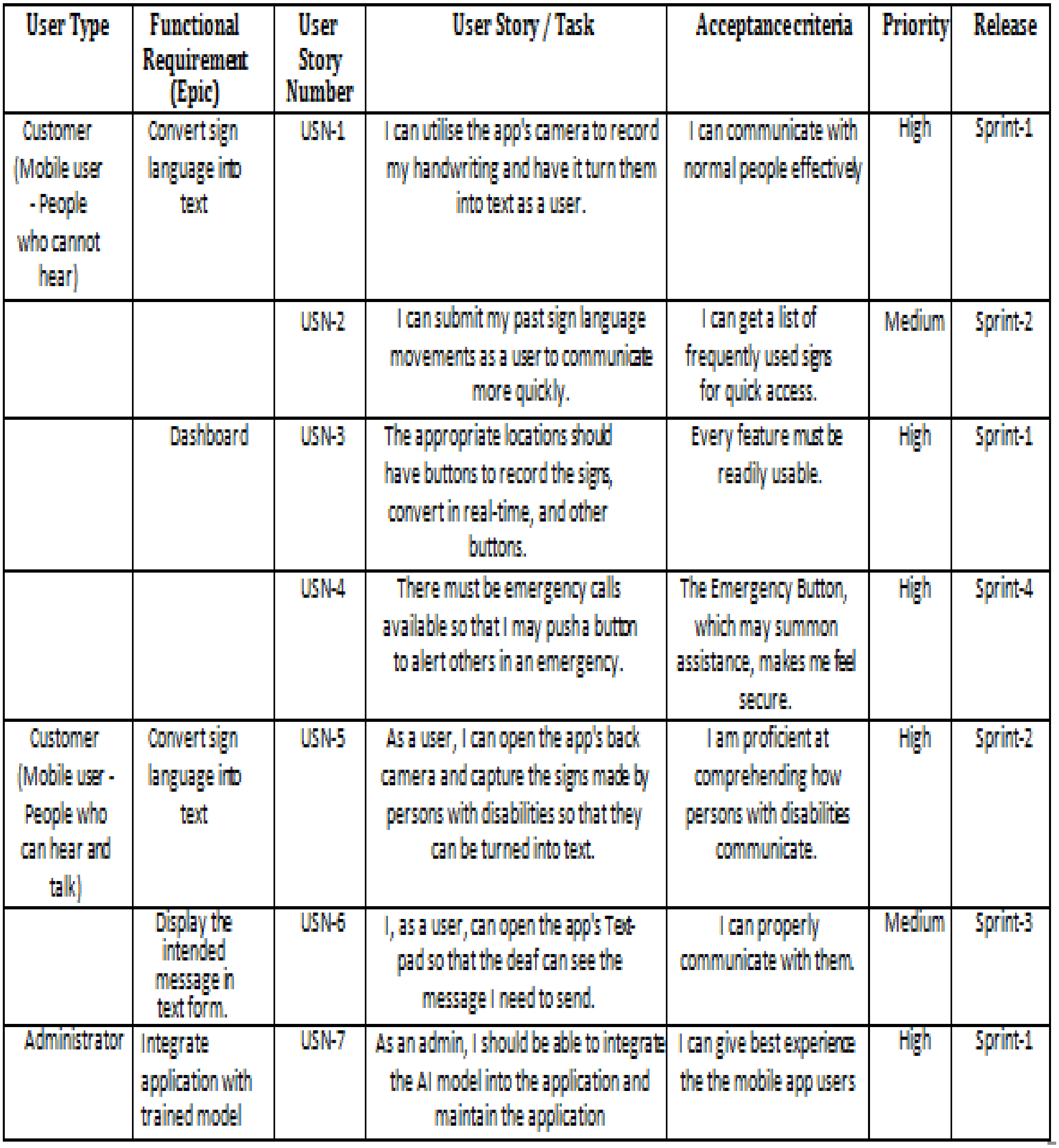


5.2 -Solution & Technical Architecture

Computer systems are designed using Technical Architecture (TA), a type of IT architecture. It entails creating a technological blueprint for the positioning, communication, and interdependence of all components in order to satisfy system-relevant requirements



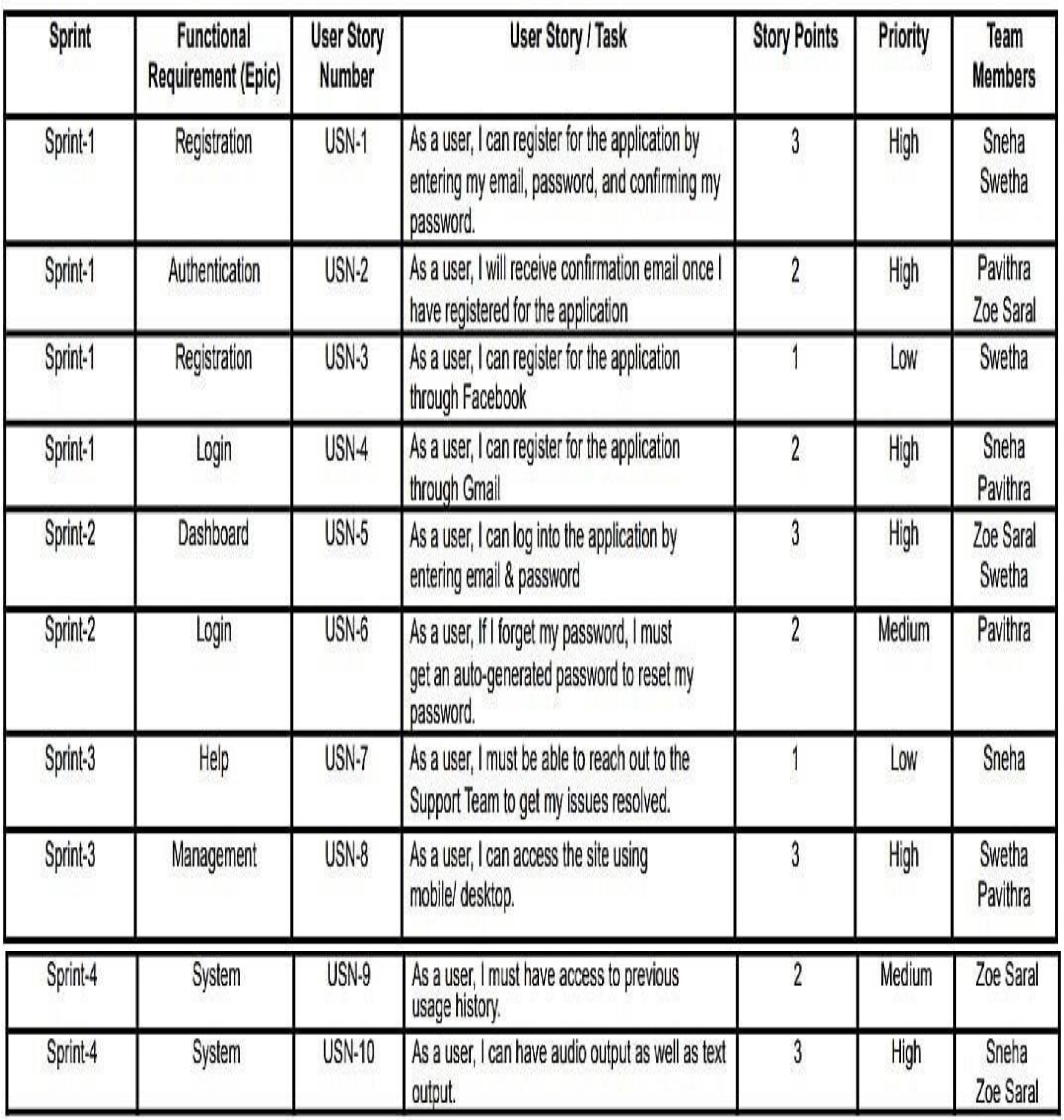
5.3 -User Stories



User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user - People who cannot hear)	Convert sign language into text	USN-1	I can utilise the app's camera to record my handwriting and have it turn them into text as a user.	I can communicate with normal people effectively	High	Sprint-1
		USN-2	I can submit my past sign language movements as a user to communicate more quickly.	I can get a list of frequently used signs for quick access.	Medium	Sprint-2
	Dashboard	USN-3	The appropriate locations should have buttons to record the signs, convert in real-time, and other buttons.	Every feature must be readily usable.	High	Sprint-1
		USN-4	There must be emergency calls available so that I may pusha button to alert others in an emergency.	The Emergency Button, which may summon assistance, makes me feel secure.	High	Sprint-4
Customer (Mobile user - People who can hear and talk)	Convert sign language into text	USN-5	As a user, I can open the app's back camera and capture the signs made by persons with disabilities so that they can be turned into text.	I am proficient at comprehending how persons with disabilities communicate.	High	Sprint-2
	Display the intended message in text form.	USN-6	I, as a user, can open the app's Text-pad so that the deaf can see the message I need to send.	I can properly communicate with them.	Medium	Sprint-3
Administrator	Integrate application with trained model	USN-7	As an admin, I should be able to integrate the AI model into the application and maintain the application	I can give best experience the the mobile app users	High	Sprint-1

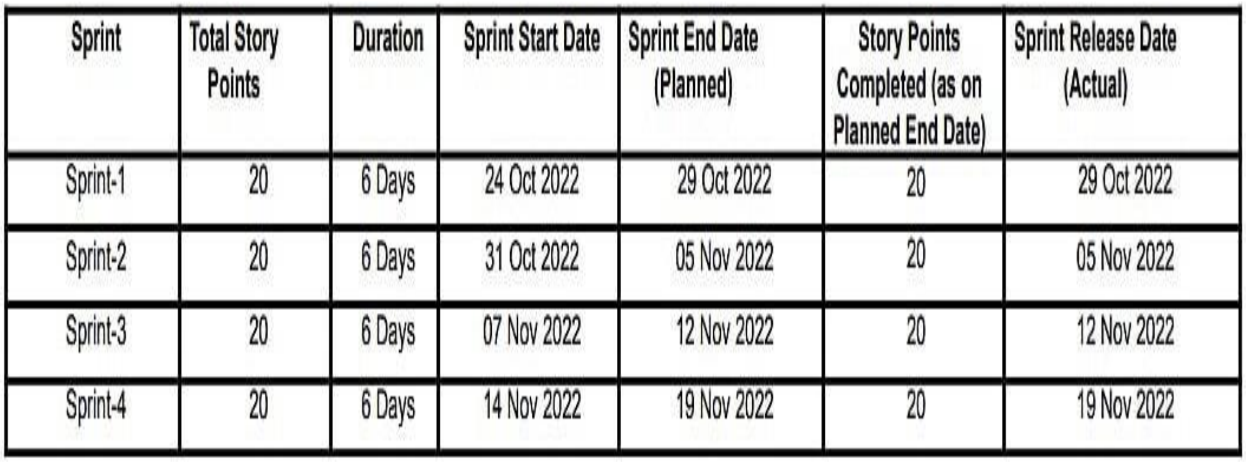
6. PROJECT PLANNING & SCHEDULING

6.1- Sprint Planning & Estimation



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.	3	High	Sneha Swetha
Sprint-1	Authentication	USN-2	As a user, I will receive confirmation email once I have registered for the application	2	High	Pavithra Zoe Saral
Sprint-1	Registration	USN-3	As a user, I can register for the application through Facebook	1	Low	Swetha
Sprint-1	Login	USN-4	As a user, I can register for the application through Gmail	2	High	Sneha Pavithra
Sprint-2	Dashboard	USN-5	As a user, I can log into the application by entering email & password	3	High	Zoe Saral Swetha
Sprint-2	Login	USN-6	As a user, If I forget my password, I must get an auto-generated password to reset my password.	2	Medium	Pavithra
Sprint-3	Help	USN-7	As a user, I must be able to reach out to the Support Team to get my issues resolved.	1	Low	Sneha
Sprint-3	Management	USN-8	As a user, I can access the site using mobile/ desktop.	3	High	Swetha Pavithra
Sprint-4	System	USN-9	As a user, I must have access to previous usage history.	2	Medium	Zoe Saral
Sprint-4	System	USN-10	As a user, I can have audio output as well as text output.	3	High	Sneha Zoe Saral

6.2 -Sprint Delivery Schedule

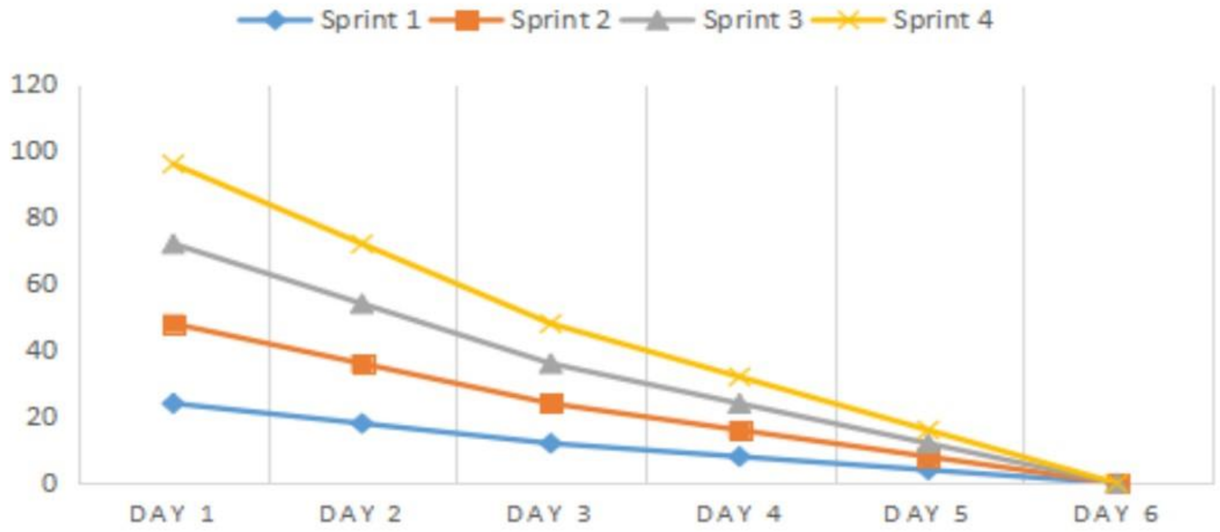


Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022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

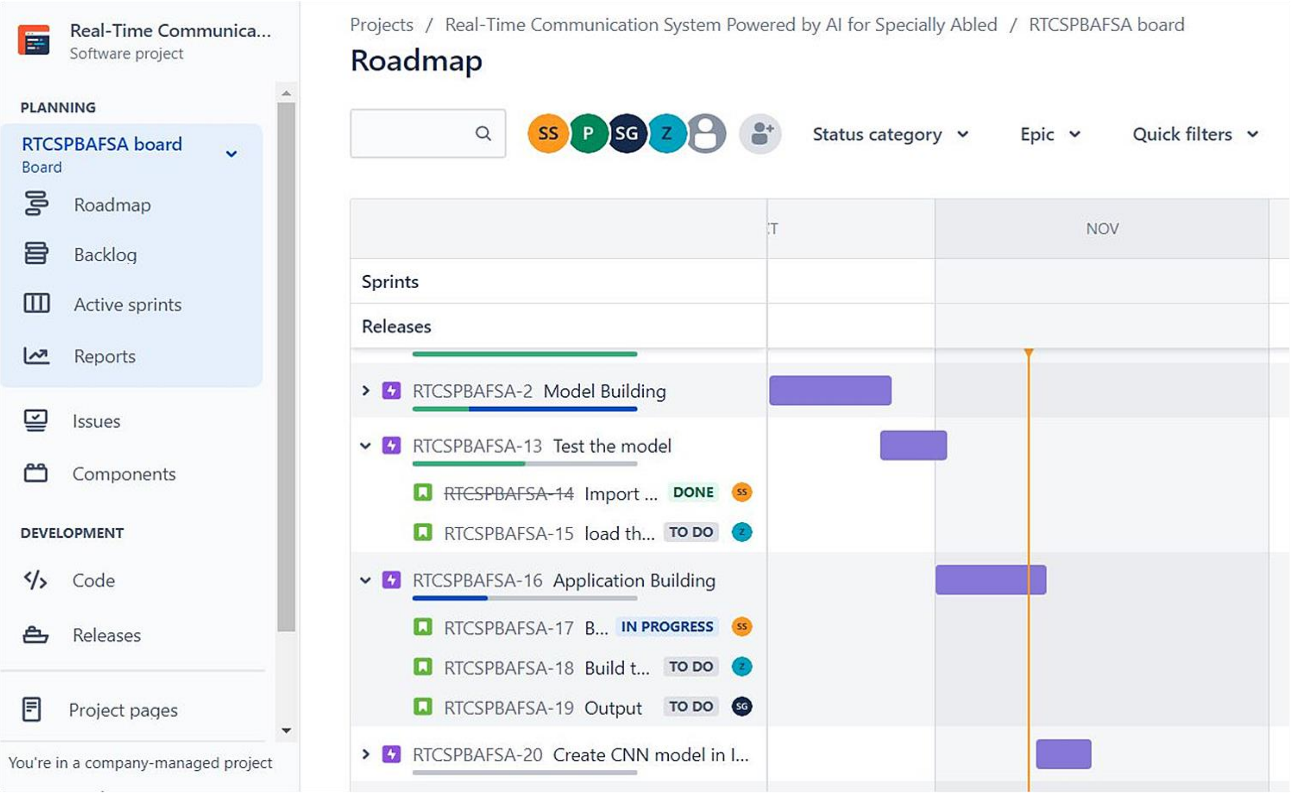
$$AV = \frac{sprint\ duration}{velocity}$$

- Average Velocity - AV
- Velocity - points per sprint
- Sprint Duration - Number of days per sprint

Average velocity = 6 /10
= 0.6



6.3 -Reports from JIRA



Real-Time Communica...
Software project

PLANNING

RTCSPBAFSA board
Board

- Roadmap
- Backlog
- Active sprints
- Reports
- Issues
- Components

DEVELOPMENT

- Code
- Releases
- Project pages

You're in a company-managed project

Projects / Real-Time Communication System Powered by AI for Specially Abled / RTCSPBAFSA board

Roadmap

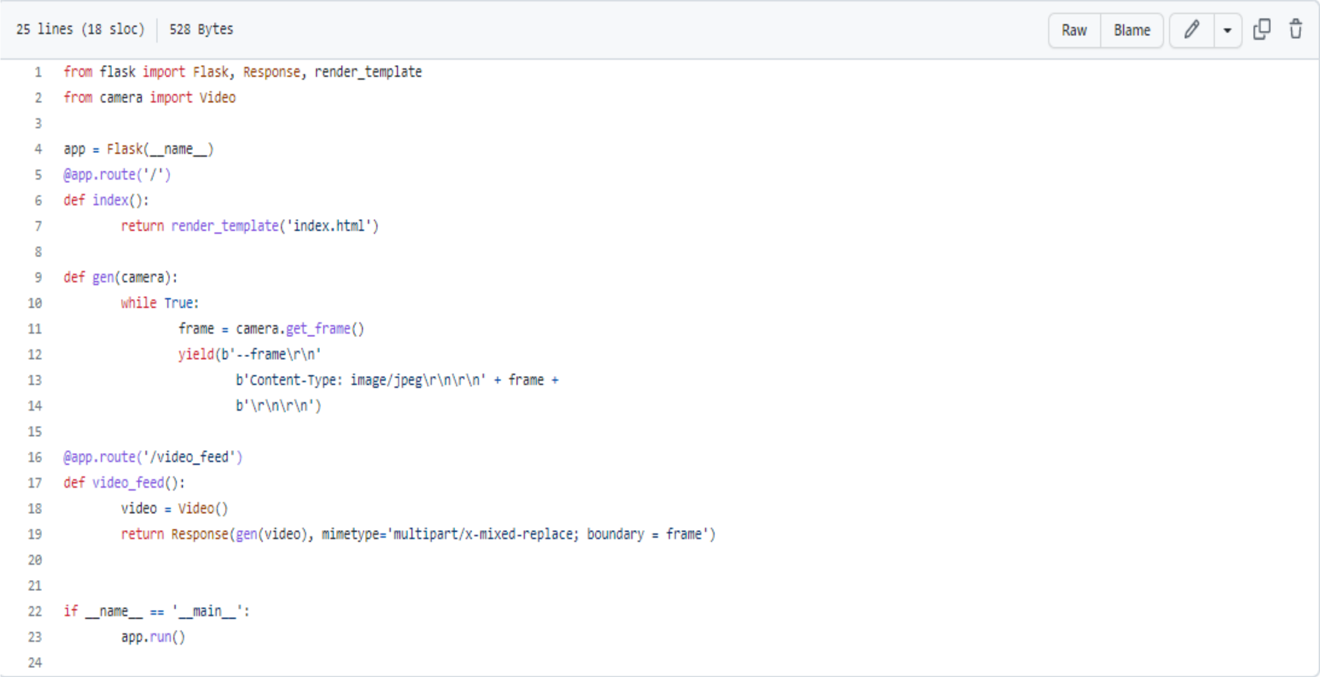
SS P SG Z — Status category — Epic — Quick filters

Sprints

Releases

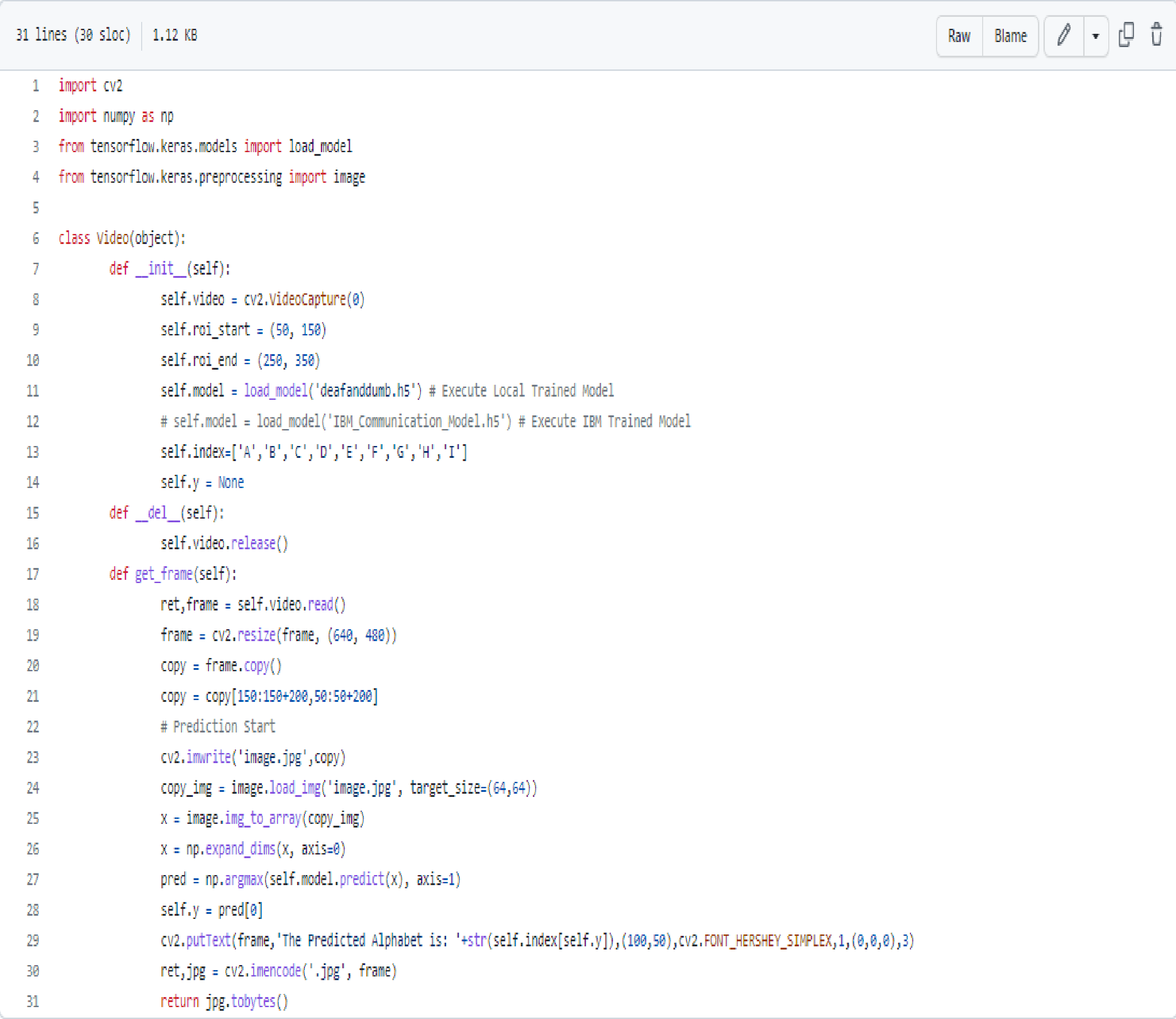
RTCSPBAFSA-2 Model Building		
RTCSPBAFSA-13 Test the model		
~~RTCSPBAFSA-14~~ Import ...	DONE	SS
RTCSPBAFSA-15 load th...	TO DO	Z
RTCSPBAFSA-16 Application Building		
RTCSPBAFSA-17 B...	IN PROGRESS	SS
RTCSPBAFSA-18 Build t...	TO DO	Z
RTCSPBAFSA-19 Output	TO DO	SG
RTCSPBAFSA-20 Create CNN model in l...		

7.Coding & Solution

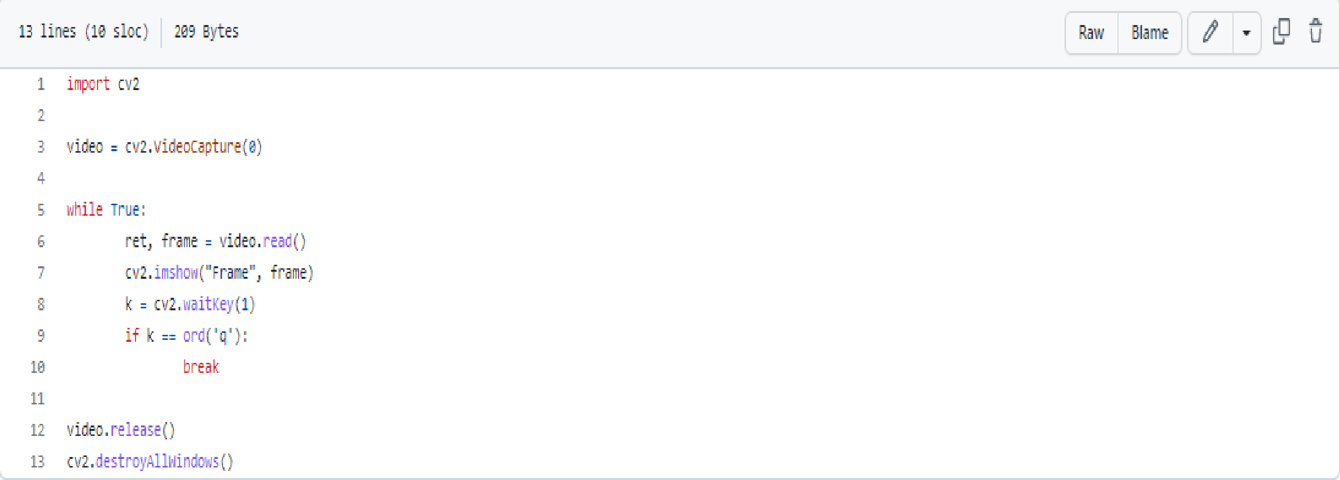


25 lines (18 sloc) | 528 Bytes

```
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()

```



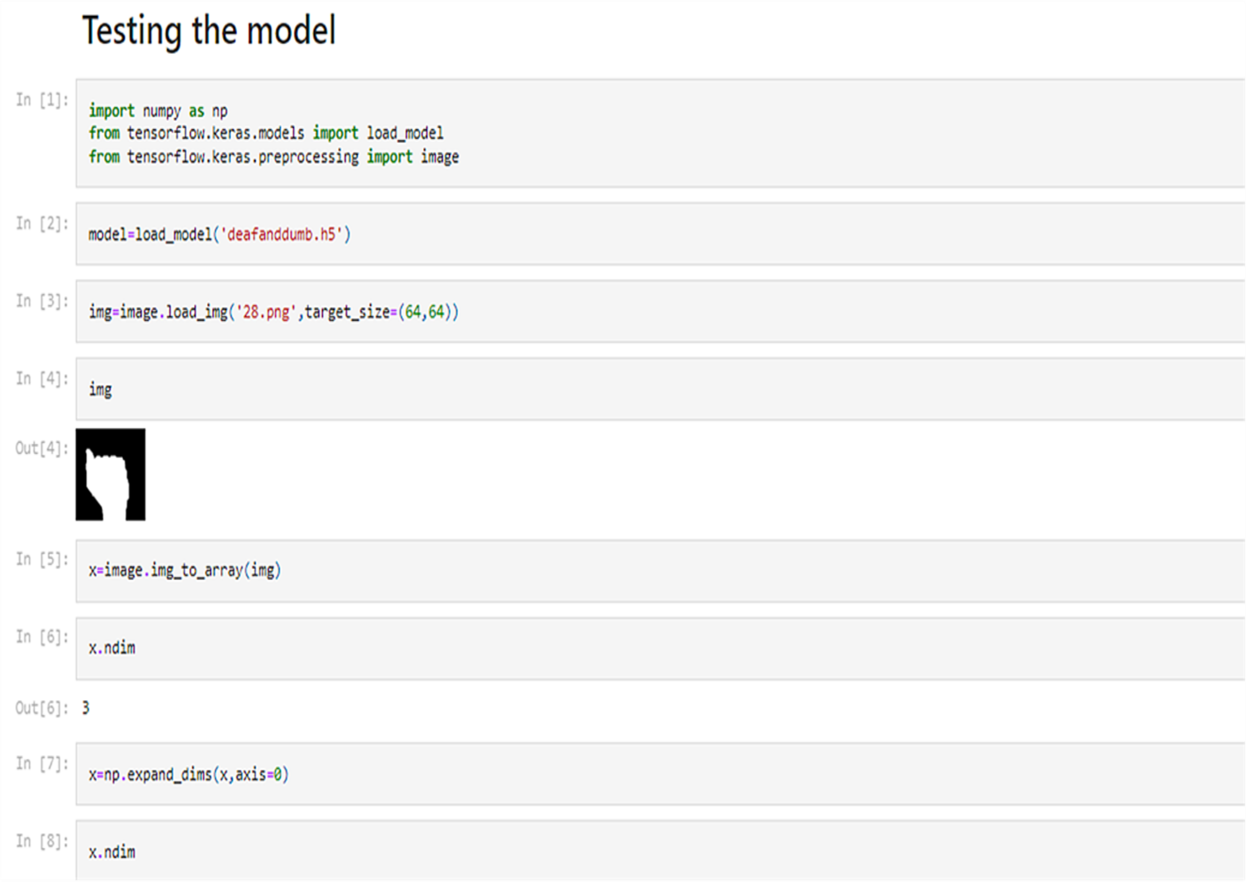
```python
import cv2
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image

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('deafanddumb.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))
                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()
```



```python
import cv2

video = cv2.VideoCapture(0)

while True:
        ret, frame = video.read()
        cv2.imshow("Frame", frame)
        k = cv2.waitKey(1)
        if k == ord('q'):
                break

video.release()
cv2.destroyAllWindows()
```

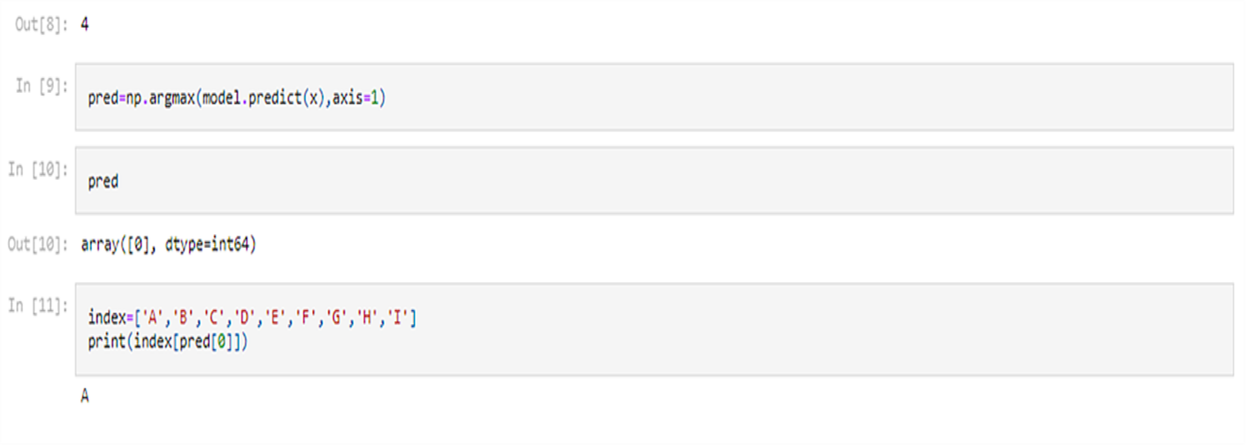
8. TESTING

8.1-Test cases



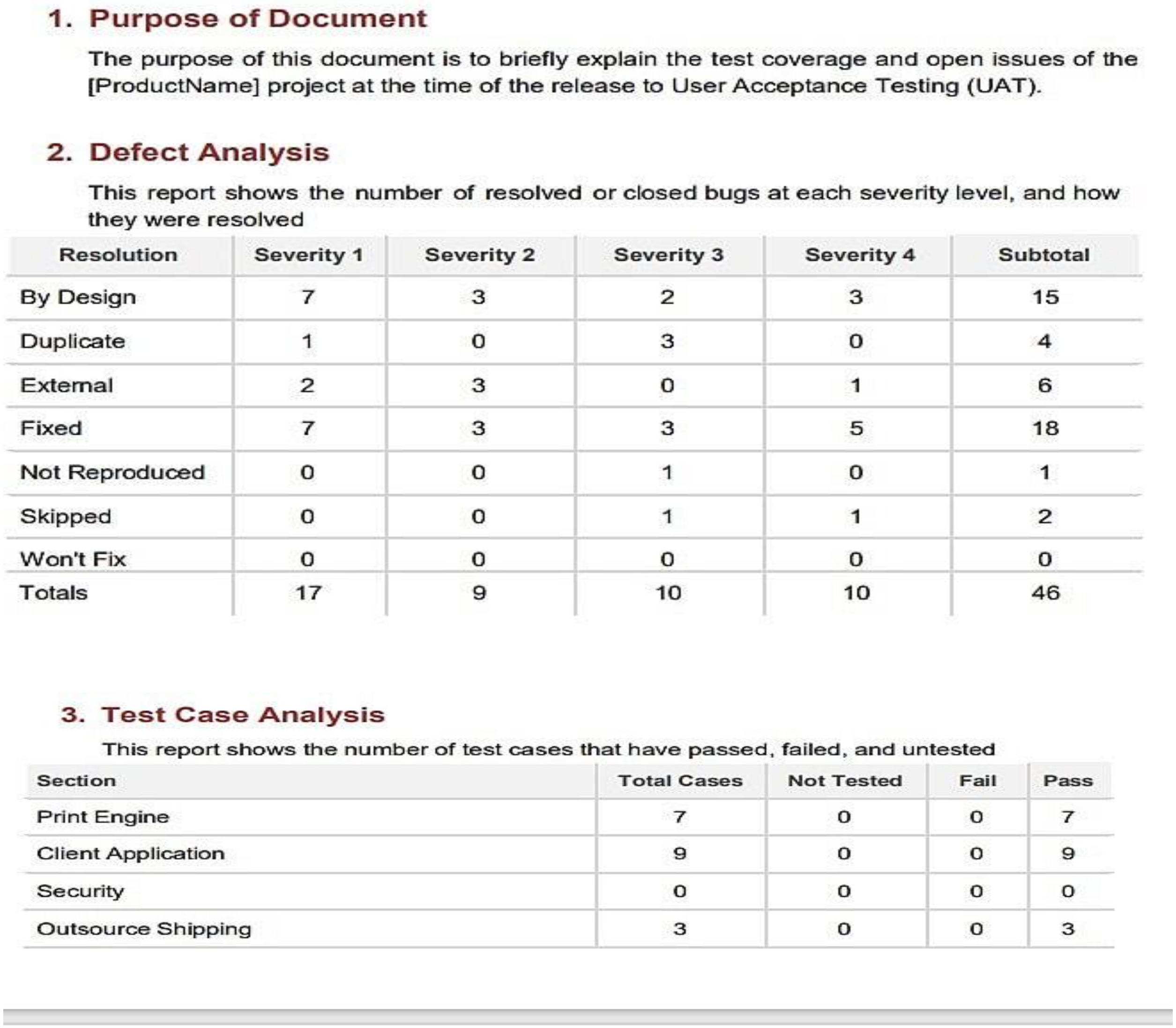
Testing the model

```
In [1]: import numpy as np
        from tensorflow.keras.models import load_model
        from tensorflow.keras.preprocessing import image

In [2]: model=load_model('deafanddumb.h5')

In [3]: img=image.load_img('28.png',target_size=(64,64))

In [4]: img

Out[4]:

In [5]: x=image.img_to_array(img)

In [6]: x.ndim

Out[6]: 3

In [7]: x=np.expand_dims(x,axis=0)

In [8]: x.ndim
```



```
Out[8]: 4

In [9]: pred=np.argmax(model.predict(x),axis=1)

In [10]: pred

Out[10]: array([0], dtype=int64)

In [11]: index=['A','B','C','D','E','F','G','H','I']
         print(index[pred[0]])

         A
```

8.2 -User Acceptance Testing



1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

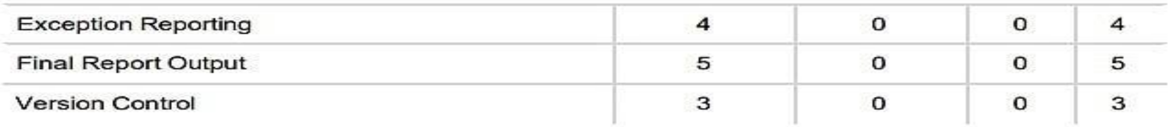
This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	7	3	2	3	15
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	7	3	3	5	18
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	0	0
Totals	17	9	10	10	46

3. Test Case Analysis

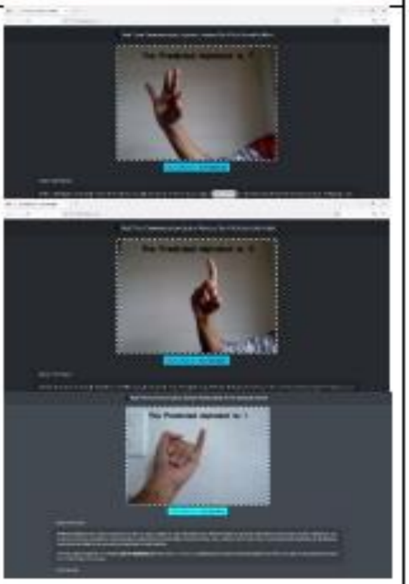
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	9	0	0	9
Security	0	0	0	0
Outsource Shipping	3	0	0	3
Exception Reporting	4	0	0	4
Final Report Output	5	0	0	5
Version Control	3	0	0	3



9. RESULTS

9.1- Performance Metrics

S.No.	Parameter	Values	Screenshot
1.	Model Summary	The goal of this project is to translate sign language into the appropriate text. The model is run in a Jupyter notebook and deployed in Watson Studio. Flask applications are then used to show the output.	
2.	Accuracy	Training Accuracy – 0.9992 Validation Accuracy -0.9778	Model Training for Real Time Communication through AI for Specially Abled Loading the Dataset & Image Data Generation Saving the Model
3.	Confidence Score (Only Yolo Projects)	Class Detected - Confidence Score -	NIL

10. ADVANTAGES

- It can recognise and translate live and moving images.
- The proposed system ensures that sign language can be easily translated into English.
- It does not necessitate the use of a high-end device.
- It is compatible with almost all operating systems and browsers.
- No prior programming knowledge is required to use the system.
- The proposed system is simple to use.
- Facilitates the life of the disabled person.

DISADVANTAGES

- The proposed system is not a two-way translation system.
- There is a possibility of erroneous translation.
- Because it is a webpage-based system, it does require internet connectivity, which can be inconvenient at times.
- It would have been more convenient if it was application-based.

11. CONCLUSION

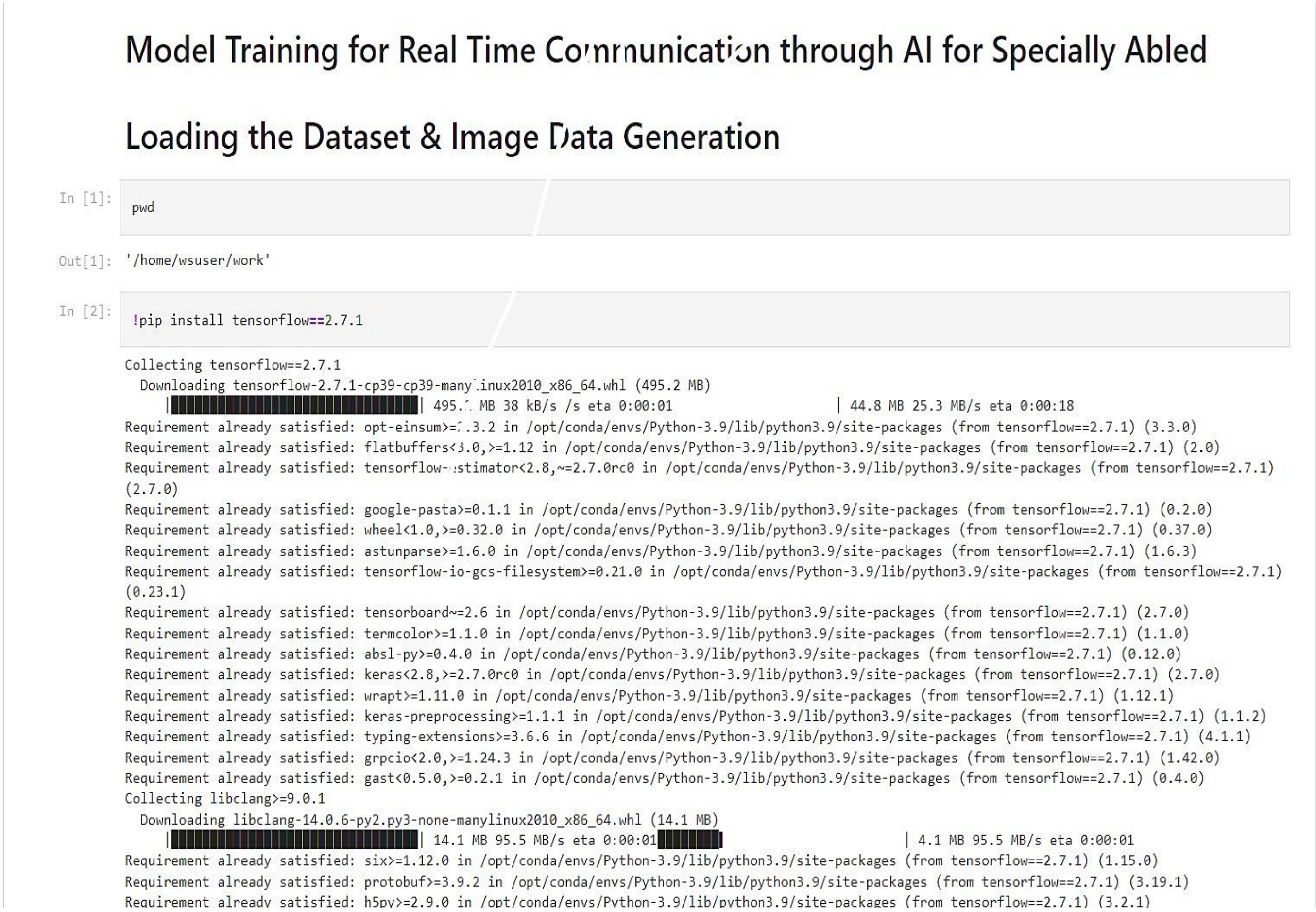
Sign language can help deaf and hearing people communicate more effectively. The system aims to bridge the communication gap between deaf people and the rest of society because it allows for two-way communication. The proposed methodology translates language into human-readable English alphabets. This system transmits hand gestures to the model, who recognises them and displays the corresponding Alphabet on the screen.

12. FUTURE SCOPE

In the future, to take the project to the next level, a two-way communication system, such as sign language to English and English to Sign Language, is being planned. The application version of the web page for both iOS and Android are also in the tends to work for future development. The system's accuracy is being explored.

13. APPENDIX

13.1-Source Code



Model Training for Real Time Communication through AI for Specially Abled

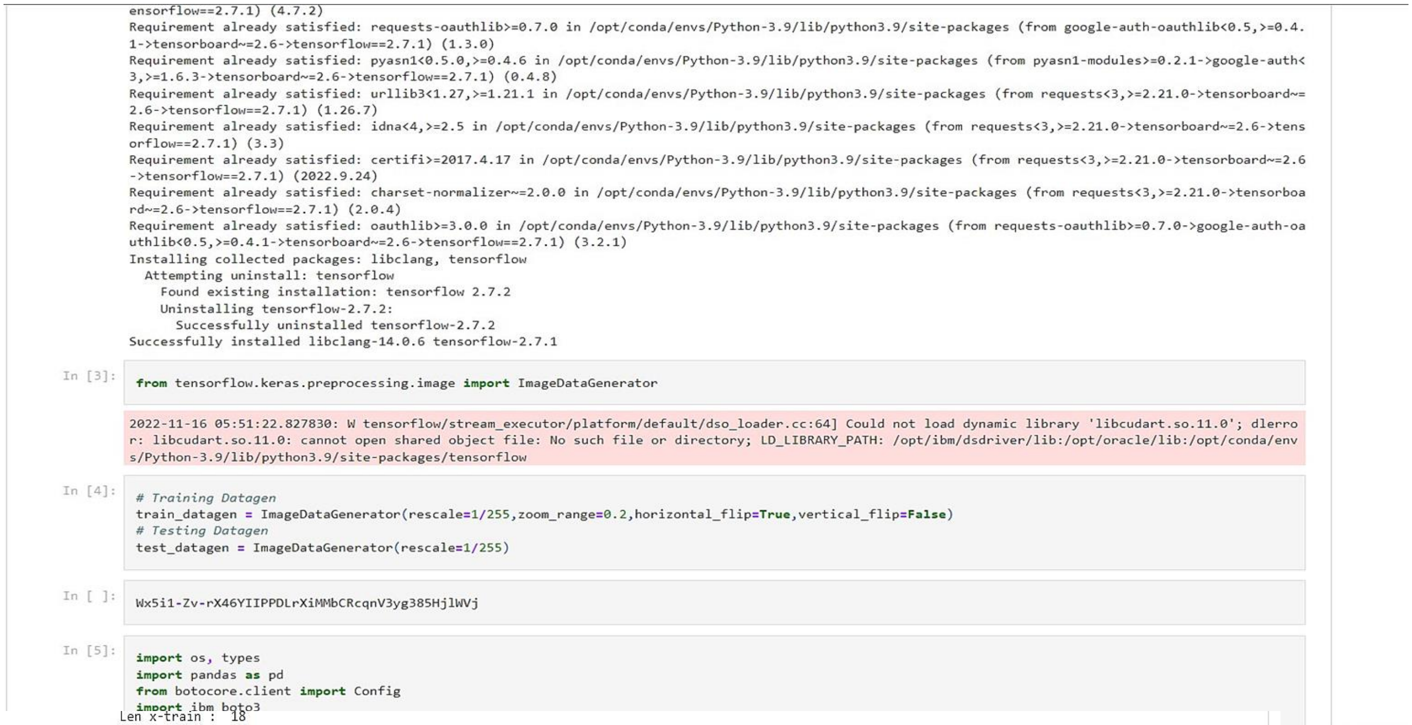
Loading the Dataset & Image Data Generation

In [1]:
```
pwd
```

Out[1]:
```
'/home/wsuser/work'
```

In [2]:
```
!pip install tensorflow==2.7.1
```

```
Collecting tensorflow==2.7.1
  Downloading tensorflow-2.7.1-cp39-cp39-manylinux2010_x86_64.whl (495.2 MB)
     |████████████████████████████████| 495.1 MB 38 kB/s /s eta 0:00:01                     | 44.8 MB 25.3 MB/s eta 0:00:18
Requirement already satisfied: opt-einsum>=2.3.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (3.3.0)
Requirement already satisfied: flatbuffers<3.0,>=1.12 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (2.0)
Requirement already satisfied: tensorflow-estimator<2.8,~=2.7.0rc0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1)
(2.7.0)
Requirement already satisfied: google-pasta>=0.1.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (0.2.0)
Requirement already satisfied: wheel<1.0,>=0.32.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (0.37.0)
Requirement already satisfied: astunparse>=1.6.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.6.3)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.21.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1)
(0.23.1)
Requirement already satisfied: tensorboard~=2.6 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (2.7.0)
Requirement already satisfied: termcolor>=1.1.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.1.0)
Requirement already satisfied: absl-py>=0.4.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (0.12.0)
Requirement already satisfied: keras<2.8,>=2.7.0rc0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (2.7.0)
Requirement already satisfied: wrapt>=1.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.12.1)
Requirement already satisfied: keras-preprocessing>=1.1.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.1.2)
Requirement already satisfied: typing-extensions>=3.6.6 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (4.1.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.42.0)
Requirement already satisfied: gast<0.5.0,>=0.2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (0.4.0)
Collecting libclang>=9.0.1
  Downloading libclang-14.0.6-py2.py3-none-manylinux2010_x86_64.whl (14.1 MB)
     |████████████████████████████████| 14.1 MB 95.5 MB/s eta 0:00:01█████████                         | 4.1 MB 95.5 MB/s eta 0:00:01
Requirement already satisfied: six>=1.12.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (1.15.0)
Requirement already satisfied: protobuf>=3.9.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (3.19.1)
Requirement already satisfied: h5py>=2.9.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from tensorflow==2.7.1) (3.2.1)
```



```
ensorflow==2.7.1) (4.7.2)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from google-auth-oauthlib<0.5,>=0.4.
1->tensorboard~=2.6->tensorflow==2.7.1) (1.3.0)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pyasn1-modules>=0.2.1->google-auth<
3,>=1.6.3->tensorboard~=2.6->tensorflow==2.7.1) (0.4.8)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard~=
2.6->tensorflow==2.7.1) (1.26.7)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard~=2.6->tens
orflow==2.7.1) (3.3)
Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboard~=2.6
->tensorflow==2.7.1) (2022.9.24)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests<3,>=2.21.0->tensorboa
rd~=2.6->tensorflow==2.7.1) (2.0.4)
Requirement already satisfied: oauthlib>=3.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests-oauthlib>=0.7.0->google-auth-oa
uthlib<0.5,>=0.4.1->tensorboard~=2.6->tensorflow==2.7.1) (3.2.1)
Installing collected packages: libclang, tensorflow
  Attempting uninstall: tensorflow
    Found existing installation: tensorflow 2.7.2
    Uninstalling tensorflow-2.7.2:
      Successfully uninstalled tensorflow-2.7.2
Successfully installed libclang-14.0.6 tensorflow-2.7.1
```

In [3]:

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
2022-11-16 05:51:22.827830: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcudart.so.11.0'; dlerro
r: libcudart.so.11.0: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /opt/ibm/dsdriver/lib:/opt/oracle/lib:/opt/conda/env
s/Python-3.9/lib/python3.9/site-packages/tensorflow
```

In [4]:

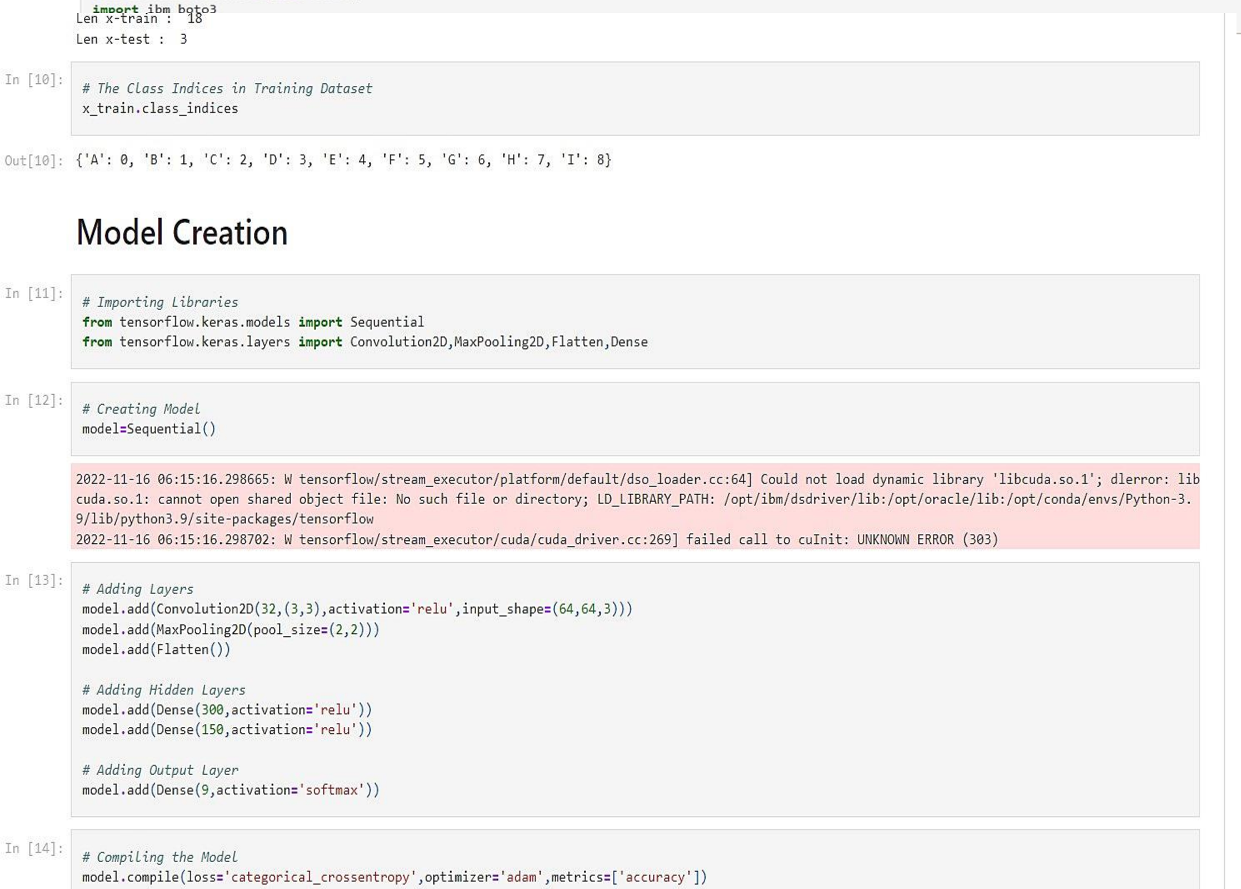
```
# Training Datagen
train_datagen = ImageDataGenerator(rescale=1/255,zoom_range=0.2,horizontal_flip=True,vertical_flip=False)
# Testing Datagen
test_datagen = ImageDataGenerator(rescale=1/255)
```

In [ ]:

```
Wx5i1-Zv-rX46YIIPPDLrXiMMbCRcqnV3yg385HjlWVj
```

In [5]:

```
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3
```



```
Len x-train :  18
Len x-test :  3
```

In [10]:

```
# The Class Indices in Training Dataset
x_train.class_indices
```

Out[10]:

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

Model Creation

In [11]:

```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

In [12]:

```
# Creating Model
model=Sequential()
```

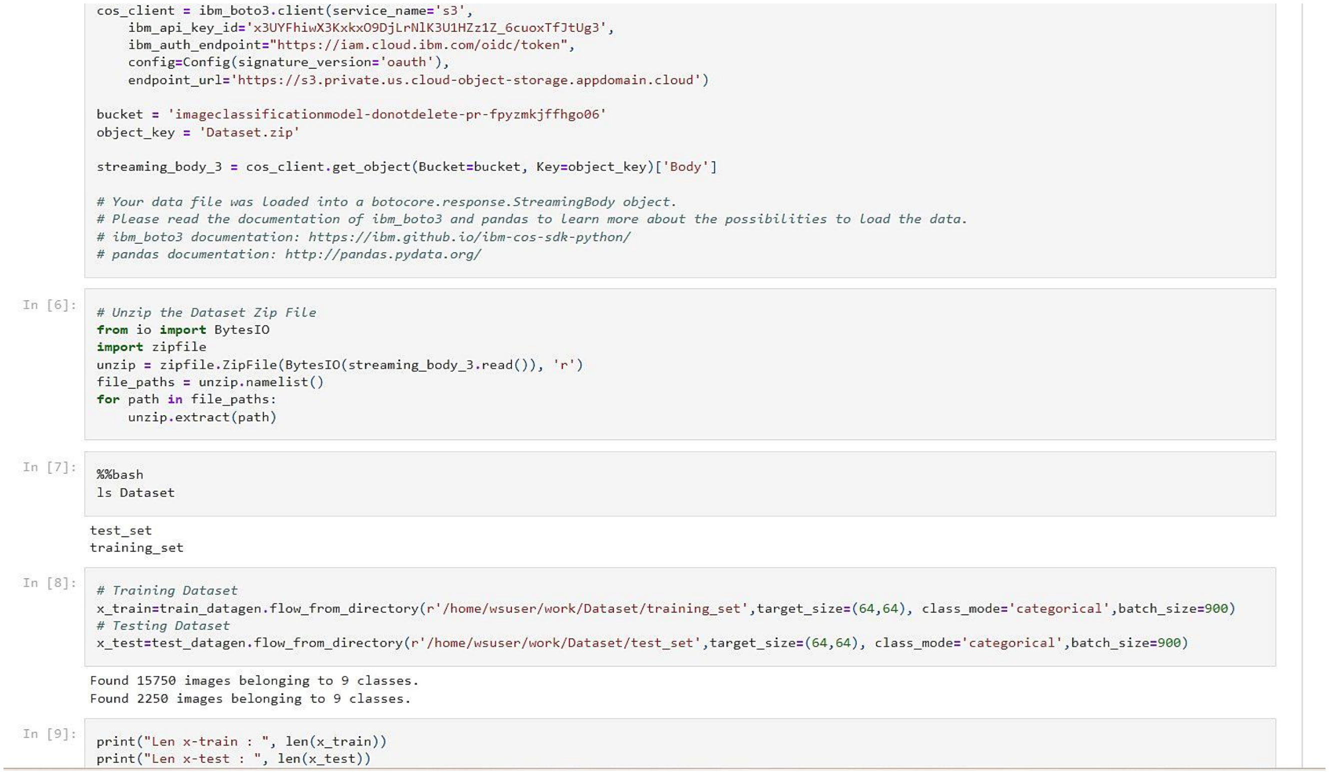
```
2022-11-16 06:15:16.298665: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.1'; dlerror: lib
cuda.so.1: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /opt/ibm/dsdriver/lib:/opt/oracle/lib:/opt/conda/envs/Python-3.
9/lib/python3.9/site-packages/tensorflow
2022-11-16 06:15:16.298702: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (303)
```

In [13]:

```
# Adding Layers
model.add(Convolution2D(32,(3,3),activation='relu',input_shape=(64,64,3)))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Flatten())

# Adding Hidden Layers
model.add(Dense(300,activation='relu'))
model.add(Dense(150,activation='relu'))

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

In [14]:

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



```
cos_client = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='x3UYFhiwX3KxkxO9DjLrNlK3U1HZz1Z_6cuoxTfJtUg3',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'imageclassificationmodel-donotdelete-pr-fpyzmkjffhgo06'
object_key = 'Dataset.zip'

streaming_body_3 = cos_client.get_object(Bucket=bucket, Key=object_key)['Body']

# Your data file was loaded into a botocore.response.StreamingBody object.
# Please read the documentation of ibm_boto3 and pandas to learn more about the possibilities to load the data.
# ibm_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/
# pandas documentation: http://pandas.pydata.org/
```

In [6]:

```
# Unzip the Dataset Zip File
from io import BytesIO
import zipfile
unzip = zipfile.ZipFile(BytesIO(streaming_body_3.read()), 'r')
file_paths = unzip.namelist()
for path in file_paths:
    unzip.extract(path)
```

In [7]:

```
%%bash
ls Dataset
```

```
test_set
training_set
```

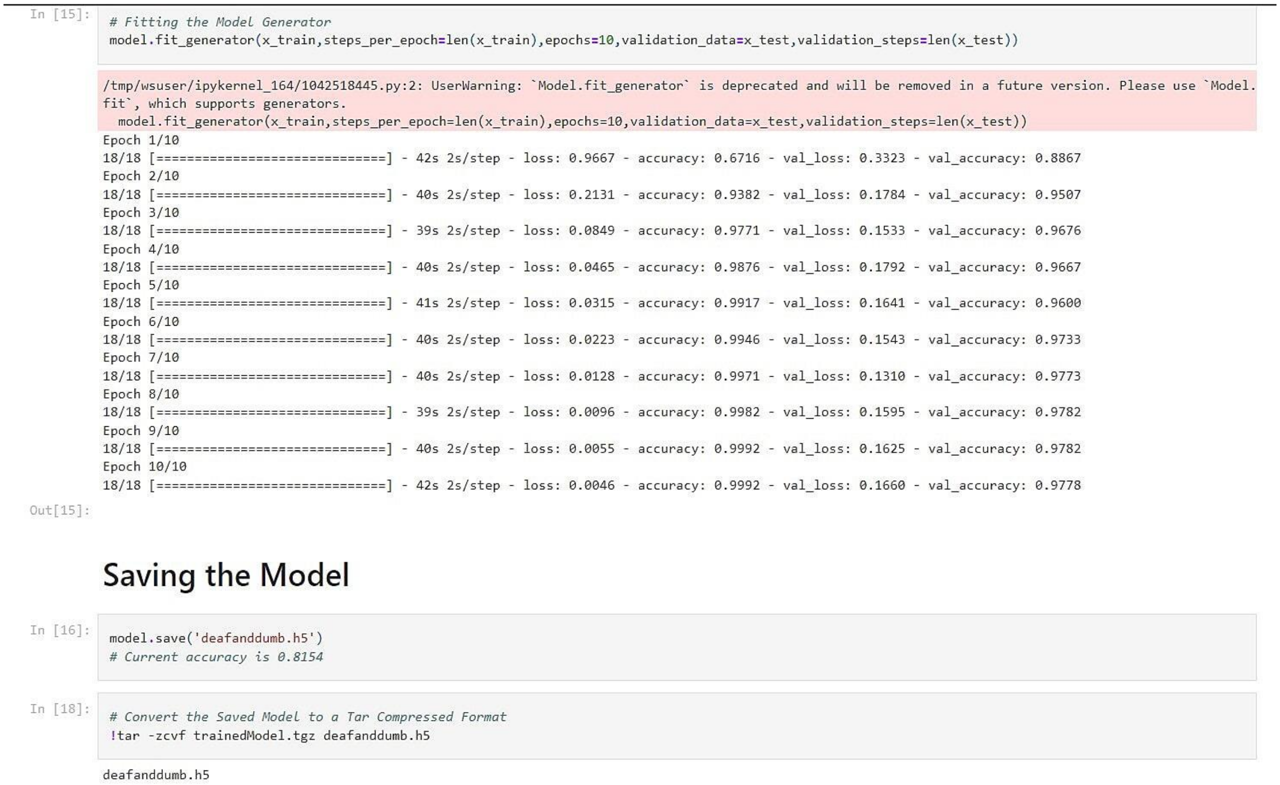
In [8]:

```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'/home/wsuser/work/Dataset/training_set',target_size=(64,64), class_mode='categorical',batch_size=900)
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'/home/wsuser/work/Dataset/test_set',target_size=(64,64), class_mode='categorical',batch_size=900)
```

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

In [9]:

```
print("Len x-train : ", len(x_train))
print("Len x-test : ", len(x_test))
```



In [15]:

```
# Fitting the Model Generator
model.fit_generator(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))
```

```
/tmp/wsuser/ipykernel_164/1042518445.py:2: UserWarning: `Model.fit_generator` is deprecated and will be removed in a future version. Please use `Model.
fit`, which supports generators.
  model.fit_generator(x_train,steps_per_epoch=len(x_train),epochs=10,validation_data=x_test,validation_steps=len(x_test))
Epoch 1/10
18/18 [==============================] - 42s 2s/step - loss: 0.9667 - accuracy: 0.6716 - val_loss: 0.3323 - val_accuracy: 0.8867
Epoch 2/10
18/18 [==============================] - 40s 2s/step - loss: 0.2131 - accuracy: 0.9382 - val_loss: 0.1784 - val_accuracy: 0.9507
Epoch 3/10
18/18 [==============================] - 39s 2s/step - loss: 0.0849 - accuracy: 0.9771 - val_loss: 0.1533 - val_accuracy: 0.9676
Epoch 4/10
18/18 [==============================] - 40s 2s/step - loss: 0.0465 - accuracy: 0.9876 - val_loss: 0.1792 - val_accuracy: 0.9667
Epoch 5/10
18/18 [==============================] - 41s 2s/step - loss: 0.0315 - accuracy: 0.9917 - val_loss: 0.1641 - val_accuracy: 0.9600
Epoch 6/10
18/18 [==============================] - 40s 2s/step - loss: 0.0223 - accuracy: 0.9946 - val_loss: 0.1543 - val_accuracy: 0.9733
Epoch 7/10
18/18 [==============================] - 40s 2s/step - loss: 0.0128 - accuracy: 0.9971 - val_loss: 0.1310 - val_accuracy: 0.9773
Epoch 8/10
18/18 [==============================] - 39s 2s/step - loss: 0.0096 - accuracy: 0.9982 - val_loss: 0.1595 - val_accuracy: 0.9782
Epoch 9/10
18/18 [==============================] - 40s 2s/step - loss: 0.0055 - accuracy: 0.9992 - val_loss: 0.1625 - val_accuracy: 0.9782
Epoch 10/10
18/18 [==============================] - 42s 2s/step - loss: 0.0046 - accuracy: 0.9992 - val_loss: 0.1660 - val_accuracy: 0.9778
```

Out[15]:

Saving the Model

In [16]:

```
model.save('deafanddumb.h5')
# Current accuracy is 0.8154
```

In [18]:

```
# Convert the Saved Model to a Tar Compressed Format
!tar -zcvf trainedModel.tgz deafanddumb.h5
```

```
deafanddumb.h5
```

In [19]:

```
%%bash
ls -ll
```

```
total 207072
drwxrwx--- 4 wsuser wscommon      4096 Nov 16 06:12 Dataset
-rw-rw---- 1 wsuser wscommon 111324760 Nov 16 06:24 deafanddumb.h5
-rw-rw---- 1 wsuser wscommon 100705415 Nov 16 06:25 trainedModel.tgz
```

Watson Machine Learning

In [20]:

```
!pip install watson-machine-learning-client --upgrade
```

```
Collecting watson-machine-learning-client
  Downloading watson_machine_learning_client-1.0.391-py3-none-any.whl (538 kB)
     |████████████████████████████████| 538 kB 23.5 MB/s eta 0:00:01
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)
Requirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)
Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
Requirement already satisfied: pandas in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.3.4)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)
Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)
Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning
-client) (0.5.0)
Requirement already satisfied: botocore<1.22.0,>=1.21.21 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learnin
g-client) (1.21.41)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-c
lient) (0.10.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from botocore<1.22.0,>=1.21.21->
boto3->watson-machine-learning-client) (2.8.2)
Requirement already satisfied: six>=1.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from python-dateutil<3.0.0,>=2.1->botocore<1.22.0,>
=1.21.21->boto3->watson-machine-learning-client) (1.15.0)
Requirement already satisfied: ibm-cos-sdk-s3transfer==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-mach
ine-learning-client) (2.11.0)
Requirement already satisfied: ibm-cos-sdk-core==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-le
arning-client) (2.11.0)

Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client)
(1.20.3)
Installing collected packages: watson-machine-learning-client
Successfully installed watson-machine-learning-client-1.0.391
```

In [21]:

```
from ibm_watson_machine_learning import APIClient
wml_credentials = {
    "url": "https://us-south.ml.cloud.ibm.com",
    "apikey": "riacBb11IauIqYeqyG0JXyv497ILBYpBK-i9ONnrRRO-"
}

client = APIClient(wml_credentials)
```

Save to Deployment Space

In [22]:

```
def guid_from_space_name(client, space_name):
    space = client.spaces.get_details()
    return (next(item for item in space['resources'] if item['entity']["name"] == space_name)['metadata']['id'])
```

In [24]:

```
space_uid = guid_from_space_name(client, 'model1')
print("Space UID : ", space_uid)
```

```
Space UID :  f334d222-b62c-4464-b436-31daf2a464bd
```

In [25]:

```
client.set.default_space(space_uid)
```

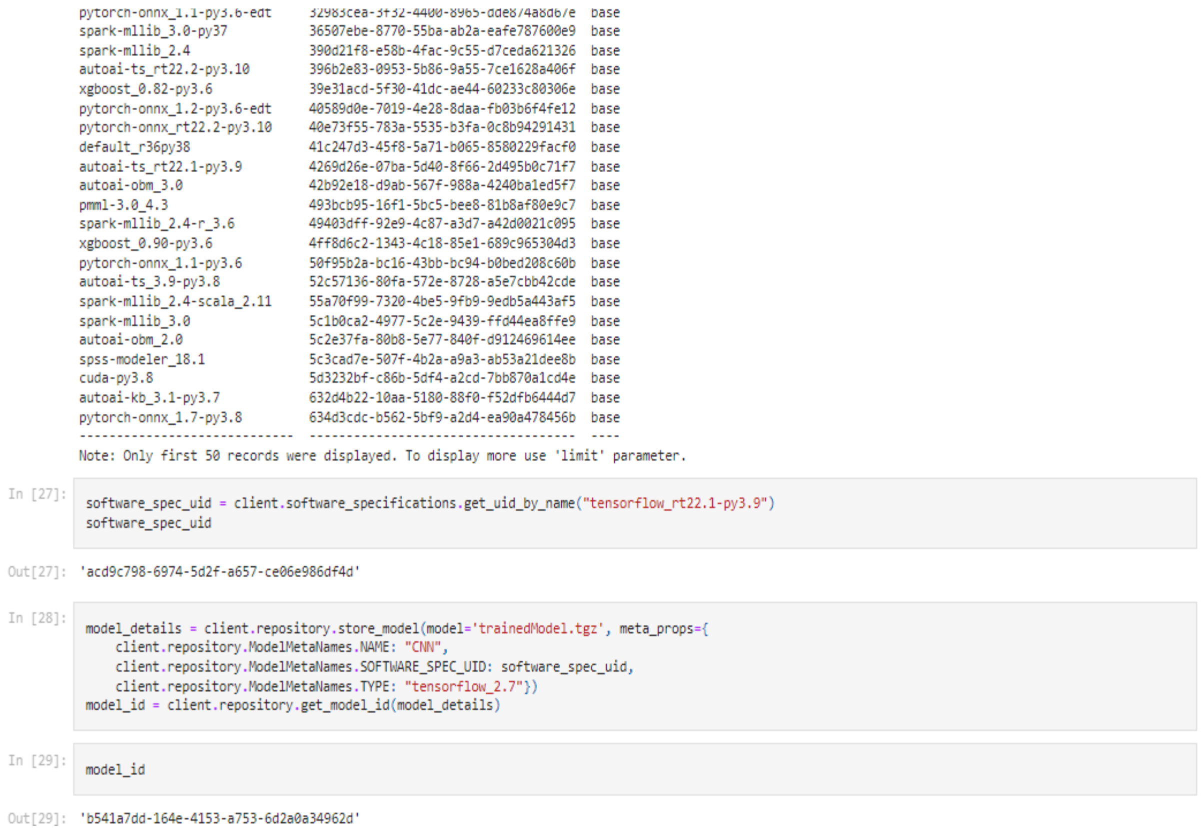
Out[25]:

```
'SUCCESS'
```

In [26]:

```
client.software_specifications.list()
```

```
----------------------------  ------------------------------------  ----
NAME                          ASSET_ID                              TYPE
default_py3.6                 0062b8c9-8b7d-44a0-a9b9-46c416adcbd9  base
kernel-spark3.2-scala2.12     020d69ce-7ac1-5e68-ac1a-31189867356a  base
```

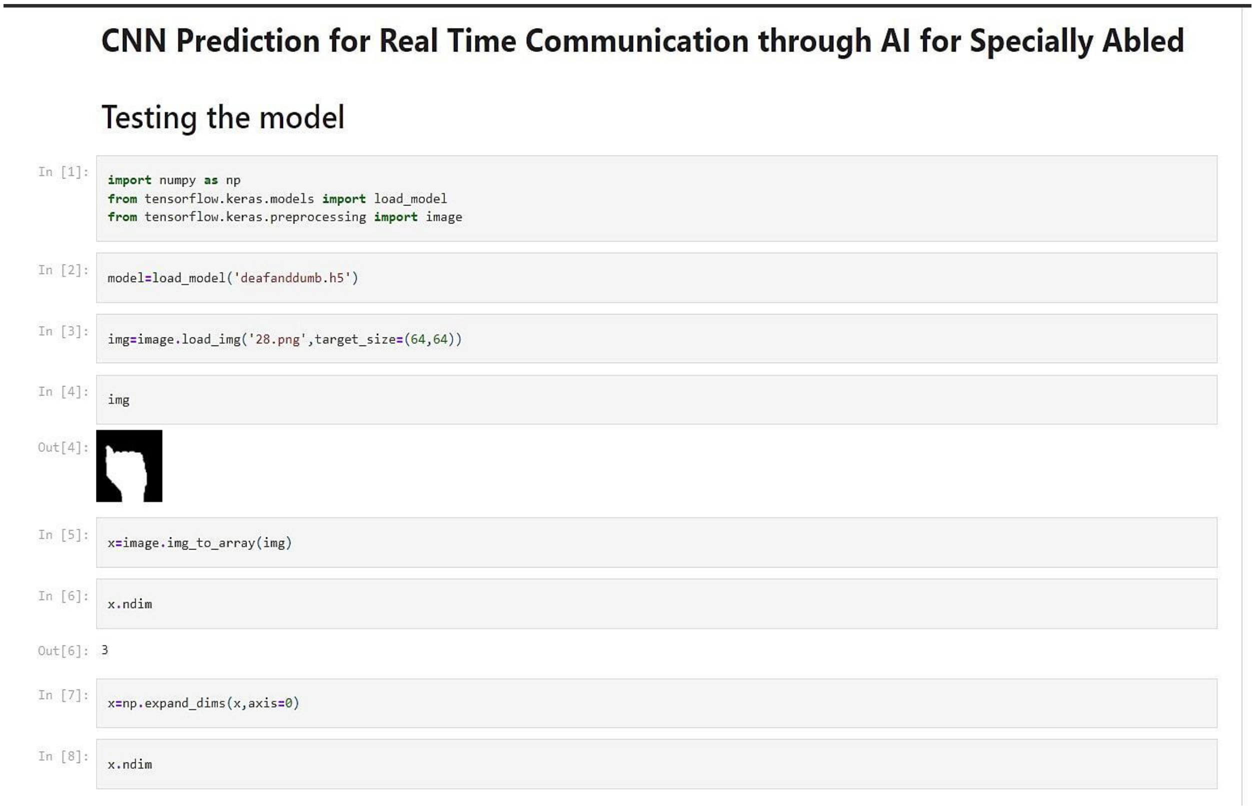


```
pytorch-onnx_1.1-py3.6-edt    32983cea-3f32-4400-8965-dde874a8d67e  base
spark-mllib_3.0-py37          36507ebe-8770-55ba-ab2a-eafe787600e9  base
spark-mllib_2.4               390d21f8-e58b-4fac-9c55-d7ceda621326  base
autoai-ts_rt22.2-py3.10       396b2e83-0953-5b86-9a55-7ce1628a406f  base
xgboost_0.82-py3.6            39e31acd-5f30-41dc-ae44-60233c80306e  base
pytorch-onnx_1.2-py3.6-edt    40589d0e-7019-4e28-8daa-fb03b6f4fe12  base
pytorch-onnx_rt22.2-py3.10    40e73f55-783a-5535-b3fa-0c8b94291431  base
default_r36py38               41c247d3-45f8-5a71-b065-8580229facf0  base
autoai-ts_rt22.1-py3.9        4269d26e-07ba-5d40-8f66-2d495b0c71f7  base
autoai-obm_3.0                42b92e18-d9ab-567f-988a-4240ba1ed5f7  base
pmml-3.0_4.3                  493bcb95-16f1-5bc5-bee8-81b8af80e9c7  base
spark-mllib_2.4-r_3.6         49403dff-92e9-4c87-a3d7-a42d0021c095  base
xgboost_0.90-py3.6            4ff8d6c2-1343-4c18-85e1-689c965304d3  base
pytorch-onnx_1.1-py3.6        50f95b2a-bc16-43bb-bc94-b0bed208c60b  base
autoai-ts_3.9-py3.8           52c57136-80fa-572e-8728-a5e7cbb42cde  base
spark-mllib_2.4-scala_2.11    55a70f99-7320-4be5-9fb9-9edb5a443af5  base
spark-mllib_3.0               5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9  base
autoai-obm_2.0                5c2e37fa-80b8-5e77-840f-d912469614ee  base
spss-modeler_18.1             5c3cad7e-507f-4b2a-a9a3-ab53a21dee8b  base
cuda-py3.8                    5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e  base
autoai-kb_3.1-py3.7           632d4b22-10aa-5180-88f0-f52dfb6444d7  base
pytorch-onnx_1.7-py3.8        634d3cdc-b562-5bf9-a2d4-ea90a478456b  base
----------------------------  ------------------------------------  ----
Note: Only first 50 records were displayed. To display more use 'limit' parameter.
```

```
In [27]: software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
         software_spec_uid

Out[27]: 'acd9c798-6974-5d2f-a657-ce06e986df4d'
```

```
In [28]: model_details = client.repository.store_model(model='trainedModel.tgz', meta_props={
             client.repository.ModelMetaNames.NAME: "CNN",
             client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid,
             client.repository.ModelMetaNames.TYPE: "tensorflow_2.7"})
         model_id = client.repository.get_model_id(model_details)
```

```
In [29]: model_id

Out[29]: 'b541a7dd-164e-4153-a753-6d2a0a34962d'
```



CNN Prediction for Real Time Communication through AI for Specially Abled

Testing the model

```
In [1]: import numpy as np
        from tensorflow.keras.models import load_model
        from tensorflow.keras.preprocessing import image
```

```
In [2]: model=load_model('deafanddumb.h5')
```

```
In [3]: img=image.load_img('28.png',target_size=(64,64))
```

```
In [4]: img
```

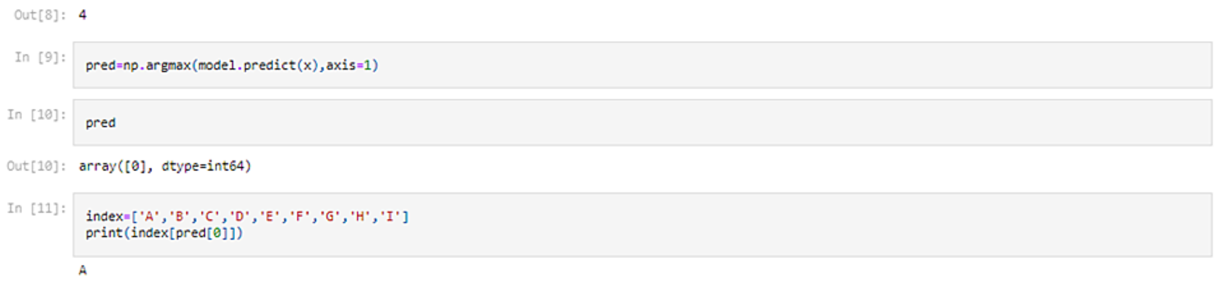
Out[4]:

```
In [5]: x=image.img_to_array(img)
```

```
In [6]: x.ndim

Out[6]: 3
```

```
In [7]: x=np.expand_dims(x,axis=0)
```

```
In [8]: x.ndim
```



```
Out[8]: 4

In [9]:  pred=np.argmax(model.predict(x),axis=1)

In [10]: pred

Out[10]: array([0], dtype=int64)

In [11]: index=['A','B','C','D','E','F','G','H','I']
         print(index[pred[0]])

         A
```

13.2-GitHub & Project Demo Link

Github Link-https://github.com/IBM-EPBL/IBM-Project-7063-1658846580

Project Demo Link-
https://drive.google.com/file/d/1Et5Tm3s2mZQL8_zVUaWbQOAozxNij9wN/view?usp=share_link