REAL-TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED

PROJECT REPORT

Submitted by

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ABSTRACT

One of the most precious gifts of nature to the human race is the ability to express itself by responding to the events that occur in its environment. Every normal person sees, hears, and then reacts to the situations by expressing himself. But there are some less lucky ones who are deprived of this precious gift. Such people, especially deaf and mute, rely on some sort of gesture language to communicate their feelings to others. The deaf, dumb and the blind follow similar problems when it comes to the use of computers. In the era of advanced technologies, where computers, laptops and other processor-based devices are an integral part of everyday life, efforts must be made to make the disabilities in life more independent.

Our goal is to design a human computer interface system that can accurately identify the language of the deaf and dumb. With the use of image processing and artificial intelligence, many techniques and algorithms have been developed in this area. Each character speech recognition system is trained to recognize the characters and convert them into the required pattern. The proposed system aims to give speech speechless, a real-time character language is captured as a series of images, and it is processed and then converted into speech and text

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CHAPTER 1
INTRODUCTION

INTRODUCTION

Communication should be universal without any barriers or limitations. This paper establishes a method for providing equality, turning the disabilities of the hearing and, or speech impaired individuals to abilities, creating a base where both the disabled and the able can communicate without any barrier. Our objective is to blend deaf and dumb within society and make them able to use their personal computers more effectively and efficiently. Our idea is to create sign assistance, like many applications which is using voice assistance such as Siri on iOS and Cortana on windows. There is need to develop an application that will create an interactive platform where the sign language can be translated to voice output and writing, and voice and writing input can also be converted to sign language. The bigger picture is creating an interactive model of communication for deaf and dumb people. Developing an app will support this vulnerable society of impaired people and enhance communication among people. The application will allow ease in communication, improving their interaction, and hence better life. This project will be a noble cause and translating the sign language into understandable words is the goal. Microsoft Windows will come in handy to enhance the actualization of this application.

According to the World Health Organization, the world population experiencing hearing and speech challenges approximates over 466 million people globally [1,2]. With such disability, instead unequally distributed resources, these people are vulnerable to discrimination [3]. The fact that every human being, abled or disabled, is entitled to a good life with equal opportunities calls for affirmative action [4,10]. This society requires attention from all quarters, especially on technological enhancement, to ensure the disabled get a comfortable life [5,16,20]. With the number increasing significantly, something needs to be done. The deaf and dumb are introverts, remaining engraved in their thoughtful world. Communication, which is essential in human life, is challenging. Humans are social beings, and effective communication is necessary [6, 22,24]. The development of technology should, therefore, serve to improve their lives as well [7]. The introduction of an application that can be used by the deaf and dumb will be a great innovation. It will not only make life easier but will as well increase their life opportunities, including employability. The deaf and dumb category must be involved within technology on PC experience as they involved in technology on smartphones. Dtalk application provides this experience for them by reading their hand movements and displays a certain function.

This application will be as a competitor for Cortana on Windows, Siri on iOS, and Alexa on Amazon and Google Assistant on android for doing some tasks in their smart devices. Healthy people use these technologies [8,9], but D-talk will be specifically for deaf and dumb using PCs. D-talk will be built by using the Spyder program because it is an open-source, good on reading images, and easy to find the codes on the web [11, 12]. The application will help the user to perform frequent tasks, which can include opening a web. So far, there is no project for dumb people like D-talk that is for PC functions with unique hand gestures created by the developer instead of the regular sign language. This society has for a long-time used sign language. However, most people are unable to understand this language making communication intricate. The application will bridge this gap by translating various signs used to actual words.

A web camera will take up the sign and send images to the app that will translate it through command prompts to words. These words will be arranged simultaneously to create a fathomable sentence. Globally acceptable signs in this language will be identified through codes that shall subsequently be translated appropriately for reading. Though the development of the app shall be complicated, its eventual outcome will be more comfortable and efficient to use. A camera will be vital in identifying the various signs of language movements. Analysing the same after coding them will be essential for accurate interpretation and translation into words. The user manual will be developed to enhance the quick learning of the application. This manual shall clearly show every sign and interpretation of the same in words. During the implementation, there might be several changes and enhancements in this application.

1.1 PROJECT OVERVIEW

Gesture is a non-verbal means of communication. It refers to expressing an idea using position, orientation or movement of a body part. Gesture recognition is the mathematical interpretation of orientation or motion of human body by a computational system. In this project, the words expressed by hand gestures by the speech and hearing impaired are converted into verbal means of communication. The translated output is displayed on a screen and “spoken” on a speaker.

Sign Language is the well-structured code, which uses hand gestures instead of sound to convey meaning, simultaneously combining hand shapes, orientations and movement of the hands. Communicative hand glove is an electronic device that can translate sign language into speech and text in order to make the communication possible between the deaf and/or mute with the general public. This technology has been used in a variety of application areas, which demands accurate interpretation of sign language. In this project, the words/letters conveyed by the disabled person are displayed on a screen and also spoken on a speaker

1.2 PURPOSE

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 using the convolutional neural network. An app is built which enables the deaf and dumb people to convey their information using signs which is converted to human understandable language and output is given as speech.

CHAPTER 2
LITERATURE SURVEY

LITERATURE SURVEY

2.1 EXISTING PROBLEM

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. Communication 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.

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2.2 REFERENCES

1. Koufos, K., EL Haloui, K., Dianati, M., Higgins, M., Elmirghani, J., Imran, M. A., &Tafazolli, R. (2021). Trends in Intelligent Communication Systems: Review of Standards, Major Research Projects, and Identification of Research Gaps. Journal of Sensor and Actuator Networks, 10(4), 60.

2. Panda, G., Upadhyay, A. K., & Khandelwal, K. (2019). Artificial intelligence: A strategic disruption in public relations. Journal of Creative Communications, 14(3), 196-213.

3. Xu, G., Mu, Y., & Liu, J. (2017). Inclusion of artificial intelligence in communication networks and services. ITU J. ICT Discov. Spec, 1, 1-6.

4. Verma, P., Shimi S. L. and Priyadarshani, R., "Design of CommunicationInterpreter for Deaf and Dumb Person", Vol.4, no.1, 2013.

2.3 PROBLEM STATEMENT DEFINITION

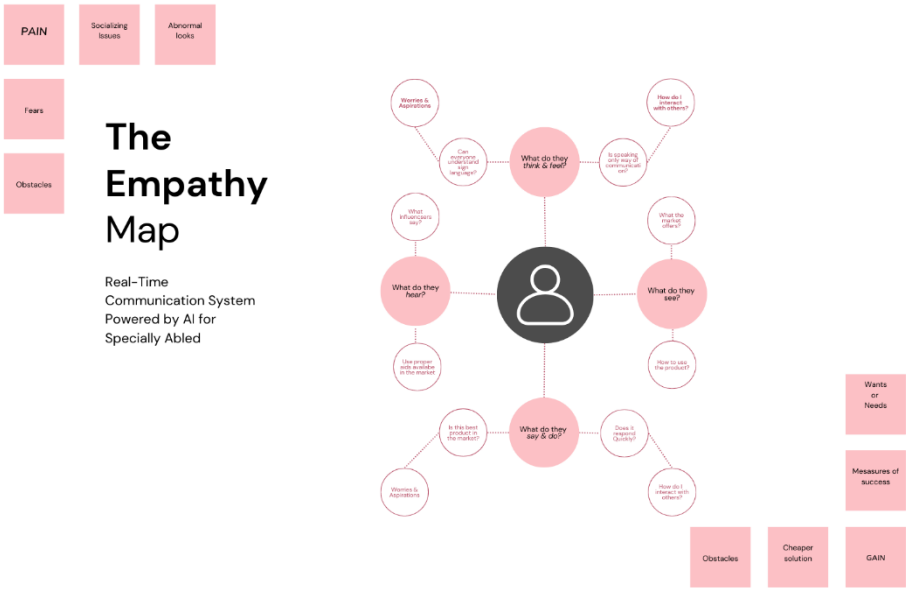
In our society, we have people with disabilities. The technology is developing day by day but no significant developments are undertaken for the betterment of these people. Communications between deaf-mute and a normal person has always been a challenging task. It is very difficult for mute people to 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 humanunderstandable language and speech is given as output.

CHAPTER 3

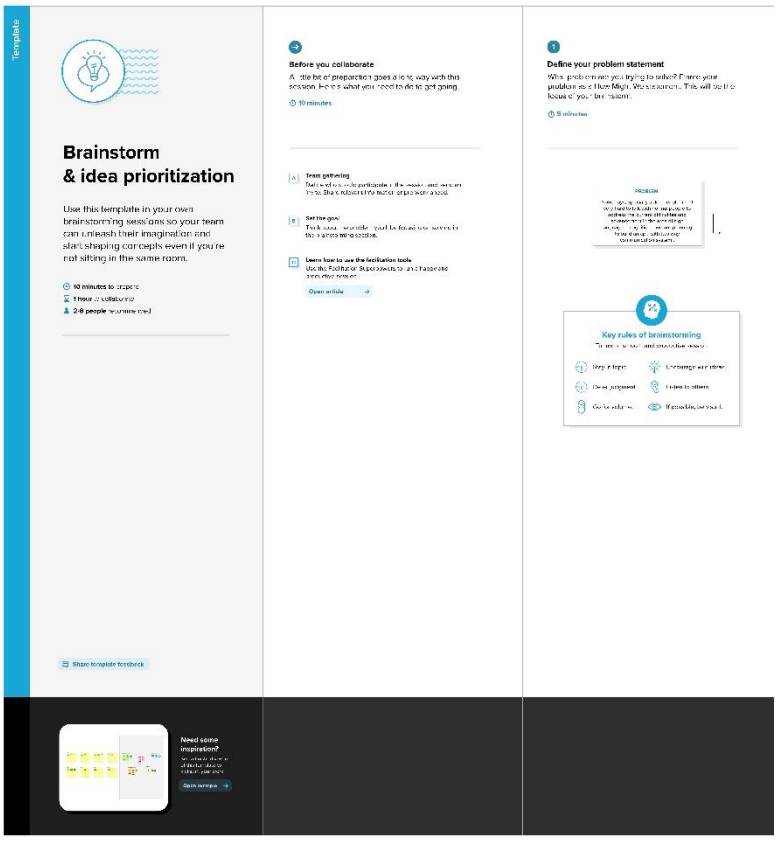
IDEATION & PROPOSED SOLUTION

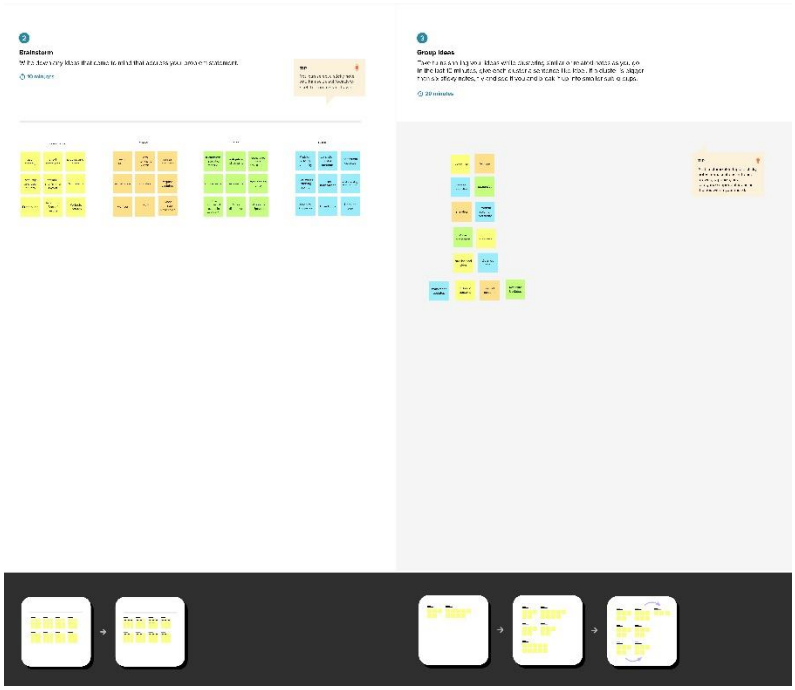
IDEATION AND PROPOSED SOLUTION

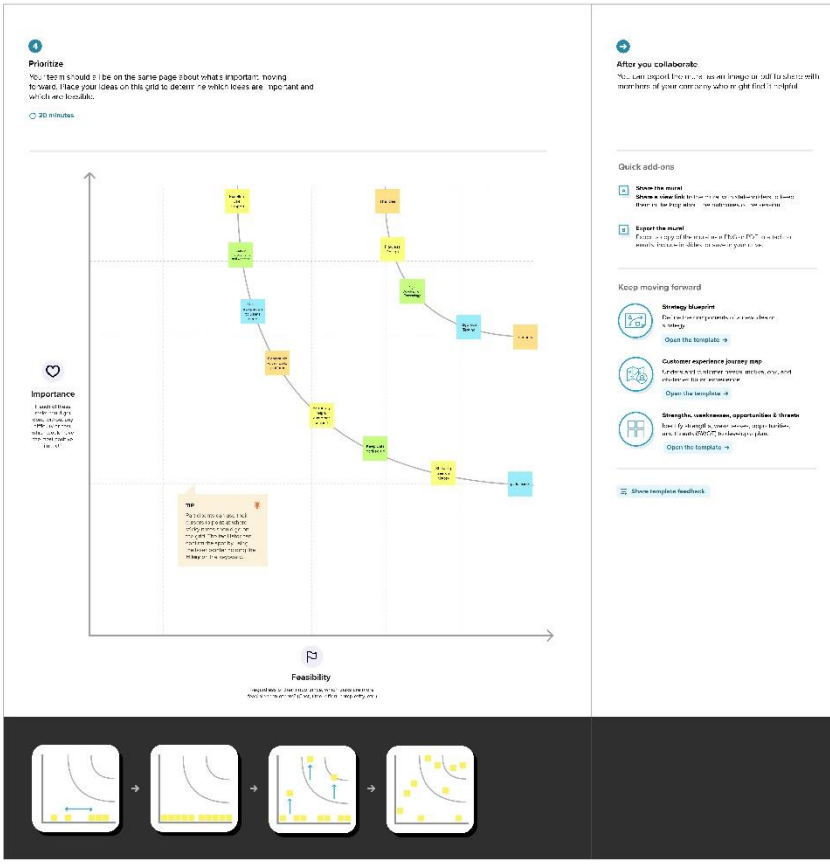
3.1 EMPATHY MAP



3.2 IDEATION AND BRAINSTORMING




2
Brainstorm
10 min, or
3
Group ideas
20 minutes


4
Prioritize
20 minutes
Importance
Feasibility
After you collaborate
Quick add-ons
Keep moving forward
Strategy blueprint
Open the template →
Customer experience journey map
Open the template →
Strategies, weaknesses, opportunities & threats
Open the template →

3.3 PROPOSED SOLUTION

S.No.	PARAMETER	DESCRIPTION
1	Problem Statement (Problem to be solved)	Differently able like dump and mute people can communicate only through the sign language, normal people those who do not know the sign language feels difficult to communicate with them.
2	Idea / Solution Description	To overcome this problem we have an idea that an application is created to communicate with the normal people.
3	Novelty / Uniqueness	This process the image of the person who is using sign language and convert it into the voice by analysing the sign used.
4	Social Impact / Customer Satisfaction	Differently able people feel free to communicate and it bring a huge difference comparing to past.
5	Business Model (Revenue Model)	There are many people in the world who is differently able,this application will become more popular among them and it will be installed by all and it will be used,and so it will produce more money.
6	Scalability of the Solution	Thus this would bring a new evolution in Real Time Communication System Powered by AI for Specially Able with less time and safe enough resources

3.4 PROBLEM SOLUTION FIT

Focus on J&P , tap into BE, understand RC	**2 .JOBS-TO-BE-DONE/PROBLEMS** J&P Ordinary people hardly recognize a disabled person's expressions and what they told.	**9. PROBLEM ROOT CAUSE** RC The problem emerges when an abled person starts a conversation with a normal person that they are unable to understand due of their knowledge.	**7.BEHAVIOUR** BE When a customer says anything, an abled person cannot comprehend it properly . Ask Before You Help: The first step is to treat persons with disabilities as equals. Don't assume they constantly need assistance with daily activities.	Focus on J&P , tap into BE, understand RC
Define CS, fit into CC	**1.CUSTOMER SEGMENT(S)** CS My client is an everyday person who makes an effort to comprehend sign language.	**6.CUSTOMER CONSTRAINTS** CC The client understands sign language, which cannot be done quickly	**5.AVAILABLE SOLUTIONS** AS With some effort, the average person can anticipate sign language. The ordinary individual can comprehend sign language at some time	Explore AS, differentiate
Identify strong TR & EM	**3. TRIGGERS** TR Lack of appropriate assistive technology (assistive, adaptive, and rehabilitative devices), an inaccessible physical environment, unfavorable attitudes about disability, **4. EMOTIONS: BEFORE / AFTER** EM Be genuine and converse with someone who has a disability in the same way you would with anyone else. Be respectful in both your inquiries and your behavior. Additionally, refrain from posing queries that you wouldn't pose to someone who is not disabled. Not every person with a handicap wants to talk about their particular skills or limits. The entire family is affected by disabilities.	**10. YOUR SOLUTION** SL If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behavior.	**8. CHANNELS of BEHAVIOUR** CH The ADA offers some useful advice, such as treating everyone with respect and avoiding patronizing them. After offering assistance, pay attention to the reactions. Follow the guidelines provided, or if your offer of help is declined, respect the decision and refrain from offering it again.	Identify strong TR & EM

CHAPTER 4
REQUIREMENT ANALYSIS

REQUIREMENT ANALYSIS

4.1 Functional & Non-functional

4.1.1 Functional Requirements:

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	Uploading image	Upload image through camera or Upload image through gallery
FR-4	Templates usage during any emergencies	Select emergency templates icon to pass the message quickly
FR-5	Text to speech	Converts respective text to sign language

4.1.2 Non-Functional Requirements:

Following are the functional requirements of the proposed solution

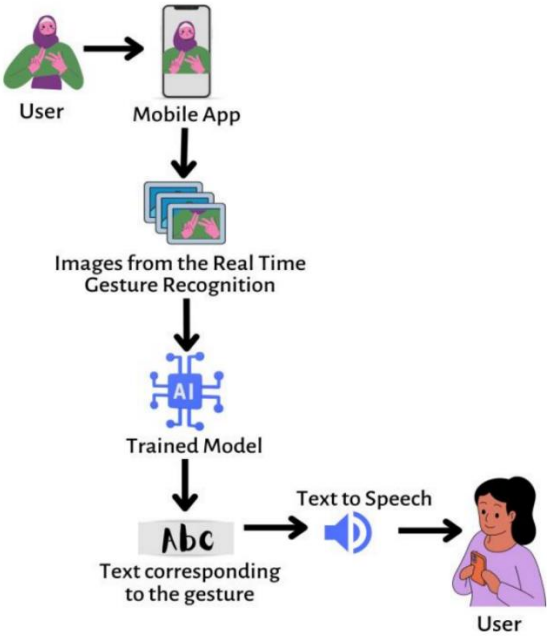
NFR-3	**Reliability**	Our application provides quality customer service with high security so this will be trustworthy.
NFR-4	**Performance**	Speed, Accuracy, Efficiency, User-friendly.
NFR-5	**Availability**	Since our application does not contain any premium customers option it will be affordable for all the users. The users can always download it from google play store or apple store or from any other online application platforms.
NFR-6	**Scalability**	It is a single user entity. On the basis of performance this application will work efficiently even with less bandwidth of internet.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The application and the product we are developing will be enabled with the facilities of voice engines which helps the user to analyse the surroundings and act accordingly. It also includes features such as speech to text and speech to signs and vice versa which allows deaf people to communicate with the outside world.
NFR-2	**Security**	This application provides a highly confidential platform when it comes to user security. It stores each and every detail of the users in a highly secured database which is impossible to access by the third parties.

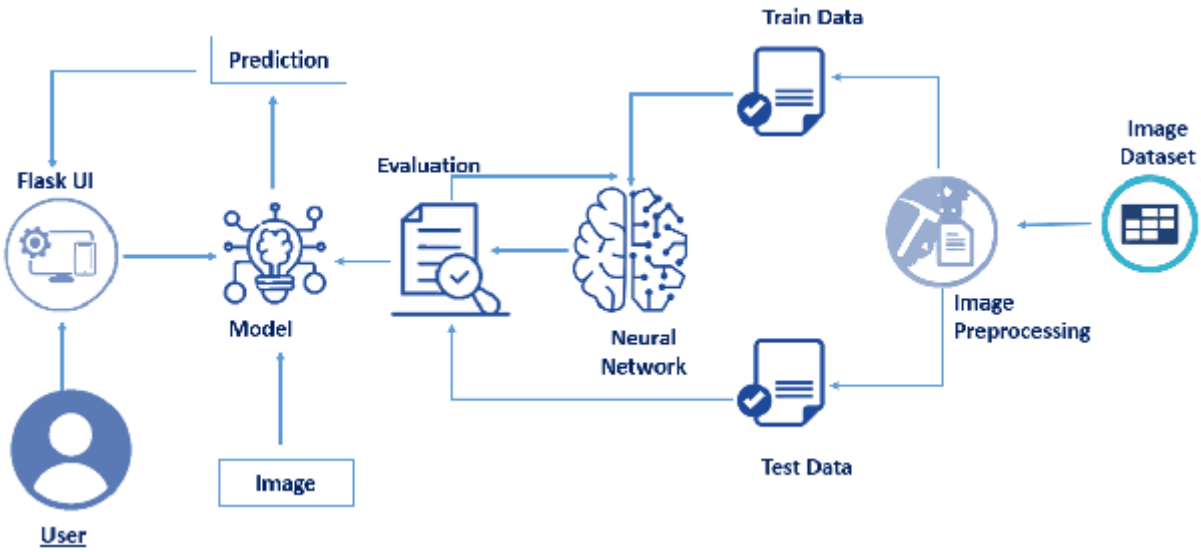
CHAPTER 5
PROJECT DESIGN

PROJECT DESIGN

5.1 Data Flow Diagrams:



5.1 Solution & Technical Architecture:



5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer *(Desktop user)*	Registration	USN-1	**Not Required**	I can access my account dashboard	High	Sprint-1
	Login	USN-2	**Not Required**		High	Sprint-1
	Dashboard	USN-3	**Not Required**			
Customer *(Desktop user)*	**Main page**	USN-4	As a User, **I can enter the web page once clicked, which provides be the Guidelines** to use the app	I can **enter the web page** once clicked	Medium	Sprint-1
Customer (Desktop user)	**Guidelines**	USN-5	As a User, **I can give a read through the guidelines to understand the functioning of the app.**	I can **give a read through the guidelines.**	Medium	Sprint-1
Customer *(Desktop user)*	**Convert Sign**	USN-6	As a User, **I can click the button Convert sign** . which directs me towards the Main screen	I can **click the button Convert sign and directed me to main screen.**	Medium	Sprint-2
Customer *(Desktop user)*	**Camera (Hand movement detection)**	USN-7	As a User, **I can show my hand sign towards the camera which converts them into text manner.**	**I can show my hand sign** towards the camera accurately.	High	Sprint-2
Customer *(Desktop user)*	**Voice mode**	USN-8	Once the text is obtained, As a User **I can click on the voice mode which provides the text in the form of speech.**	**I can click on the voice mode** which provides the text in the form of speech.	High	Sprint-2
Customer Care Executive	**Provide the necessary functionalities required to use the app.**		As an Executive, I can **provide the Specifications of Camera required, and other factors** that are required for smooth functioning of the app.	**I can provide the Specifications** of Camera required, and other factors	Low	Sprint-1
Customer Care Executive	**Check the performance of the app**		As an Executive, I can **check the usage and queries obtained from the end users**.	I can **check the usage and queries** obtained from the end users.	Medium	Sprint-1

CHAPTER 6

PROJECT PLANNING

AND

SCHEDULING

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation:

Milestone	Functional Requirement (Epic)	Milestone Story Number	Milestone Story / Task
Milestone 1	Data Collection	M1	We're collecting dataset for building our extend and making two organizers, one for preparing and another one for testing.
Milestone 2	Image Pre-processing	M2	Bringing in picture information generator libraries and applying picture information generator usefulness to prepare the test set.
Milestone 3	Building Model	M3	Bringing in the show building libraries, Initializing the show, Including Convolution layers, Including the Pooling layers, Including the Straighten layers, Including Thick layers, Compiling the demonstrate Fit and Spare the demonstrate.
Milestone 4	Testing Model	M4	Consequence the bundles to begin with. At that point we spare the demonstrate and stack the test picture, pre-process it and anticipate it.
Milestone 5	Application Layer	M5	Construct the flask application and the HTML pages.
Milestone 6	Train Conversation Engine	M6	Enrol for IBM Cloud and Train Picture Classification Demonstrate
Milestone 7	Final Result	M7	To guarantee all the exercises and coming about the ultimate yield.

6.2 Sprint Delivery Schedule:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect Dataset.	9	High	Girishun Kumar R, Kishore M
Sprint-1		USN-2	Image pre-processing	8	Medium	Girishun Kumar R, Kishore M
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers and compile the model	10	High	Girishun Kumar R, Jai Krishna K
Sprint-2		USN-4	Training the image classification model using CNN	7	Medium	Girishun Kumar R, Jai Krishna K
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	Girishun Kumar R, Jai Krishna K
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	8	Medium	Sri Nandhish Kumar, Jai Krishna K

CHAPTER 7

CODING AND SOLUTIONING

CODING & SOLUTIONING

7.1 FEATURE 1

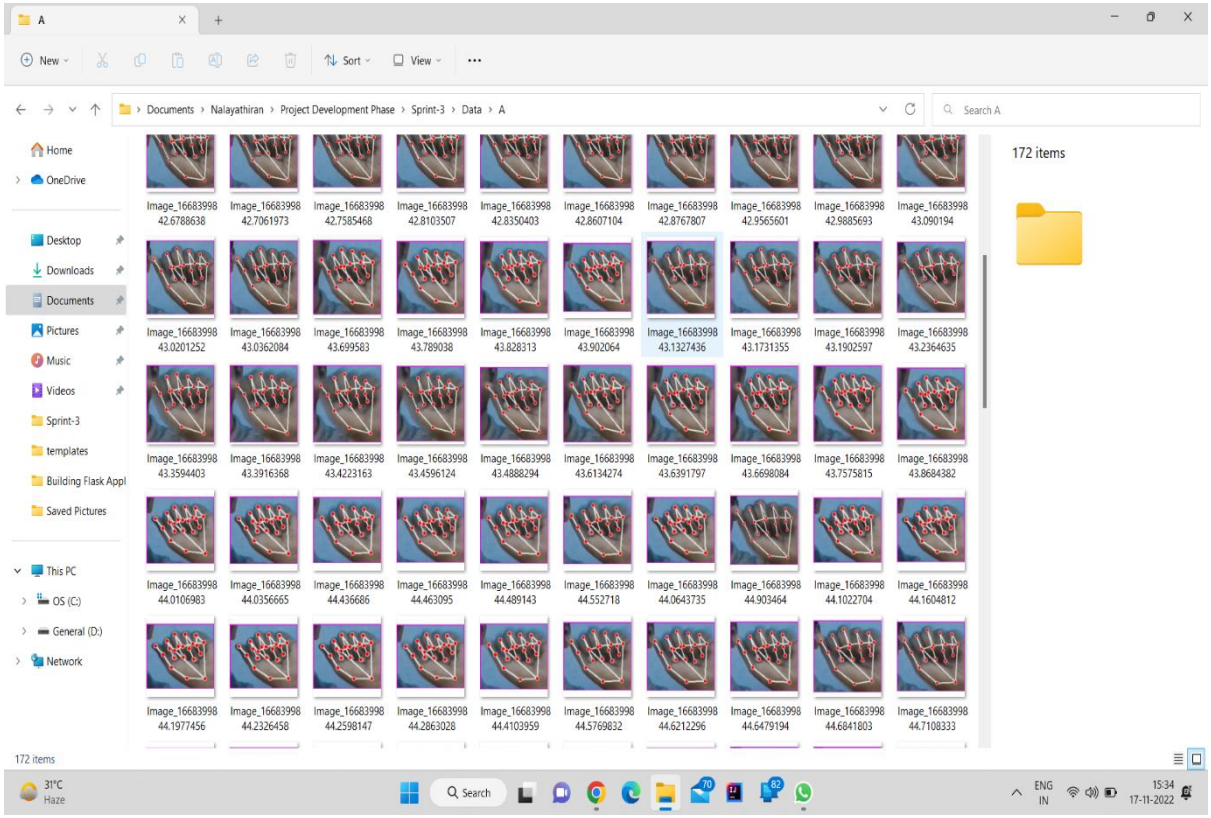
7.1.1 CREATING CNN MODEL AND PREDICTION BASE PROGRAMS

i. Collecting Datasets.

```python
import cv2
from cvzone.HandTrackingModule import HandDetector
import numpy as np
import math
import time

cap = cv2.VideoCapture(0)
detector = HandDetector(maxHands=1)

offset = 20
imgSize = 300

folder = "Data/I"
counter = 0

while True:
    success, img = cap.read()
    hands, img = detector.findHands(img)
    if hands:
        hand = hands[0]
        x, y, w, h = hand['bbox']

        imgWhite = np.ones((imgSize, imgSize, 3), np.uint8) * 255
        imgCrop = img[y - offset:y + h + offset, x - offset:x + w + offset]

        imgCropShape = imgCrop.shape

        aspectRatio = h / w

        if aspectRatio > 1:
            k = imgSize / h
            wCal = math.ceil(k * w)
            imgResize = cv2.resize(imgCrop, (wCal, imgSize))
            imgResizeShape = imgResize.shape
            wGap = math.ceil((imgSize - wCal) / 2)
            imgWhite[:, wGap:wCal + wGap] = imgResize
```

```
37
38          else:
39              k = imgSize / w
40              hCal = math.ceil(k * h)
41              imgResize = cv2.resize(imgCrop, (imgSize, hCal))
42              imgResizeShape = imgResize.shape
43              hGap = math.ceil((imgSize - hCal) / 2)
44              imgWhite[hGap:hCal + hGap, :] = imgResize
45
46          cv2.imshow("ImageCrop", imgCrop)
47          cv2.imshow("ImageWhite", imgWhite)
48
49      cv2.imshow("Image", img)
50      key = cv2.waitKey(1)
51      if key == ord("s"):
52          counter += 1
53          cv2.imwrite(f'{folder}/Image_{time.time()}.jpg', imgWhite)
54          print(counter)
```

ii. Saving the collected image in a Data directory which contain Train and Test folder.

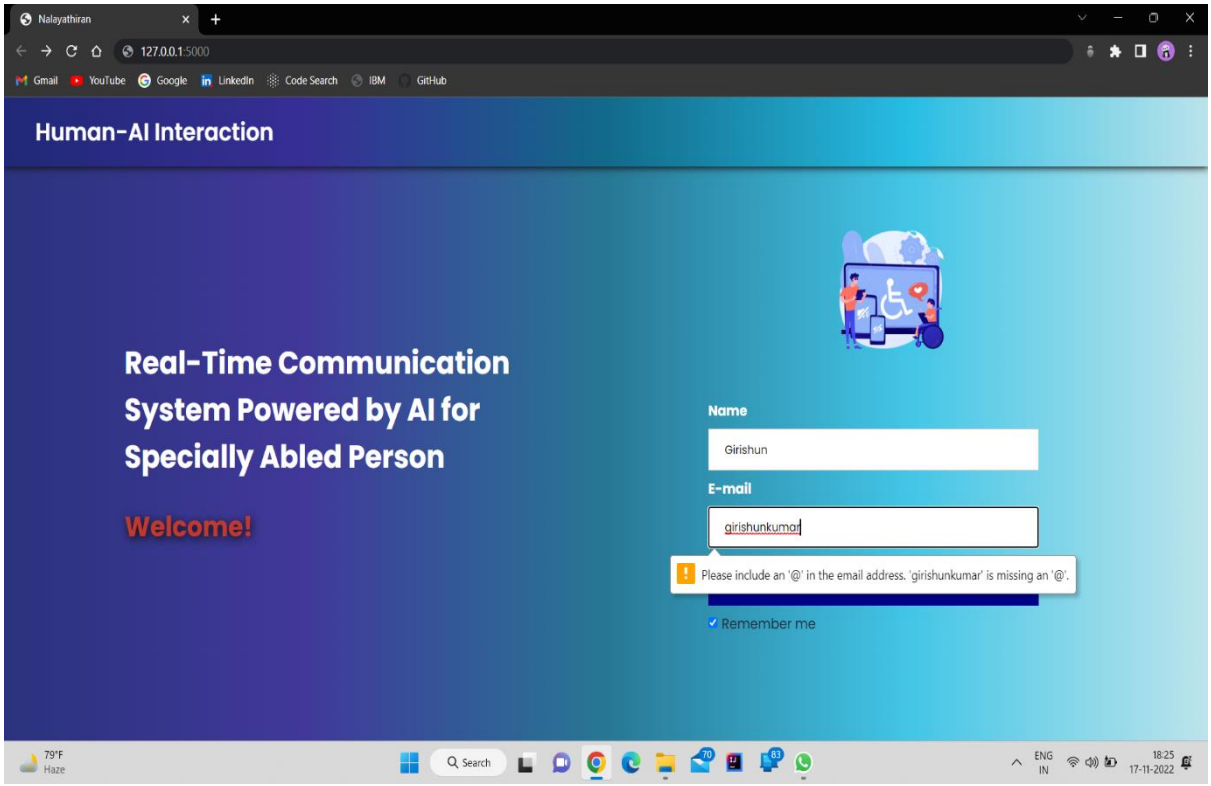


MAIN FLASK APP:

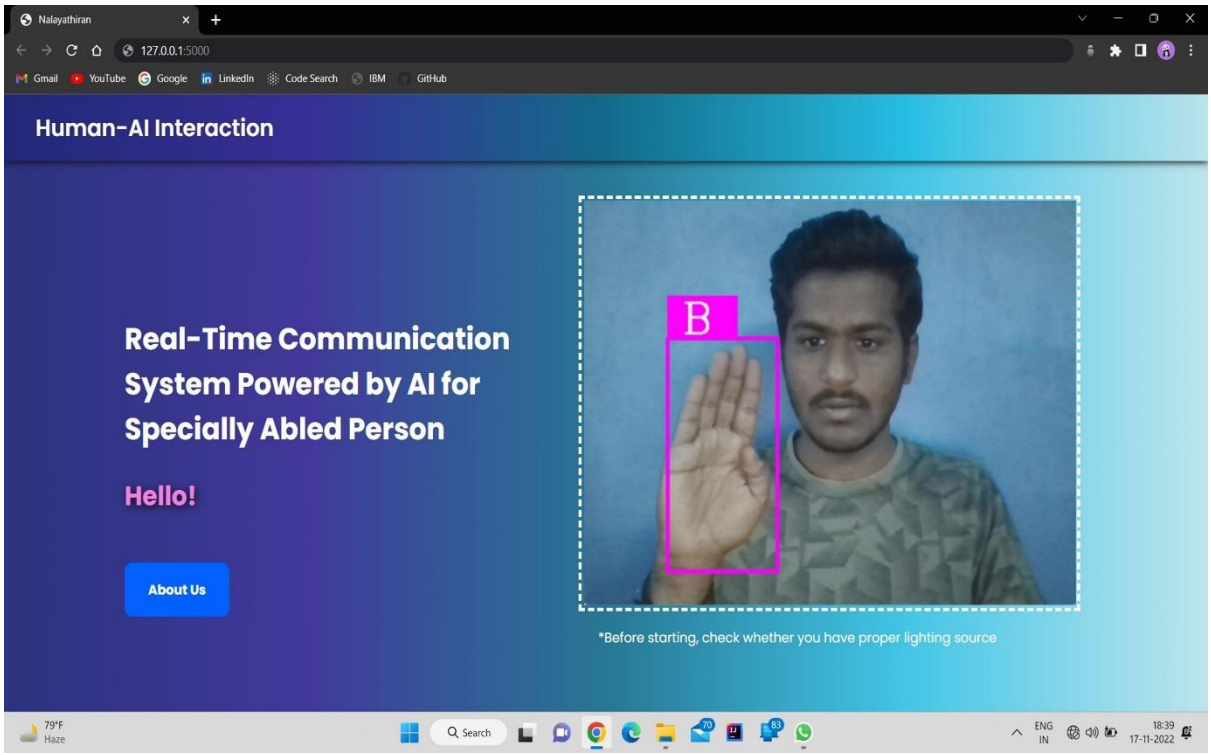
```python
from flask import Flask, Response, render_template
import time
import pyttsx3
import cv2
import numpy as np
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image

# camera frames
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('ash_model.h5')
        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 Alphabet is: '+str(self.index[self.y]),(170,50),cv2.FONT_HERSHEY_SIMPLEX,1,(0,0,0),3)
        ret,jpg = cv2.imencode('.jpg', frame)
        var = str(self.index[self.y])
        text_speech = pyttsx3.init()
        text_speech.say(var)
        text_speech.runAndWait()
```

```python
# flask
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()
```

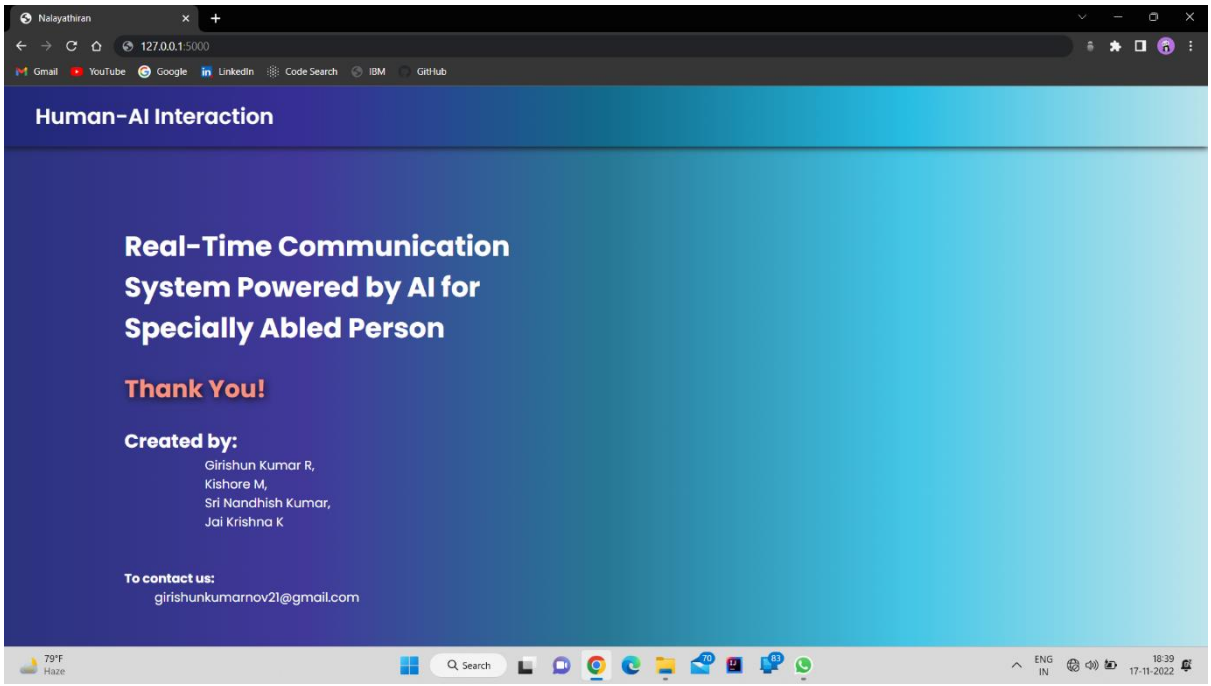
MAIN PAGE:



VIDEO TRANSLATE PAGE:



ABOUT PAGE:



TESTING

8.1 TEST CASES

Loading the Dataset & Image Data Generation

In [14]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

In [15]:
```
# 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 [25]:
```
# Training Dataset
x_train=train_datagen.flow_from_directory(r'C:\Users\india\Desktop\Final_Project\Dataset\test_set',target_size=(64,64), class_mode='categorical',batch
# Testing Dataset
x_test=test_datagen.flow_from_directory(r'C:\Users\india\Desktop\Final_Project\Dataset\training_set',target_size=(64,64), class_mode='categorical',bat
```

```
Found 4969 images belonging to 9 classes.
Found 4969 images belonging to 9 classes.
```

In [26]:
```
print("Len x-train : ", len(x_train))
print("Len x-test : ", len(x_test))
```

```
Len x-train :  6
Len x-test :  6
```

In [27]:
```
# The Class Indices in Training Dataset
x_train.class_indices
```

Out[27]:
```
{'A': 0, 'B': 1, 'C': 2, 'D': 3, 'E': 4, 'F': 5, 'G': 6, 'H': 7, 'I': 8}
```

Model Creation

In [28]:
```
# Importing Libraries
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Convolution2D,MaxPooling2D,Flatten,Dense
```

In [29]:
```
# Creating Model
model=Sequential()
```

In [30]:
```
# 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 [31]:
```
# Compiling the Model
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

In [32]:
```
# 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
6/6 [==============================] - 23s 4s/step - loss: 5.1206 - accuracy: 0.1690 - val_loss: 3.6505 - val_accuracy: 0.3119
Epoch 2/10
6/6 [==============================] - 22s 4s/step - loss: 2.3945 - accuracy: 0.3266 - val_loss: 1.5087 - val_accuracy: 0.4991
Epoch 3/10
6/6 [==============================] - 22s 4s/step - loss: 1.4384 - accuracy: 0.4837 - val_loss: 1.0430 - val_accuracy: 0.5836
Epoch 4/10
6/6 [==============================] - 23s 4s/step - loss: 1.0761 - accuracy: 0.6488 - val_loss: 0.7109 - val_accuracy: 0.7955
Epoch 5/10
6/6 [==============================] - 27s 5s/step - loss: 0.7835 - accuracy: 0.7774 - val_loss: 0.4046 - val_accuracy: 0.9501
Epoch 6/10
6/6 [==============================] - 25s 5s/step - loss: 0.5470 - accuracy: 0.8756 - val_loss: 0.2540 - val_accuracy: 0.9752
Epoch 7/10
6/6 [==============================] - 22s 4s/step - loss: 0.4018 - accuracy: 0.9090 - val_loss: 0.1675 - val_accuracy: 0.9799
Epoch 8/10
6/6 [==============================] - 22s 4s/step - loss: 0.2862 - accuracy: 0.9406 - val_loss: 0.1185 - val_accuracy: 0.9847
Epoch 9/10
6/6 [==============================] - 22s 4s/step - loss: 0.2108 - accuracy: 0.9612 - val_loss: 0.0880 - val_accuracy: 0.9863
Epoch 10/10
6/6 [==============================] - 22s 4s/step - loss: 0.1548 - accuracy: 0.9738 - val_loss: 0.0736 - val_accuracy: 0.9843
```

Out[32]:

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	11	2	3	2	18
Duplicate	1	3	4	0	8
External	3	5	0	0	8
Fixed	12	2	5	22	41
Not Reproduced	0	1	0	0	1
Skipped	0	0	1	2	3
Won't Fix	0	4	1	1	7
Totals	27	17	14	27	86

3. Test Case Analysis

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

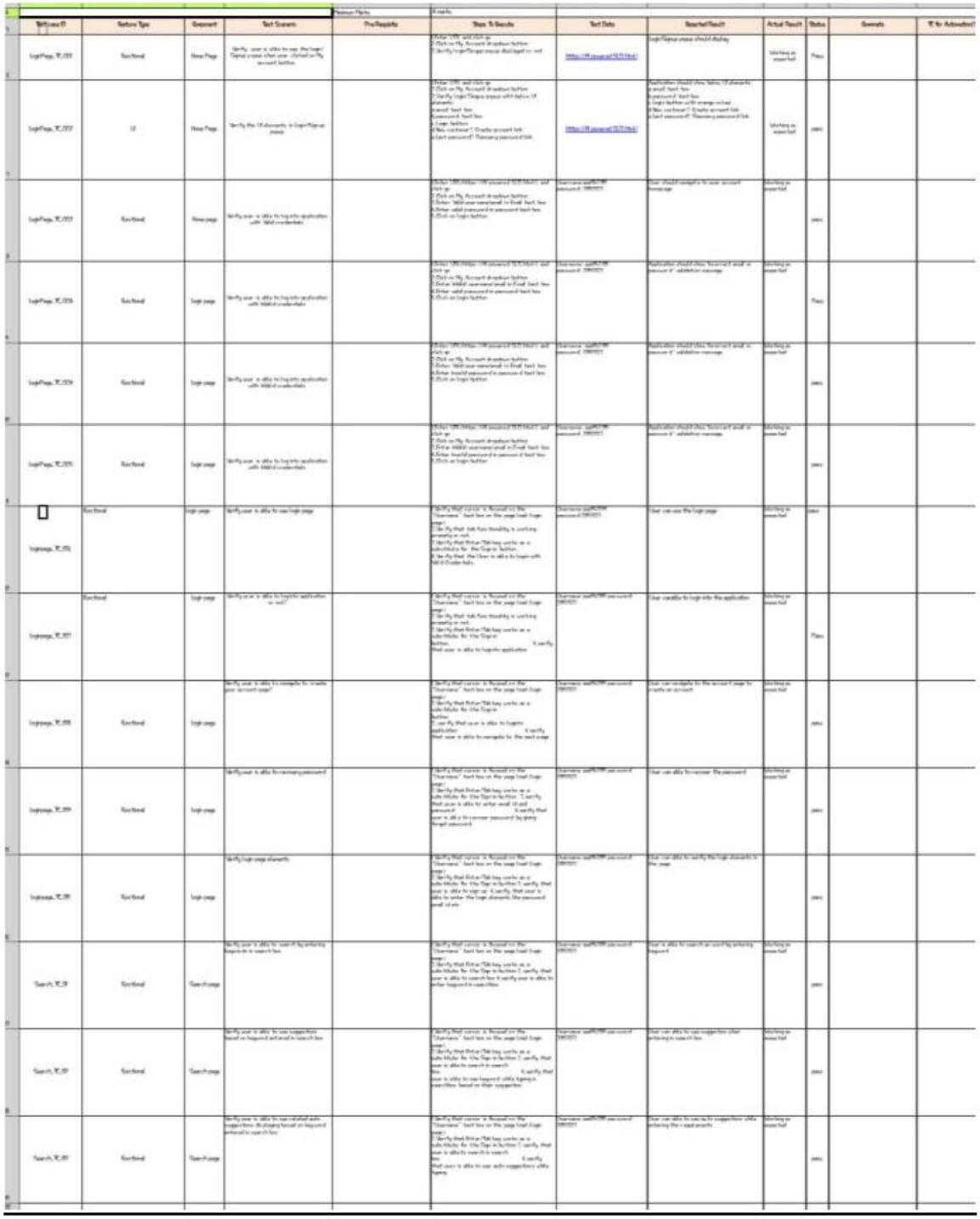
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	8	0	0	8
Client Application	49	0	0	49
Security	4	0	0	4
Outsource Shipping	4	0	0	4
Exception Reporting	11	0	0	11
Final Report Output	2	0	0	2
Version Control	1	0	0	1

CHAPTER 9

RESULT

RESULTS

9.1 PERFORMANCE METRICES:



CHAPTER 10

ADVANTAGES

AND

DISADVANTAGES

ADVANTAGES & DISADVANTAGES

Advantages:

- It is a cost-effective way of getting several people from different locations to attend meetings and conferences.
- It enables employees from across the world to communicate with each other 24×7 and share ideas or solve problems quickly.

Disadvantages:

- Also accuracy depends upon distance between camera and object.
- It takes a lot of time to listen, speak, read, or write to someone.

CHAPTER 11
CONCLUSION

CONCLUSION

The proposed communication system between Deaf and Dumb people and ordinary people are aiming for it when bridging the communication gap between two societies. It provides complete two - sided communication in an efficient manner between the disabled and the normal person. For communication between deaf person and a second person, a mediator is required to translate sign language of deaf person. But a mediator is required to know the sign language used by deaf person. But this is not always possible since there are multiple sign languages for multiple languages. So to understand all sign languages, Hand gestures of deaf peoples by normal peoples this system is proposed.

CHAPTER 12
FUTURE SCOPE

FUTURE SCOPE

The speech-to-text and text-to-speech technologies helped those people who had difficulties in communicating or expressing their feelings to the normal people. This reduces the communication gap between the normal people and the specially abled people. Using image pre-processing and Artificial Intelligence it is easy to understand the context of objects and clearly explains it to the people who use it for communication.

CHAPTER 13
APPENDIX

APPENDIX

SOURCE CODE

https://github.com/IBM-EPBL/IBM-Project-21849-1659792778