Real-Time Communication System Powered by AI for Specially Abled

Team ID: PNT2022TMID50654

PROJECT REPORT

ABSTRACT

People with impaired speech and hearing use Sign language as a form of communication. Disabled People use these sign language gestures as a tool of non-verbal communication to express their own emotions and thoughts to other common people. Conversing with people having a hearing disability is a major challenge. Deaf and Mute people use hand gesture sign language to communicate, hence normal people face problems in recognizing their language by signs made. Hence there is a need for systems that recognize the different signs and conveys the information to normal people. But these common people find it difficult to understand their expression, thus trained sign language expertise is needed during medical and legal appointments, educational and training sessions. Over the past few years, there has been an increase in demand for these services. Other forms of services such as video remote human interpreting using the high-speed Internet connection, has been introduced, thus these services provide an easy to use sign language interpreter service, which can be used and benefited, yet have major limitations. To address this problem, we can implement artificial intelligence technology to analyze the user’s hand with finger detection. In this proposed system we can design the vision based system in real time environments. And then using a deep learning algorithm named Convolutional neural network algorithm to classify the sign and provide the label about the recognized sign.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Sign language recognition is the process of translating the user's gestures and signs into text. It aids those who are unable to interact with the general population in communication Using image processing methods and neural networks, the motion is mapped to pertinent text in the training data, transforming unprocessed photos and videos into text that can be read and understood. People who are dumb are typically prohibited from having regular conversations with other people in society. They sometimes struggle to communicate with regular people through gestures because the majority of people only recognise a small number of them. People who are deaf or have hearing loss are unable to communicate vocally, so they must frequently use some type of visual communication. The primary form of communication for the deaf and dumb community is sign language. Similar to other languages, it contains grammar and vocabulary, but it communicates primarily through images.

1.2 PURPOSE

The problem occurs when those who are stupid or deaf attempt to use these grammars of sign language to interact with others. This is because the majority of individuals are not familiar with these grammar standards. The popularity of international programmes and the financing they get highlight the value of sign language. In this age of technology, a computer-based solution is highly desired by the dumb community. Teaching a computer to recognise speech, facial expressions of emotion, and human gestures are some steps toward achieving this goal. Gestures are used to convey information nonverbally. Humans are capable of an endless amount of motions at any given moment. Since human motions are seen visually, computer vision researchers are particularly interested in them. The project's objective is to develop an HCI that can recognise human motions. These motions must be translated into machine language using a challenging programming process. In our paper, we concentrate on Image Processing and Template Matching for better output creation.

2. LITERATURE REVIEW

2.1 EXISTING PROBLEM

2.1.1 TITLE: A STUDY ON ARABIC SIGN LANGUAGE RECOGNITION FOR DIFFERENTLY ABLED USING ADVANCED MACHINE LEARNING CLASSIFIERS

AUTHOR: MOHAMMED MUSTAFA,2021

Around 70 million people use sign language worldwide, and an automated method for translating it could significantly improve communication between sign language users and those who might not understand it. Nonverbal communication that includes the use of other bodily parts is called sign language. Face expressions, together with movements of the hands, eyes, and lips used in sign language communication to communicate information. People who have trouble hearing or speaking rely heavily on sign language as a form of communication in daily life. The inconsistent shape, size, and posture of the hands or fingers in an image was however shown by computer translation of sign language, which was highly complicated. SLR can be used in two main ways: based on a picture or sensor. The main advantage of image-based frameworks is that people do not need to use complicated equipment. In any case, the preprocessing process necessitates large computations. Sensors frameworks use gloves fitted with sensors rather of relying just on cameras. Like spoken language, sign language is not confined to a certain location or region. It is trained differently over the world (Shin et al. 2019). It is sometimes referred to as Chinese Sign Language, American Sign Language, African Sign Language, and Arabic Sign Language (ArSL). India does not have a standardized sign language with important modifications, unlike sign languages in Europe and America. However, a dictionary of ISL was just created by Coimbatore's Vivekananda University for the Ramakrishna Missions. There are currently 2037 signs available in Indian Sign Language (ISL). Similar to how SLR models are separated into sensor glove based and vision based categories. Research on SLR can be divided into contact-based and vision-based methods.

2.1.2TITLE: SIGN LANGUAGE TRANSFORMERS:

JOINT END-TO-END SIGN LANGUAGE RECOGNITION AND TRANSLATION
AUTHOR: NECATI CIHAN CAMG¨OZ, 2021.

The translation is improved by having a mid-level sign gloss representation, which efficiently recognises the various signs, according to earlier research on sign language translation. Performance significantly In fact, gloss level tokenization is necessary for the state-of-the-art in translation to function. We present a unique architecture based on transformers that simultaneously learns Continuous Sign Language Recognition and Translation while being end-to-end trainable. This is accomplished by combining the recognition and translation issues into a single, unified architecture employing a Connectionist Temporal Classification (CTC) loss. This collaborative approach achieves significant performance improvements while simultaneously resolving two related sequence-to-sequence learning problems without the need for ground-truth timing information. The primary form of communication for the Deaf community is sign language, which is their native tongue. They use a variety of complementing channels as visual languages to communicate ideas. This comprises both manual and non-manual characteristics, such as head, shoulder, and torso movement as well as manual characteristics like hand shape, movement, and stance. The purpose of sign language translation is to either extract an equivalent spoken language sentence from written text or translate written text into a video of signs. A clip of someone doing the continuous sign. However, a large portion of this latter work is done in the field of computer vision, where linguists refer to these channels as articulators. Word embedding with spatial embedding has concentrated on understanding the order of sign glosses rather than providing a complete translation into a spoken language counterpart (Sign Language Translation, or SLT). Word order variations, the use of multiple channels to convey simultaneous information, and the use of direction and space to indicate the relationships between objects are just a few examples of these differences.

2.1.3 TITLE: SIGN LANGUAGE RECOGNITION SYSTEMS: A DECADE SYSTEMATIC LITERATURE REVIEW
AUTHOR: ANKITA WADHAWAN,2020.

As spoken languages are pronounced with the lips and heard with the ear, they utilise the "vocal-auditory" channel. Additionally, all writing systems come from, or are spoken languages' representations. Because they use the "corporalvisual" channel, which is created with the body and perceived with the eyes, sign languages (SLs) are unique. SLs are widely used by the deaf communities but are not internationally recognized. They are considered natural languages because deaf people can spontaneously gather and communicate with one another anywhere. SLs have independent vocabularies and grammatical structures and are not descended from spoken languages . The signs that the deaf use actually have the same internal structure as spoken words. The signs of SLs are produced using a small number of different sounds, just as hundreds of thousands of English words are. A fixed number of gestural characteristics. As a result, signs are not complete gestures but rather can be analyzed as a collection of linguistically important characteristics. A gloss, the basic component of an SL and the closest representation of a sign's meaning, is made up of combinations of the aforementioned qualities. SLs, comparable to the spoken ones, contain a list of grammatically flexible rules that apply to both manual and non-manual elements. Signers utilize both of them concurrently (and frequently with a flexible temporal structure) to create phrases in an SL. A particular feature may be the most important consideration when interpreting a gloss, depending on the context. It can change a verb's meaning, provide spatial and temporal context, and distinguish between things and people. A signer's glosses can be inferred from video recordings using a process known as sign language recognition (SLR). Despite the fact that there is a lot of labor, There is a severe paucity of comprehensive experimental research in the subject of SLR. Additionally, most articles don't release their code or present findings from all available datasets. As a result, experimental findings in the field of SL are rarely repeatable and interpretable.

2.1.4 TITLE: A COMPREHENSIVE STUDY ON SIGN LANGUAGE RECOGNITION METHODS AUTHOR: NIKOLAS ADALOGLOU,2020

The sign language is used widely by people who are deaf-dumb these are used as a medium for communication. A sign language is nothing but composed of various gestures formed by different shapes of hand, its movements, orientations as well as the facial expressions. There are around 466 million people worldwide with hearing loss and 34 million of these are children. `Deaf' people have very little or no hearing ability. They use sign language for communication. People use different sign languages in different parts of the world. Compared to spoken languages they are very less in number. In the existing system, lack of datasets along with variance in sign language with locality has resulted in restrained efforts in finger gesture detection. Existing project aims at taking the basic step in bridging the communication gap between normal people and deaf and dumb people using Indian sign language. Effective extension of this project to words and common expressions may not only make the deaf and dumb people communicate faster and easier with outer world, but also provide a boost in Developing autonomous systems for understanding and aiding them. The Indian Sign Language lags behind its American Counterpart as the research in this field is hampered by the lack of standard datasets. In addition to the intrinsic challenges of human motion analysis (such as variations in the participants' appearances, the characteristics of the human silhouette, and the execution of the repetition of operations, the presence of obstructions, etc.) A signer's glosses can be inferred from video recordings using a process known as sign language recognition (SLR). Despite the fact that there is a lot of labor, There is a severe paucity of comprehensive experimental research in the subject of SLR.

2.1.5T ITLE: TRANSFERRING CROSS-DOMAIN KNOWLEDGE FOR VIDEO SIGN LANGUAGE RECOGNITION
AUTHOR: DONGXU LI,2020

As a fundamental sign language interpretation task, word-level sign language recognition (WSLR) aims to help deaf people communicate. However, WSLR is very difficult because it requires quick body movements, facial expressions, and complex, fine-grained hand gestures. Isolated Sign Words Web News Sign Words Localizer has been demonstrated recently using deep learning approaches. Our model learns domain-invariant characteristics to transfer knowledge from web news signs to WSLR models. Our model recognises the example frames in the figure as the signature that best captures the gesture on the WSLR job, their advantages. Although the largest existing datasets have a limited number of instances, e.g., on average 10 to 50 instances per word, annotating WSLR datasets requires domain-specific knowledge. This is significantly less than typical video datasets on action learning and recognition, for example. The sign recognition task's inadequate training data may cause overfitting or in some other way hinder WSLR's performance.Models under realistic circumstances. On the other hand, there are many readily available news videos with subtitles available online that could be useful for WSLR. Despite the availability of sign news videos, it is quite difficult to translate this knowledge to WSLR. First, there are no annotations of temporal location or categories and just flimsy labels for the presence of signs in subtitles. Furthermore, these labels are loud. In this study, we provide a technique for transferring cross-domain knowledge from news signs to WSLR models to enhance their performance. More specifically, using a base WSLR model in a sliding window fashion, we first create a sign word localizer to extract sign words. Then, we suggest jointly coarse-aligning two domains. Employing isolated and news indicators to train a classifier. We compute and store the centroid of each class of the coarsely-aligned new words in an external memory termed prototype memory after getting the representations of the coarsely aligned news words.

2.2 REFERENCES

[1] Mohammed Mustafa, “ A study on arabic sign language recognition for differently abled using advanced machine learning classifiers”,2020.

[2]Necati Cihan Camg¨oz, “: Sign language transformers: joint end-to-end sign language recognition and translation”,2021.

[3]Ankita Wadhawan, “Sign language recognition systems: a decade systematic literature review”,2020

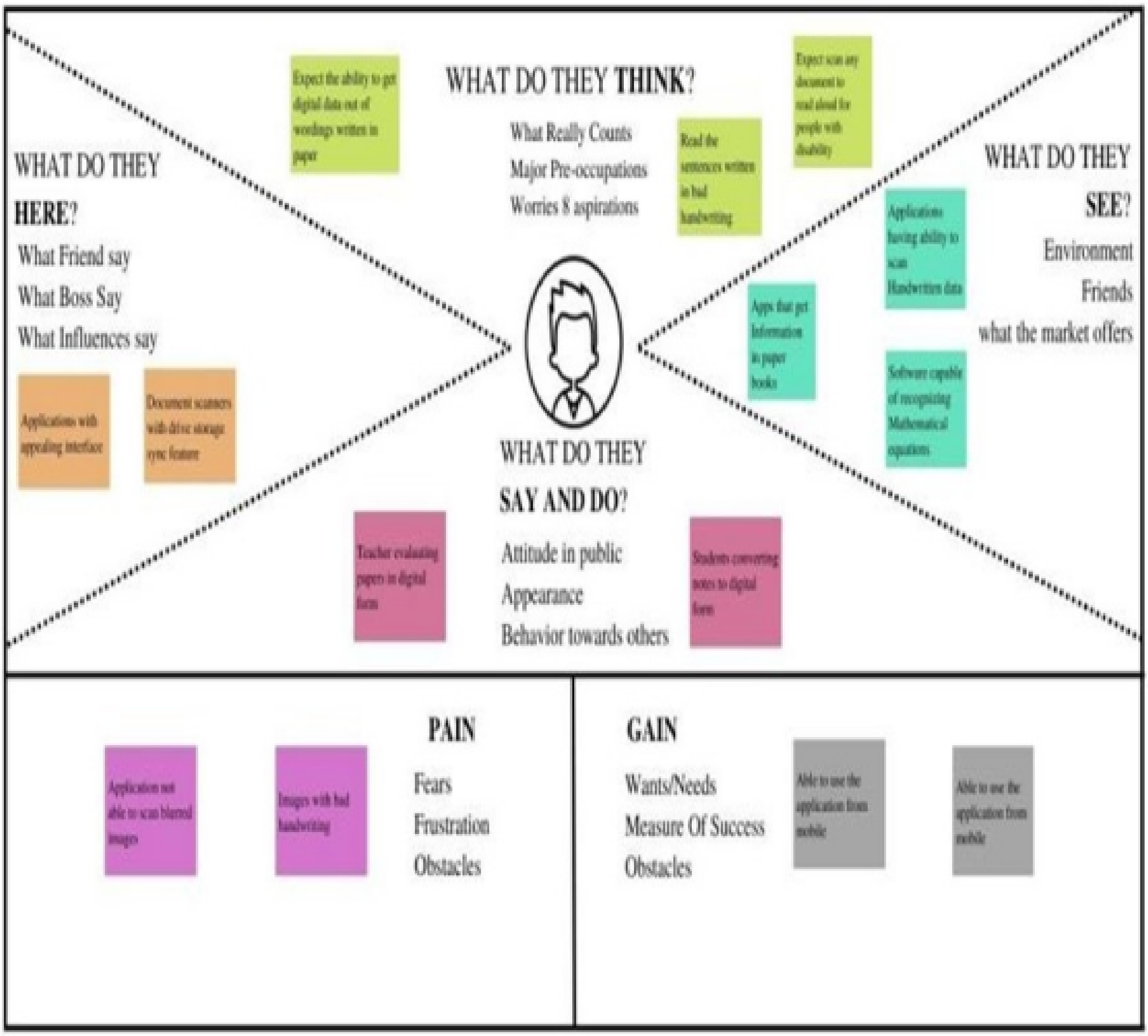
[4]Nikolas Adaloglou “ a comprehensive study on sign language recognition methods”,2020.

[5]Dongxu li,“ transferring cross-domain knowledge for video sign language recognition”,2020

2.3 PROBLEM STATEMENT:

3. IDEATION PHASE & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



3.2 IDEATION AND BRAINSTORMING

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problemto be solved)	An application for deaf and dumb people to convey their information using signs which get converted to human-understandable languageand speech in Artificial Intelligence
2.	Idea / Solution description	By using Voice Conversion System with Hand Gesture Recognition and translation will be very useful to have a proper conversation
3.	Novelty / Uniqueness	We are using a convolution neural network to create a model that is trained on different hand gestures and an app is built for the use this mode
4.	Social Impact / Customer Satisfaction	Communicating with others and being connected in the society and remove accessibilitybarriers
5.	Business Model (Revenue Model)	By Using: Better communication with the disabled and Financial By Without Using: Can't Communicate and leads to loneliness

3.4 PROPOSED SOLUTION FIT

1.CUSTOMER SEGMENTS(CS)	6.CUSTOMER CONSTRAINTS (CC)	5.AVAILABLE SOLUTIONS(AS)
There were two customers: • Deaf and Dumb People who can't convey the message properly. • The normal People who are trying to communicate them were customers.	• Specially Abled Person use their hand signals to get communicate with other. • Normal people will face difficulty in understanding the sign language.	• CNN to identify the hand gestures. • AI to communicate with gesture and voice • Flask to develop application.
2. JOBS TO BE DONE	**9. PROBLEM ROOT CAUSE(RC)**	**7. BEHAVIOUR(BE)**
• Create an efficient app to convert hand gestures to voice and text. • Develop cnn model to recognize the voice and text. • Developing and Training the Dataset is major task	• The Communication barrier is root cause. • Problem of conveying message properly to the normal people. • The proper expression of the feel was not expressed	• Searching the medium to express the feelings. • Searching a device to get translate.
3. TRIGGERS(TM)	**4. YOUR SOLUTION(SL)**	**8.CHANNELS OF BEHAVIOUR (CH)**
• The ability of the customers to communicate efficiently at serious and necessary situations.	• This application help in communication between the normal people and dumb and deaf people	The Application developed by us is the main channel of the behavior. Online translation is also and Channel of Behaviour.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

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. Registration through Gmail.
FR-2	User Medical Details	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. Confirmation via Email.
FR-3	User Personal Details	COLOR BLINDNESS: As a user who is color blind, I want links to be distinguishable on the page so that I can find the links and navigate the site. Registration through Gmail.

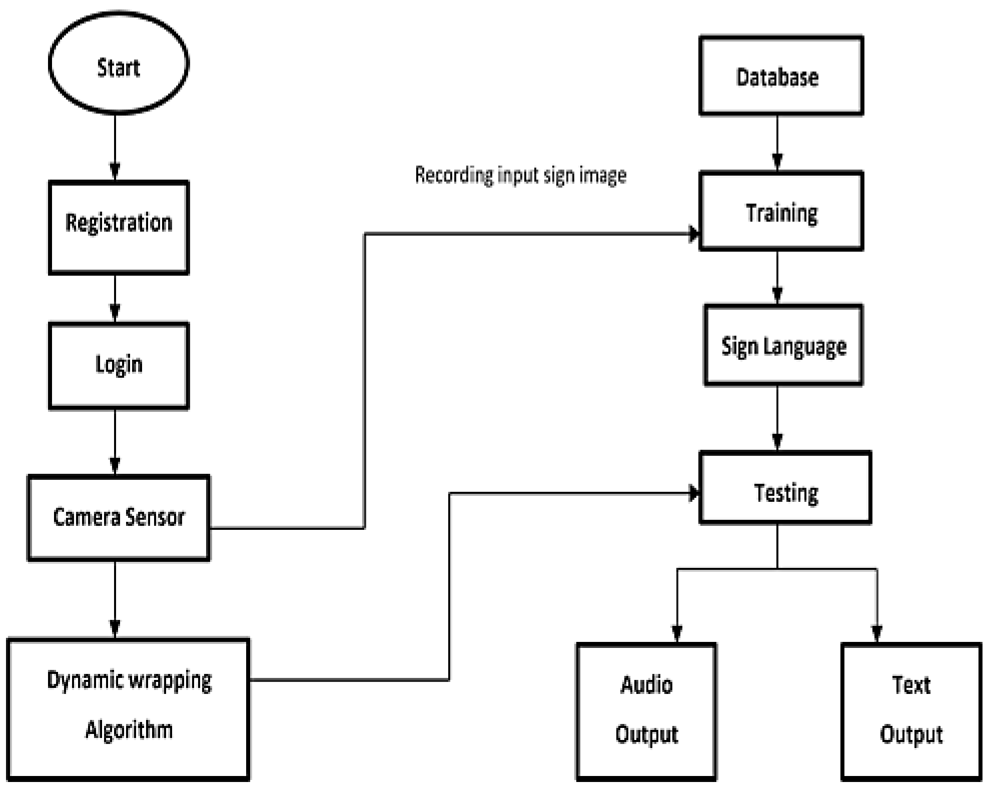
4.2 Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	• Visual and Audio Help • Text size scaling • Reverse contrast
NFR-2	**Security**	• Walking in a single file or in narrow space . • Steps, Stairs and Slope. • Kerbs and Roads.
NFR-3	**Reliability**	• 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.

5. PROJECT DESIGN

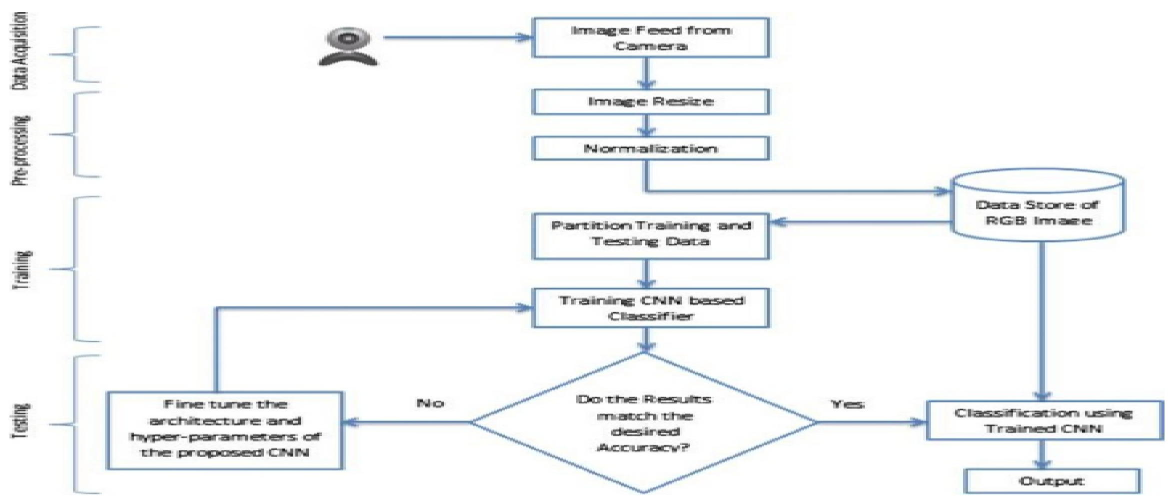
5.1DATA FLOW DIAGRAM:-

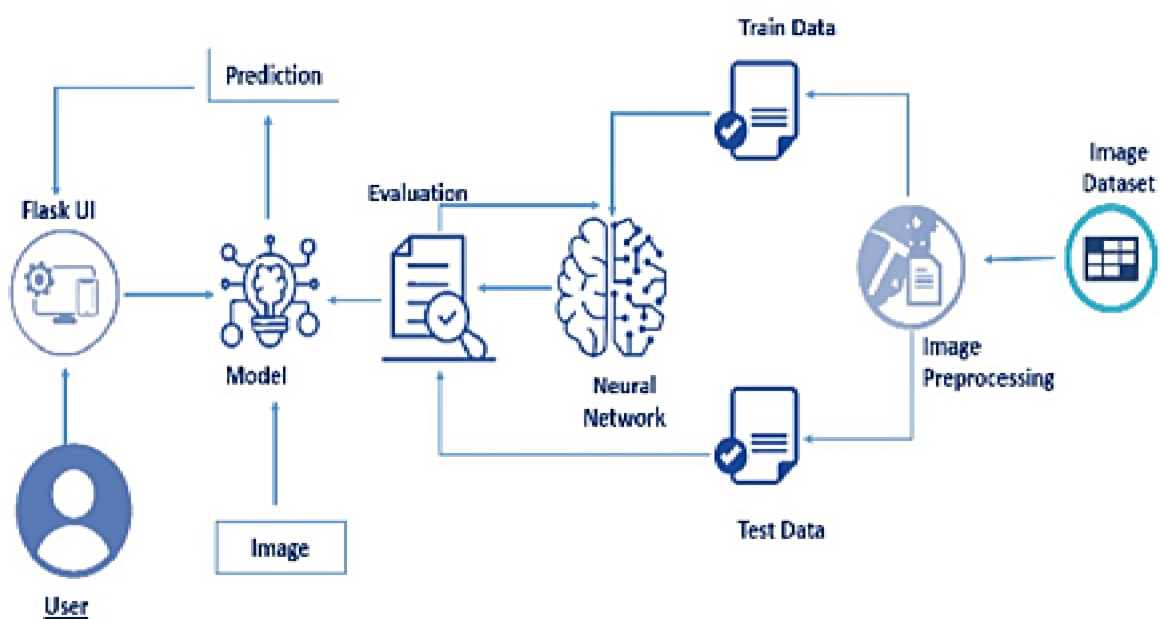
Data Flow Diagrams: A data flow diagram (DFD) is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement



5.2 SOLUTION & TECHNICAL ARCHITECTURE

Software architecture involves the high level structure of software system abstraction, by using decomposition and composition, with architectural style and quality attributes. A software architecture design must conform to the major functionality and performance requirements of the system, as well as satisfy the non-functional requirements such as reliability, scalability, portability, and availability. Software architecture must describe its group of components, their connections, interactions among them and deployment configuration of all components.





6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation

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

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Data Collection	1	Medium	Ajithkumar M
Sprint-1	Data Collection	USN-2	Split Testand Train Dataset	1	High	Antony Sesu Kishon A
Sprint-1	Image Preprocessing	USN-3	Load Image Data Generator	2	High	Thaniyel J
Sprint-1	Image Preprocessing	USN-4	Apply Image Data Generator to Test Dataset	2	Medium	Vishal Bharath Kumar T
Sprint-1	Image Preprocessing	USN-5	Apply Image Data Generator to Train Dataset	2	Medium	Starwin A
Sprint-2	Model Building	USN-6	Build the Model	3	High	Ajithkumar M
Sprint-2	Model Building	USN-7	Add Layers to the Model	3	High	Antony Sesu Kishon A
Sprint-2	Model Building	USN-8	Compile the Model	3	Medium	Thaniyel J
Sprint-2	Train the Model	USN-9	Fit the Model	3	High	Starwin A
Sprint-2	Train the Model	USN-10	Save the Model	2	Medium	Vishal Bharath Kumar T
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3	Testing the Model	USN-11	Load the Saved Model	2	Medium	Ajithkumar M
Sprint-3	Testing the Model	USN-12	Load the Test Samples	3	Medium	Thaniyel J
Sprint-3	Testing the Model	USN-13	Preprocess the test Samples	3	Medium	Starwin A
Sprint-3	Testing the Model	USN-14	Predict the Image Sample	5	High	Vishal Bharath Kumar T
Sprint-3	Testing the Model	USN-15	Evaluate the Model for few more Validation	5	High	Antony Sesu Kishon A
Sprint-4	Application Building	USN-16	Build the HTML Page	4	Medium	Antony Sesu Kishon A
Sprint-4	Application Building	USN-17	Build the Flask Application	4	Medium	Vishal Bharath Kumar T
Sprint-4	Application Building	USN-18	Bind the Model with the Flask Application	5	High	Ajithkumar M
Sprint-4	Application Building	USN-19	Train Model in IBM Cloud	4	High	Thaniyel J
Sprint-4	Application Building	USN-20	Host the Application in IBM Cloud	3	High	Starwin A

6.2 Sprint Delivery Schedule

ProjectTracker, Velocity & BurndownChart:

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	8	2 Days	04 Nov 2022	05 Nov 2022	8	06 Nov 2022
Sprint-2	14	3 Days	04 Nov 2022	06 Nov 2022	13	06 Nov 2022
Sprint-3	18	5 Days	05 Nov 2022	10 Nov 2022	18	08 Nov 2022
Sprint-4	20	10 Days	08 Nov 2022	18 Nov 2022	20	17 Nov 2022

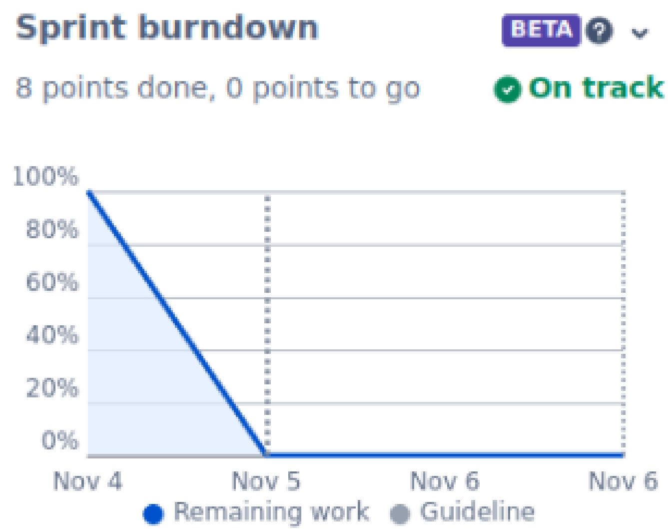
Velocity:

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

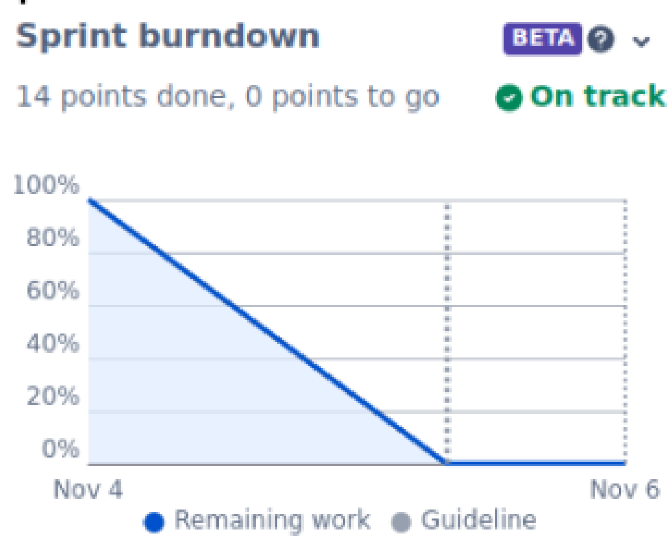
AV = 6/10 = 0.6

SPRINT BURNDOWN CHART:

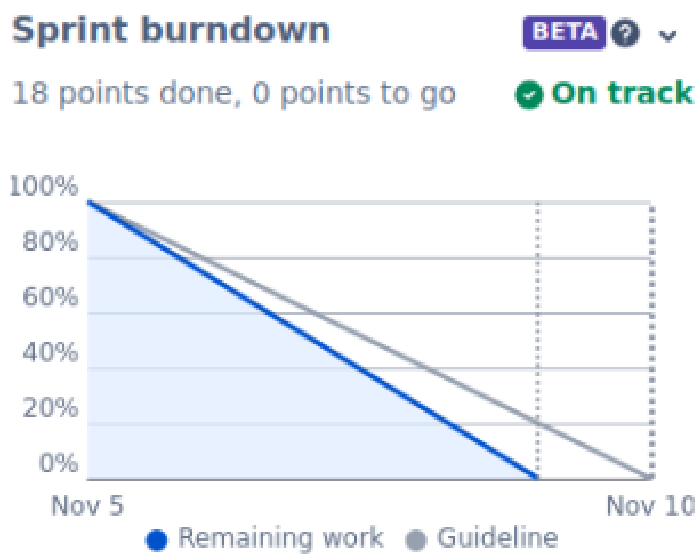
Sprint 1:



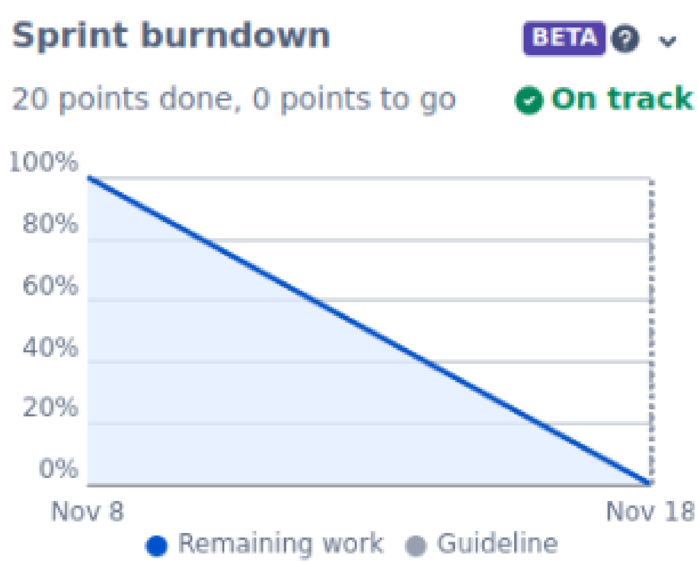
Sprint 2:



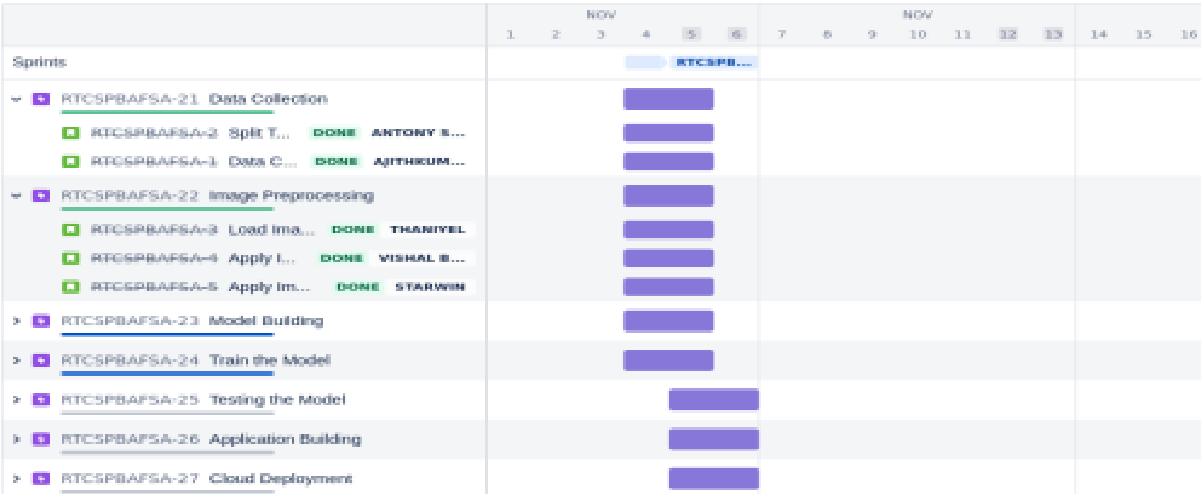
Sprint 3:

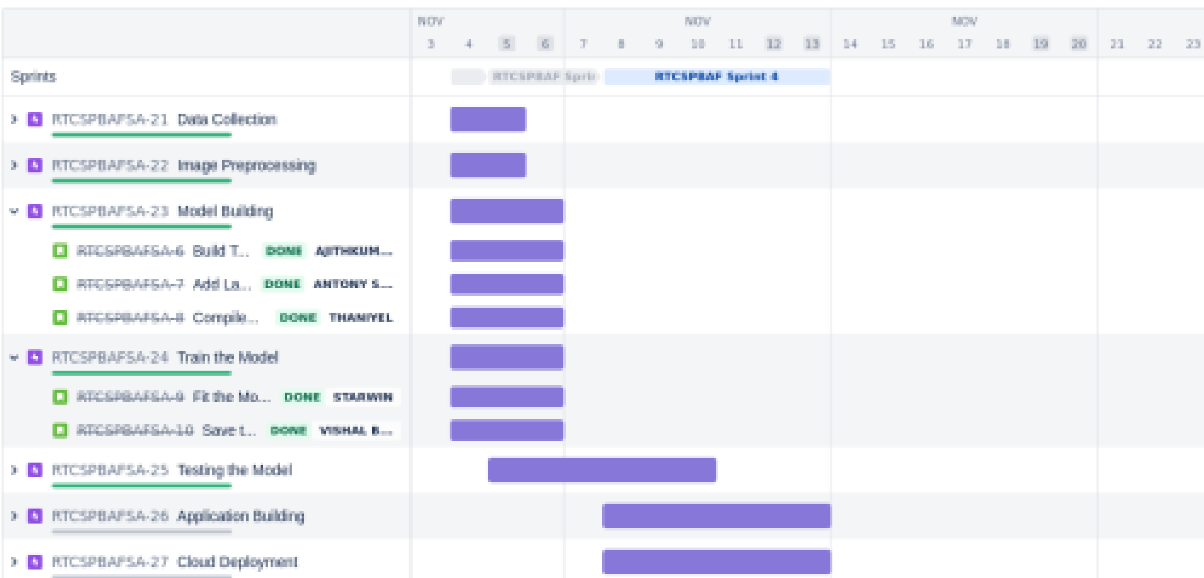


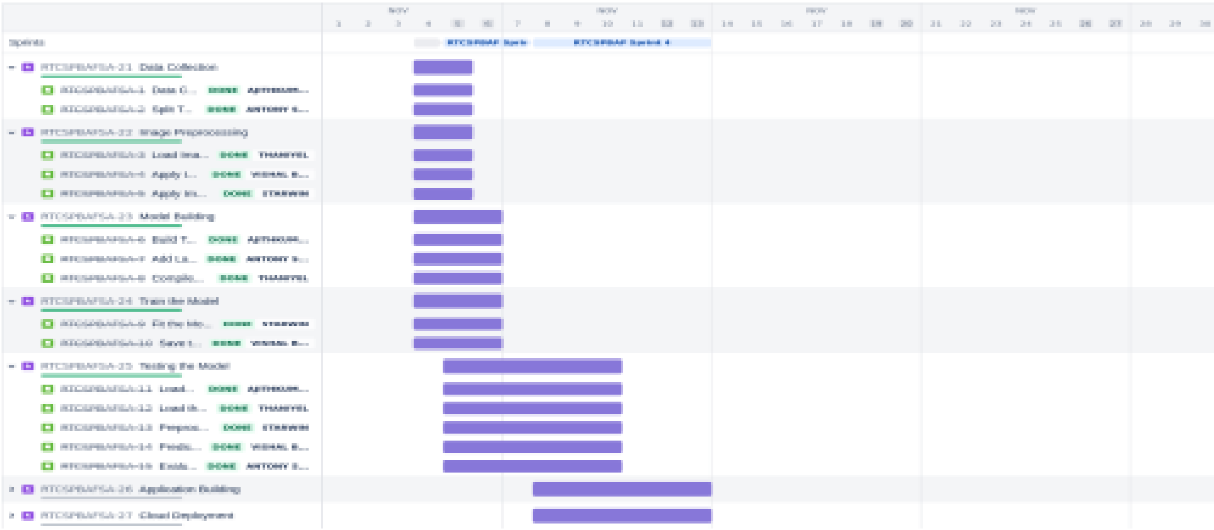
Sprint 4:

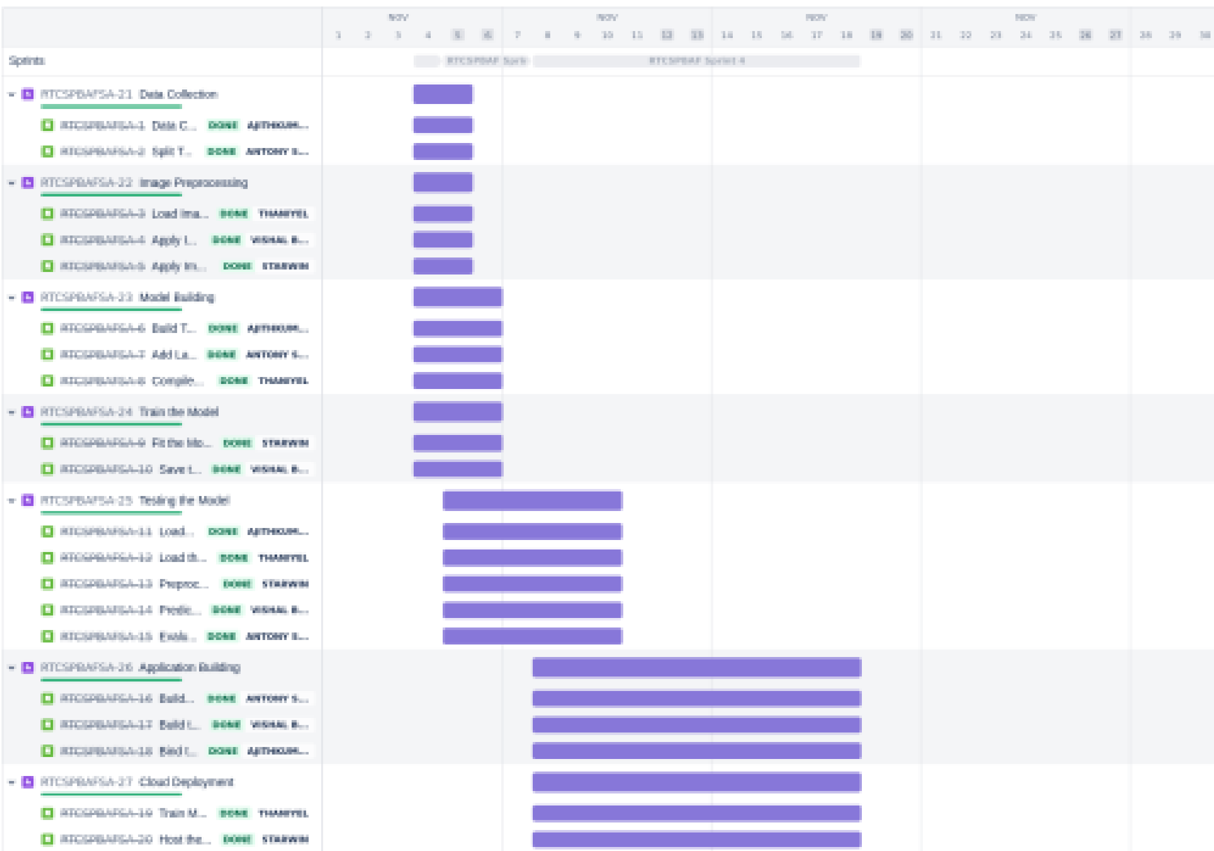


6.3 Reports from JIRA






Sprints
RTCSPBAFSA-21 Data Collection
RTCSPBAFSA-22 Image Preprocessing
RTCSPBAFSA-23 Model Building
RTCSPBAFSA-24 Train the Model
RTCSPBAFSA-25 Testing the Model
RTCSPBAFSA-26 Application Building
RTCSPBAFSA-27 Cloud Deployment


Sprints
RTCSPBAFSA-21 Data Collection
RTCSPBAFSA-22 Image Preprocessing
RTCSPBAFSA-23 Model Building
RTCSPBAFSA-24 Train the Model
RTCSPBAFSA-25 Testing the Model
RTCSPBAFSA-26 Application Building
RTCSPBAFSA-27 Cloud Deployment

7. CODING AND SOLUTIONING

Feature 1:

Facial recognition technology is quickly becoming a part of everyday life. It’s used to improve public security, the accuracy of photo tagging and even make grocery shopping easier.Today, facial recognition software is being used for blind children to read books aloud and as an accessible way for deaf people to communicate with others via video chat.

Feature 2:

Predictive text is a feature on most modern cell phones that quickly allows you to choose one of several words displayed after typing only a few letters. This can be helpful for people with disabilities because it will allow them to press fewer buttons while texting or writing messages.As technology progresses, new ways to adapt cell phones to work with disabilities will become available.

8.TESTING

8.1Test-CaseAnalysis

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

Section	Total Cases	Not Tested	Fail	Pass
View Home Page	7	0	1	6
Click Reference	15	0	3	12
Image displayed	12	0	0	12
Camera access	11	0	2	9
PrintEngine	8	0	0	8
ClientApplication	49	0	0	49
Security	4	0	0	4
OutsourceShipping	4	0	0	4
ExceptionReporting	11	0	0	11
FinalReportOutput	2	0	0	2
VersionControl	1	0	0	1
Predict Sign	4	0	0	4
ExceptionReporting	11	0	0	11
FinalReportOutput	2	0	0	2
VersionControl	1	0	0	1

8.2 USER ACCEPTANCE TESTING:

1.Purpose of Document:

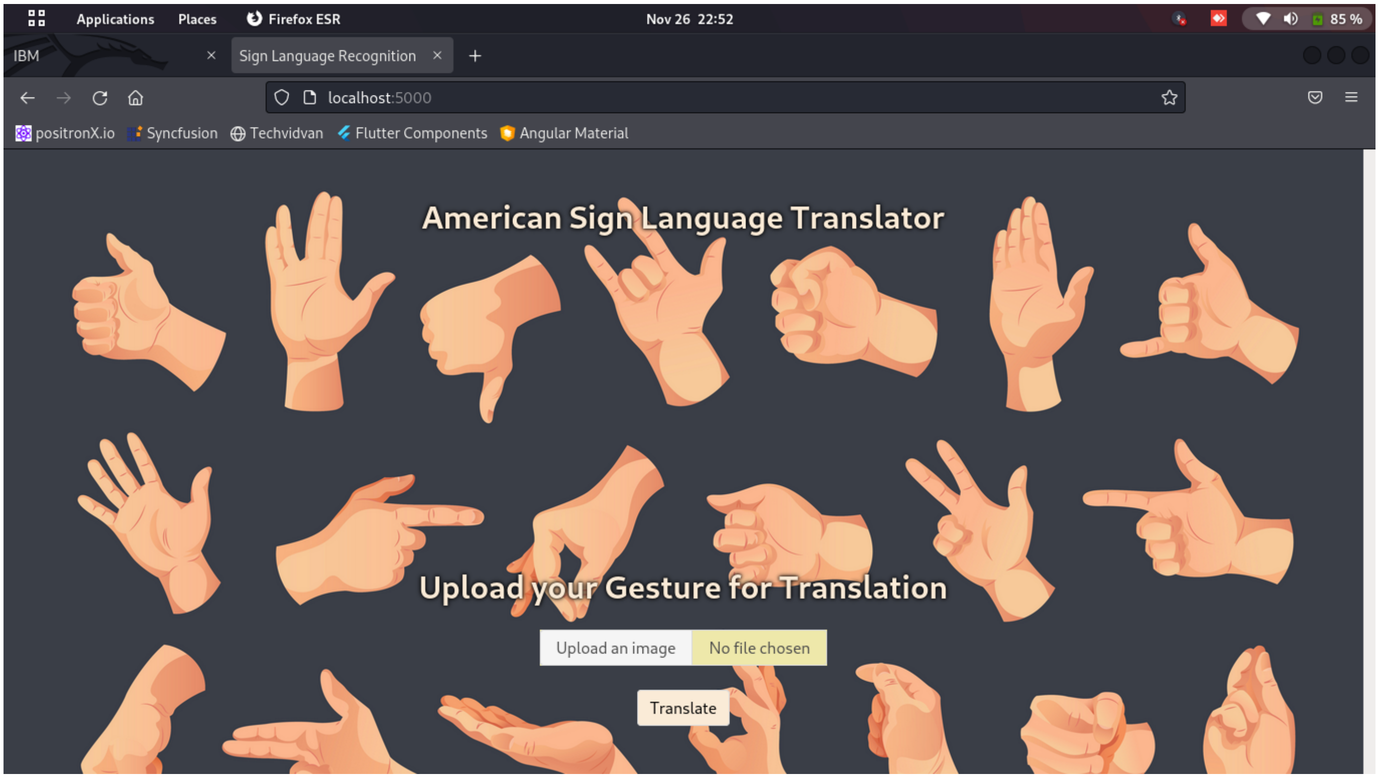
The purpose of this document is to briefly explain the test coverage and open issues of project-Real Time Communication System Powered By AI For Specially Abled at the time of the release to User Acceptance Testing (UAT).

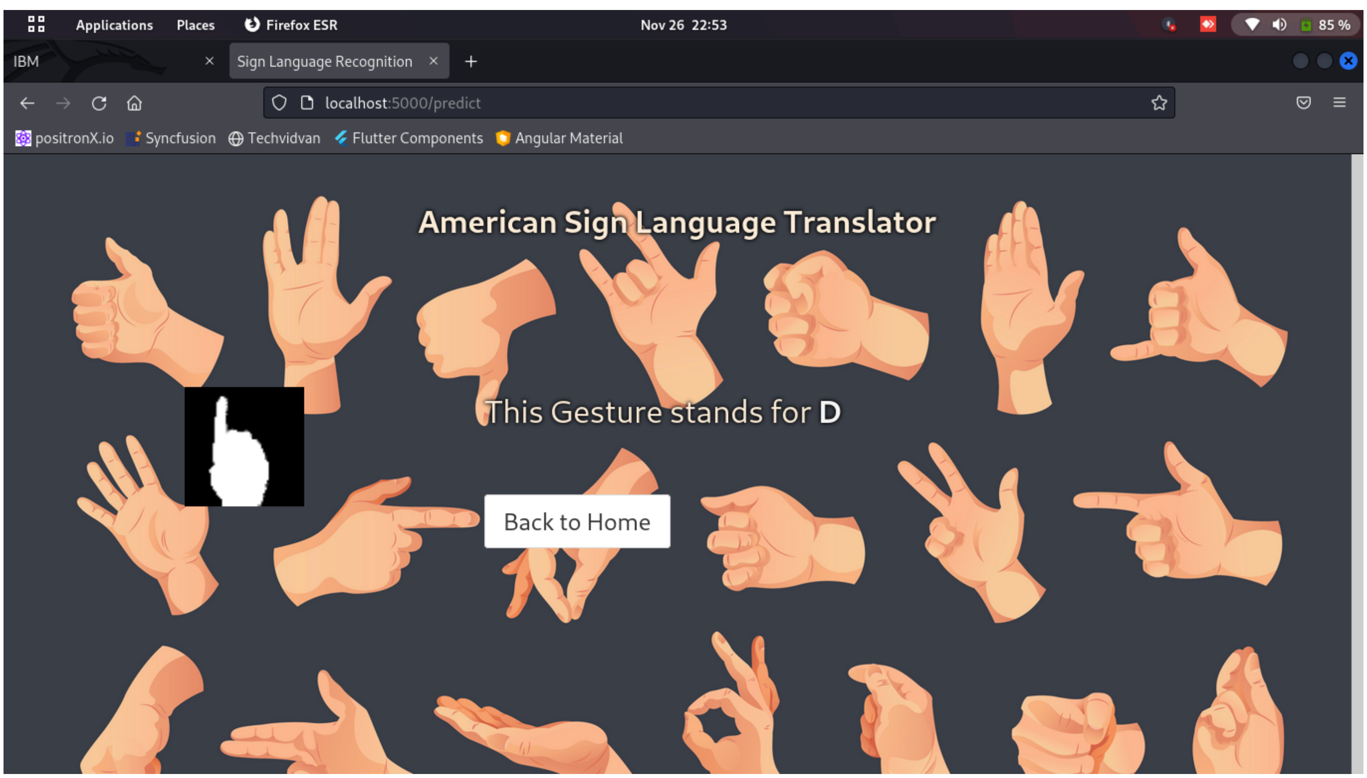
2.Defect Analysis:

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	0	0	0	0	2
Sign Detection	0	0	0	0	1
Threshold and image	0	0	0	1	1
Fixed	0	1	3	1	2
External	0	1	1	0	1
Image sensing	0	0	1	0	0
Model Comparison	0	1	0	0	1
Totals	0	2	5	2	8

9. RESULTS


Applications
Places
Firefox ESR
Nov 26 22:52
85 %
IBM
Sign Language Recognition
localhost:5000
positronX.io
Syncfusion
Techvidvan
Flutter Components
Angular Material
American Sign Language Translator
Upload your Gesture for Translation
Upload an image
No file chosen
Translate


Applications
Places
Firefox ESR
Nov 26 22:53
85 %
IBM
Sign Language Recognition
localhost:5000/predict
positronX.io
Syncfusion
Techvidvan
Flutter Components
Angular Material
American Sign Language Translator
This Gesture stands for D
Back to Home

10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES:

●The limitation of the system is that it employs a logical mechanism for classification of letters based on sensor values.
●Implementation of a Machine Learning algorithm like Artificial Neural Networks for classification of letters can help clear the boundaries between similar gestures.
●Another limitation is the lack of portability as a Windows-based computer is needed for the backend.
●The speech is converted to sign language very quickly to provide greater and faster understanding to specially-abled people.
●The user interface is convenient and simple for both people.

10.2 DISADVANTAGES:

●Accuracy of system may vary depending upon light intensity changes.
●Also accuracy depends upon distance between camera and object.
●The number of images and pixels for the model to train in the dataset is not high so accuracy is moderate level.
●It will be improved by changing the dataset.
●Currently, we have deployed a dataset in the model for the alphabets A to I only.

11. CONCLUSION:

The main objective of this research has been achieved successfully. Gesture interpretation works best in case users who understand sign language may interact with people who are unfamiliar with sign language. Speech interpretation is helpful for sign language non-speakers who want the accompanying hand sign to be understood. Room conditions such as lighting can play a role in predicting the outcome of poor lighting. The light that is either too bright or too dim will result in inaccurate hand segmentation, resulting in inaccurate gesture prediction. The type of inaccuracy can emerge from the user's peripherals, such as poor web camera development of technology is essential, and its deployment in sign language is highly critical. It will serve to bring efficiency in communication, not only to the deaf and dumb but those with the ability to hear and speak as well. In addition to creating opportunities for their career growth, it will enhance their social life through effective communication.Making an impact and changing the lives of the deaf and dump through technology will be an innovation of the year worth the time and resources.At the beginning of the D-Talk idea, the developers think to have more than one task for this application, but in the end, they narrow the task to have only one.

12. FUTURE SCOPE:

▪The system forms the base infrastructure for a complete communicational aid system for the deaf and mute.

▪To expand its capabilities, more languages can be easily added by adjusting sensor values.

▪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 realtime character language is captured as a series of images, and it is processed and then converted into speech and text

▪Proposed systems scope is related with education of dumb peoples. Dumb people faces many problems when normal person could not understand their language. They were facing communication gaps with normal people.

▪For communication between deaf person and a second person, a mediator is required to translate sign language of deaf people. 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.

13. APPENDIX
13.1 Code:

app.py:
```
import cv2
import os
import numpy as np
from keras.models import load_model
from skimage.transform import resize
from flask import Flask, render_template, request, send_from_directory


model = load_model('aslpng.h5')
UPLOAD_FOLDER = './uploads'

app = Flask(__name__)


def detect(frame):
    img = resize(frame, (64, 64, 1))
    img = np.expand_dims(img, axis = 0)
    if(np.max(img) > 1):
        img = img/255.0
    prediction = model.predict(img)
    prediction = (model.predict(img) > 0.5).astype('int32')
    if prediction[0][0] == 1:
        label = 'A'
    elif prediction[0][1] == 1:
        label = 'B'
    elif prediction[0][2] == 1:
        label = 'C'
    elif prediction[0][3] == 1:
        label = 'D'
    elif prediction[0][4] == 1:
        label = 'E'
    elif prediction[0][5] == 1:
        label = 'F'
    elif prediction[0][6] == 1:
        label = 'G'
    elif prediction[0][7] == 1:
        label = 'H'
```

```
    elif prediction[0][8] == 1:
        label = 'I'
    else:
        label = 'No Match Found'

    return label


@app.route('/predict', methods = ['GET', 'POST'])
def upload_file():
    if request.method == 'GET':
        render_template('index.html')
    else:
        file = request.files['image']
        upload_image_path = os.path.join(UPLOAD_FOLDER, file.filename)
        file.save(upload_image_path)
        frame = cv2.imread(os.path.join(UPLOAD_FOLDER, file.filename))
        label = detect(frame)
        return render_template(
            'predict.html', image_file_name = file.filename, label = label
        )


@app.route('/predict/<filename>')
def send_file(filename):
    return send_from_directory(UPLOAD_FOLDER, filename)


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



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

index.html:

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <title>Sign Language Recognition</title>
    <link rel="stylesheet" href="../static/css/bulma.min.css">
    <script defer src="../static/js/all.js"></script>
    <style>
      body{
        background-image: url('../static/images/bg.jpg');
        background-size: cover;
      }
    </style>

  </head>


<body>

<!-- .hero -->
<section class="hero is-fullheight" has-background-black>

    <section class="section">
        <div class="container">
            <h1 class="title" style="color: antiquewhite; text-align: center; text-shadow: 0 0 3px black,
0 0 5px black">
                American Sign Language Translator
            </h1>
        </div>
        </section>



    <section class="section">
        <div class="container has-text-centered bg-text" style="width: 100%">
                <p class="subtitle">
                  <strong style="color: antiquewhite; font-size: 32px; text-shadow: 0 0 3px black, 0 0 5px
black">
                    Upload your Gesture for Translation
                  </strong>
```

```html
        </p>
       <div>
        <i class="arrow_down"></i>
        <form action="/predict" method="post" enctype="multipart/form-data" style="margin-
top: 30px; width: 80%; text-align: center; margin: auto;">
         <div class="file has-name is-centered" style="border: 10px;">
           <label class="file-label" style="background-color: palegoldenrod;">
            <input class="file-input" type="file" id="image" name = "image">
            <span class="file-cta">
             <span class="file-label">
              Upload an image
             </span>
            </span>
            <span class="file-name" id="file-name">
             No file chosen
            </span>

           </label>
          </div>
          <br>
          <input type="submit" value="Translate" class="button" name = "image"
id="classify_button" style="background-color: antiquewhite; color: black;">
        </form>

        </div>

       </div>
      </div>
    </div>
</section>


<!-- /.hero -->


<script src="../static/script.js"></script>
</body>
</html>
```

predict.html:

```html
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <title>Sign Language Recognition</title>
    <link rel="stylesheet" href="../static/css/bulma.min.css">
    <script defer src="../static/js/all.js"></script>

    <style>
         body{
        background-image: url('../static/images/bg.jpg');
        background-size: cover;
        }

        .center {
            display: flex;
            justify-content: center;
            align-items: center;
        }
    </style>

  </head>


<body>

<!-- .hero -->
<section class="hero is-fullheight" has-background-black>

    <section class="section">
        <div class="container" >
            <h1 class="title" style="color: antiquewhite; text-align: center; text-shadow: 0 0 3px black,
0 0 5px black">
                American Sign Language Translator
            </h1>
        </div>
        </section>

        <div class="columns">
```

```
            <div class="column is-narrow">
            </div>


            <div class="column is-one-third has-text-centered">
              <!-- <figure class="image is-1by1"> -->
                <img class="pred_img" src="{{ url_for('send_file', filename=image_file_name)}}"
width="120" height="120"/>
              <!-- </figure> -->
            </div>
            <div class="column" style="font-size:2.5rem" >

                  <h2 id ="pred" style="color: antiquewhite; font-size: 32px; text-shadow: 0 0 3px
black, 0 0 5px black">
                     This Gesture stands for <span style="font-weight: bold; color:whitesmoke;">{{
label }}</span>
                  </h2>
                  <br>
                  <a href="/" class="button is-outlined" style="font-size:1.5rem">Back to Home</a>
               </div>
         </div>

   <section class="section">
         <div class="container">
         </div>
         </section>
      </section>
<!-- /.hero -->

<script src="../static/script.js"></script>

</body>
</html>
```

13.2 Github & Project Demo Link:

Demo Link: https://vimeo.com/774331952

Github Link: https://github.com/IBM-EPBL/IBM-Project-15538-1659600205