## Real-Time Communication System Powered by AI for Specially Abled

USING AI

*A Project report submitted in partial fulfilment of 7th semester in degree Of*

BACHELOR OF ENGINEERING

IN

**ELECTRONICS AND COMMUNICATION ENGINEERING**

*Submitted By*

**Team ID: PNT2022TMID33638**

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# V.S.B ENGINEERING COLLEGE, KARUR

**(Approved by AICTE & Affiliated by Anna University, Chennai)**

## BONAFIDE CERTIFICATE

Certified that this project report "**REAL – TIME COMMUNICATION SYSTEM POWERED BY AI FOR SPECIALLY ABLED"** is the Bonafide record work done by **Ms VINOTHA.B** (**922519106181**), **Ms SIVARANJANI.A** (**922519106153**), **Ms NANDHINI.M** (**922519106501)**, and **Ms KOPPERUMDEVI.S**(**922519106080**) for **IBM-NALAIYATHIRAN** in **VII** semester of **B.E.,** degree course **in Electronics and Communication Engineering** branch during the academic year of 2022 – 2023.

**Head of the Department**

**Mrs. Dr P.S Gomathi**

# ACKNOWLEDGEMENT

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We are grateful to our head of the department **Mrs. Dr P.S GOMATHI** and our IBM Nalaiyathiran project coordinator **Mrs. Dr P.S GOMATHI** Department of Electronics and Communication Engineering for their valuable support.

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# ABSTRACT

Limited access to built environments such as buildings and other health issues is one of main barriers faced by disabilities people(DP). Based on the increasing interest in the integration of the artifical intelligent(AI) into buildings, our ongoing research explores how AI and wearable technology can benefit in(DPs) an AI.

In this paper, we present our first prototype application that helps DPs achieve daily life tasks inside a building such as monitoring environmental conditions and controlling in-building devices. We then report the initial results from a preliminary test with two people with different sensors(AI) impairments and discuss the opportunities and challenges for further improvements.

## TABLE OF FIGURES

# 1.Introduction :

Smartwatches contain accelerometers and gyroscopes that sense a user's movements, and can help identify the activity a user is performing. Research into smartphone-based activity recognition has exploded over the past few years, but research into smartwatch-based activity recognition is still in its infancy. In this paper we compare smartwatch and smartphone-based activity recognition, and smartwatches are shown to be capable of identifying specialized hand-based activities, such as eating activities, which cannot be effectively recognized using a smartphone (e.g., smartwatches can identify the "drinking" activity with 93.3% accuracy while smartphones achieve an accuracy of only 77.3%). Smartwatch-based activity recognition can form the basis of new biomedical and health applications, including applications that automatically track a user's eating habits.

# PROJECT OBJECTIVE:

A convenient feature of many smartwatches is their heart rate monitor, movement sensing and voice monitoring or guiding. You may want to check your heart rate regularly for a variety of reasons, from improving your athletic performance to managing your stress levels to tracking your heart health.

## By the end of this project you will:

- You will be able to learn how to get and prepare the dataset.
- You will be able to know how to do image processing.
- You will understand how Sensor are work.
- Classify images using a Convolutional Neural Network.
- You will be able to know what are the activation functions can be used.
- You will be able to know how to read images using Open CV.
- You will know convolutional Neural Networks for Computer vision AI Problems. Upon learning and completing all the above objectives, we can obtain a model which predicts the moments of specially abled .

# 2.LITERATURE SURVEY

## 2.1 REFERENCES


1. Sinno Jialin Pan et al., "Transfer learning for wifi-based indoor localization", *Association for the Advancement of artificial intelligence (AAAI) workshop The Association for the Advancement of Artificial Intelligence Palo Alto*, vol. 6, pp. 43-48, 2008.

2. E. Morganti, L. Angelini, A. Adami and D. Lalanne, "A smart watch with embedded sensors to recognize objects grasps and forearm gestures", *International Symposium on Robotics and Intelligent Sensors 2012 (IRIS 2012)*, vol. 41, no. 2012, pp. 1169-1175.

3. G. Costante, L. Porzi, O. Lanz, P. Valigi and E. Ricci, "Personalizing a smartwatch-based gesture interface with transfer learning", *2014 22nd European Signal Processing Conference (EUSIPCO)*, pp. 2530-2534, 2014.

4. D. E. Riedel, S. Venkatesh and Wanquan Liu, "Spatial Activity Recognition in a Smart Home Environment using a Chemotactic Model", *2005 International Conference on Intelligent Sensors Sensor Networks and Information Processing*, pp. 301-306, 2005.

5. J. Yang, Y. Li and M. Xie, "MotionAuth: Motion-based authentication for wrist worn smart devices", *2015 IEEE International Conference on Pervasive Computing and Communication Workshops (PerCom Workshops)*, pp. 550-555, 2015.


## 2.2 PROBLEM STATEMENT DEFINITION

- Accumulated tension can lead to high blood pressure, fertility problems, insomnia, and an elevated risk of heart attack, among other health issues for Disability person.
- The latest Fitbit Sense smartwatch has a strong focus on stress-busting and it detect even the single movement of Disability person by using movement sensor.
- The biggest barrier for people with disability is how society disables them.
- Stereotyping, stigma, and discrimination are challenges people with disability face every day.
- Much of the disabled community faces exclusion from parts of society other people take for granted.

- Negative attitudes held by the families of the disabled, and often the disabled themselves, hinder disabled persons from taking an active part in the family, community or workforce. Differently-abled people face discrimination in everyday life.

- According to studies, PWDs often have lower education accomplishments, poorer health conditions, higher poverty rates and less economic engagement than people without disabilities.

- They are disabled not only by their bodies but by society as well.

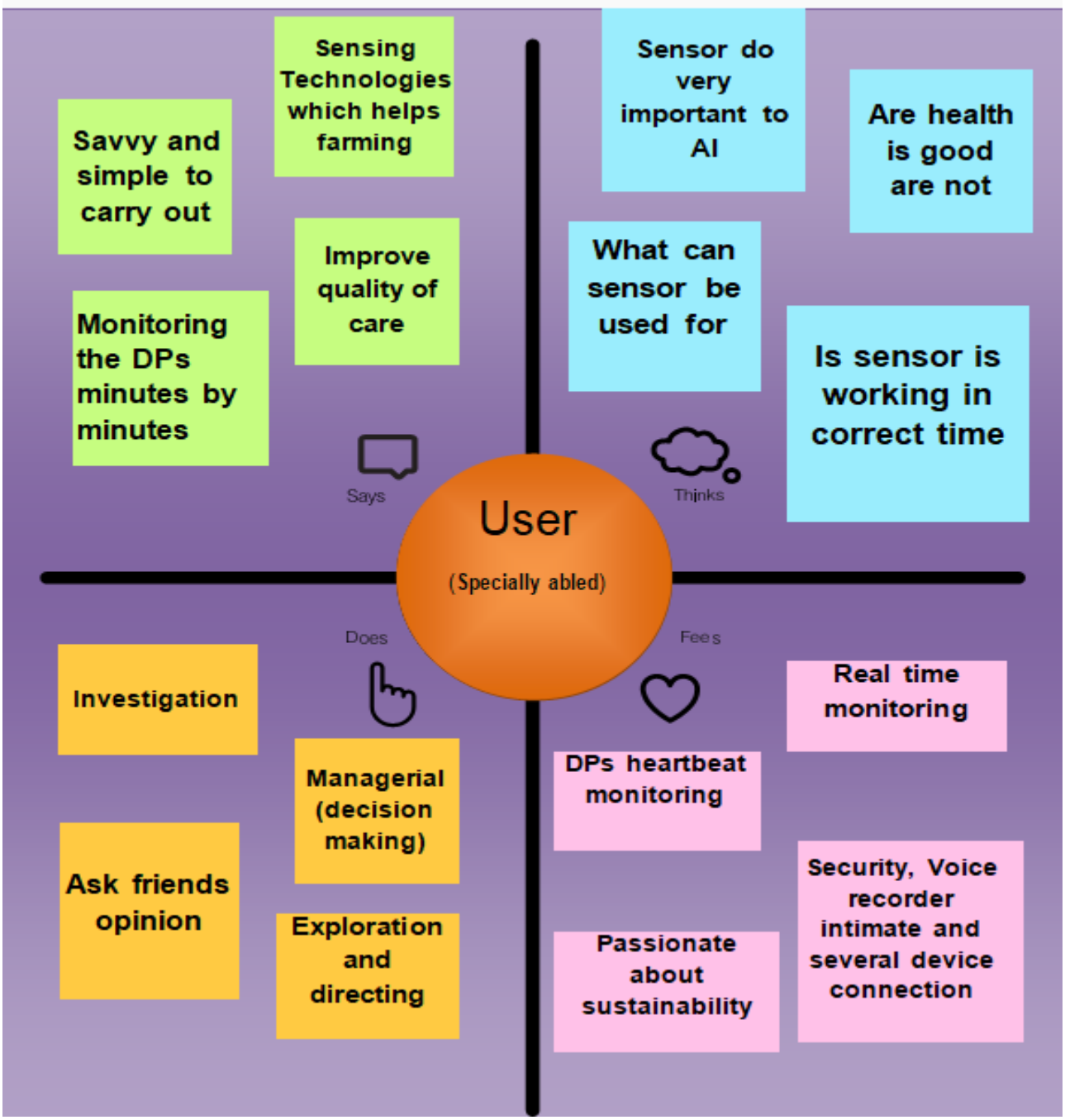
- Persons with disabilities lack access to employment opportunities and even if they are able to get employment they face problems such as reasonable accommodation at work, accessible public transportation to get them to work and back and discrimination and ignorance about their potential at work.

- There are many challenges that a person with disabilities has to go through to secure employment and keep it. In some cases, you might find that people with disabilities are paid less than their non-disabled counterparts.

- In other cases, you'll find them being mistreated at their workplaces, and looked down upon as people who cannot be relied on simply because of their disability.

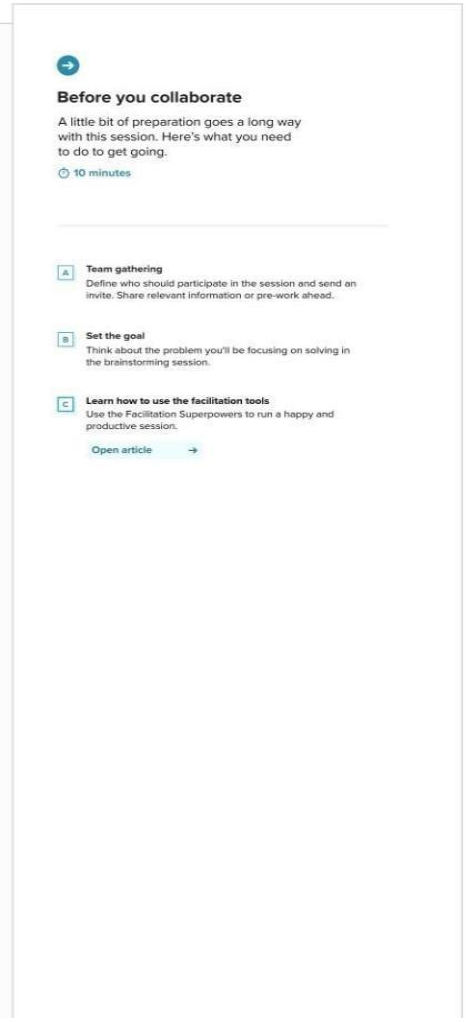
# 3.IDEATION & PROPOSED SOLUTION:

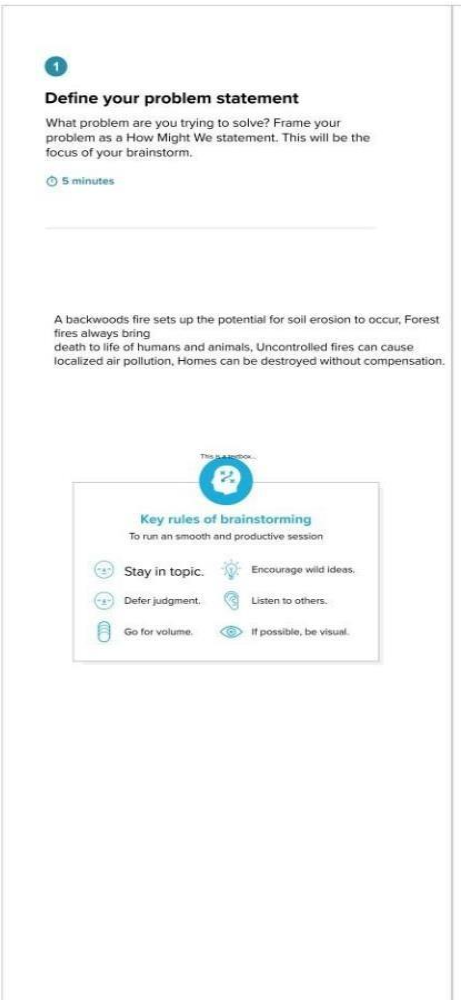
## 3.1 EMPATHY MAP CANVAS



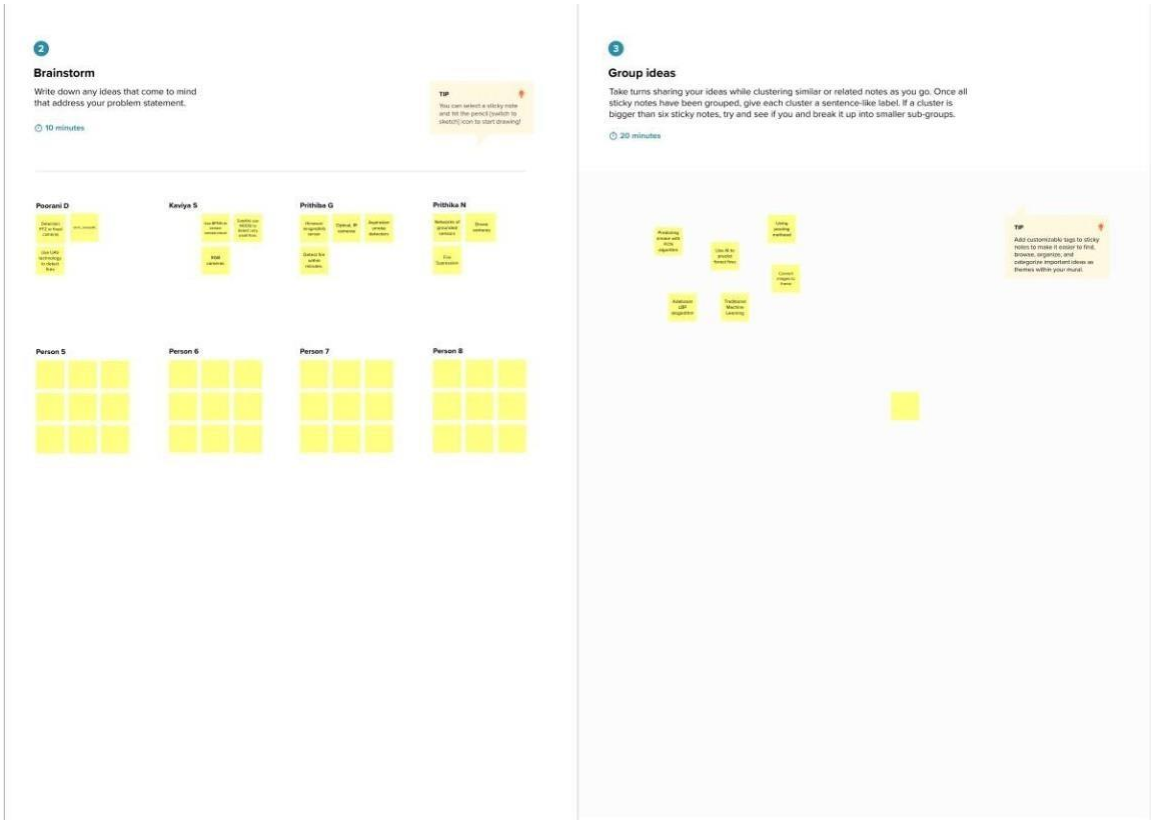
## 3.2 Ideation & Brainstorming:

Conceptualizing gives a free and open climate that supports everybody inside a group to partake in the imaginative reasoning cycle that prompts critical thinking. Focusing on volumeover esteem, out-of-the-case thoughts are gladly received and based upon, and all membersare urged to team up, helping each other foster a rich measure of clever fixes **Step-1: Team Gathering, Collaboration and Select the Problem Statement**

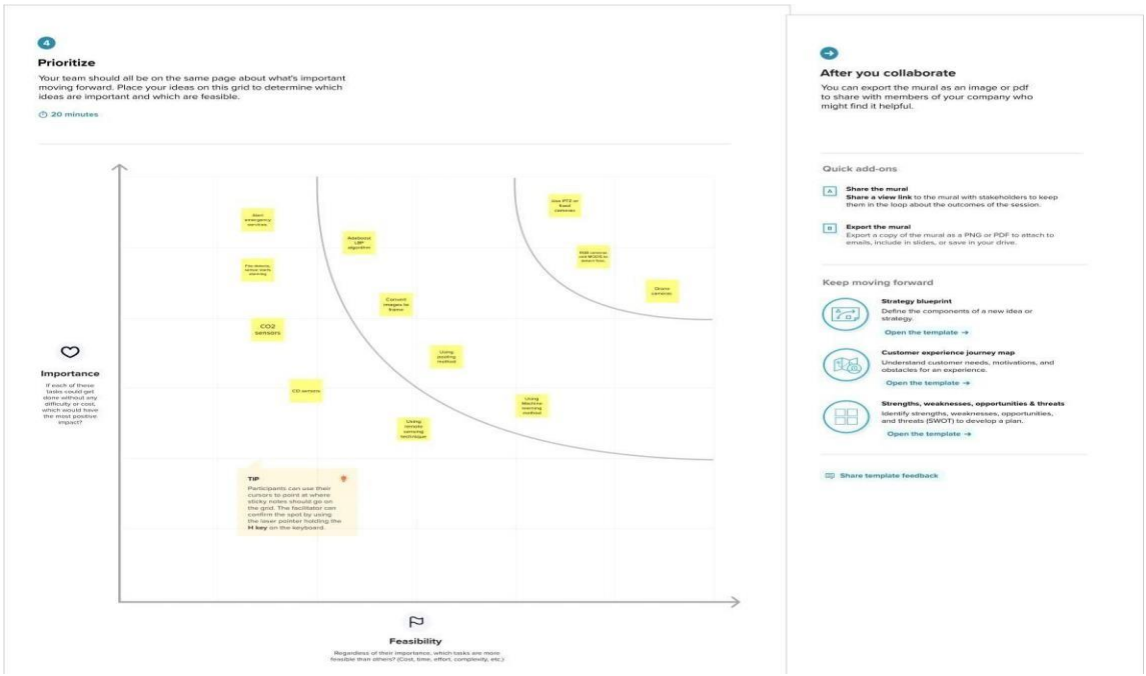


## Step-2: Brainstorm, Idea Listing and Grouping




## Step-3: Idea Prioritization



## 3.3 PROPOSED SOLUTION :

**Proposed Solution Template:**

Project team shall fill the following information in proposed solution template.

| S. No. | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | Accumulated tension can lead to **high blood pressure, fertility problems, insomnia, and an elevated risk of heart attack**, among other health issues for Disability person. The latest Fitbit Sense smartwatch has a strong focus on stress-busting and it detect even the single movement of Disability person by using movement sensor. |
| 2. | Idea / Solution description | A convenient feature of many smartwatches is their heart rate monitor, movement sensing and voice monitoring or guiding. You may want to check your heart rate regularly for a variety of reasons, from improving your athletic performance to managing your stress levels to tracking your heart health<br>. |
| 3. | Novelty / Uniqueness | Movement sensor, Heartbeat monitoring sensor, Siri, Connecting with phone(call) to family members. |
| 4. | Social Impact / Customer Satisfaction | Security, Quality of Services, Quick process, Water proof, Bluetooth connection, Automatic detecting sensors (monitor and movement). |
| 5. | Business Model (Revenue Model) | • Smart watch<br>• Sensors |
| 6. | Scalability of the Solution | To achieve accumulated tension can lead to high blood pressure, fertility problems, insomnia, and an elevated risk of heart attack, among other health issues for Disability person. The latest fitbit Sense smart watch has a strong focus on stress-busting and it detect even the single movement of Disability person by using movement sensor. |

## 3.4 PROBLEM SOLUTION FIT:

**VSB Engineering College, karur-639111**
**Project Design phase – I**
**Problem Solution fit**

**Project name: Real-Time Communication System Powered by AI for Specially Abled** **Team Id :** PNT2022TMID33638

| | | |
|---|---|---|
| **1.Customer segments :-**<br><br>The customers who are going to adapt this project contains of<br>o Physically challenged peoples (like deaf & blind)<br>o Aged people those need physical help | **6.Customer constrains:-**<br><br>The customer wants a device which could solve the problems in communication. When they need a help or they are in the absence of humans and that device should fulfill all the following constrains<br>o Cost efficient.<br>o Frequent & fast communication | **5.Available solutions :-**<br><br>The real – communication System Powered by AI for Specially Abled could be the best solution for this problem statement that has been provided by the special abled and also its specifically satisfies the customers constrains also. |
| **2.Jobs to be done :-**<br>**The customer wants the immediate help from the communication system and get solution for their physical problems.** | **9.Problem route cause:-**<br>The problem has its route stabled at the rate of the fast-moving world since people move most of times and since they have their work to be stagnated similarly. | **7.Behavior:-**<br>**The customer needs frequent communication at the emergency situations though the real time communication system powered by AI for Specially Abled.** |
| 3.Triggers :-<br>Some of the triggers are advertisements in the television and information from the experts.<br><br>4.Emotions:-<br>With the modern world at emergency situations results unwanted loses but this device overcomes that defect. | **10.Solution:-**<br>Our solution of this project is to monitor the activities of specially abled and take immediate actions when they need any physical help. | 8.Channels of behavior:-<br>• The channels of behavior recombines the ration of the following<br>• Online<br>• Offline |

# 4. REQUIREMENT ANALYSIS:

## 4.1 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 Gmail |
| FR-2 | User Confirmation | Confirmation via Email |
| FR-3 | Communication requirement | For one on one mentoring, teacher will be available. |
| FR-4 | User requirement | Option should be shown for hand sign to text and voice conversion and vice versa |
| FR-5 | User Communication | Communication can be done through pc or mobile. |

| | | |
|---|---|---|
| FR-6 | Regulatory requirements | In case of any cyber attacks the app gets automatically shut down. |
| FR-7 | Reporting | Automated notification will be received by the developer in case of any issues. |
| FR-8 | Compliance to rules or law | Terms and conditions, private policy, End user subscription agreement and cookies. |

### 4.2 Non-functional Requirements:

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

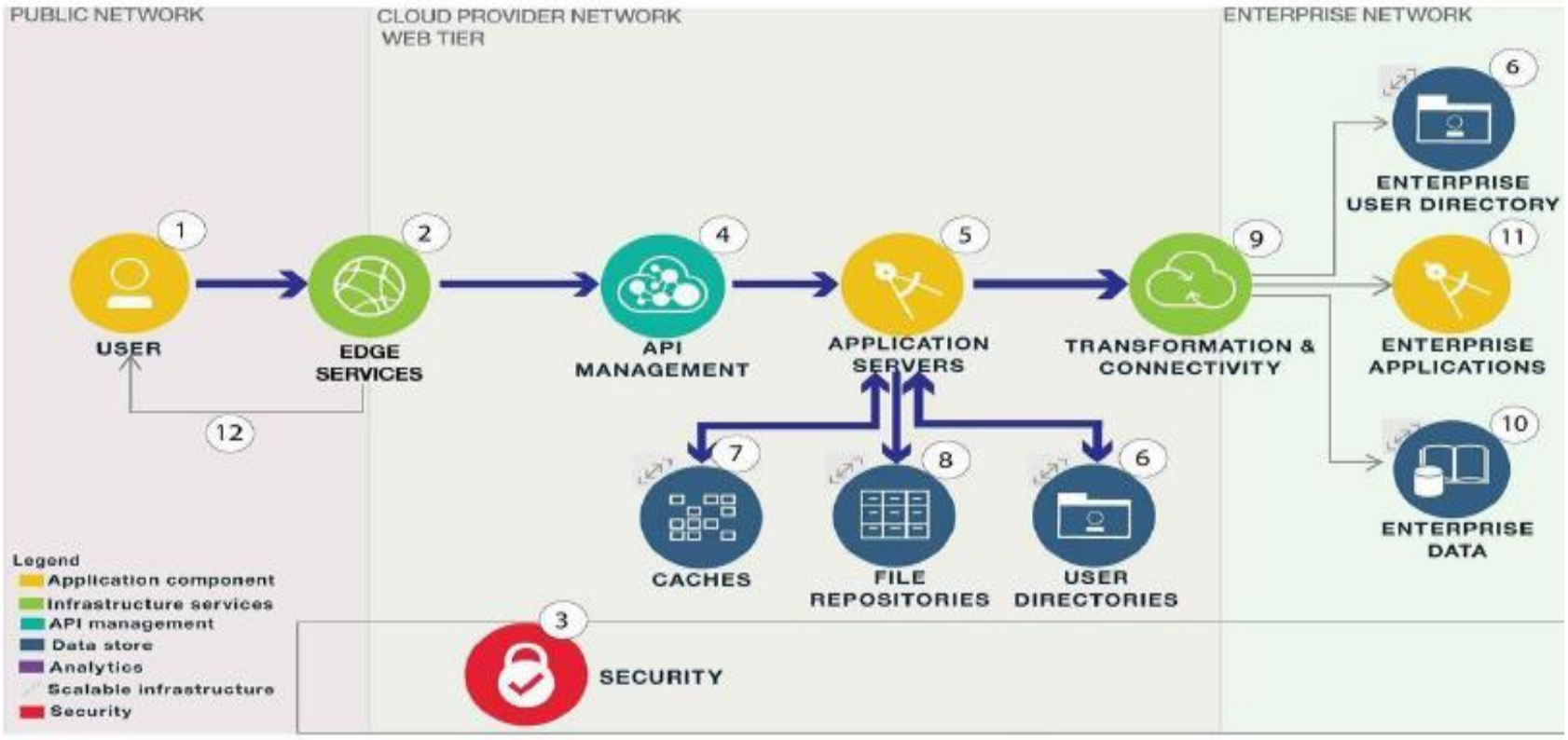
| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NFR-1 | **Usability** | The camera captures all expressions including facial expressions and hand gestures which can be easily used by all age groups. It can be used by deaf-mute people and their care takers. |
| NFR-2 | **Security & Privacy** | A fire alarm system warns people when smoke, fire,carbon monoxide or other fire-related or general notification emergencies are detected. |
| NFR-3 | **Reliability** | It has achieved 1.24 seconds of classification timewith an accuracy of 91% and F1 score of 0.91. |
| NFR-4 | **Accuracy** | The system must have a great accuracy rate. The accuracy is important so that the disabled students could get a clear understanding. |
| NFR-4 | **Performance** | The performance of the model is efficient. The cost-effective nature of the system makes it extremely liable. The latency is very less for the conversion process. |

| | | |
|---|---|---|
| NFR-5 | **Availability** | The solution is suitable for different languages and can be used in many countries. It can be trained for all the available sign languages. This model can be used at any time anywhere. |
| NFR-6 | **Scalability** | The system gives output rapidly. It also predicts quickly when it gets so many inputs at a time. It predicts different types of sign language at a time. Upto 25000 users can be use this model at a time. |

# 5. PROJECT DESIGN:

## 5.1 DATA FLOW DIAGRAMS:

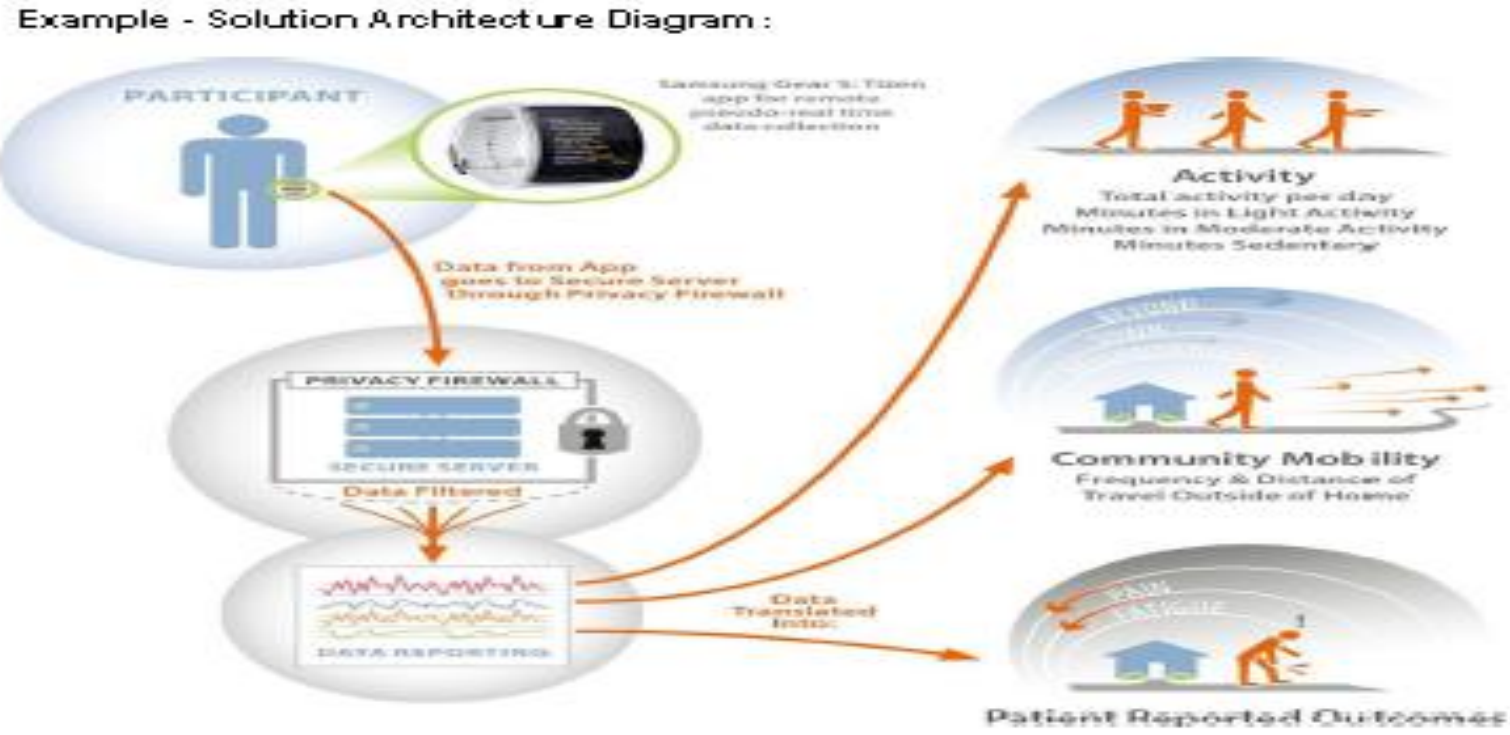
Data Flow Diagram :



## 5.2 **SOLUTION & TECHINICAL ARCHITECTURE:**

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- A convenient feature of many smartwatches is their heart rate monitor, movement sensing and voice monitoring or guiding. You may want to check your heart rate regularly for a variety of reasons, from improving your athletic performance to managing your stress levels to tracking your heart health.
- The latest fitbit Sense smart watch has a strong focus on stress-busting and it detect even the




Reference: https://www.sciencedirect.com/science/article/pii/S1532046418302120

## 5.3 USER STORIES:

# User Stories :

| User Type | Functional Requiremnt (Epic) | User Name | User Feedback | Acceptance criteria | Rating | Release |
|---|---|---|---|---|---|---|
| Customer (Mobile user) | Registration | kavya@gmail.com | As a user, I can register for the application by entering my email, password, and confirming my password. | I can access my account / dashboard | ♥ ♥ ♥ ♥ ♥ | Sprint-2 |
| | Registration | abishek@gmail.com | As a user, I will receive confirmation email once I have registered for the application | I can receive confirmation email & click confirm | ♥ ♥ ♥ ♥ ♥ | Sprint-1 |
| Customer (Webuser) | Registration | sathish@gmail.com | As a user, I can register for theapplication through Facebook | I can register & access the dashboard with Facebook Login | ♥ ♥ ♥ ♥ ♥ | Sprint-2 |
| | Registration | Bharathi2@gmail.com | As a user, I can register for theapplication through Gmail | | ♥ ♥ ♥ ♥ ♥ | Sprint-1 |
| | Registration | vanitha@gmail.com | As a user, I can log into the applicationby entering email & password | | ♥ ♥ ♥ ♥ ♥ | Sprint-1 |

# 6. PROJECT PLANING & SCHEDULING:

## 6.1 SPRINT DELIVERY SCHEDULE:

## Product Backlog, Sprint Schedule, and Estimation

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 | Registration | USN-1 | Not Required | 2 | High | - |
| Sprint-1 | Login | USN-2 | Not Required | 1 | High | - |
| Sprint-1 | Main page | USN-4 | As a User, **I can enter the web page once clicked, which provides be the Guidelines** to use the app | 1 | Medium | **Vinotha.B Nandhini .M Kopperumdevi.S** |
| Sprint-1 | Guidelines | USN-5 | As a User , **I can give a read through the guidelines to understand the functioning of the app.** | 1 | Medium | **Vinotha.B Nandhini .M Sivaanjani.A** |
| Sprint-2 | Convert Sign | USN-6 | As a User, **I can click the button Convert sign** , which directs me towards the Main screen | 4 | Medium | **Nandhini .M Sivaanjani.A Kopperumdevi.S** |

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-2 | **Camera(Hand movement detection)** | USN-7 | As a User, **I can show my hand sign towards the camera which converts them into text manner.** | 8 | High | **Vinotha.B Nandhini .M** |
| Sprint-3 | 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.** | 3 | High | **Vinotha.B Kopperumdevi.S** |
| Sprint-1 | **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. | 1 | Low | **Vinotha.B Nandhini .M Kopperumdevi.S** |
| Sprint-4 | **Check the performance of the app** | | As an Executive, I can **check the usage and queries obtained from the end users**. | 1 | Medium | **Vinotha.B Sivaanjani.A** |
| Sprint-4 | **Receive queries based on the usage** | | As an Admin, I can **take the queries from the customer care and perform the testing phase again , loading the other signs in the dataset**, in order to make the customers to use the app effectively. | 2 | High | **Vinotha.B Nandhini .M Kopperumdevi.S** |

# Project Tracker, Velocity & Burndown Chart:

| 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 | 6 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | | 29 Oct 2022 |
| Sprint-2 | 12 | 12 Days | 31 Nov 2022 | 11 Nov 2022 | | 11 Nov 2022 |
| Sprint-3 | 3 | 3Days | 13 Nov 2022 | 15 Nov 2022 | | 15 Nov 2022 |
| Sprint-4 | 4 | 4 Days | 17 Nov 2022 | 20 Nov 2022 | | 20 Nov 2022 |

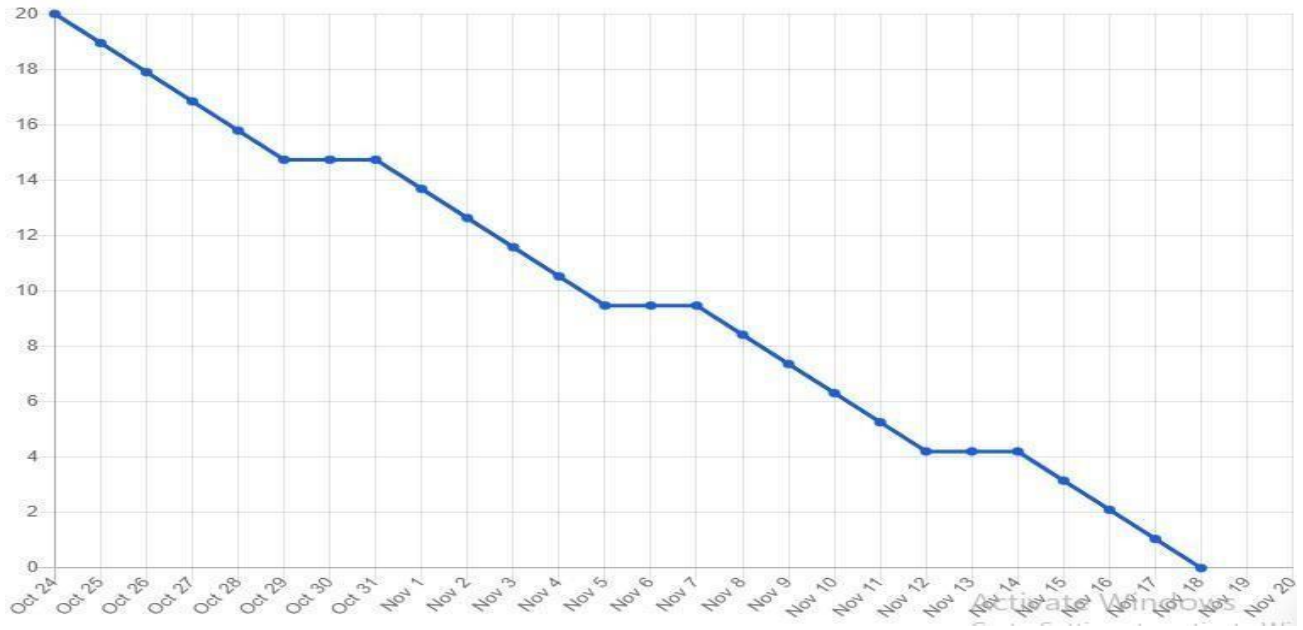
## Velocity:

Imagine we have a 5-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

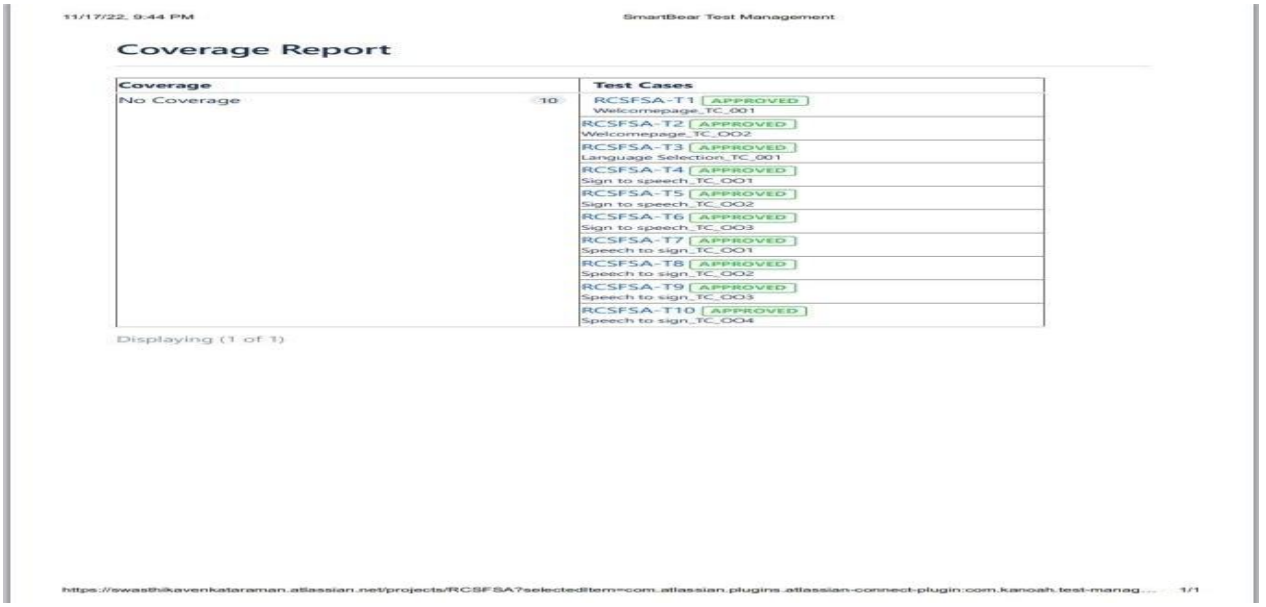
AV=Sprint Duration/Velocity =20/5=10

## Burndown Chart:

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




# 6.2 REPORTS FROM JIRA



# Traceability Report

| Coverage | Test Cases | Test Execution Results | Issues |
|---|---|---|---|
| No Coverage 10 | RCSFSA-T1 APPROVED 1<br>Welcomepage_TC_001 | PASS 0<br>Executed on: 17/Nov/22 8:50 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T2 APPROVED<br>Welcomepage_TC_OO2 1 | PASS 0<br>Executed on: 17/Nov/22 9:41 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T3 APPROVED<br>Language Selection_TC_001 1 | PASS 0<br>Executed on: 17/Nov/22 8:54 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T4 APPROVED<br>Sign to speech_TC_OO1 1 | PASS 0<br>Executed on: 17/Nov/22 9:44 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T5 APPROVED<br>Sign to speech_TC_OO2 1 | PASS 0<br>Executed on: 17/Nov/22 9:01 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T6 APPROVED<br>Sign to speech_TC_OO3 1 | PASS 0<br>Executed on: 17/Nov/22 9:04 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T7 APPROVED<br>Speech to sign_TC_OO1 1 | PASS 0<br>Executed on: 17/Nov/22 9:07 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |

| Coverage | Test Cases | Test Execution Results | Issues |
|---|---|---|---|
| | RCSFSA-T8 APPROVED<br>Speech to sign_TC_OO2 1 | PASS 0<br>Executed on: 17/Nov/22 9:12 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T9 APPROVED<br>Speech to sign_TC_OO3 1 | PASS 0<br>Executed on: 17/Nov/22 9:18 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |
| | RCSFSA-T10 APPROVED 1<br>Speech to sign_TC_OO4 | PASS 0<br>Executed on: 17/Nov/22 9:24 pm<br>Environment: -<br>Executed by: Swasthika Venkataraman | None |

Displaying (1 of 1)



## Traceability matrix

| Coverage \ Test Cases | RCSFSA-T1 - Welcomepage_... | RCSFSA-T2 - Welcomepage_... | RCSFSA-T3 - Language Selec... | RCSFSA-T4 - Sign to speech_... | RCSFSA-T5 - Sign to speech_... | RCSFSA-T6 - Sign to speech_... | RCSFSA-T7 - Speech to sign_... | RCSFSA-T8 - Speech to sign_... | RCSFSA-T9 - Speech to sign_... | RCSFSA-T10 - Speech to sign... |
|---|---|---|---|---|---|---|---|---|---|---|
| No Coverage | | | | | | | | | | |

Displaying (1 of 1)

**Last test execution:** Pass

# 7. CODING & SOLUTIONING:

## 7.1 Libraries to be installed

pip install fer
pip install flask
pip install cv2
pip install numpy
pip install keras
pip install tensorflow
pip install cvzone
pip install pyttsx3
pip install scikit-image

## 7.2 Real time sign to speech

Sign language is generally used by the people who are unable to speak, for communication. Most people will not be able to understand the Universal Sign Language (unless they have learnt it) and due to this lack of knowledge about the language, it is very difficult for them to communicate with mute people. A device that helps to bridge a gap between mute persons and other people forms the crux of this project. Our system makes use of a model build using CNN that is capable of detection sign languages real time.

## 7.3 Facial Emotion Detection

Our system makes use of the FER model. Facial Emotion Recognition (commonly known as FER) is one of the most researched fields of computer vision till date and is still in continuous evaluation and improvement. The model is a convolutional neural network with weights saved to HDF5 file in the data folder relative to the module's path. It can be overridden by injecting it into the FER() constructor during instantiation with the emotion_model parameter.

## 7.4 Language Customization

Google Translate is a free multilingual machine translation service. It can translate the Website's text content from one language to another. It offers a huge list of languages to translate and has an efficient, reliable and easy way to translate the webpage in whatever language the user wants. It supports over 100 languages. Use this website translator to convert webpages into your choice of language.

## 7.5 Real time speech to text

With the Web Speech API, we can recognize speech using JavaScript. It is super easy to recognize speech in a browser using JavaScript and then getting the text from the speech to use as user input. We use the **SpeechRecognition** object to convert the speech into text and then display the text on the screen. Our system is capable of doing this over real time. It is capable of recognizing any languages in which the user is trying to communicate. But the support for this API is limited to the **Chrome browser only**. So if you are viewing this example in some other browser, the live example below might not work.

# 8.Testing

## 8.1 Test Cases

- Verify if user can see the options when user clicks the URL
- Verify if the UI elements are getting displayed properly
- Verify if the user can choose any languages
- Verify if the user is getting redirected to the sign to speech page
- Verify if the application can convert the sign to speech
- Verify if the user can exit the sign to speech page
- Verify if the user is getting redirected to the speech to sign page
- Verify if the UI elements are being displayed
- Verify if the application can convert speech to text on clicking voice to text button.
- Verify if the user can exit the speech to sign page.

## 8.2 UAT Testing

### 1. Defect Analysis

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

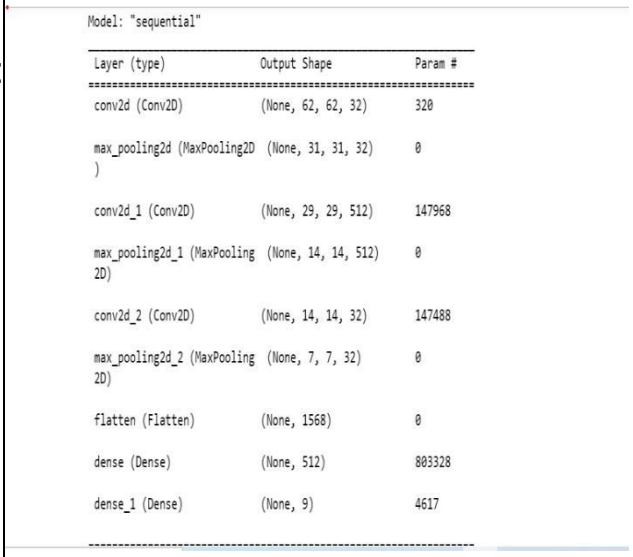
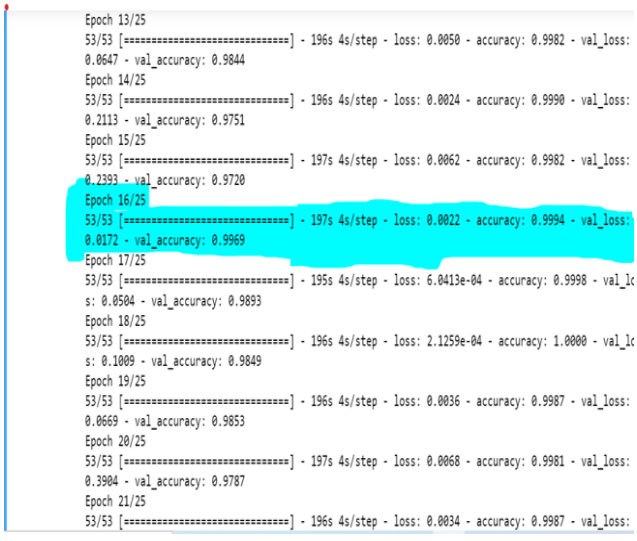
| Resolution | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Subtotal |
|---|---|---|---|---|---|
| By Design | 11 | 7 | 4 | 2 | 24 |
| Duplicate | 1 | 0 | 2 | 0 | 3 |
| External | 2 | 3 | 2 | 1 | 8 |
| Fixed | 10 | 5 | 3 | 14 | 32 |
| Not Reproduced | 0 | 0 | 1 | 0 | 1 |
| Skipped | 0 | 0 | 1 | 1 | 2 |
| Won't Fix | 1 | 0 | 0 | 0 | 1 |
| Totals | 25 | 15 | 13 | 18 | 71 |

## 2. 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 | 15 | 0 | 0 | 15 |
| Security | 2 | 0 | 0 | 2 |
| Outsource Shipping | 2 | 0 | 0 | 2 |
| Exception Reporting | 9 | 0 | 0 | 9 |
| Final Report Output | 4 | 0 | 0 | 4 |
| Version Control | 2 | 0 | 0 | 2 |

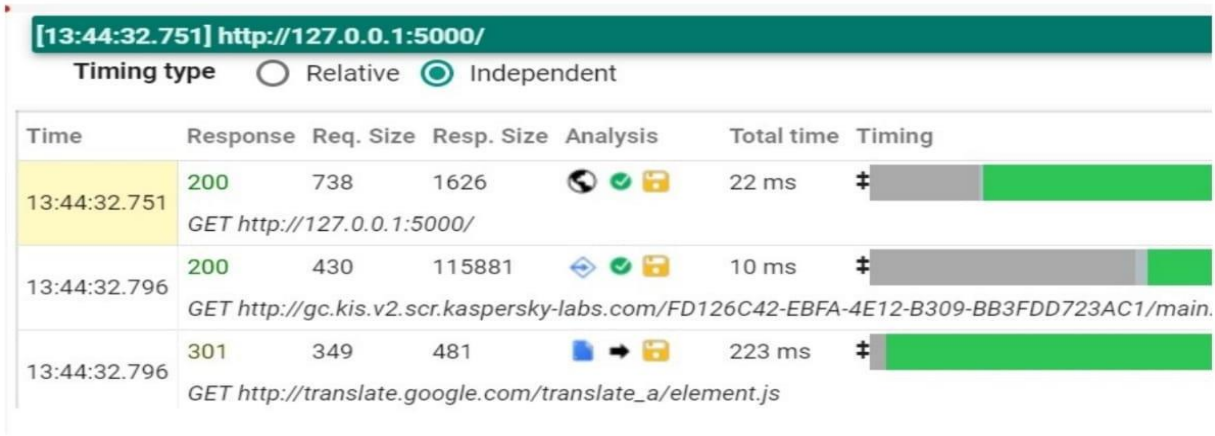
## 8.3 Performance Testing

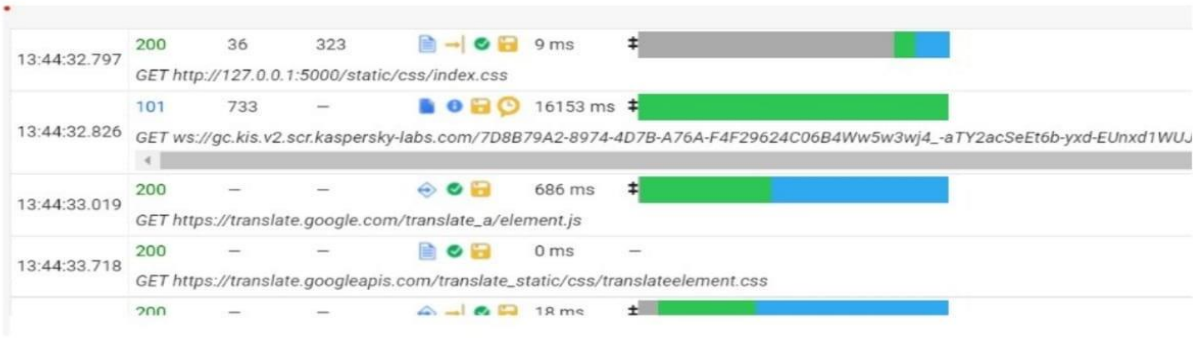
| S.NO | Parameter | Values | Screenshot |
|---|---|---|---|
| 1. | Model Summary | Total params: 1,103,721<br>Trainable params: 1,103,721<br>Non-trainable params: 0 |  |
| 2. | Accuracy | Training Accuracy - 0.9994<br><br>Validation Accuracy -0.9969 |  |

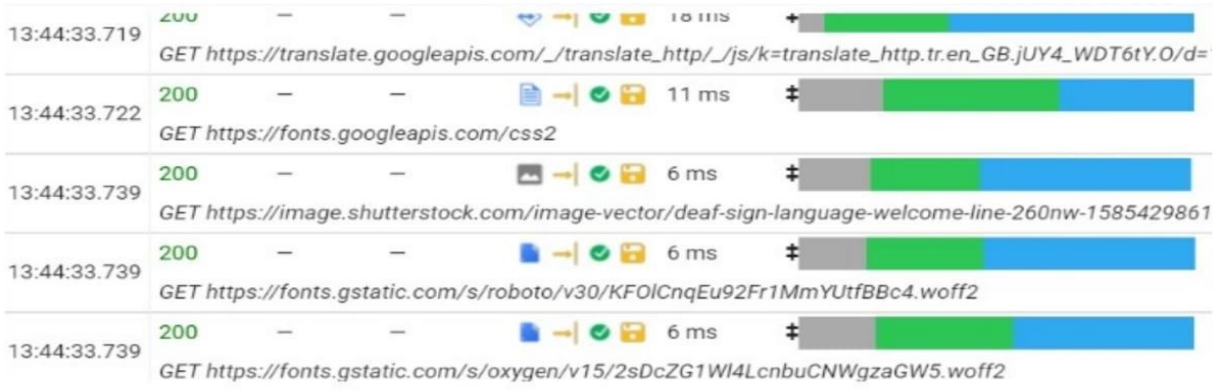
# 9. Results:

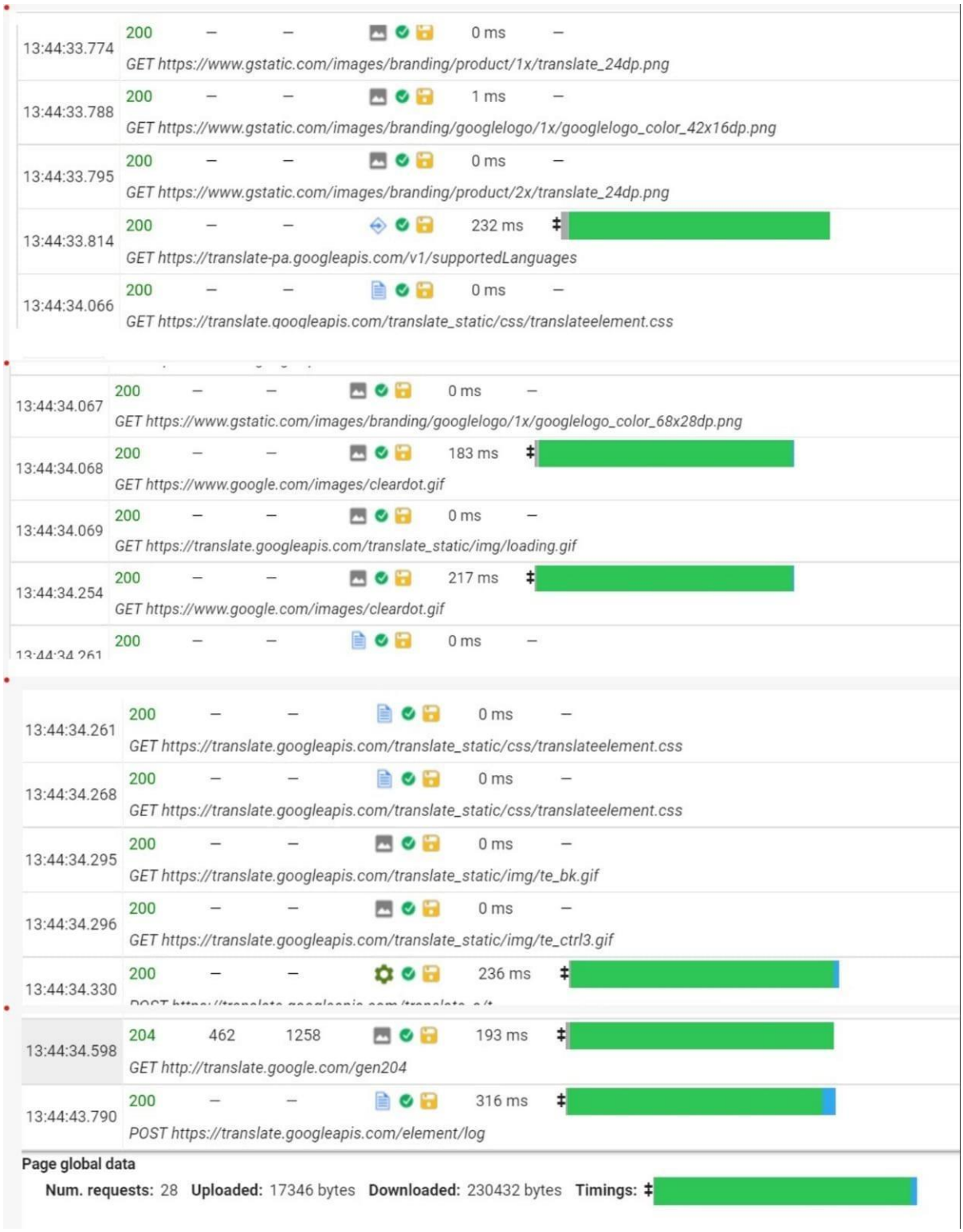
## Performance Metrics

The following images can be studied to understand the performance metricsof our system




13:44:33.774 200 – – 0 ms –
GET https://www.gstatic.com/images/branding/product/1x/translate_24dp.png
13:44:33.788 200 – – 1 ms –
GET https://www.gstatic.com/images/branding/googlelogo/1x/googlelogo_color_42x16dp.png
13:44:33.795 200 – – 0 ms –
GET https://www.gstatic.com/images/branding/product/2x/translate_24dp.png
13:44:33.814 200 – – 232 ms
GET https://translate-pa.googleapis.com/v1/supportedLanguages
13:44:34.066 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/css/translateelement.css
13:44:34.067 200 – – 0 ms –
GET https://www.gstatic.com/images/branding/googlelogo/1x/googlelogo_color_68x28dp.png
13:44:34.068 200 – – 183 ms
GET https://www.google.com/images/cleardot.gif
13:44:34.069 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/img/loading.gif
13:44:34.254 200 – – 217 ms
GET https://www.google.com/images/cleardot.gif
13:44:34.261 200 – – 0 ms –
13:44:34.261 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/css/translateelement.css
13:44:34.268 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/css/translateelement.css
13:44:34.295 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/img/te_bk.gif
13:44:34.296 200 – – 0 ms –
GET https://translate.googleapis.com/translate_static/img/te_ctrl3.gif
13:44:34.330 200 – – 236 ms
13:44:34.598 204 462 1258 193 ms
GET http://translate.google.com/gen204
13:44:43.790 200 – – 316 ms
POST https://translate.googleapis.com/element/log
Page global data
Num. requests: 28 Uploaded: 17346 bytes Downloaded: 230432 bytes Timings:

## 10. Advantages and Disadvantages

## Advantages:

- Real time sign to speech detection.
- Model provides good accuracy.
- Real time facial emotion detection.
- Language Customization.
- Real time speech to text conversion.
- Friendly UI
- Data privacy

## Disadvantages:

- At times the website may lag.
- Model is not tested on a wide set of data set, having all the signs.
- Sign language customization feature is not available.
- User cannot take notes while using the app.
- User cannot make calls using the app.
- Speech recognition works only on google chrome.

## 11. Conclusion

Communication is crucial for self-expression. Additionally, it meets one's necessities. Effective communication is necessary for career advancement. Effective communication skills can make your personal life easier and improve your interactions with others by facilitating mutual understanding. A system that translates speech into acceptable sign language for the deaf and dumb has been developed as part of our project. It also translates sign language into a human hearing voice to communicate with average people. A convolution neural network has been used to build a model that is trained on various hand motions. Utilizing this concept, an app is created. Through the use of signs that are translated into speech and human-understandable English, this software aids deaf and dumb individuals to communicate easily.

## 12. Future Scope

The following are the features that can be added in our application:

- A communication app can be built with the same set of features. The user can choose the appropriate mode (speech to sign or sign to speech) and accordingly the real time detection would take place on both the end users' application.
- The accuracy of the model shall be increased.
- Customization of languages shall be added.
- Users shall be allowed to write notes while on call.
- Customization of signs can also be added as a feature.

# 13. Appendix

## Source Code

## Model Building

```
import cv2
import os

os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'
import numpy as np

from keras.models import Sequential
import matplotlib.pyplot as plt

from keras.layers import Dense, Dropout, Activation, Flatten
from keras.layers import Conv2D, MaxPool2D

from keras_preprocessing.image import ImageDataGenerator
test_path = 'Dataset/test_set'

train_path = 'Dataset/training_set'
train=ImageDataGenerator(rescale=1./255,zoom_range=0.2,shear_range=0.2,horizontal_flip=T
rue)

test=ImageDataGenerator(rescale=1./255)
train_batches = train.flow_from_directory(directory=train_path, target_size=(64,64),
class_mode='categorical', batch_size=300,shuffle=True,color_mode="grayscale")

test_batches = test.flow_from_directory(directory=test_path, target_size=(64,64),
class_mode='categorical', batch_size=300, shuffle=True,color_mode="grayscale")
model = Sequential()

model.add(Conv2D(32, kernel_size=(3, 3), activation='relu', input_shape=(64,64,1)))
model.add(MaxPool2D(pool_size=(2,2)))

model.add(Conv2D(512, (3, 3), padding="valid"))
model.add(MaxPool2D(pool_size=(2,2)))

model.add(Conv2D(32, (3, 3), padding="same"))
model.add(MaxPool2D(pool_size=(2,2)))

model.add(Flatten())
```

```
model.add(Dense(512,activation ="relu"))
model.add(Dense(9,activation ="softmax"))
 model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])

 history = model.fit(train_batches, batch_size=32,validation_data=test_batches,epochs=25)

        model.save('model.h5')
```

## Model Testing

```
 import keras
 from keras.models import load_modelimport
 cv2
import numpy as np
import os
 os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'
 val=['A','B','C','D','E','F','G','H','I']

model=load_model('model.h5')
from skimage.transform import resize
 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
predict_x=model.predict(img)
 print(predict_x)

predict=np.argmax(predict_x,axis=1)
x=predict[0]
 print(val[x])
 frame=cv2.imread(r"C:\Users\Akshaya\PycharmProjects\Realtime_Communicati
 on_System_For_Specially_Abled\Dataset\test_set\B\1.png")
        data=detect(frame)
```

## Flask App Building

```
import numpy as np
import os
import math
import cv2
from fer import FER
import pyttsx3
from keras.models import model_from_json
os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'
from keras.models import load_model
from flask import Flask, render_template, Response, request
import tensorflow as tf
from cvzone.HandTrackingModule import HandDetector
from skimage.transform import resize
facecascade= cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
graph=tf.compat.v1.get_default_graph()
writer=None
model=load_model('model.h5')
font = cv2.FONT_HERSHEY_SIMPLEX
vals=['A','B','C','D','E','F','G','H','I']
emotion_detector = FER(mtcnn=True)
app=Flask(___name__,template_folder="template")
print("Accessing video stream")
app.static_folder = 'static'
vs=cv2.VideoCapture(0)
detector=HandDetector(maxHands=1)
pred=""
def SpeakText(command):
engine = pyttsx3.init()
```

```
engine.say(command)
engine.runAndWait()
 def generate_frames():
while (vs.isOpened()):
success, frame = vs.read()
 hands, frame=detector.findHands(frame)
dominant_emotion, emotion_score =
emotion_detector.top_emotion(frame)
if not success:
 break
else:
if hands:
 hand=hands[0]
x,y,w,h=hand['bbox']
imgCrop=frame[y-20:y+h+20,x-20:x+w+20]
 black=np.ones((300,300,3), np.uint8)*0
ishape=imgCrop.shape
if h/w>1:
 k=300/h
 wcal=math.ceil(k*w)
 imgresize=cv2.resize(imgCrop,(wcal,300))
 irshape=imgresize.shape
wgap=math.ceil((300-wcal)/2)
black[:,wgap:wcal+wgap]=imgresize
else:
k=300/w
 hcal=math.ceil(k*h)
imgresize=cv2.resize(imgCrop,(300,hcal))
irshape=imgresize.shape
 hgap=math.ceil((300-hcal)/2)
```

```
black[hgap:hcal+hgap,:]=imgresize
img=resize(black,(64,64,1))
 img=np.expand_dims(img,axis=0)
if(np.max(img)>1):
img = img/255.0
 predict_x=model.predict(img)
classes_x=np.argmax(predict_x,axis=1)
x=classes_x[0]
 SpeakText(vals[x])
dominant_emotion=str(dominant_emotion)
if(dominant_emotion!=""):
 value=vals[x] +" "+ dominant_emotion
else:
value=vals[x]
 cv2.putText(frame,value,(x+20,y+20),cv2.FONT_HERSHEY_SIMPLEX,1,(255, 255, 150),2,cv2.LINE_AA)
ret, buffer = cv2.imencode('.jpg', frame)
frame = buffer.tobytes()
 yield (b'--frame\r\n'
 b'Content-Type: image/jpeg\r\n\r\n' + frame + b'\r\n')
 @app.route('/')
def index():
return render_template('index.html')
@app.route('/sign_to_speech')
def sign_to_speech():
 return  render_template('sign_to_speech.html')
@app.route('/speech_to_sign')
def speech_to_sign():
 return render_template('speech_to_sign.html')
```

```
@app.route('/video',methods=['GET', 'POST'])
def video():
 return Response(generate_frames(), mimetype='multipart/x-mixed-replace;boundary=frame')
 if (____name_____== "_____main____"):
                app.run(debug=True)
```

## HTML Files

## index.html

```
<!DOCTYPE
html>
 <html lang="en">
 <head>
 <style>
 body{
background-image: url("https://image.shutterstock.com/image-vector/deaf-sign-language-welcome-line-260nw-1585429861.jpg");
background-repeat: no-repeat;
 background-size: cover;
}
</style>
 <script>
 function loadGoogleTranslate()
 {
 new google.translate.TranslateElement("element")
 }
 </script>
 <script src="http://translate.google.com/translate_a/element.js?cb=loadGoogleTranslate"
 ></script>
```

```
<meta charset="UTF-8" />
<meta http-equiv="X-UA-Compatible" content="IE=edge" />
 <meta name="viewport" content="width=device-width, initial-scale=1.0" />
<title>Document</title>
<link rel="stylesheet" href="{{ url_for('static', filename='css/index.css') }}" />
 </head>
<body>
<section class="main">
 <div class="inside">
<div class="wrapper">
<div class="Head">
 <h1>Welcome</h1>
<span></span>
<div id="element"></div>
 </div>
 <a class="box1 box" href="sign_to_speech">Sign to speech</a>
<a class="box1 box" href="speech_to_sign">Speech to sign</a>
</div>
 </div>
</section>
</body>
 </html>
```

## Speech_to_sign,html

```
 <html>
 <head>
<meta charset="utf-8">
<meta http-equiv="X-UA-Compatible" content="ie=edge">
```

```
<meta name="viewport" content="width=device-width, initial-scale=1">
<script
src="http://translate.google.com/translate_a/element.js?cb=loadGoogleTranslate"
></script>

 <script>

 function loadGoogleTranslate()

 {

 new google.translate.TranslateElement("google_element")

 }

</script>
<script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>
 <script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></scri pt>
 <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
 <style>
 .row { display:
 flex;
 }

 .col {
flex: 50%;
}
 *,*:after,*:before{
-webkit-box-sizing: border-box;
-moz-box-sizing: border-box;
 -ms-box-sizing: border-box;box-
 sizing: border-box;
```

```
}
body{
 font-family: arial;
font-size: 16px;
margin: 0;
 color: #000;
 display: flex;
align-items: center;
justify-content: center;
 min-height: 100vh;
 }
 .voice_to_text{
width: 600px;
text-align: center;
 }
h1{
color: #000000;
 font-size: 50px;
 }
 #convert_text{
 width: 100%;
height: 200px;
border-radius: 10px;
resize: none;
padding: 10px;
 font-size: 20px;
margin-bottom: 10px;
}
 button{
```

```
padding: 12px 20px;
background: #0ea4da;
 border: 0;
color: #fff;
font-size: 18px;
 cursor: pointer;
border-radius: 5px;
}
 </style>
 </head>
 <body>
 <div class="container">
  <div class="row">
  <div class="col">
 <img src="https://img.freepik.com/free-vector/sign-language-alphabet-hand-drawn-style_23-2147872270.jpg?w=2000" style="width:50%;"/>
</div>
<div class="col"><div class="voice_to_text">
 <div class="text_center" id="google_element"></div>
<h1>Voice to text converter</h1>
<textarea name="" id="convert_text"></textarea>
 <button id="click_to_record" class="btn-primary">Voice to Text</button><br/>
<a href="/">
<button class="btn btn-danger btn-lg">Exit</button>
 </a>
</div>
</div></div></div>
 <script type="text/javascript" src="{{ url_for('static',filename='javascript/script.js') }}"></script>
```

```
</body>

</html>

Sign_to_speech.html

<html>

<head>

<style>

img{

display: block;

margin-left: auto;

margin-right: auto;

}

</style>

<script>

function loadGoogleTranslate()

{

new google.translate.TranslateElement("google_element")

}

</script>

<script src="http://translate.google.com/translate_a/element.js?cb=loadGoogleTranslate"
></script>

<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>

<script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></scri pt>

<link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css"/>
```

```
</head>

<body>
<h1>Sign to speech</h1>
<div>
<div class="text-center" id="google_element"></div>
<img src="{{ url_for('video') }}" width="50%" height="50%"/>
<br/>
<div class="text-center">
<a href="/">
<button class="btn btn-danger btn-lg" >Exit</button>
</a></div>
</div>

</body>

</html>
```

## CSS Files

### Index.css

```
@import url("https://fonts.googleapis.com/css2?family=Oxygen:wght@400;700&family=
Roboto:wght@300;900&display=swap");

* {
box-sizing: border-box;
padding: 0;
margin: 0;
}

:root {
--black: #000;
--white: #fff;
```

```
--hover: #000;
}

.main {
position: relative;
 height: 100vh;
 width: 100%;

display: flex;
align-items: center;
 justify-content: center;
 }

.inside {
position: relative;
 height: 60%;
width: 50%;
background: rgba(255,255,255,0.9);
 border-radius: 30px;
/* border: 5px solid var(--black); */
display: flex;
 align-items: center;
justify-content: space-evenly;
-webkit-box-shadow: 12px 12px 17px 1px rgba(0, 0, 0, 0.59);
 -moz-box-shadow: 12px 12px 17px 1px rgba(0, 0, 0, 0.59);
box-shadow: 12px 12px 17px 1px rgba(0, 0, 0, 0.59);
}

 .wrapper { position:
 relative;
height: 75%;
width: 30%;
```

```
display: flex;
align-items: center;
 justify-content: space-evenly;
flex-direction: column;
}

 .Head {
 position: relative;
font-size: 3rem;
text-transform: uppercase;
 font-family: "Roboto", sans-serif;
font-weight: 900;
display: flex;
 align-items: center;
 justify-content: center;
 flex-direction: column;
 height: 30%;
 }

 .Head h1 {
 font-size: 3rem;
 }

 .Head span { position:
 relative;
 height: 5px;
 width: 60%;
 background: var(--black);
 }

.box {
position: relative;
```

```
font-family: "Oxygen", sans-serif;
font-weight: 700;
 border: 2px solid var(--black);
      border-radius:
          1.5rem;
text-decoration: none;
 overflow: hidden;
cursor: pointer;
z-index: 1;
 }
 .box1 {
padding: 0.8rem 2rem;
}

.box2 {
padding: 0.8rem 1.5rem;
 }
 .box:hover {
color: var(--white);
background: var(--hover);
 }
```

## Javascript Files

### Script.js

```
click_to_record.addEventListener('click',function(){
var speech = true;
 const SpeechRecognition = window.speechRecognition ||window.webkitSpeechRecognition;
 const recognition =new SpeechRecognition();
 recognition.interimResults = true;
 recognition.addEventListener('result', e => {
```

```
const transcript = Array.from(e.results)
.map(result => result[0])
 .map(result => result.transcript)
 .join('')

 document.getElementById("convert_text").innerHTML = transcript;
 console.log(transcript);
 });

if (speech == true) {
recognition.start();
 }
 })
```

**Output**

## 13.2 Github and Demo Link:

**https://github.com/IBM-EPBL/IBM-Project-41609-1660643356**