Final Report

A Real-Time Communication System For Specially Abled

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1. Introduction

1.1 Project Overview

The project deals with building an application that helps typically challenged people to communicate between themselves and the common people. Communication between a person with hearing/speech impairment and a normal person has always been a challenging task. This application tries to reduce the barrier of communication by developing an assistive application for specially challenged people To have proper communication between a normal person and a handicapped person in any language, a voice conversion system with hand gesture recognition and translation will be very helpful.

1.2 Purpose

The project intends to create a system that can translate speech into specified sign language for the deaf and dumb as well as translate sign language into a human-hearing voice in the desired language to communicate a message to normal people. A convolution neural network is being used to build a model that is trained on various hand motions. Based on this model, an app is created. With the help of this app, persons who are deaf or dumb can communicate using signs that are translated into speech and human-understandable words.

2. 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. Communications between deaf-mute and a normal person has always been a challenging task. It is complicated 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 handy to have a proper conversation between a normal person and an impaired person in any language.

2.2 References

Text to speech conversion • S. Venkateswarlu The present paper has introduced an innovative, efficient and realtime cost beneficial technique that enables user to hear the contents of text images instead of reading through them. It combines the concept of Optical Character Recognition (OCR) and Text to Speech Synthesizer (TTS) in Raspberry pi. This device consists of two modules, image processing module and voice processing module. The device was developed based on Raspberry Pi v2 with 900 MHz processor speed. • Easy get hacked • Less accurate

Design of the architecture for text recognition and reading in an online assessment applied to visually impaired students • Alex Leon This paper describes the architecture for text recognition and reading in an online assessment applied to visually impaired students. For this purpose, it is intended to implementation online evaluation system exclusively to recognize alphanumeric information, i.e., letters and numbers, through the use of an Application Programming Interface or also known as speech and text processing API's, where the computer can understand and respond in natural language • Operating system Problem. • Chance of misunderstanding

Voice source modelling using deep neural networks for statistical parametric speech synthesis • Tuomo Raitio A voice source modelling method employing a deep neural network (DNN) to map from acoustic features to the time-domain glottal flow waveform. First, acous-tic features and the glottal flow signal are estimated from each frame of the speech database. Pitch-synchronous glottal flow time-domain waveforms are extracted, interpolated to a constant duration, and stored in a codebook. Then, a DNN is trained to map from acoustic features to these duration-normalised glottal waveforms. At synthesis time, acoustic features are generated from a statistical parametric model, and from these, the trained DNN predicts the glottal flow wave-form. • High implementation costs. • Noisy environment

2.3 Problem Definition Statement

People with disabilities are a part of our society. Even though technology is constantly evolving, little is being done to improve the lives of these people. Communication with a deaf-mute person has always been difficult. Because hand sign language is not taught to the general public, it can be difficult for silent people to communicate with non-mute people. In times of crisis, they may find it difficult to communicate. When other modes of communication, such as speech, are unavailable, the human hand has remained a popular method of information transmission. A voice conversion system with hand gesture recognition and translation will be very helpful in establishing proper communication between a normal person and a handicapped person in any language.

3. Ideation and Proposed Solution

3.1 Empathy Map Canvas


Template
Empathy map
Use this framework to develop a deep, shared understanding and empathy for other people. An empathy map helps describe the aspects of a user's experience, needs and pain points, to quickly understand your users' experience and mindset.
Share template feedback
Build empathy
The information you add here should be representative of the observations and research you've done about your users.
SAY
THINK
Make others useful
Finding new ideas
User friendly interface
Finish the task
Will it detect gestures ?
Do invent better things ?
Will it progress ?
Conversion of voice is affective for deaf and dumb.
High voice conversion
Cost effective
More convenient
Efficient for deaf and dumb
User friendly
Instant messaging
Video and tele conferencing
Earlier detection
DOES
FEEL

3.2 Ideation and Brainstorming

3.3 Proposed Solution

S No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	In this world there are many with disabilities. They face fewer education, less job opportunities due to impaired communication and difficulties in communicating with others. They are struggle to accommodate themselves in the world designed around hearing, leading to lack of inclusiveness along with breakdown of their mental, physical and social health. Lack of efficient gesture detection system designed specifically for the differently abled person

2.	Idea / Solution description	• 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.
3.	Novelty / Uniqueness	• The proposed work aims at converting sign gestures into speech that can be understood by normal people. The entire model pipeline is developed by CNN architecture for the classification of 26 alphabets.
4.	Social Impact / Customer Satisfaction	• It's a mobile application • Sign to speech which can be understood by normal people, speech to sign (2 in 1 application) • Due to this every disability can be treated as a normal person.
5.	Business Model (Revenue Model)	• Single User application • Free of cost to access.
6.	Scalability of the Solution	• Simple in nature. • Due to simplicity It is available in the play store • Can be downloaded easily and get installed on any ANDROID device.

3.4 Proposed Solution Fit

1. CUSTOMER SEGMENT(S) It is based on the characteristics of the group we are targeting and is divided. It deals with emotional balance.	**6. CUSTOMER LIMITATION** The customer can only ask for only what he can get and not all he can get. What they want is almost every product to be done based on similarities among a group of customers so it would be difficult to get solutions for all problems.	**5. AVAILABLE SOLUTIONS** There are many applications and websites which help the specially-abled in many ways. Also, websites are available which are created by the government and are not for personal use.
2. PROBLEMS / PAINS Mental trauma. Not able to accomplish. Family issues. Hesitate to ask for help. **3. TRIGGERS TO ACT** Make it easy. Act faster. Quick recognition. **4. EMOTIONS** Plays a major role in every project. It needs support for every individual as they go through a lot which cannot be mentioned. So while preparing something needs to be aware of how they react to the product.	**9. PROBLEM ROOT / CAUSE** They need to deal with devices which are costlier, and many cannot afford those devices. People are not satisfied with the devices, and privacy issues. **10. YOUR SOLUTION** Create an application which can help specially-abled people and normal people-related services provided to different types of people.	**7. BEHAVIOUR** Behaviour is the clustering process. This is totally based on how the customer interacts with your product and their buying behaviour. This is also based on how frequently the customer buys from you. **8. CHANNELS of BEHAVIOUR** Social media videos made but users of the websites so that others can use them. Advertise online with specially-abled influencers to test and promote it.

4. Requirement Analysis

4.1 Functional Requirement

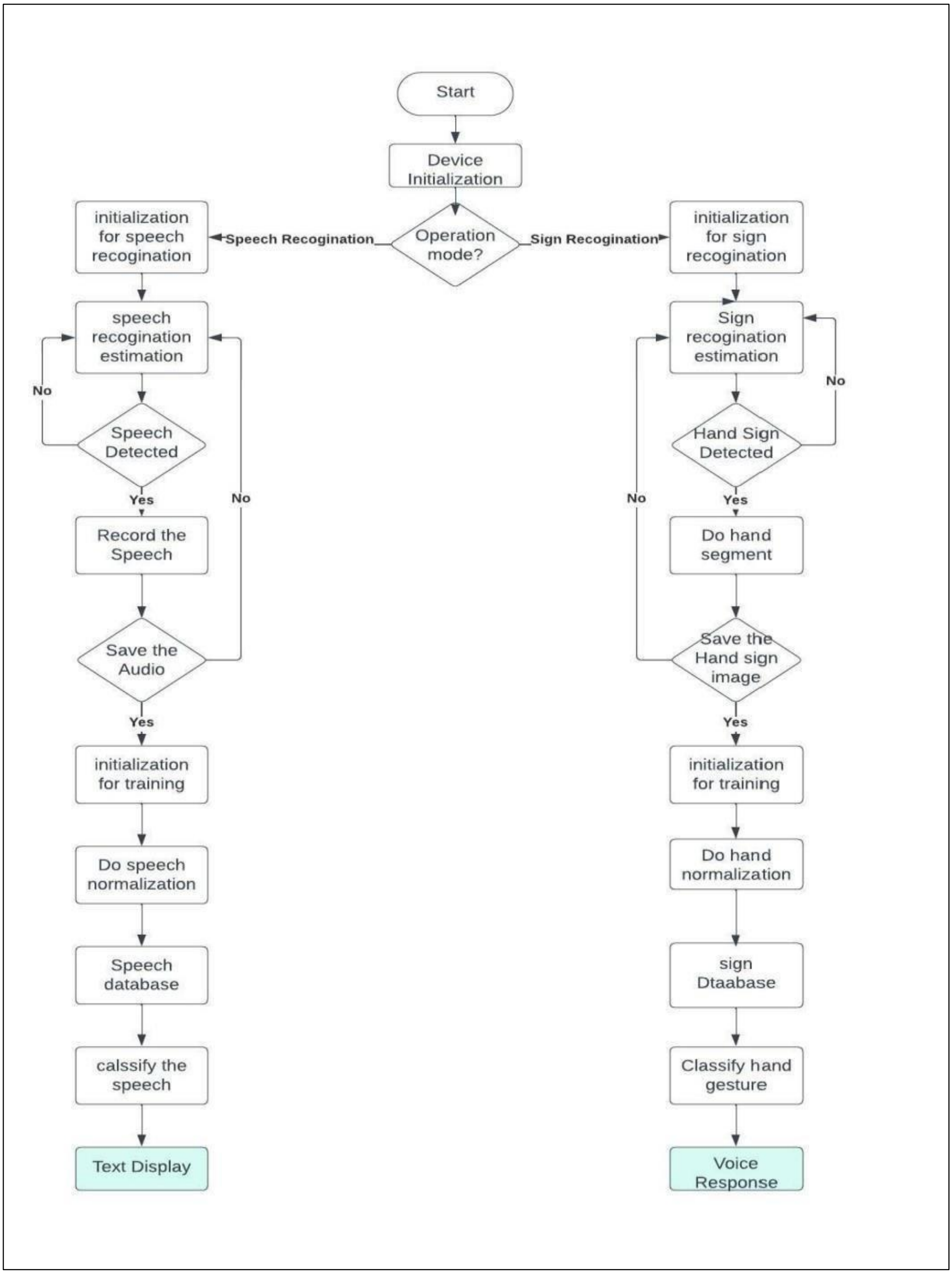
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through Mobile Number
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP Confirmation via Message
FR-3	Update Profile	Update user • Biodata • profile picture, etc.
FR-4	User Authentication	Authentication can be done using fingerprints. And also can be done using face and voice recognition.
FR-5	Report	This will be more useful to improve the issues faced by deaf and dumb people.

4.2 Non-Functional Requirement

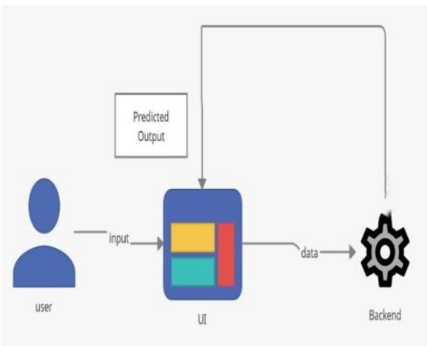
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The user will have access to all the resources present in that website.
NFR-2	**Security**	User information is protected.
NFR-3	**Reliability**	It offers accurate results.
NFR-4	**Performance**	The web application makes use of light weight model hence the result will be accurate and fast.
NFR-5	**Availability**	The web application can be accessed 24/7 from anywhere when connected to the internet.
NFR-6	**Scalability**	The trained ML model can provide accurate results whenever the size of the dataset and the number of users is extended.

5. Project Design

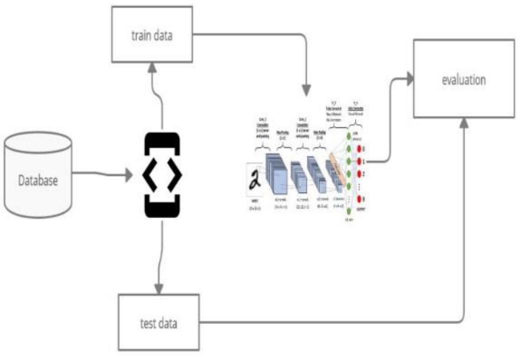
5.1 Dataflow Diagram



5.2 Solution and Technical Architecture

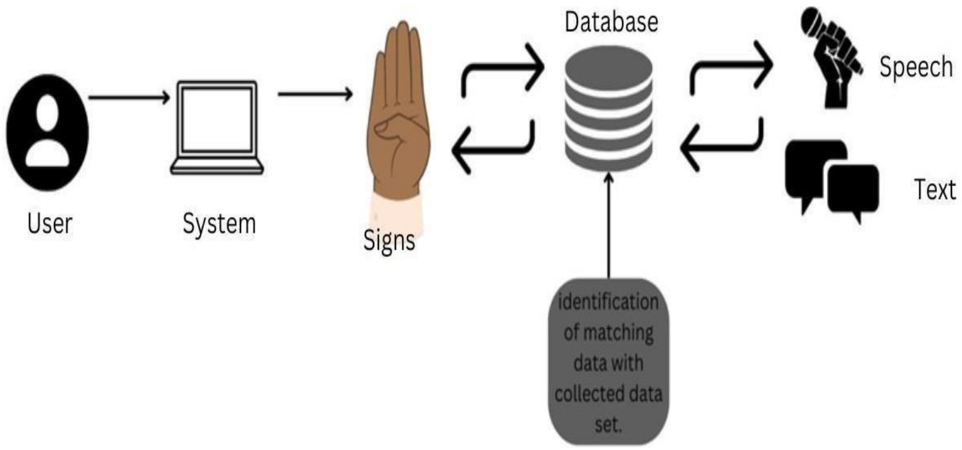


DEPLOYMENT

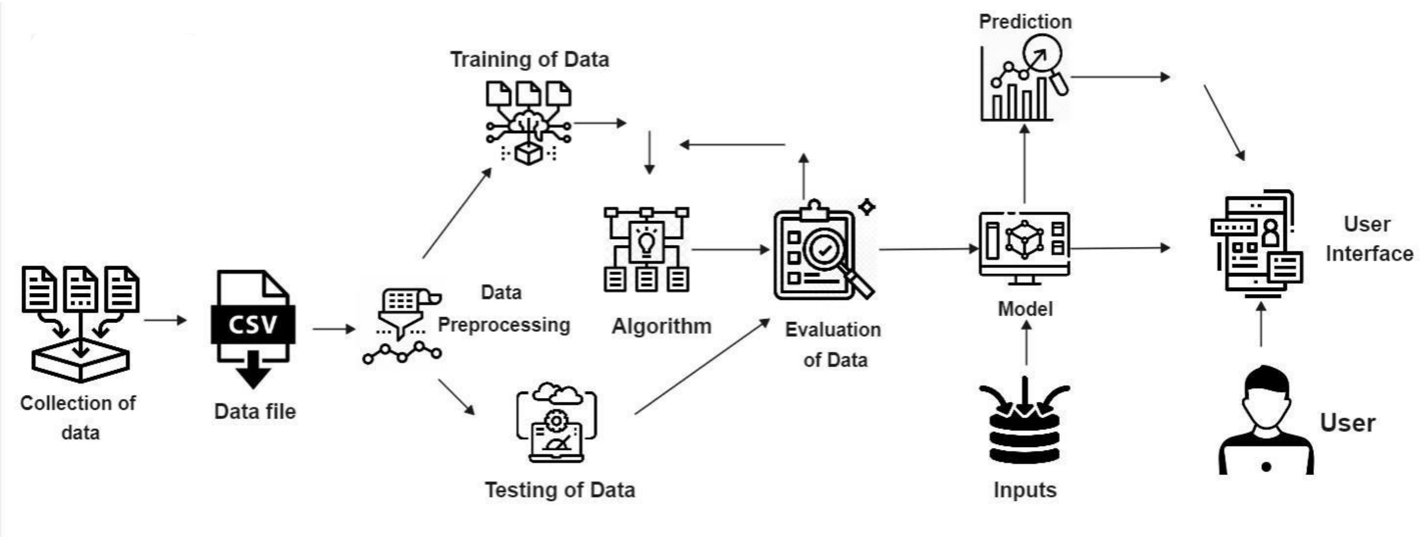


TRAINING AND EVALUATION

Solution Architecture



Technical Architecture



	Functional Requirement (Epic)	User Story Number		criteria		
Customer	Uploading the real time data.	USN-1	The user will be presented with two options. Speech to sign language conversion. 2. Sign language to speech conversion.	They can access the portal	High	Sprint-1
		USN-2	Language selection	They can access the portal	Low	Sprint-1

		USN-3	The deaf-mute person will choose the speech to sign language conversion which would take them into a portal that collects the real time data (sign language recognition) and converts it into speech simultaneously.	Video processing	High	Sprint-2
		USN-4	Emotion detection	Video processing	Medium	Sprint-1
		USN-5	Normal person would choose speech to sign language which would take them into a portal where their speech is converted into sign language simultaneously.	Video and audio processi ng	High	Sprint-1

5.3 User Story

User	User Story / Task	Acceptance	Priority	Release

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	G KAVIYA , USHA KUMARI
Sprint-1		USN-2	Image pre-processing	8	Medium	B MOHAMED FAHAD, J VAISHNAVI
Sprint-2	Model Building	USN-3	Import the required libraries, add the necessary layers, and compile the model	10	High	G KAVIYA , USHA KUMARI
Sprint-2		USN-4	Training the image classification model using CNN	7	Medium	B MOHAMED FAHAD, J VAISHNAVI
Sprint-3	Training and Testing	USN-5	Training the model and testing the model's performance	9	High	G KAVIYA , USHA KUMARI
Sprint-4	Implementation of the application	USN-6	Converting the input sign language images into English alphabets	8	Medium	B MOHAMED FAHAD, J VAISHNAVI.

6.1 Sprint Planning and Estimation

Product Backlog, Sprint Schedule, and Estimation

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	G KAVIYA , USHA KUMARI
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6.2 Sprint Delivery Schedule

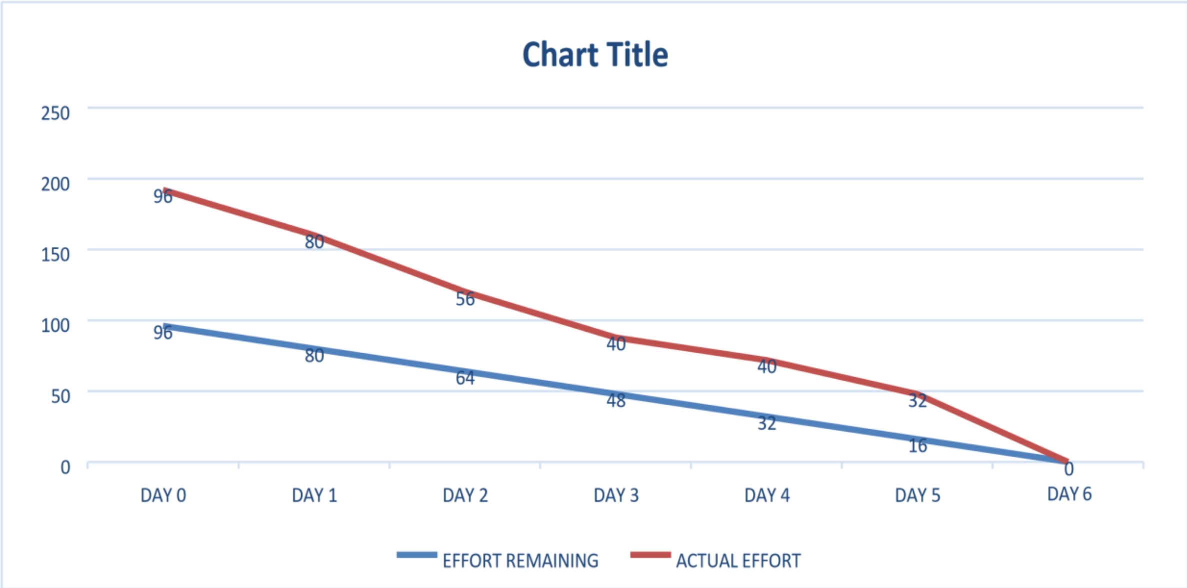
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	04 Nov 2022	5	04 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	11 Nov 2022	7	11 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	18 Nov 2022	5	18 Nov 2022

Project Tracker, Velocity & Burndown Chart:

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

AV = 6/10 = 0.6

Velocity:



Imagine we have a 10-day sprint duration, and the velocity of the team is 6 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Burndown Chart:

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

6.2 Reports From JIRA

11/17/22, 9:44 PM SmartBear Test Management

Coverage Report

Coverage		Test Cases
No Coverage	10	RCSFSA-T1 APPROVED Welcomepage_TC_001
		RCSFSA-T2 APPROVED Welcomepage_TC_OO2
		RCSFSA-T3 APPROVED Language Selection_TC_001
		RCSFSA-T4 APPROVED Sign to speech_TC_OO1
		RCSFSA-T5 APPROVED Sign to speech_TC_OO2
		RCSFSA-T6 APPROVED Sign to speech_TC_OO3
		RCSFSA-T7 APPROVED Speech to sign_TC_OO1
		RCSFSA-T8 APPROVED Speech to sign_TC_OO2
		RCSFSA-T9 APPROVED Speech to sign_TC_OO3
		RCSFSA-T10 APPROVED Speech to sign_TC_OO4

Displaying (1 of 1)

https://swasthikavenkataraman.atlassian.net/projects/RCSFSA?selectedItem=com.atlassian.plugins.atlassian-connect-plugin:com.kanoah.test-manag... 1/1

11/17/22, 9:45 PM SmartBear Test Management

Traceability Report

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

https://swasthikavenkataraman.atlassian.net/projects/RCSFSA?selectedItem=com.atlassian.plugins.atlassian-connect-plugin:com.kanoah.test-manag... 1/2

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

Traceability Tree

Traceability	Summary
No Coverage	
Covered by Test Case RCSFSA-T1	Welcomepage_TC_001
Executed on 17/Nov/22 8:50 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T2	Welcomepage_TC_OO2
Executed on 17/Nov/22 9:41 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T3	Language Selection_TC_001
Executed on 17/Nov/22 8:54 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T4	Sign to speech_TC_OO1
Executed on 17/Nov/22 9:44 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T5	Sign to speech_TC_OO2
Executed on 17/Nov/22 9:01 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T6	Sign to speech_TC_OO3
Executed on 17/Nov/22 9:04 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T7	Speech to sign_TC_OO1
Executed on 17/Nov/22 9:07 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T8	Speech to sign_TC_OO2
Executed on 17/Nov/22 9:12 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T9	Speech to sign_TC_OO3
Executed on 17/Nov/22 9:18 pm	PASS Executed by Swasthika Venkataraman
Covered by Test Case RCSFSA-T10	Speech to sign_TC_OO4
Executed on 17/Nov/22 9:24 pm	PASS Executed by Swasthika Venkataraman

Displaying (1 of 1)

7. Coding and 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 get the text from the speech to use as user input. We use the **Speech Recognition** 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 language 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 the 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 by clicking the 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, and how they were resolved

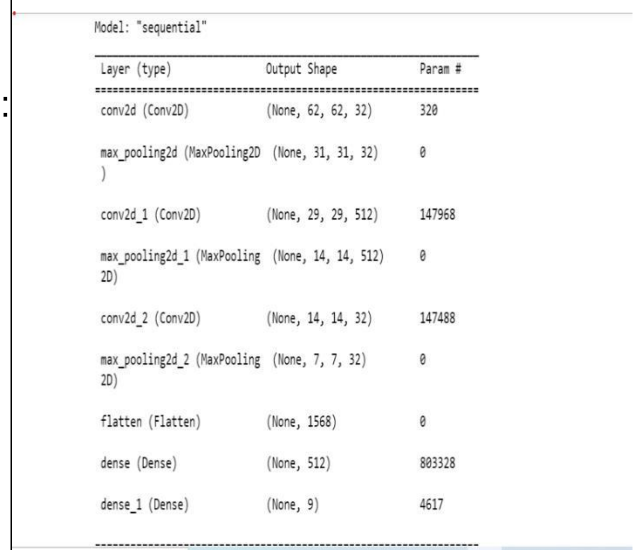
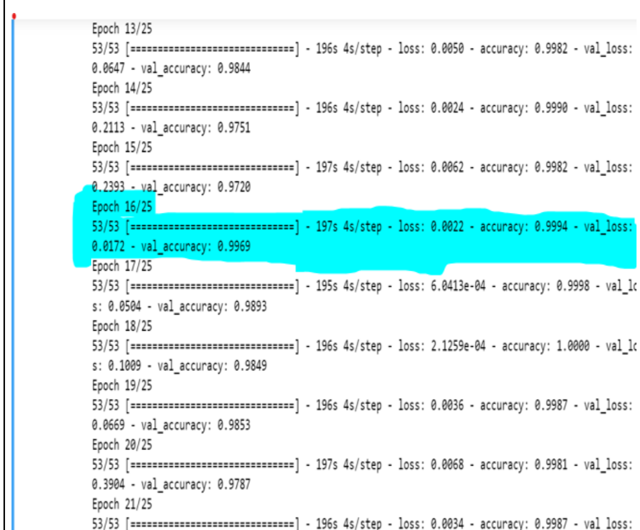
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	11	7	4	2	24
Duplicate	1	0	2	0	3
External	2	3	2	1	8
Fixed	10	5	3	14	32
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	1	0	0	0	1
Totals	25	15	13	18	71

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

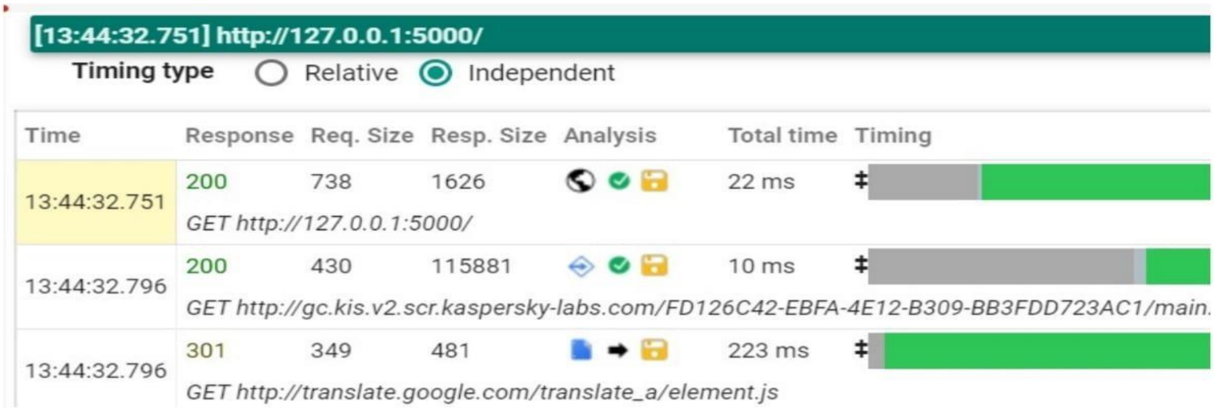
8.3 Performance Testing

S.NO	Parameter	Values	Screenshot
1.	Model Summary	Total params: 1,103,721 Trainable params: 1,103,721 Non-trainable params: 0	 Model: "sequential" Layer (type) Output Shape Param # conv2d (Conv2D) (None, 62, 62, 32) 320 max_pooling2d (MaxPooling2D) (None, 31, 31, 32) 0 conv2d_1 (Conv2D) (None, 29, 29, 512) 147968 max_pooling2d_1 (MaxPooling2D) (None, 14, 14, 512) 0 conv2d_2 (Conv2D) (None, 14, 14, 32) 147488 max_pooling2d_2 (MaxPooling2D) (None, 7, 7, 32) 0 flatten (Flatten) (None, 1568) 0 dense (Dense) (None, 512) 803328 dense_1 (Dense) (None, 9) 4617
2.	Accuracy	Training Accuracy - 0.9994 Validation Accuracy -0.9969	 Epoch 13/25 53/53 [==============================] - 196s 4s/step - loss: 0.0050 - accuracy: 0.9982 - val_loss: 0.0647 - val_accuracy: 0.9844 Epoch 14/25 53/53 [==============================] - 196s 4s/step - loss: 0.0024 - accuracy: 0.9990 - val_loss: 0.2113 - val_accuracy: 0.9751 Epoch 15/25 53/53 [==============================] - 197s 4s/step - loss: 0.0062 - accuracy: 0.9982 - val_loss: 0.2393 - val_accuracy: 0.9720 Epoch 16/25 53/53 [==============================] - 197s 4s/step - loss: 0.0022 - accuracy: 0.9994 - val_loss: 0.0172 - val_accuracy: 0.9969 Epoch 17/25 53/53 [==============================] - 195s 4s/step - loss: 6.0413e-04 - accuracy: 0.9998 - val_lo s: 0.0504 - val_accuracy: 0.9893 Epoch 18/25 53/53 [==============================] - 196s 4s/step - loss: 2.1259e-04 - accuracy: 1.0000 - val_lo s: 0.1009 - val_accuracy: 0.9849 Epoch 19/25 53/53 [==============================] - 196s 4s/step - loss: 0.0036 - accuracy: 0.9987 - val_loss: 0.0669 - val_accuracy: 0.9853 Epoch 20/25 53/53 [==============================] - 197s 4s/step - loss: 0.0068 - accuracy: 0.9981 - val_loss: 0.3904 - val_accuracy: 0.9787 Epoch 21/25 53/53 [==============================] - 196s 4s/step - loss: 0.0034 - accuracy: 0.9987 - val_loss:

9. Results

Performance Metrics

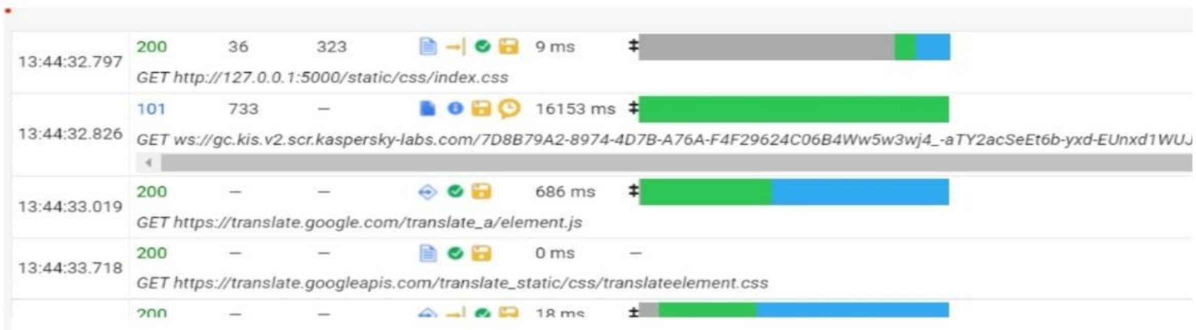
The following images can be studied to understand the performance metrics of our system



[13:44:32.751] http://127.0.0.1:5000/

Timing type ○ Relative ◉ Independent

Time	Response	Req. Size	Resp. Size	Analysis	Total time	Timing
13:44:32.751	200	738	1626		22 ms	
	GET http://127.0.0.1:5000/					
13:44:32.796	200	430	115881		10 ms	
	GET http://gc.kis.v2.scr.kaspersky-labs.com/FD126C42-EBFA-4E12-B309-BB3FDD723AC1/main.					
13:44:32.796	301	349	481		223 ms	
	GET http://translate.google.com/translate_a/element.js					



13:44:32.797	200	36	323		9 ms	
	GET http://127.0.0.1:5000/static/css/index.css					
13:44:32.826	101	733	–		16153 ms	
	GET ws://gc.kis.v2.scr.kaspersky-labs.com/7D8B79A2-8974-4D7B-A76A-F4F29624C06B4Ww5w3wj4_-aTY2acSeEt6b-yxd-EUnxd1WUJ					
13:44:33.019	200	–	–		686 ms	
	GET https://translate.google.com/translate_a/element.js					
13:44:33.718	200	–	–		0 ms	–
	GET https://translate.googleapis.com/translate_static/css/translateelement.css					
	200	–	–		18 ms	

13:44:33.719	200	–	–		18 ms	
	GET https://translate.googleapis.com/_/translate_http/_/js/k=translate_http.tr.en_GB.jUY4_WDT6tY.O/d=					
13:44:33.722	200	–	–		11 ms	
	GET https://fonts.googleapis.com/css2					
13:44:33.739	200	–	–		6 ms	
	GET https://image.shutterstock.com/image-vector/deaf-sign-language-welcome-line-260nw-1585429861					
13:44:33.739	200	–	–		6 ms	
	GET https://fonts.gstatic.com/s/roboto/v30/KFOlCnqEu92Fr1MmYUtfBBc4.woff2					
13:44:33.739	200	–	–		6 ms	
	GET https://fonts.gstatic.com/s/oxygen/v15/2sDcZG1Wl4LcnbuCNWgzaGW5.woff2					

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 to 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 user’s applications.
- 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=True) 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_model import 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

```
from flask import Flask, Response, render_template
```

```
import cv2



app = Flask(__name__)
cap = cv2.VideoCapture(0)
@app.route('/')
def index():
    return  render_template('index.html')

def generate_frames():
    while True:
        success, frame = cap.read()
        imgOutput=frame.copy()
        yield (b'--frame\r\n'
               b'Content-Type: image/jpeg\r\n\r\n' + imgOutput + b'\r\n')
@app.route('/predict',methods=['POST','GET'])
def predictions():
    #The prediction model code goes here
    #Once the start Button is pressed the prediction model starts
    pass
@app.route('/stop',methods=['POST','GET'])
def stopping():
    #The text to speech code goes here
    #Once the stop button is pressed the text is converted into speech
    pass

@app.route('/video')
```

```
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

```
<head>
    <link rel="stylesheet" href={{ url_for('static', filename='css/style.css') }}>
  </head>
  <body>


    <h2 class="header">Sign Language TO Speech</h2>
    <div class="video">
        <img src="{{ url_for('video') }}" width="50%">
    </div>
    <div class="container">
    <form action='/predict' method='post'>
    <button type="submit" name="start" value="start" class="button1" >Start</button>
    </form>
  <form action='/stop' method='post'>

    <button type="submit" name="stop" value="stop" class="button2" >Stop</button>
  </form>
  </div>
  <div class="instruction">
    <center>
    <p> <details>
      <summary><b>Instructions to Use</b></summary>
      <p>Once the webcam is <b>ON</b> Click <strong>"START"</strong> to start the predicition model.<br>
```

```
      <br>
      >>Click <strong>"s"</strong> to save the text.<br>
      <br>
      >>Click <strong>"a"</strong> to leave a space.<br>
      <br>
      >>Click <strong>"d"</strong> to delete a character from right to left.<br>
      <br>
      >>Click <strong>"w"</strong> to delete entire text.<br>
      <br>
      >> The Saved text appears on the top left corner of the video Screen<br>
      <br>
      >> Once you are satisfied with the saved text press<b>"STOP"</b> to convert it into speech<br>
      <br>
      >><b>NOTE: The hand must be on the screen to display the text to save,delete or to leave a space between them.</b>

      </p>
    </details></p>
  </center>
</div>
<br>
<br>
<div class="team">
<center>
<details>
  <summary><b>Team</b></summary>
  <p><b>Ibm ID-2475-1658472446</b>
  <br>
   1.Sajith<br>
   2.Stanlee<br>
   3.Sachin<br>
   4.Harish<br>


  </p>
</details>
```

```
</center>
</div>
<p>Feel Free to contact us !!!!!</p>
<center>
<div class="alert info">
  <span class="closebtn">&times;</span>
  <strong>NOTE:</strong> A disturbance free background with good lighting(White-
background) is preferred.

</div>
</center>
<script>
  var close = document.getElementsByClassName("closebtn");
  var i;

  for (i = 0; i < close.length; i++) {
    close[i].onclick = function(){
      var div = this.parentElement;
      div.style.opacity = "0";
      setTimeout(function(){ div.style.display = "none"; }, 600);
    }
  }
  </script>

  <a class="social-icon"href="https://in.linkedin.com/in/sajith-m-82431721a?trk=profile-
badge" target="_blank">
    <ion-icon name="logo-linkedin"></ion-icon>
  </a>
  <a class="git"href="https://github.com/IBM-EPBL/IBM-Project-2475-1658472446.git"
target="_blank">
    <ion-icon name="logo-github"></ion-icon>
  </a>



  <script src="https://platform.linkedin.com/badges/js/profile.js" async defer
type="text/javascript"></script>
  <script type="module"
src="https://unpkg.com/ionicons@5.5.2/dist/ionicons/ionicons.esm.js"></script>
```

```
  <script nomodule
src="https://unpkg.com/ionicons@5.5.2/dist/ionicons/ionicons.js"></script>




  </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-
handdrawn-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>
```

```html
<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

```css
@import
url("https://fonts.googleapis.com/css2?family=Oxygen:wght@400;700&family=Roboto:w
ght@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-28638-1660114698