ZKG INTERNATIONAL

ISSN: 2366-1313

SPEECH TO INDIAN SIGN LANGUAGE USING NATURAL LANGUAGE PROCESSING

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Abstract: *People interact with each other mostly through speech. Birth abnormalities, accidents, and oral disorders have all contributed to the significant rise in the number of deaf and dumb people in recent years. Because deaf and dumb persons are unable to interact with others, they must rely on visual communication. Sign language is a kind of communication in which meaning is conveyed through visually transmitted sign patterns. It is mostly used by persons who are deaf or hard of hearing to communicate fluently. This initiative is designed to assist these persons with special needs in participating in society on an equal footing. The Speech to Indian Sign Language system is built as a website where the user inputs audio (or) text into the system. The system then applies natural language processing to the input and maps to a video with the relevant Indian Sign Language (ISL). The video is mapped by comparing the pre-processed text to the Indian Sign Language (ISL) Dataset for the presentation of sign symbols. The user is shown the video as well as the Indian Sign Language (ISL) sentence. We suggest a method to assist those who are unable to communicate with ordinary people due to a lack of advanced gadgets such as power, data gloves, and coloured finger caps, among other things.*

Keywords: *Indian sign language, natural language processing, tokenization, Web-scraping.*

I. INTRODUCTION

Deaf people speak in sign language, which makes it difficult for others to converse with them. To address this problem, we have developed "Speak in Hindi Sign Language" using Natural Language

ISSN: 2366-1313

Processing. It is a real-time device that accepts audio and textual content upon input and emits appropriate signals and symptoms to speak with the deaf. The Speech to Hindi Sign Language system is built as a website where a person provides the device with a voice (or text) input. The device then applies natural language processing to the input and compares it to the applicable Indian Sign Language (ISL). The tag code to be rendered is generated by matching the pre-processed textual content to an Indian Sign Language (ISL) dataset [1].

As a result, generation is used to remove the obstacles that ordinary people face when sharing their ideas with hearing-impaired people, and it will serve as an ear for the deaf.

Because it carries expressions and gestures, sign language provides greater context and insight into the subject being communicated. There are about 7,139 recognized living languages in the world, which can be divided into 142 language families. Deaf community sign language, which belongs to the family of sign language relatives, is one of the 142 families of sign languages used by humans with hearing and speech disabilities to communicate. Depending on where in the arena the paper is used, this same family contains about 128 sign languages [2].

Of the approximately 7.9 billion people on the planet, approximately 1.57 billion suffer from hearing loss. This figure represents about 20.3% of the world's population. Approximately 6 million people in India use Hindi Sign Language to speak, making it the 151st most "spoken" language in the world.

Over the years, there has been little or no improvement in data access for this population. In India, the battle is still going on between the deaf and the dumb for access rights to education, employment and communication since there are only a few universities with sign language interpreters. Most of these schools are located in large cities, which makes access to statistics scarcer in agricultural regions of the United States. Therefore, it becomes to pave the way for those people who not only reduce the gap in the proportion of hearing impaired and sign language interpreters, but also make them neutral through a platform. Ensures self-education and acquires knowledge of sign language. This paper proposes a unique, easy-to-use, and time-saving online platform for deaf and mute humans that can serve as a powerful means of communication and mastery for them.

ISSN: 2366-1313

Technology is rapidly shifting and the way the arena operates is improving. This requires overcoming communication barriers to the network with hearing and speech problems. Presently, there are only about 250 certified sign language interpreters in India for a deaf and mute population of between 1.8 million and 7 million.

First of all, sign languages are not international. Many, but not all, international websites have specific sign languages. No lecture on sign language is followed all over the world and varies in different regions. BSL (British Sign Language) and ASL (American Sign Language) are famous conventions of sign language, used in Europe and America respectively. This idea aims to target the Indian population.

Secondly, learning to read and write can be very challenging for the general population with hearing impairments. For those who can study and write, experiencing the context of what is being spoken becomes difficult, especially in cases involving non-verbal sounds or movements. This is why, most of the time, deaf and mute humans tend to use sign language or lip reading. Sign language is most preferred because it includes hand movements, lip movements, and expressions, providing more context and meaning. Lip movements and expressions are vital in sign language, as they help distinguish between comparable searching hand signals [3].

II. LITERATURE SURVEY

Distinct scholars have utilised a variety of ways to recognise different sign languages or hand gestures from different parts of the world. Some researchers used static hand motions, while others used video and real-time techniques. In this paper more research papers have been considered which deals with Indian Sign Language.

In [4] This paper was written by Ankita Harkude, Sarika Namade, Shefali Patil, and Anita Morey published by International Journal of Engineering and Innovative Technology (IJEIT) in 2020. Sign language is the mother tongue of deaf individuals, according to this research. This comprises hand gestures, arm or body movements, and facial expressions. This project makes use of Indian Sign Language. This technology enables the deaf population to participate in activities that typical people perform, such as everyday interaction and information access. This application accepts voice as input, translates it to text, and then shows graphics in Indian Sign Language. The system's front end is built with EasyGui,

ISSN: 2366-1313

while speech input through the microphone is handled with the PyAudio module. The Google Speech API is used to recognize the speech NLP is then used to pre-process the text (Natural Language Processing).

In [5] This paper was written by Rakesh Kumar, Vishal Goyal, and Lalit Goyal published by International Conference on Natural Language Processing: System Demonstrations in 2020. Hearing-impaired persons cannot hear announcements given at railway stations, such as which train is traveling to which destination. This Machine Translation system receives announcements in the form of English text as input and creates synthetic animations in Indian Sign Language (ISL) as output. The technology, created for a particular area of railway reservations, transforms Hindi strings entered by reservation clerks into Indian Sign Language (ISL) gloss strings that are then converted using HamNoSys to the animated human avatar.

In [6] This paper was written by Archana S. Ghotkar, Rucha Khatal, Sanjana Khupase, Surbhi Asati & Mithila Hadap (2012). In this system there are 4 modules: real time hand tracking, hand segmentation, feature extraction and gesture recognition. Cam shift method and Hue, Saturation, Intensity (HSV) colour model are used for hand tracking and segmentation. For gesture recognition, Genetic Algorithm is used. We propose an easy-to-use and inexpensive approach to recognize single handed as well as double handed gestures accurately. This system can help millions of deaf people to communicate with other normal people.

In[6] This paper was written by R Rumana, Reddygari Sandhya Rani, Mrs. R. Prema (2021). Hand gesture is one of the methods used in sign language for non-verbal communication. It is most used by deaf & dumb people who have hearing or speech problems to communicate among themselves or with normal people. it is a software which presents a system prototype that can automatically recognize sign language to help deaf and dumb people to communicate more effectively with each other or normal people. An interpreter will not be always available and visual communication is mostly difficult to understand.

In[7] This paper was written by Khallikkunaisa, Arshiya Kulsoom A, Chandan Y P, Fathima Farheen, Neha Halima (2020). With a population of around 7.8 billion today communication is a strong means for understanding each other. Around 9,000 million individuals are vocally and hearing impaired. Gesture

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based communication is the fundamental method of communication for this section of our society. This language uses a set of representations which are finger sign, expression, or mixture of both to precise their information among others. This system presents a completely unique approach of application-based translation of sign-action analysis, recognition and generating a text description in English.

TESSA [8] is a Speech-to-British Sign Language translation technology that attempts to let a deaf person communicate with a post office clerk. A formulaic grammar approach is used by the system. The translation is done using a phrase lookup database and a collection of predetermined phrases. However, because there are just a few sentences to use as templates, the conversation between the participants is limited. This makes TESSA a highly domain specific system.

III. PROPOSED SYSTEM

Proposed system seeks to generate a sign language representation of a given English text. Thus, we develop one for Indian sign language based on transfer-based translation. This translation system will depend on the conversion of English text to Indian sign language bearing its vocabulary knowledge.

This language does have its own synchronic grammar and is not the same as spoken English or Hindi as illustrated in a handbook

SYSTEM ARCHITECTURE

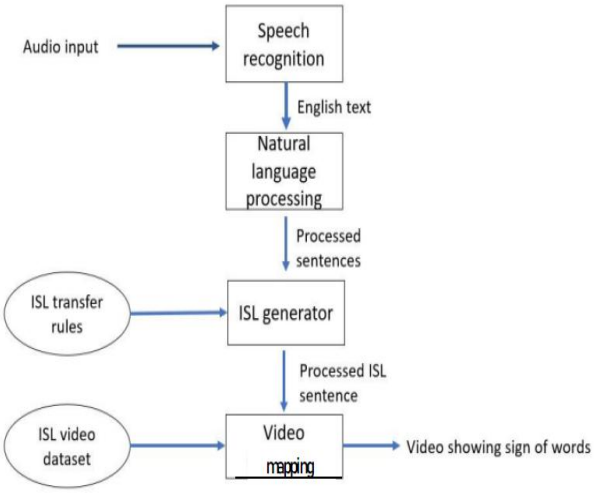

Fig.1 System architecture

The above Figure 4.2 explains about the Architecture of the System in the project "Speech to Indian Sign Language using Natural Language Processing." The system is designed using Django framework. The system takes audio (or) text as input and coverts the audio to text. the text is then parsed and the resulting tokenized sentence is received as output. the NLP is then implemented to receive the processed Indian Sign Language (ISL) text. The lemmatization is implemented where the same form of words is grouped together and the system perceive these words as a single word. Next the stop words i.e., the

ISSN: 2366-1313

words having no meaning in the sentence but used for grammatical purposes are filtered from the array.

In the next phase the system maps the per-processed text with Indian Sign Language (ISL) Dataset and compares to a video of Indian Sign Language (ISL signs) which is given as the output of the system. The array is then processed and mapped to the videos in the Indian Sign language (ISL) dataset. Finally, a video containing Indian Sign Language (ISL) signs is generated which is given as the output of the system.

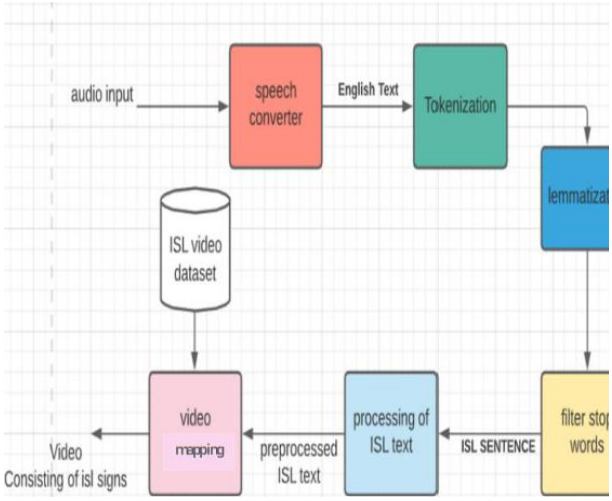

Fig.2 System design

The Speech to Indian Sign Language system is built as a website, via which the user may provide the system with either audio input or written input. Speech recognition is accomplished with the help of the JavaScript Web Speech API. The system will next apply natural language processing, such as tokenization, lemmatization, and the filtering of stop words, to the input, and it will compare a video with the matching Indian Sign Language (ISL). The results are presented in the form of video rather than still photos or gifs.

IV. IMPLEMENTATION

To download the video clips for each word, we will go to http://www.indiansignlanguage.org/. Each video will be manually labelled, and those that we deem irrelevant will be removed. We would prefer to keep an unfiltered input that includes a wide variety of terms.

The system consists of 5 modules:

1. Speech Recognition

2. Natural Language Processing

3. Indian Sign Language (ISL) Generator

4. Elimination of Stop Words

5. Video Conversion Stage

The system's input might be a written English text that is analysed to create a sentence structure with grammatical representation. Then, because English text follows the Subject-Verb-Object structure, but ISL follows the Subject-Object-Verb structure with variations of negative and interrogative phrases, rearrangement is

ISSN: 2366-1313

finished to fulfil ISL grammatical needs. When undesired words are deleted, ISL can only employ words that have meaning and no words that have a purpose, such as connecting verbs, articles, and so on. The result is forwarded to the lemmatization module, which reduces each word to its root type. Words that are not in the dictionary are substituted with synonyms

Speech Recognition

Speech recognition involves receiving speech through a device's microphone, which is then checked by a speech recognition service against an inventory of grammar (basically, the vocabulary you would like to have recognized during a specific app.) once a word or phrase is with success recognized, it is came as a result (or list of results) as a text string, and any actions will be initiated as a result. The JavaScript Web Speech API is employed for speech recognition during this system. the net Speech API features a main controller interface and variety of closely-related interfaces for representing grammar, results, etc. Generally, the default speech recognition system accessible on the device are used for the speech recognition.

Natural Language Processing

Natural Language Processing (NLP) is the process of using code or a machine to change or understand text or speech. An analogy is that people talk to each other, understand each other's points of view, and then give the right answer. In NLP, this kind of interaction, understanding, and response is made by a computer instead of a person. Here, the language processor uses NLTK (Natural Language Toolkit)]. The NLTK (Natural Language Toolkit) may be a set of libraries and programmes for using math and language in the real world. It is one of the most powerful libraries for human language technology. It has packages that make machines understand human language and do what needs to be done. The Two Steps involved in natural language processing are as follows:

Tokenization:

Tokenization is a common task in natural language process (NLP). It is a fundamental step in traditional natural language processing methods. Tokenization could be a way of separating a piece of text into smaller units known as tokens. Here, tokens will be either words, characters, or sub words. Hence, tokenization will be broadly classified into three types – word, character, and sub words tokenization. the most common way

ISSN: 2366-1313

of forming tokens relies on area i.e., word tokenization. Our system uses each word tokenization and character tokenization. For example, consider the sentence: "My father could be a teacher." Assuming area as a delimiter, the tokenization of the sentence results in three tokens (M)-(father)-(is)-(a)-(teacher). As each token could be a word, it becomes an example of Word tokenization.

Lemmatization:

In NLTK, lemmatization is the computational process of determining a word's lemma based on its meaning and context. Typically, lemmatization refers to the morphological study of words that eliminates inflectional ends. It assists in returning the bottom or dictionary form of a word, known as the lemma.

The NLTK Lemmatization approach is based on the morph function provided into WorldNet. Text pre-processing comprises stemming and lemmatization for each word. Many individuals find the two words to be confusing.

Lemmatization is more common than stemming for the following reasons: The stemming algorithm removes the suffix from the word. In a larger sense, cut either the beginning or end of a word. Lemmatization, on the other hand, is a more robust procedure that considers morphological examination of the words. It yields the lemma, which serves as the basis for all its inflectional forms. The creation of dictionaries and the search for the correct form of a term need in-depth linguistic skills. Stemming is a broad process, but lemmatization is an intelligent operation that searches the dictionary for the correct form. Therefore, lemmatization facilitates the formation of superior machine learning alternatives.

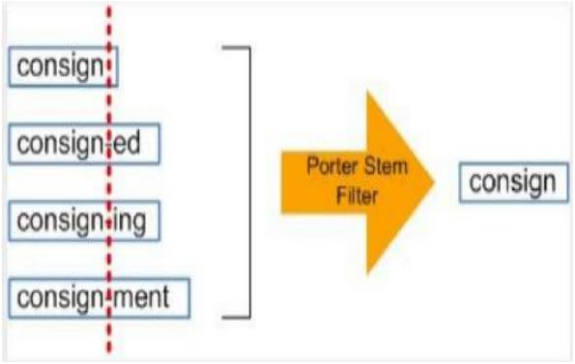

Fig.3 Lemmatization

Indian Sign Language (ISL) Generator

The English tokens are rearranged in this module to generate the ISL phrase. We will change the phrase structure tree we acquired from the previous lesson with ISL grammar rules, such that the updated tree now represents the structure and syntax of ISL. When both languages have differing grammatical rules, translating from one to the other is a difficult undertaking. When the source language is

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spoken and the target language is a sign language, the complexity rises dramatically. We should process the text using Indian Sign Language (ISL) grammar rules to convert the source language to the target language, and the processed text must now represent the structure and grammar of Indian Sign Language (ISL).

Elimination of Stop Words

Stop words are words that do not contribute much meaning to a statement in any language. They may be safely ignored without affecting the sentence's meaning. A stop word is a widely used word (such as "the," "a," "an," or "in") that a search engine has been configured to disregard while indexing and retrieving items as the results of a search query. We do not want these terms to eat up important processing time or take up space in our data. We may simply eliminate them by keeping a list of terms that you regard to be stop words. In Python, the NLTK (Natural Language Toolkit) offers a list of stop words in the NLTK data directory. For example, consider the sentence: "My father is a teacher." Since "is," "a" are stop words they are filtered from the sentence. so, the output for the above sentence once filtering stop words is given as (My)-(father)-(teacher).

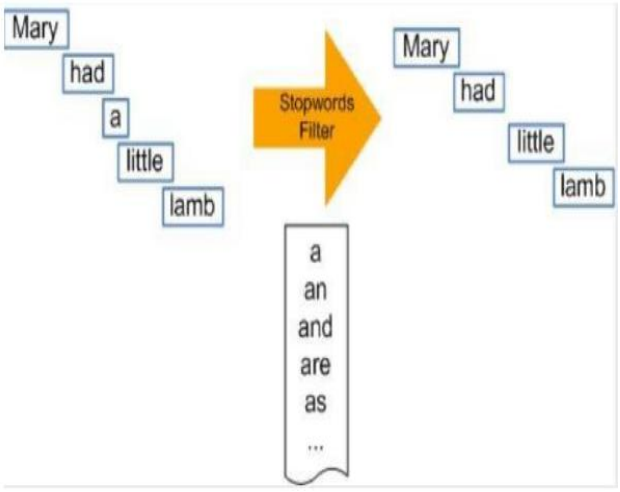

Fig.4 Elimination of stop words

Video Conversion Stage

After we have the ISL converted text from the previous phases, the software will look for matches in the dataset for each of the words. This will be based on a basic string-matching algorithm that will be applied to the processed input text and video labels. Finally, on the screen is a presentation of a series of videos in order, one after the other.

V. RESULTS

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Fig.5 Various Huma signs divided

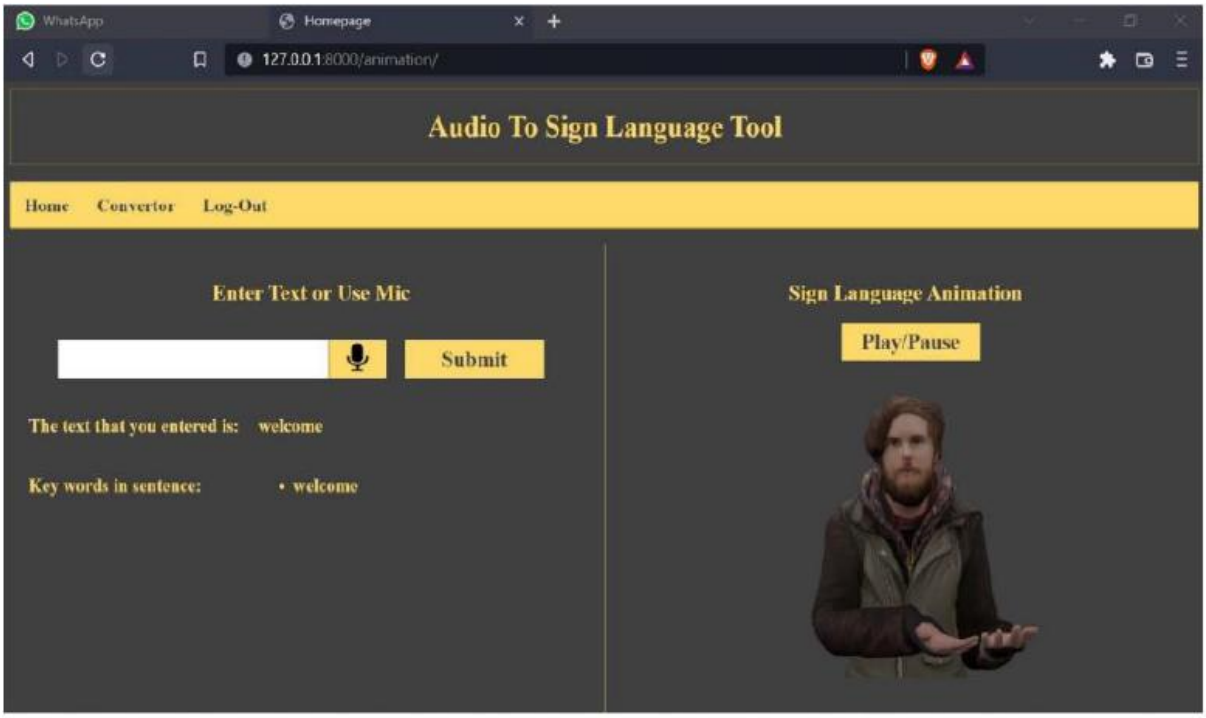

Fig.6 Animation Generated Output

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VI. CONCLUSION

The Speech to Indian Sign Language system is built as a website, via which the user may provide the system with either audio input or written input. Speech recognition is accomplished with the help of the JavaScript Web Speech API. The system will next apply natural language processing, such as tokenization, lemmatization, and the filtering of stop words, to the input, and it will compare with the matching Indian Sign Language (ISL). The results are presented in the form of video rather than still photos or gifs. This project aims to bridge the gap between hearing persons and those who speak normally by developing a communicative platform that is both engaging and powerful for deaf people who have hearing impairments.

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