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MULTILINGUAL TEXT TO SIGN LANGUAGE TRANSLATOR

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ABSTRACT
Each individual possesses the inherent entitlement to fair and equal opportunities. All information must be readily available to the deaf community globally, just like it is to the hearing community. There has to be a direct channel for communication between hearing and deaf persons for this to occur. This research endeavors to bridge communication gaps by designing and implementing a more efficient and accurate Multilingual Speech to Sign Language Translator leveraging Python, Django, HTML, CSS, and JavaScript's Web Speech API. The project addresses the need for improved accessibility and inclusivity by developing a real-time translator capable of converting spoken language or written text into sign language gestures. Integrating speech recognition technology and language translation algorithms, the system strives to facilitate seamless interactions between diverse linguistic communities and the hearing-impaired. In this project, sign language databases mapping phrases and words to corresponding signs will be created to pump data into the algorithm. Then, during the real-life session, the text will be compared against the database to seek for accurate translation. The study explores the technical methodology, challenges encountered, and the potential impact of such a system in fostering enhanced communication across language barriers and enabling greater accessibility for the hearing-impaired community.

Keywords: Multilingual speech , Sign Language Translator

Introduction

Communication has been essential to the evolution of our species since the beginning of time. In the present day, it is inconceivable to conduct daily affairs and navigate life without a shared language among all parties involved. Even though individuals with hearing impairments have devised sign languages to surmount obstacles posed by spoken language barriers, they still confront various challenges in their daily experiences. Two individuals who are deaf and have no other physical disabilities can engage in communication using sign language. Even than Sign languages vary across different regions and communities, indicating that they are not universally standardized and are different around boundaries. For instance, American Sign Language (ASL) have distinct characteristics from that of British Sign Language (BSL), and both differ from Japanese Sign Language (JSL).

Nowadays, a scenario can arise where someone who is hearing has to speak with someone who is deaf, or the other way around, feasible communication barriers may arise. In such scenarios, a translation process becomes essential to adapt spoken language into sign language for the benefit of the deaf person. Multilingual sign language translators are essential for enabling communication between people who use different sign languages. Therefore, a multilingual sign language translator can help reduce communication barriers between users of various sign languages. It can also help deaf people interact with hearing individuals who are not familiar with sign language.

To overcome the above problems, a solution is needed to automate the translation. This Paper puts forth a proposal for a Multilingual Text to Sign Language Translator. The main goal is to develop a reliable real-time translation tool that can precisely translate from written or verbal communication into sign language and the other way around while accommodating a wide range of spoken sign languages from various regions and cultures. Capture and integrate non-verbal cues such as body language, and hand movements along with facial expressions into the sign language translation for comprehensive communication. By testing the attendance system, an individual's text or speech is successfully detected and recognized; then the data is automatically recorded into the system and in real time is converted into gestures using a 3D avatar.

Literature

The history of sign language dates back centuries, with evidence suggesting that various forms of sign communication were used in ancient civilizations. With the founding and establishment of schools for the Deaf in the 18th century, sign languages were formalized. A prominent pioneer in this field was the Abbé Charles-Michel de épée, a French educator who established the first public school for the Deaf in Paris in the late 18th century.

In India, research on sign language, especially Indian Sign Language, is limited. India, being a multilingual nation, exhibits diverse regional languages and sign languages corresponding to boundaries of each state. It's noteworthy that there are several resemblance between the sign languages of India and the United Kingdom, given India's historical association as the former province of the British Empire. The Indian Sign Language Research & Training Center (ISLRTC) has initiated investigations into applications that facilitate the learning and understanding of American Sign Language (ASL) for deaf individuals in India. This is prompted by the accessibility and ease of learning associated with American Sign Language (ASL). There is an estimated 98% illiteracy rate among India's 1.1 million deaf people. The endeavors of schools for the hearing impaired is to use hearing aids to carry out this plan, however this cannot be done in a public setting.

Due to the severe lack of resources for sign languages, current vision-based SLP techniques produce poor translations due to test-time generalization issues and out-of-vocabulary (OOV) issues [1]. The author presents an avatar-based SLP system that consists of an avatar animation generating module and a sign language translation (SLT) model in order to solve these issues [1]. It additionally employs two additional techniques: named entity transformation to reduce the need for out-of-vocabulary (OOV) tokens and generating context vectors using a pre-trained language model such as BERT to ensure coherence in teaching the decoder.

A system for automated machine translation of multilingual speech into Indian Sign Language involves an automatic process that utilizes an avatar to translate spoken language. Into Indian Sign Language (ISL). The system operates through three stages: speaker-independent voice recognition for isolated words in Punjabi, Hindi, and English; conversion of the source language into Indian Sign Language (ISL); and representing the ISL gestures and motion through a 3D avatar based on the HamNoSys system. The system employs a dictionary-based machine translation approach to transform text into sign language.[2] The speech recognition models were trained and evaluated for quality and accuracy using the training and testing speech sample files in Punjabi, Hindi, and English. Empirical findings from the automatic machine translation demonstrate that the models that are being trained have attained a minimum accuracy of 91%, 89%, and 89% for English, Punjabi, and Hindi, respectively. The suggested system is appropriate for both educational and communication purposes for individuals with hearing impairments. The systematic review on the topic of machine translation from written text to sign language offers an in-depth examination of traditional and cutting-edge projects in mechanical translation into sign language and generation of sign language. The paper discusses research on various classifications of sign language machine translation, providing insights into their advantages and limitations. Additionally, it covers various approaches for sign language generation, highlighting their respective benefits and drawbacks [2]. Diverse methodologies for generating sign language are examined, highlighting their respective benefits and drawbacks. The evaluation underscores the necessity for increased efforts in sign presentation to ensure it becomes a convenient and comfortable means of communication for the deaf community. In the work by Dasgupta et al., an English-language sentence is taken as input, subjected to syntactic analysis, and results in the generation of an Indian Sign Language (ISL) sentence structure.[2]

The conversion of written or spoken words into sign language is one of the primary objectives of these new web-based applications and natural language processing technology [3]. Utilization of NLP-based voice recognition allows user the ability to capture their speech using either a text input device or a microphone. The related video is shown If the video is not in the database, the word is disregarded or omitted.[3]

Through permitting the utilization of verbal language to sign language in commercialization their real-life and on-time benefits can be observed. In India, an all-encompassing language interpreter has been put into place for train announcements [4]. The statement is rendered in ASL gloss, and the Web UI offers an intuitive design with a video of an avatar who employs hand gestures to communicate.[4]

This research outlines an end-to-end system that captures an English audio as an input and uses speech recognition to convert it into text. WordNet is a lexical database that is employed to generate ISL gloss from recognized English text.[5]

The application of these concepts and technologies generates a comprehensive translation with higher degree of precession and accuracy. The model leverages and incorporates the semantics of a pre-established sign language database, Google Cloud Speech Recognizer API, and Natural Language Processing (NLP) [6]. In accordance with the experimental findings, the suggested method performs 77% more precisely on average than the other models under discussion and overshadows them by processing time of 0.85 seconds.[6]

To train the models and then to test them a huge amount of dataset is required that can be obtained from research conducted to make INCLUDE [7]. Throughout the work comprises of 0.27 million frames with 4,287 videos and 263-word signs from 15 distinct word categories [7]. The top-performing model demonstrate 94.5% accuracy on the INCLUDE-50 dataset and 85.6% accuracy on the INCLUDE dataset. This model simply trains a decoder; an encoder and feature extractor are pre-trained. [7].

There are several surveys on deaf population of India that gives us an insight of their needs and all the challenges that they face in their daily life.[9] The article deals with the animation prospect of the system and contains (i) The difficulties distinctive to sign language avatars. (ii) the sign expressions that were created to combine distinct symbols. (iii) the potential methods for sign synthesis. (iv) the difficulties and animation methods for composing words in sign language.[9]

Tessa [11] is a device designed to translate spoken language into British Sign Language, with the goal of facilitating interaction between a deaf individual and a postal clerk. The methodology employs an approach to grammar that is formulaic. A database of prepared phrases and a phrase lookup tool are used to do the translation. However, the interaction between the participants is limited because there are only a few sentences that can be used as templates. Because of this, TESSA is a very specialized system.[12]

In 2005, Morrissey [13] introduced a computerized translation system that converted English to Dutch Sign Language by utilizing examples as the basis. This system employed a statistical approach, training its data through the use of IBM and Hidden Markov Models. The algorithm could only analyze tiny data sets because there was no well-annotated corpus available.

A transfer architecture system is demonstrated by the ViSiCAST translator suggested by Bangham et al. It converts English into British Sign Language (BSL) by utilizing HPSG. The phonological aspects of this system are depicted using HamNoSys [14]

Kar and colleagues developed a Hindi-to-ISL (Indian Sign Language) translation system specifically for railway reservation purposes [12]. Their system operates using HamNoSys to interpret input from a reservation clerk into ISL. The results are displayed as animated ISL-gloss strings. INGIT [14], developed by Kar et al., relies on a hybrid formulaic grammar approach, differing from TESSA's

strictly formulaic method. Notably, as Hindi and ISL share the same word order, distinguishing the structure was unnecessary.
In Bharati and team's "Automated Speech to Sign Language Conversion using Google API and NLP" approach, speech is first obtained as input and then processed through Google API to convert it into text [12]. Subsequently, Natural Language Processing (NLP) is employed to remove any contaminated portions within the collected free text. A matching operation is conducted for each word or letter against a sign language video database. The system queries the database for corresponding clips, which are then compiled to form a cohesive sign language video representing the entire string. The system's final output is a video representation.
This research presents an innovative approach by employing recent advancements in motion generation, neural machine translation (NMT), and generative adversarial networks to automatically produce sign language. Reliant on extensive annotations, this approach mainly demands skeletal level annotations and little gloss for training [16]. Convert spoken language phrases into sequences of sign poses by fusing a Motion Graph and an NMT network. After that, the pose data is utilized to develop a generative framework that generates exceptionally authentic sign language video sequences. We use the PHOENIX14T Sign Language Translation dataset to assess our method's translation capabilities. For text-to-gloss translation, we established a baseline and reported a BLEU-4 score of 16.34/15.26 on development and test sets.[16]
Additionally, "The Lancet" [15] presents an extensive research study focusing on the prevalence and impact of hearing loss spanning from 1990 to 2019.

METHODOLOGY

The methodology involves rigorous requirement analysis, user- friendly system design, agile development for core functionalities, integration of centralized inventory and robust search features, modules for detailed information. The primary objective is to receive user input and transform it into sign language. This involves segmenting the text/speech into smaller manageable chunks, searching for corresponding words/letters from a database, and ultimately presenting the user with the appropriate signs or gestures as the conclusion, by mapping them onto 3D avatars. For informational purposes, sign language makes use of manual communication techniques such facial expressions, hand gestures, and physical motions. With the use of 3D avatar or video clips for particular words, this project focuses on translating text into sign language, providing a means of communication for individuals with speech impairments who use hand signs and gestures. Language comprehension is tough for normal people. Therefore, a system that can distinguish between various signals and gestures and communicate information to the deaf from hearing persons is required. It eliminates the gap between those with physical disabilities and average people. Our method yields the result in the shortest amount of time with the greatest degree of precision and accuracy in compared to other methods currently in use.
The primary objective of this initiative is to make it easier for deaf individuals to interact socially with persons in society who don't understand sign language. The deaf community will profit from this online application since it is open source and freely available and converts text into sigh language. To enhance chances for success and development in school, employment, interactions with others, and public access locations.
Taking text input from the user is the initial action that is conducted. The sentence's grammatical structure is then examined and changed to meet ISL syntax criteria. Following that, the performed activity involves lemmatization and elimination of stop words. This process is carried out because Indian Sign Language (ISL) does not incorporate stop words or specific word formations with inflections, after the ISL syntax is prepared that is mapped on 3D avatar made on blender. The animation that represents each alphabet in the word is combined to complete this procedure. The alphabet is regularly scraped and/or merged. until all of the sentence's words have been retrieved as 3D model frames. The words are concatenated collectively once they have all been received to the

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finalized animation result.

The user interface of the suggested system is quite straightforward. To promote ease of use among all persons, the goal was to make it as intuitive as possible. There is a text box on the landing page or home page. when the user accesses the text box it connects to keyboard of the system and Users can input the sentence they wish to translate. The recording of the text to be translated results in the appearance of a loading icon.

This is there to reassure the user that there hasn't been any system lag, delay, or malfunction. The website redirects to a different webpage after generating the result animation. The animation in sign language is presented as the outcome on the final webpage.

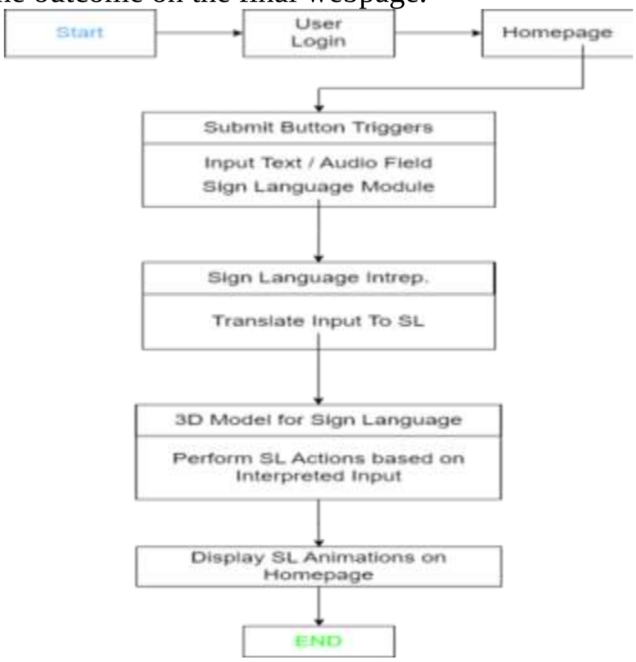

Fig: Flowchart of Proposed Methodology

IMPLEMENTATION

Step1: Designing the Frontend

Technologies Required: HTML, CSS, JavaScript.

Process: This phase involves creating the frontend interface. Initially, the homepage is developed to serve as the primary user interface. Furthermore, specific areas for animations on the webpage are defined, and mechanisms for text and audio input are implemented to enable user interaction.

Step2: Speech Recognition

Technologies Required: JavaScript, JavaScript Web Speech API.

Process: Utilization of JavaScript's Web Speech API is pivotal in capturing spoken words and converting them into textual content. Additionally, a system to retain the record of spoken words is established.

Step3: Text Processing

Technologies Required: Python, NLTK, JavaScript Process: Text processing involves the backend handling of translation tasks utilizing Python. Libraries or APIs such as Google Translate are employed for translation purposes.

Furthermore, the creation of API endpoints facilitates text data translation and transmission of result.

Step4: Unit Testing of Each Module

Technologies Required: Manual Testing, Excel

Process: The unit testing phase necessitates the meticulous definition of test cases and scenarios. Each test case is systematically executed through manual testing procedures.

Step5: Integrate with Django
Technologies Required: Python, Django, Firebase
Process: Integration with Django involves the development of backend functionalities capable of managing translation requests. The creation of API endpoints aids in receiving text data, executing translations, and transmitting results. Moreover, integration of various modules like Text Processing, Speech Recognition, and Frontend occurs during this phase.
Step6: Integration Testing (Frontend and Backend)
Technologies Required: Excel
Process: Similar to unit testing, this phase necessitates the definition of test cases and scenarios. Execution is carried out manually to validate the integration between frontend and backend components.
Step7: Develop 3D Model for Animation
Technologies Required: Blender
Process: The creation of a 3D model capable of performing diverse sign language motions is the primary objective of this phase. This involves the utilization of Blender for modeling purposes.
Step8: Prepare Database of Animations
Technologies Required: Firebase, Animation Videos, Blender
Process: The preparation of an animation database involves animating sign language motions using Blender. Capturing diverse animations of the 3D model is integral, and subsequently, all captured animations are uploaded onto the Firebase database.
Step9: Mapping of Animation with Words
Technologies Required: Python, Firebase
Process: Mapping animations with respective words is a significant aspect of this phase. Python is utilized for the mapping process and to access the Firebase database.
Step10: Integrate the Mapped Data with the Website
Technologies Required: Django, Python, JavaScript
Process: Integration of mapped data into the website involves the amalgamation of frontend and backend components. This phase ensures seamless operation of integrated data within the website framework.
Step11: System Testing
Technologies Required: Excel
Process: The system testing phase involves comprehensive test case and scenario development for the website. Execution of all test cases is performed manually to validate the overall system's functionality.
Step12: Deployment and Management of the Website
Technologies Required: Heroku, Python, Git and GitHub Process: Deployment and management of the website encompass live server deployment using platforms like Heroku. Version controlling through Git and GitHub, as well as managing the Continuous Integration/Continuous Deployment (CI/CD) pipeline plays a pivotal role in this phase.

RESULT

The interface will offer options to input speech directly through the microphone or manually enter text for translation. Users can click a button to start speaking, and their speech will be converted into text using the Web Speech API.
Upon speech recognition or text input, the system will display the recognized text on the interface. This recognized text will then be translated into the desired language using backend Python functionalities The backend will process the translated text to generate accompanying sign language gestures or symbols. The system will then present the translated text alongside its associated sign language output in a visual format.
Users will receive prompt and clear feedback on the translated text and the accompanying sign language output. Interaction buttons or prompts will guide users on how to speak, input text, and view

the translations in sign language.
The web interface will be designed using HTML and CSS to ensure responsiveness across various devices and screen sizes. It will prioritize accessibility features for users with different abilities..
The system aims to provide accurate translations of recognized speech or entered text into the desired language. The associated sign language output should effectively represent the meaning conveyed by the translated text.
The system will operate in real-time, enabling users to see the translated text and corresponding sign language output almost instantly after providing input.
Once deployed on a web server, the translator will be accessible online, allowing users to access the functionality from anywhere with an internet connection.

CONCLUSION

We have introduced a very efficient and accurate method for translating multilingual text into sign language which can easily act as a substitute for traditional human translator which act as a means of communication in various social scenarios. It represents a significant stride towards enhancing communication accessibility and involvement for the deaf and hard-of-hearing community. This method is secure enough. No need for specialized hardware for installing the system in required sites. There are some future works possible in this area like improving the enormity of its database and add more fluency in animation. In end it stands as a testament to the transformative power of technology in making the world more accessible and interconnected for individuals with diverse communication needs.

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