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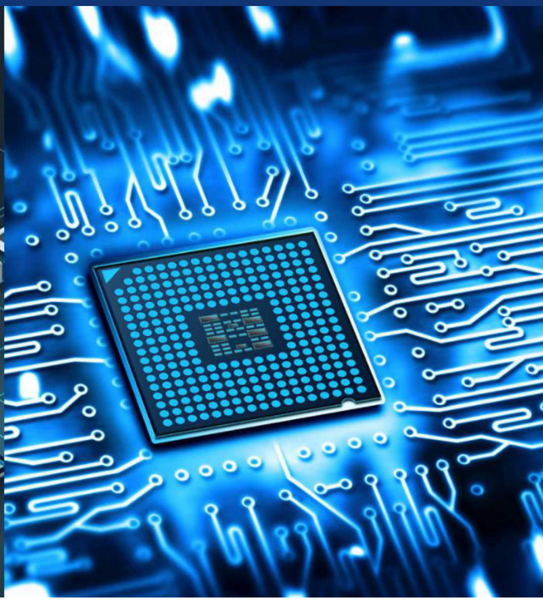

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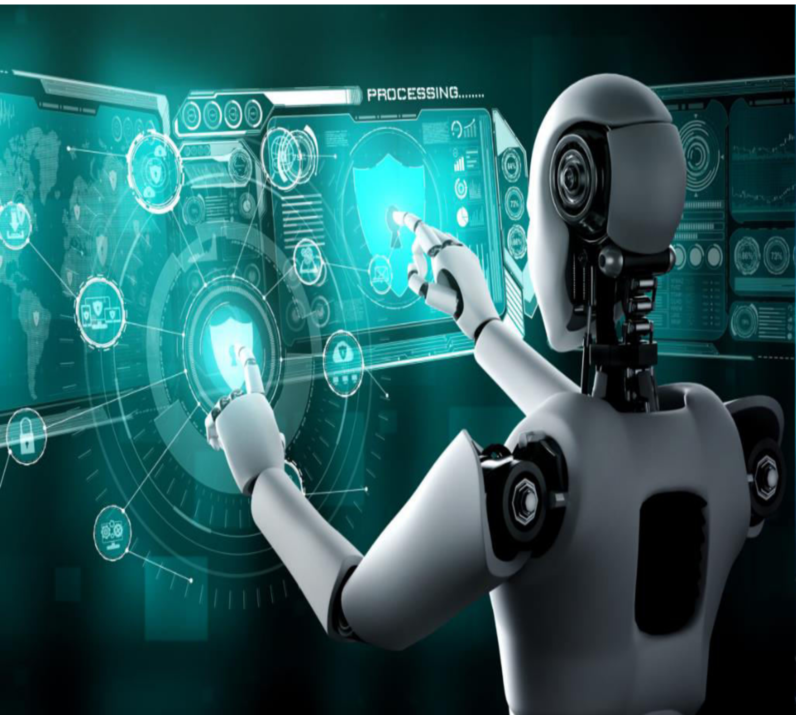

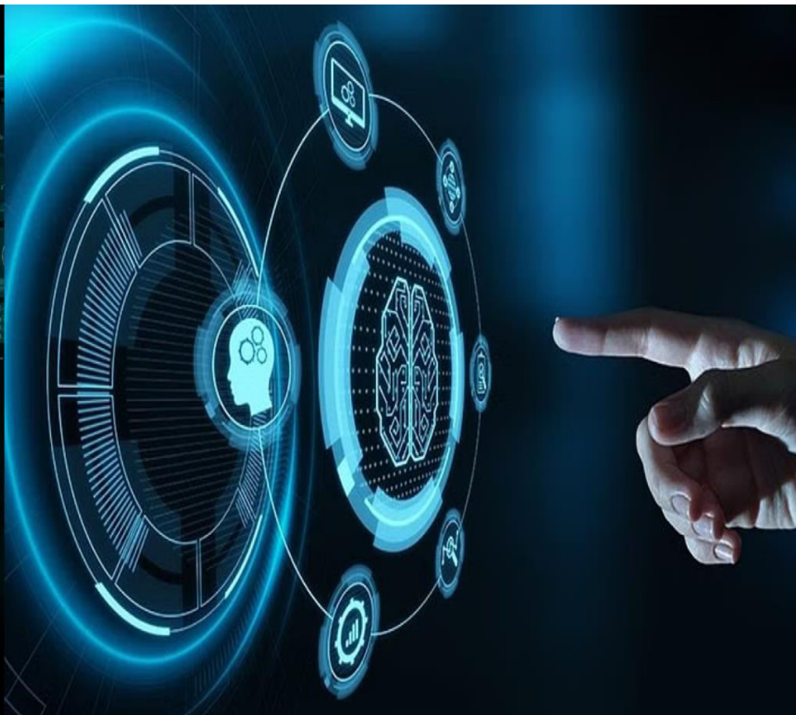

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International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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Talking Fingers

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ABSTRACT: This project introduces a comprehensive system that bridges the communication gap for individuals relying on Indian Sign Language (ISL) by converting spoken input into a cohesive ISL video response. The methodology begins with speech-to-text conversion, followed by sentence restructuring, parsing, and text refinement through lemmatization and stop word filtering. The refined text is then transformed into ISL syntax, and corresponding video clips are retrieved from a local database and merged into a seamless video output. This system leverages natural language processing, deep learning, and multimedia synthesis to create an accessible, efficient, and impactful solution for inclusive communication.

KEYWORDS: Indian Sign Language, Speech-to-Text Conversion, Natural Language Processing, Multimedia Synthesis, ∟ **Deaf-Mute Community**

I. INTRODUCTION

In India, individuals who are deaf or mute continue to face significant challenges in accessing education, employment opportunities, and communication resources. This issue is exacerbated by the limited number of schools equipped with sign language interpreters. The few such institutions that do exist are primarily concentrated in urban centres, leaving rural areas with even scarcer access to information and educational support. This geographic disparity further compounds the difficulties faced by the hearing-impaired population, creating an urgent need for solutions to bridge these gaps.

Addressing this concern requires the development of initiatives that can reduce the stark imbalance between the hearing-impaired population and the availability of qualified sign language interpreters. Furthermore, it is crucial to empower individuals with hearing and speech disabilities by providing platforms that facilitate self-education and learning of sign language. To meet this need, the proposed solution is an innovative, user-friendly, and time-efficient online platform designed specifically for deaf and mute individuals. Such a platform would serve as an effective tool for both communication and learning, enabling greater independence for this community.Sign languages are not universal. Each country often has its unique version of sign language, and this proposal specifically targets the Indian population. Learning to read and write presents significant difficulties for many hearing-impaired individuals. Even for those who manage to acquire literacy skills, interpreting the full context of spoken communication remains a challenge. This issue is especially pronounced in scenarios involving non-verbal sounds or actions, which are often critical to conveying meaning.

Many deaf-mute individuals rely on either sign language or lip-reading as primary modes of communication. Among these, sign language is generally preferred because it incorporates hand movements, lip movements, and facial expressions. These additional visual cues provide a richer context, allowing for more effective and meaningful communication. By offering a platform tailored to the unique needs of the Indian hearing-impaired population, this initiative aims to close critical gaps in accessibility and foster a more inclusive society.

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II. LITERATURE REVIEW

In paper [1] recent efforts have focused on translating speech to ISL using NLP techniques. Dasgupta et al. proposed a system that converts English text to ISL structure, but it struggled with handling the unique syntax of ISL.TESSA (Speech-to-BSL System): One of the early systems designed to translate speech into British Sign Language (BSL) in specific domains, like post-office services. The system relied on pre-determined phrases, which limited its application to specific scenarios.[2] ViSiCAST (BSL Translation System): A more advanced system translating spoken English into BSL, it used a syntactic parser and incorporated sign language grammar through HamNoSys notation. It was part of a broader effort to improve accessibility for the hearing-impaired in public service settings. A two-way communication system is suggested in the paper [4] but the authors are only able to convert 26 alphabets and three characters with an accuracy rate of 99.78% using CNN models. The authors only suggest that future work must be conducted in the field of natural language processing to convert speech into sign language. In the paper [5], the authors propose a system that converts sign language into English and Malayalam. The authors of the paper suggest using an Arduino Uno, which uses a pair of gloves to recognize the signs and translates the signs from ISL to the preferred language. The system is useful, as it recognizes two-hand and motion signs. The Indian Sign Language interpreter presented in the paper [6] uses hybrid CNN models to detect multiple sign gestures and then goes on to predict the sentence that the user is trying to gesture by using natural language processing techniques. The system is able to achieve 80–95% accuracy under various conditions. In another study, the HSR model is used by the authors in converting ISL signs into text. The HSR model gives an advantage over RGB-based models, but this system has an accuracy ranging from 30 to 100% depending upon the illumination, hand position, finger position [7] etc. The authors of [8] paper propose a system that recognizes 26 ASL signs and converts them into English text. They use principal component analysis to detect the signs in MATLAB. The ASL to sign language synthesis tool uses VRML avatars and plays them using a BAP player. The major problem with the system is that many complex movements are not possible using the current VRML avatars. For example, touching the hand to any part of the body is not possible in the current system [9]. In another study mentioned in [10], one video-based sign language translation system converts signs from ISL, BSL, and ASL with an overall accuracy of 92.4%. The software utilizes CNN and RNN for the real-time recognition of dynamic signs. The system then converts the signs into text and then uses text–speech API to give an audio output to the user. The authors of another paper first use the Microsoft Kinect 360 camera to capture the movement of the ISL signs. A unity engine is used to display the Blender 3D animation created by the authors. Although the system can successfully convert words into sign language, it is not able to convert phrases/multiple words into ISL. The work presented by the authors of [11] is another bidirectional sign language system. The system is able to achieve 97% accuracy when translating sign languages to text or audio. Authors use Google to API to convert speech to text and then the system produces a 3D figure using the unity engine after extracting keywords from the input [12]. Another system proposed by the authors in the paper [13] converts Malayalam text and gives a 3D animated avatar as the sign language output. The system uses HamNoSys notation, as it is the main structure of the signs [14]. A unique Russian text to Russian sign language [15] system utilizes semantic analysis algorithms to convert text to sign language. It focuses on the lexical meanings of the words. Although the system can reduce the sentence into gestures, it is observed by the authors that the sentence proposition can be improved by further making the algorithm more efficient.

III. PROPOSED METHODOLOGY

Speech Input: This step involves receiving spoken input directly from the user. By allowing users to communicate naturally through speech, this functionality ensures a more accessible and user-friendly experience for individuals seeking to convey their messages effectively.

Speech to Text Conversion: Once the spoken input is received, it is converted into text format using advanced speech-to-text technology. This conversion is critical for further processing, as it enables the system to analyze the user's intent and structure the message for subsequent stages.

Modify and Parse Sentence Structure: The converted text is then analyzed to identify and restructure its grammatical composition. This step enhances clarity and understanding by modifying the sentence structure where necessary, ensuring that the message is coherent and suitable for further transformation into ISL syntax.

Lemmatization: At this stage, individual words within the sentence are reduced to their base or root forms. Lemmatization ensures that variations of a word (e.g., "running," "ran") are standardized, improving the accuracy of the subsequent ISL syntax generation.

Stop Word Filtering: Commonly used words that do not contribute significant meaning to the sentence, such as "the," "is," or "and," are identified and removed. This step streamlines the input by isolating the key words that are most relevant to the intended message.

Generate ISL Syntax: Using the filtered key words, the system creates a syntax structure that is aligned with Indian Sign Language (ISL). This step transforms the text into a format that adheres to ISL grammar and conveys the intended meaning effectively.

Retrieve YouTube Links: The system then searches for corresponding ISL video clips from a locally stored database. These clips represent the individual signs or concepts identified in the generated ISL syntax, ensuring that the output is accurate and contextually appropriate.

Merge Video Clips: After retrieving the relevant video clips, they are combined into a cohesive video sequence. This merging process ensures that the final output forms a smooth and coherent response that aligns with the original spoken input.

Final Result Display: The completed ISL video response is then displayed to the user. This final result enables deaf-mute individuals to access information or communicate effectively using ISL, fulfilling the original intent of the spoken input.

IV. RESULTS

The developed model successfully achieves the objective of facilitating seamless communication through Indian Sign Language (ISL) translation. The system begins by accurately capturing and processing audio input from the user, leveraging advanced speech-to-text conversion technology to transcribe spoken words into text format with high precision. This transcription forms the foundation for subsequent linguistic transformations.

The text is then effectively converted into ISL syntax, adhering to the grammatical structure and conventions unique to ISL. The model further demonstrates its utility by retrieving corresponding ISL video clips from a curated YouTube directory. These video clips, representing individual words or concepts, are systematically merged to form a cohesive video output. The final result is a smooth and coherent ISL video translation that faithfully represents the input speech.

This seamless pipeline, from audio input to the generation of a complete ISL video, underscores the model's robustness and reliability. The result showcases the potential of integrating speech recognition, natural language processing, and multimedia synthesis to enhance accessibility for deaf-mute individuals. The system's ability to merge multiple video segments into a unified output ensures that the intended message is conveyed effectively and naturally, making it a practical and impactful solution for real-world use.

V. CONCLUSION AND FUTURE WORK

The project successfully demonstrates the potential of integrating advanced technologies like speech recognition, natural language processing, and multimedia synthesis to bridge the communication gap for the deaf-mute community. By converting spoken language into Indian Sign Language (ISL) videos, the system provides an accessible and user-friendly solution for facilitating effective communication.

The pipeline, which includes speech-to-text conversion, ISL syntax generation, and the retrieval and merging of video clips, performs reliably, ensuring accuracy and coherence in the final output. This innovative approach not only highlights the possibilities of leveraging AI and deep learning for inclusivity but also sets a strong foundation for future enhancements, such as expanding the ISL video database or improving the handling of complex linguistic variations.

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Overall, this project is a significant step toward empowering individuals with speech and hearing impairments, enabling greater accessibility and inclusion in communication.

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