INDIAN SIGN LANGUAGE DETECTION SYSTEM USING MACHINE LEARNING

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Introduction:

In a world where verbal communication often takes precedence, there exists a vibrant yet often overlooked community that relies on gestures as their primary mode of expression. This community encompasses individuals who are deaf, hard of hearing, and those unable to vocalize their thoughts. For them, sign language transcends mere communication; it is a lifeline through which they convey their deepest thoughts, emotions, and desires.

Within the diverse linguistic landscape of India, Indian Sign Language (ISL) emerges as a profound testament to human expression. It encapsulates the richness of cultural diversity and serves as a poignant symbol of inclusion.

Imagine a world where individuals fluent in Indian Sign Language (ISL) seamlessly connect with those unfamiliar with its intricacies. This vision propels the "Indian Hand Sign Language Detection System" project forward.

Our primary objective is clear: to empower individuals within the deaf and hard of hearing community by bridging the communication chasm between sign language users and non-signers. This project epitomizes the fusion of technology and social inclusivity, building upon earlier research and technological strides to redefine the boundaries of communication.

Drawing inspiration from past endeavors, our journey focuses on crafting a user-centric interface that caters to diverse communication needs. Leveraging advanced machine learning and computer vision technologies, we strive to develop a system capable of real-time detection of ISL alphabets and digits, without the need for manual translation.

Central to our mission is the creation of an intuitive interface, accessible through both mobile applications and websites. This interface provides live video feeds of recognized hand signs, complemented by text and voice outputs, thereby enhancing user accessibility and experience.

Through collaborative endeavors and a steadfast commitment to inclusivity, we envision a future where communication barriers dissolve, allowing every individual, regardless of their abilities or communication preferences, to be heard and understood. This project serves not merely as a technological innovation but as a testament to the transformative power of empathy, inclusion, and human connection.

Objectives

1. Enhancing Communication for the Deaf and Hard-of-Hearing: The primary objective of the "Indian Hand Sign Language Detection System" project is to facilitate seamless and immediate communication for individuals who rely on Indian Sign Language (ISL), thereby bridging the communication gap between sign language users and non-signers.

2. Real-Time Hand Sign Detection: Leveraging advanced machine learning and computer vision technologies, the project aims to develop a system capable of accurately and swiftly detecting ISL alphabets and digits (A-Z and 0-9) in real time, without the need for manual translation.

3. Accessibility and Inclusivity: The project is intentionally designed to be accessible and inclusive, catering to the unique communication needs of individuals who are deaf or hard of hearing and people who can’t speak. Additionally, it facilitates effective interaction with individuals who do not understand sign language, fostering inclusivity and bridging communities.

4. User-Centric Interface Design: The project prioritizes creating an intuitive and user-friendly interface, either through Mobile App or a website. This interface offers a live video feed of recognized hand signs, accompanied by text and voice output, thus improving user experience and accessibility. And also Providing an interface where non-signers can enter the alphabet or the digit to know that sign.

5. Breakthrough in Communication Paradigms: The project represents a significant advancement in communication technology, revolutionizing the way individuals who rely on ISL interact with the world around them and paving the way for more inclusive communication practices.

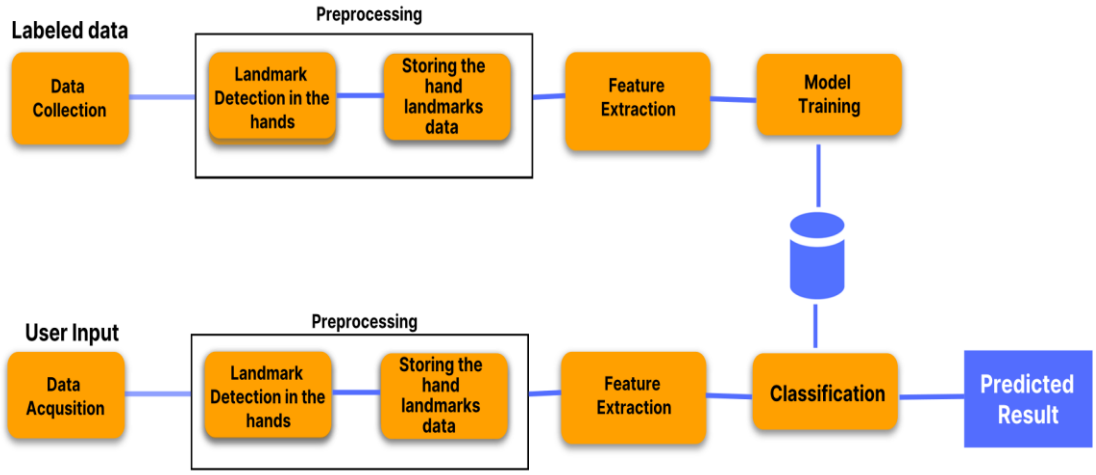
6. Empowering Diverse Voices: Ultimately, the project aims to empower individuals, regardless of their abilities or communication preferences, by providing them with the tools and opportunities to communicate, connect, and be heard in a world that celebrates diversity and inclusivity. And also educating and creating awareness about the Indian sign language (ISL) among the people.

Methodology:

Using advanced technologies such as Machine Learning and Computer Vision, helps detect and interpret Indian Sign Language (ISL) signs (A-Z and 0-9) shown in real-time video, enabling prediction of the user's hand gestures. They analyze the movements of your hands and show the corresponding sign in text format.

The working of the project as follows:

1. Dataset Collection: Gathering a diverse set of images, including different signs (*A-Z & 0-9*) from various individuals, to ensure the model can understand different hand gestures effectively.
2. Pre-processing: Enhancing image quality by adjusting dimensions, converting to grayscale, and applying filters for noise reduction and edge detection to prepare images for analysis.
3. Feature Extraction: Identifying significant features within images using MediaPipe landmarks detection to understand spatial patterns and clustering techniques for pattern recognition These features, which capture essential information about hand movements and positions, serve as inputs for the machine learning models.
4. Model Training and Testing: Created a ML model by training the features extracted from the dataset images collected for the different signs (A-Z & 0-9) it with labelled data to learn relationships between input features and sign labels, with rigorous testing to ensure accurate predictions on new data. Created two models, one model for all the signs which involves only one hand and another model for the sign required two hands.
5. Classification of User Input: Deploying the trained model to classify user input, displaying the predicted sign in a user-friendly interface such as a web app and creates a bounding box around the hands to display the sign predicting within the camera frame screen.



Model Architecture

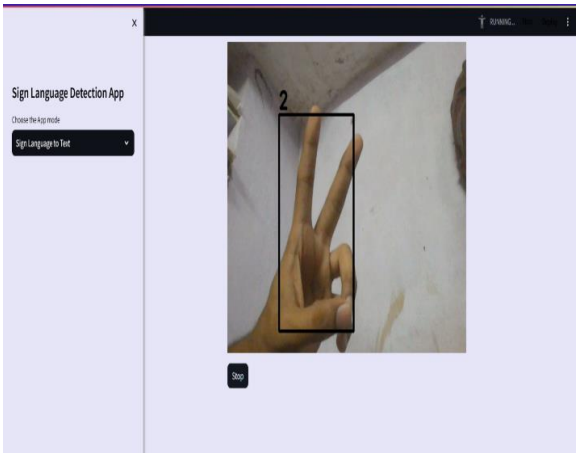
Conclusion:

The "Indian Hand Sign Language Detection System" project yields promising results that mark a significant stride forward in inclusive communication technology. Through meticulous development and integration of advanced machine learning and computer vision techniques, the system demonstrates impressive accuracy and efficiency in real-time detection and interpretation of Indian Sign Language (ISL) alphabets and digits gestures.

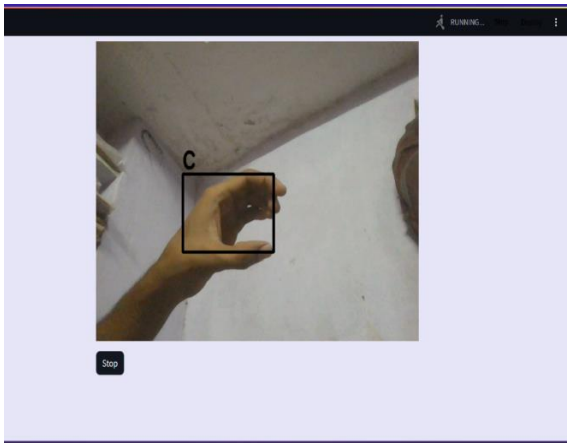
Key outcomes include the successful deployment of a user-centric interface, accessible through Web App. This interface provides live video feeds of recognized hand signs, accompanied by text outputs, thereby enhancing accessibility and user experience. Moreover, the system showcases a high level of adaptability, catering to the diverse communication needs of individuals with varying levels of sign language proficiency.

This Web App also has a feature where a non signers can enter the letter to know about a particular ISL sign (A-Z & 0-9) as the output we display a image of that sign by which the non-signer can know or learn that particular sign (A-Z & 0-9).

The project's conclusion underscores its transformative impact on communication paradigms, particularly for individuals within the deaf and hard of hearing community. By bridging the communication gap between sign language users and non-signers, the system fosters greater inclusivity and connectivity in society. Furthermore, it serves as a testament to the potential of technology to empower diverse voices and dismantle barriers to communication.



Web App predicting the digits in Real time



Web App predicting the alphabets in Real time

Scope for future work:

In envisioning the future scope of the project, the aim is to extend beyond the detection of individual ISL signs to encompass a more comprehensive understanding of sign language communication. This involves creating a model capable of identifying not only the different signs such as alphabet and digits in English within ISL but also prioritizing the detection of the most frequently used and essential signs for everyday communication.

Furthermore, the project seeks to introduce innovative features that enhance the utility and accessibility of the system. One such feature entails the ability to combine individual ISL alphabet signs into cohesive words, reflecting the natural language formation process. This functionality not only facilitates smoother communication but also serves as a stepping stone towards more advanced language processing capabilities.

Moreover, a key focus is on inclusivity and language diversity. By incorporating a feature that converts combined ISL words into voice output, individuals with varying levels of sign language proficiency can engage in seamless communication. Additionally, the system aims to promote linguistic inclusivity by enabling the conversion of combined words from English to different regional languages, ensuring accessibility across diverse linguistic communities.

Expanding the scope further, the project envisions integrating mathematical operations into the system's functionality. By leveraging the digits within ISL, users can perform mathematical calculations directly within the interface, enhancing the practical utility of the system in various contexts.

In essence, the future direction of the project is rooted in the ethos of empowerment, accessibility, and inclusivity, with a vision to revolutionize communication for individuals within the deaf and hard of hearing community, transcending linguistic barriers and fostering greater connectivity in a diverse world.