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Sign Language Recognition

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Abstract: *Communication barriers between the hearing-impaired community and the hearing population can hinder social integration and access to essential services. This project aims to bridge that gap by developing a Sign Language to Text Converter that translates hand gestures into readable text in real-time. Utilizing computer vision and machine learning techniques, the system captures hand movements through a camera, processes the gestures using trained models, and converts them into corresponding text output. The converter is designed to support commonly used signs from American Sign Language (ASL), ensuring a more inclusive and accessible communication platform. With potential applications in education, customer service, and daily interactions, this tool enhances accessibility and promotes greater inclusivity for the deaf and hard-of-hearing community.*

Keywords: Communication barriers

I. INTRODUCTION

Sign language is a vital means of communication for the deaf and hard-of-hearing community. However, the lack of widespread understanding of sign language among the general population often creates a communication barrier, limiting equal access to services, education, and social interaction. To address this issue, technology can play a significant role by acting as a bridge between sign language users and non-signers.

This project focuses on developing a Sign Language to Text Converter that utilizes computer vision and machine learning techniques to interpret hand gestures and convert them into readable text. By using a camera to capture sign language gestures and applying gesture recognition algorithms, the system can translate these signs into text in real-time. This tool aims to enhance communication, promote inclusivity, and empower individuals with hearing impairments to interact more effectively in a variety of environments.

Objectives

- To develop a real-time system that captures and interprets sign language gestures using a camera.
- To convert recognized sign language gestures into readable text for improved communication between hearing-impaired individuals and non-signers.
- To implement computer vision and machine learning algorithms for accurate gesture recognition and classification.
- To support a set of commonly used signs from a specific sign language (e.g., ASL or ISL) for effective communication.
- To create an easy-to-use interface that can be deployed on platforms such as desktop or mobile devices.
- To enhance accessibility and inclusivity by reducing the communication gap between the deaf community and the hearing population.

Purpose

The purpose of this project is to create a technological solution that facilitates effective communication between individuals who use sign language and those who do not. By converting sign language gestures into readable text in real time, the system aims to break down language barriers, promote inclusivity, and support the social integration of the deaf and hard-of-hearing community. This tool is intended to assist in everyday interactions, improve accessibility in public and private services, and enhance independence and confidence among sign language users.

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Project Modules

Input Acquisition Module

Captures real-time video feed using a webcam or mobile camera.

Prepares the input frames for processing.

Preprocessing Module

Performs image processing techniques such as background subtraction, skin color detection, resizing, and normalization.

Enhances the quality and consistency of input data.

Gesture Recognition Module

Uses machine learning or deep learning models (e.g., CNN, LSTM) to classify hand gestures.

Detects and identifies

Scope

The scope of this project is to develop a system capable of recognizing and translating sign language gestures into readable text in real-time. The system will primarily focus on a subset of static and dynamic gestures from a widely used sign language, such as American Sign Language (ASL) or Indian Sign Language (ISL). It will utilize computer vision and machine learning techniques to detect hand movements using a camera and convert them into meaningful text output.

This project is intended for use in day-to-day conversations, educational environments, and basic service interactions. While the initial version may support a limited vocabulary, the system can be scaled to include a broader set of signs and languages in the future. The converter will be designed for platforms like PCs or Android devices, ensuring portability and ease of use.

Design Concept

The design of the Sign Language to Text Converter is centered around real-time gesture recognition using computer vision and machine learning. The system is divided into several functional components that work together to capture, process, interpret, and display sign language as text.

User Interface (UI)

- A simple, user-friendly interface that allows users to start/stop the camera feed and view the translated text output.
- Can be implemented as a desktop or mobile application.

Camera Input Module

- Captures real-time video of the user's hand gestures using a built-in or external camera.
- Continuously feeds frames to the processing system.

Preprocessing Module

- Processes video frames using image processing techniques (e.g., grayscale conversion, background subtraction, edge detection).
- Normalizes hand position, size, and lighting for better gesture recognition.

Gesture Recognition Module

- Uses a trained machine learning or deep learning model (e.g., Convolutional Neural Network) to classify hand gestures.
- Can be designed to recognize alphabets, numbers, or predefined signs depending on the dataset used.

Text Generation Module

- Converts the recognized gestures into corresponding text.
- Handles the sequencing of letters or words for fluid sentence formation.

Output Display Module

- Displays the generated text on the screen in real time.

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- Optionally allows saving or copying the text for further use.

Future Integration Possibilities

- Text-to-speech (TTS) module to give voice output.
- Multilingual support and gesture customization for different sign languages.

Advantages

Bridges the Communication Gap

- Facilitates effective interaction between deaf/mute individuals and those who do not understand sign language.

Promotes Inclusivity

- Enhances accessibility in public spaces, education, workplaces, and healthcare by making communication more inclusive.

Real-Time Translation

- Converts gestures into text instantly, making conversations smoother and more natural.

Cost-Effective Solution

- Reduces dependency on human interpreters, providing an affordable and scalable communication tool.

Educational Tool

- Assists in teaching sign language by visualizing and translating gestures, useful for learners and educators alike.

Portable and User-Friendly

- Can be implemented on mobile or desktop platforms, making it convenient for everyday use.

Encourages Technological Empowerment

- Empowers the deaf community by giving them tools to communicate independently and confidently.

II. CONCLUSION

The Sign Language to Text Converter is a significant step toward enhancing communication between the hearing-impaired community and the general population. By utilizing computer vision and machine learning, the system effectively translates hand gestures into readable text in real time, breaking down communication barriers and promoting inclusivity. Although the current implementation may support only a limited set of gestures, it lays the foundation for further development and expansion into more complex sign languages and real-world applications. With continued improvement, this technology has the potential to greatly impact education, healthcare, customer service, and day-to-day social interactions, creating a more accessible and connected world for all.

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