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Sign Language (ASL) Translation

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Abstract

This project explores the development of a sign language detection system using computer vision techniques. By leveraging hand pose estimation and deep learning models, the system will be able to identify the use of sign language in video streams. The successful development of this project has the potential to significantly improve communication accessibility for deaf and hard of hearing individuals.

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Problem Statement

Sign language is a vital mode of communication for the deaf and hard-of-hearing community. Despite its importance, there is a communication gap between sign language users and those who do not understand it. With advancements in computer vision and machine learning, there is an opportunity to bridge this gap by developing a system that can detect and interpret sign language in real-time.

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Aim and Objective

Aim:

- To develop a robust, real-time sign language detection system that accurately recognizes and translates sign language gestures into written language, thereby facilitating effective communication between sign language users and non-users.

Objective:

- **Data Collection and Preparation**
- **Model Development**
- **Real-time Integration**
- **Performance Evaluation**
- **Robustness and Generalization**
- **Documentation and Deployment**

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Proposed Solution

Dataset Collection and Preprocessing

Model Development

Real-time Detection System

Evaluation and Validation

Deployment and Documentation

Expected Benefits:

- Enhanced Communication
- Accessibility
- Scalability

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System Architecture

- Input Module
- Hand Detection Module
- Data Preprocessing Module
- Feature Extraction Module
- Classification Model
- Translation Module
- Output Module
- Optimization and Performance Monitoring

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System Deployment Approach

- Standalone Application
- Web Application
- Cloud-Based Service (API)
- Mobile Application

Algorithm & Deployment

Algorithm Selection:

- **Accuracy vs. Efficiency:**
  - Deep learning models offer high accuracy but require significant computational resources.
  - Simpler models (Decision Trees) are less powerful but run efficiently on lower-end devices.
- **Real-time vs. Offline processing:**
  - For real-time applications (e.g., video conferencing), choose an algorithm with fast processing speed. This might favor simpler models or optimized deep learning architectures.
  - Offline processing (e.g., analyzing pre-recorded videos) allows for more complex models with higher accuracy.

Deployment based on Algorithm:

- **Deep Learning Models:**
  - **Deployment:** Cloud platforms (APIs) or powerful computing devices are ideal due to their high computational demands.
  - **Example:** A cloud-based sign language translation service using a CNN model.
- **Simpler Models:**
  - **Deployment:** More flexible options like mobile apps or standalone applications.
  - **Example:** A mobile app for basic sign recognition using an SVM model.

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Conclusion

In summary, our real-time ASL sign detection and translation system offers a practical solution for improving communication accessibility for individuals with hearing impairments.

Through the integration of Python and computer vision techniques, we've created a system capable of accurately detecting and translating ASL signs into English alphabets in real-time.

This advancement has the potential to significantly enhance inclusivity and empower individuals with hearing impairments to communicate effectively in various settings.

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Future Scope

- Gesture Recognition for Complete Phrases
- Multi-language Support
- Improvement in Accuracy and Robustness
- Real-time Feedback and Correction
- Integration with Wearable Devices
- Accessibility Enhancements
- Community Engagement and Collaboration

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Reference

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- https://www.researchgate.net/publication/262187093_Sign_language_recognition_State_of_the_art
- https://www.nature.com/articles/s41598-023-43852-x
- https://chatgpt.com

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Video of Project (Demo):

https://drive.google.com/file/d/1wSlKt9oKId1VRzrl9xcErYMFIztuNtu1/view?usp=drive_link

GitHub Link:

https://github.com/KavipatelI18/Sign-Language-Translation

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Thank you!