**American Sign Language (ASL) Detection**

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1. **Project Overview**

This project presents an American Sign Language Detection and Learning System that leverages deep learning (MobileNetV2) and an interactive Streamlit-based web application to recognize and teach ASL gestures. The system addresses the communication gap between hearing and speech-impaired individuals and others, offering gesture recognition, learning support, and interactive features for both accessibility and education.

1. **Problem Statement**

Effective communication between deaf/mute individuals and the wider community often faces barriers due to limited knowledge of sign language. Manual interpretation is not always feasible, and existing learning platforms lack interactivity. An automated ASL recognition system with engaging features is necessary for practical use, education, and awareness.

1. **Highlights**

* Develop a CNN-based recognition model (MobileNetV2 backbone) trained on ASL dataset.
* Provide a user-friendly web app with gesture recognition, history tracking, and learning modules.
* Enable real-time prediction, gesture quizzes, and gesture references.
* Support personalization features such as theme switching and voice guidance.
* Facilitate learning through Word Maker and downloadable reports.

1. **System Design**

* Model Training: ASL Alphabet dataset (Kaggle) processed with augmentation and trained using MobileNetV2 (~97% accuracy).
* Web Application: Built on Streamlit with modular architecture.
* Features:

1. Live Prediction & Upload Prediction for gesture recognition.
2. Prediction History & Downloads with session timestamps.
3. Gesture Quiz & Reference for practice and self-learning.
4. Word Maker to build words from predicted gestures.
5. Sidebar Controls with theme selection and voice narration.
6. **Results & Visualization**

* Achieved ~98% accuracy in ASL alphabet recognition.
* Visualizations: prediction probability bars, confusion matrices, and session-wise comparisons.
* Edge cases (similar hand signs) handled with high confidence.
* Users can track, compare, and download prediction results.

1. **Benefits & Limitations**

**Benefits:** Accessible, interactive, supports learning and practice, offers quizzes, customizable UI, and audio guidance.  
**Limitations:** Fixed dataset, no real-time video sequence translation, limited multi-language voice support.

**7. Conclusion**

The ASL Detection and Learning System bridges accessibility and education through deep learning and interactive design. By combining gesture recognition, quizzes, and personalization features, it serves as both a communication aid and a self-learning tool. Future improvements include dynamic sentence-level translation, multi-language voice narration, and mobile app deployment.