Project Proposal
Hand Gesture Recognition

Problem Definition

Some situations require hand free interaction like when hands are occupied, you have to maintain hygiene in medical setting or assist people with disabilities. I will develop hand gesture recognition system that can classify hand gestures using a webcam. The system try to recognize common hand gestures like fist, open palm, thumbs up, peace sign, and pointing finger.

Data Source and Collection

I will create a dataset by recording video samples using a webcam and will try to collect multiple samples under different conditions like different lighting and backgrounds. Data will be labeled with the gesture name and MediaPipe library will detect hands in each frame and extract 21 landmark points (x, y, z coordinates of fingertips, knuckles, and wrist), which will serve as the feature set for training.

Pre-Processing

OpenCV will be used to capture video frames and process them in real time. Frames will be converted to to RGB format for MediaPipe processing. The 21 hand landmarks extracted by MediaPipe will be normalized relative to the wrist position to to make the model invariant to hand size and distance from camera. The dataset will be split into 80% training and 20% testing sets.

Model Development

Will use supervised classification model and primary choice is Random Forest classifier because it works well with the small feature set (63 features: 21 landmarks × 3 coordinates) and is fast for real-time inference. The model will be trained to predict the hand gestures.

Evaluation

Model will be evaluated using the accuracy, precision metrics. confusion matrix will visualize which gestures are confused with each other. target is to achieve at least 85-90% accuracy and real time performance will be measured by frames processed per second.

Implementation

Model will use live webcam feed and the system will capture frames, detect hands using MediaPipe, extract landmarks, and feed them to the classifier. Predicted gestures will be shown on video frame with confidence score. Demonstration will show system responding in real time.

Tools and Technologies

Python, OpenCV (webcam access and video processing), MediaPipe (hand detection and landmark extraction), scikit-learn (Random Forest classifier),NumPy and Pandas (data handling), Matplotlib (visualization)

Timeline

- **Week 1:** Setup, data collection, and labeling.
- **Week 2:** Preprocessing, model training, and evaluation.
- **Week 3:** Real-time integration, testing, documentation, and presentation preparation.