Virtual Mouse Control Using Hand Gestures

1. Introduction

This project demonstrates how computer vision techniques can be used to implement a virtual mouse interface using hand gestures. It enables users to control the cursor and perform mouse clicks using only a webcam and simple hand gestures, making it useful for accessibility and touchless interactions.

2. Tools and Libraries

- Python
- OpenCV
- MediaPipe
- AutoPy

3. Project Overview

The system captures real-time video feed from the webcam, detects a single hand using MediaPipe, and identifies key landmarks to determine finger positions. Cursor movement is achieved by mapping the index finger's position to screen coordinates, and mouse clicks are simulated based on gesture recognition.

4. Key Features

- Cursor movement using index finger.
- Left-click using index and middle finger pinch.
- Right-click using thumb and index finger pinch.
- Press ESC key when all fingers are up (except thumb).
- Exit the program when only the thumb is down.

5. Performance and Limitations

- Works reliably in well-lit conditions.
- Some lag may be observed on slower systems.
- Limited to one hand for simplicity.
- Gesture recognition accuracy depends on the camera angle and frame rate.

6. Future Enhancements

- Support for dual-hand tracking.
- Gesture-based scrolling.
- Integration with audio feedback or voice assistants.
- Improved gesture classification with machine learning.

7. Conclusion

This project showcases the use of OpenCV and MediaPipe in building a practical computer vision application. It also offers hands-on experience with real-time video processing, gesture detection, and system interaction, which are essential skills in modern data science workflows.