Virtual Mouse Using Hand Gesture Recognition

This project enables touchless computer control using webcam and intuitive hand gestures. It combines MediaPipe and OpenCV for smooth cursor movement, clicks, and scrolling. Designed to enhance natural interaction and accessibility in everyday computing.

Technology Overview: Hand Tracking with MediaPipe

Real-time Tracking

Tracks 21 hand landmarks with high accuracy at 30+ frames per second.

Robust Detection

Works well under diverse lighting and complex backgrounds.

Precise Data

Delivers exact fingertip positions essential for gesture control.

Webcam Compatible

Efficient on standard webcams without requiring special hardware.

Image Processing with OpenCV

Frame Capture

Captures and preprocesses video frames from webcam feed.

Detects the hand region for further analysis.

Finger Extraction

Identifies precise finger positions for gesture recognition.

Applies smoothing to ensure stable and natural cursor movement.

Coordinate Mapping

Transforms finger positions into screen coordinates.

Enables cursor to move fluidly across different screen sizes.

Cursor Movement via Index Finger

Intuitive Control

The index fingertip guides the mouse pointer position directly.

Smooth Tracking

Noise reduction ensures steady and precise cursor movement.

Screen Calibration

Cursor mapping adjusts accurately to different screen resolutions.

Natural Interaction

Movement mimics usual hand pointing for effortless control.

Gesture Controls for Mouse Actions

Left Click

Pinch thumb and index finger together to click.

Right Click

Pinch index and middle fingers together to trigger right click.

Scrolling

Scroll up or down using open palm or finger swipes.

Accuracy

Thresholds prevent accidental gesture recognition.

Benefits and Use Cases

Accessible Control

Supports users with mobility impairments for easier interaction.

Hygienic Interaction

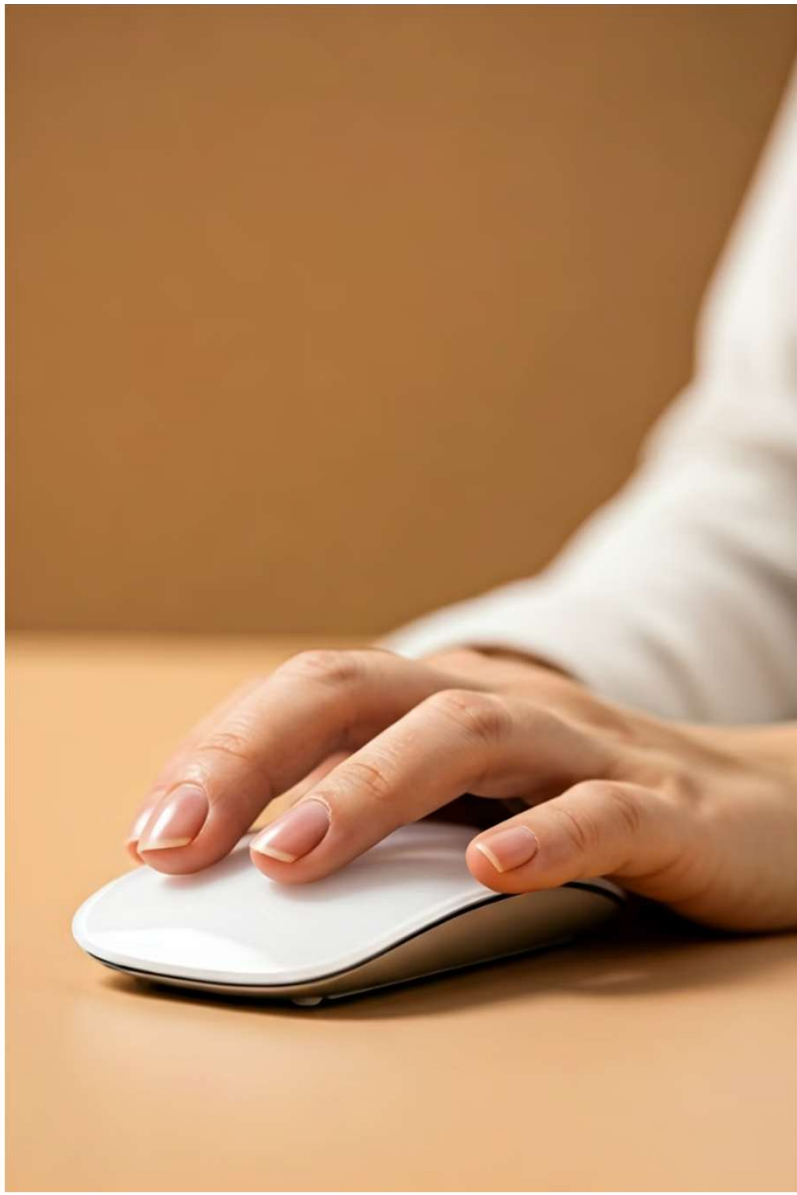
Ideal for environments requiring touchless operation.

Presentations

Enhances dynamic control during talks without physical devices.

Ergonomic Benefits

Reduces repetitive strain from traditional mouse use.



Challenges and Limitations

Lighting Sensitivity

Poor lighting can degrade tracking accuracy.

User Calibration

Needs adjustment for different users and screen setups.

Occlusion Issues

Fast or obscured hand movements may cause misinterpretation.

Hardware Dependency

Performance varies with webcam quality and processing power.

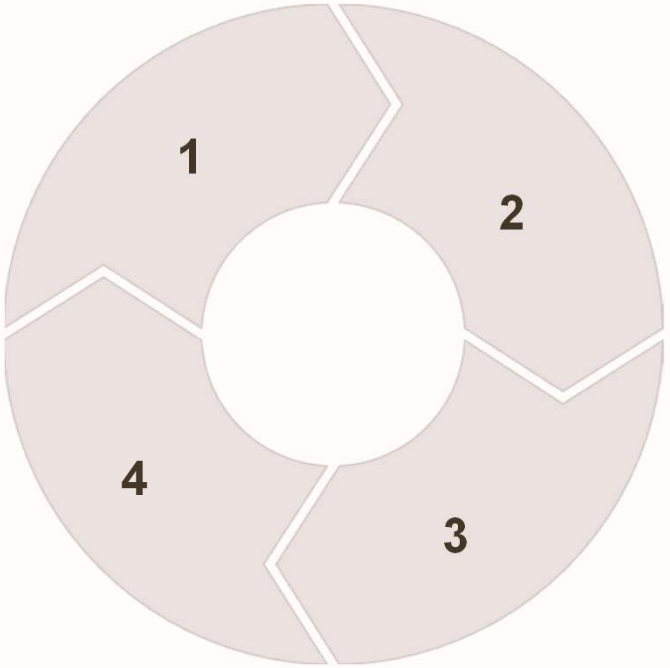
Conclusion and Future Directions

Current Impact

Offers natural, contactless control for diverse users and contexts.

Expanding Access

Aim to support more devices and varied environments.



Future Integration

Potential in VR, AR, and multi-hand gesture systems.

AI Enhancement

Incorporate AI for gesture prediction and increased accuracy.