ಭಾರತೀಯ ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ ಸಂಸ್ಥೆ ರಾಯಚೂರು
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Indian Institute of Information Technology Raichur

Project: Human Computer Interaction using Computer Vision Technique

CS323-Computer Vision

by

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Submitted to-
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Contents

Abstract

This project aims to develop a **touchless hand gesture-based control system** that enables users to interact with their computers without touching any device. Using a webcam and **MediaPipe**-based hand tracking, the system detects specific gestures to control mouse movements, perform right clicks, and scroll up or down in real time. This system introduces a hygienic and innovative way to interact with computers, promoting safer, more intuitive interactions.

Introduction

As we move towards more natural ways of interacting with computers, touchless and gesture-based systems are gaining attention. In this project, a **real-time hand gesture recognition system** is developed using **MediaPipe**, **OpenCV**, and **PyAutoGUI** to control mouse functions.

The system can:

- Move the mouse cursor
- Perform a right-click
- Scroll up
- Scroll down

All by recognizing specific hand gestures in front of a webcam.

Problem Statement

Traditional computer interaction relies heavily on physical devices such as a mouse, keyboard, or touch screen, which can be inconvenient and unsanitary. Especially in public places or during pandemics, **contactless interaction methods** become critical. This project addresses this by providing a **camera-based touchless control** system using simple hand gestures.

Objectives

- Develop a contactless computer interaction system.

- Use computer vision techniques to track hand landmarks.
- Implement real-time mouse control based on hand gestures.
- Achieve reasonable gesture recognition accuracy.

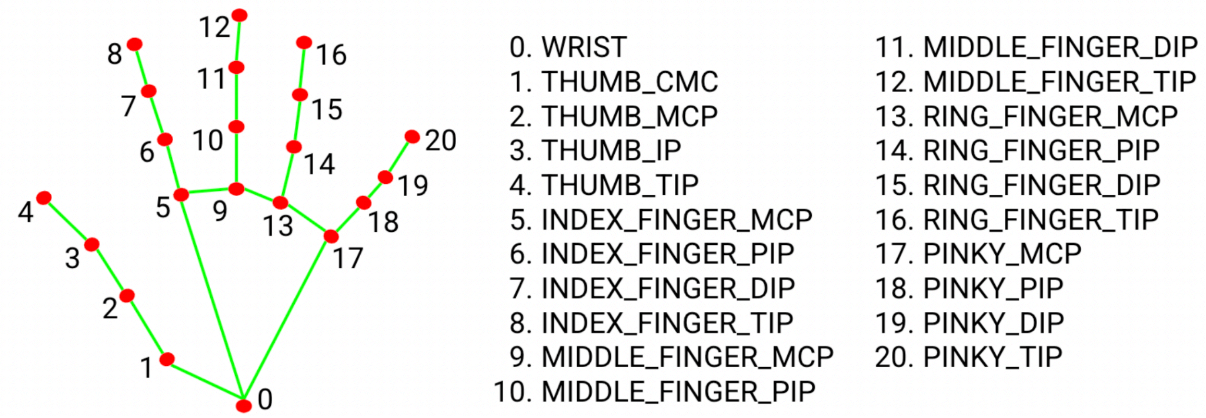
Tools and Technologies Used

Tool/Technology	Purpose
Python	Programming Language
OpenCV	Image Processing and Webcam Input
MediaPipe	Hand Tracking and Landmark Detection
PyAutoGUI	Mouse Movement and Click Simulation
Math	Distance Calculations
Time	Delay and Event Timing Control

Methodology

The system workflow can be divided into the following steps:

1. **Webcam Initialization**:
   Capture live video feed using OpenCV.
2. **Hand Tracking Setup**:
   Initialize MediaPipe’s Hand module to detect hand landmarks.



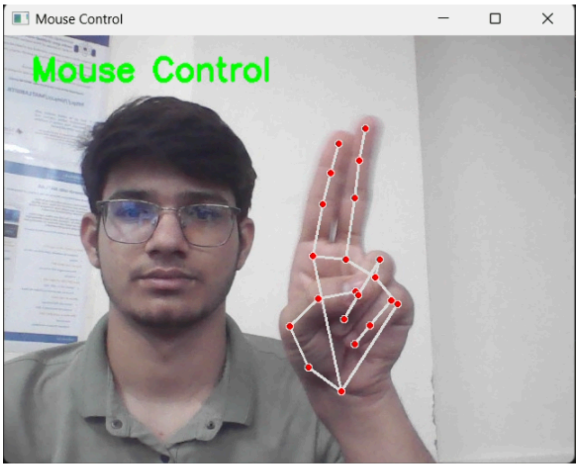
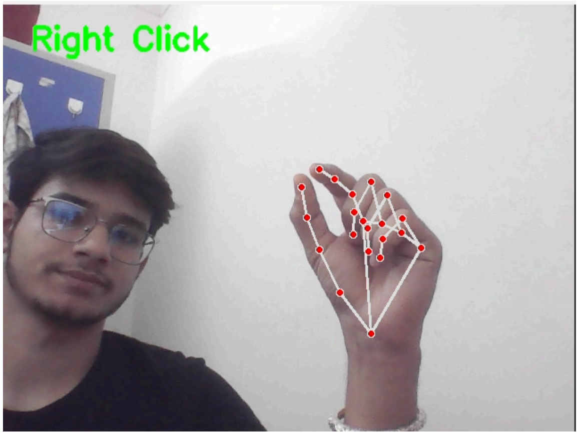
3. **Gesture Detection**:

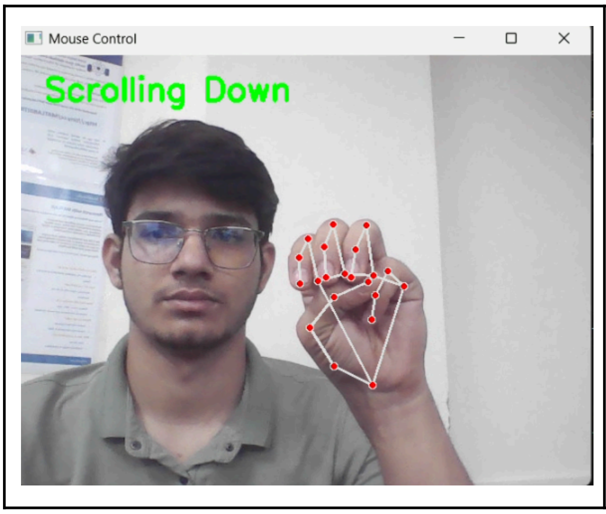
   - **Move Mouse**:
     If the **index and middle fingers** are close together, control the cursor position.

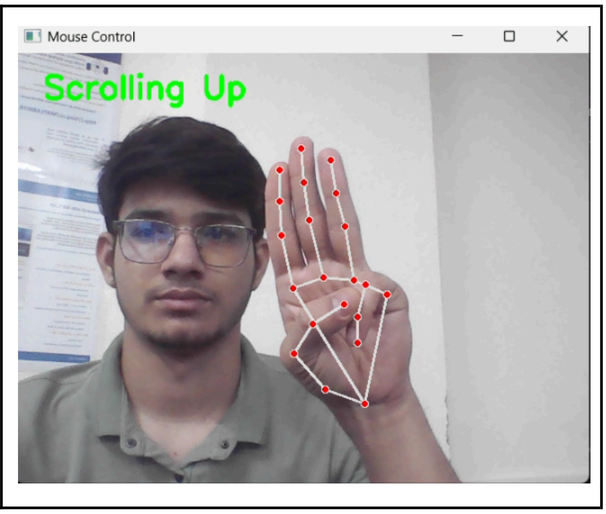
   - **Right Click**:
     If the **thumb and index finger** are close, trigger a right-click.

   - **Scroll Up**:
     If **three fingers** (index, middle, ring) are up, scroll up.

   - **Scroll Down**:
     If **all fingers** are closed (fist), scroll down.

Mouse control	**Right- click**
 	





4. **Mouse Action Simulation**:
 Use PyAutoGUI to move the cursor, perform clicks, and scrolling based on detected gestures.

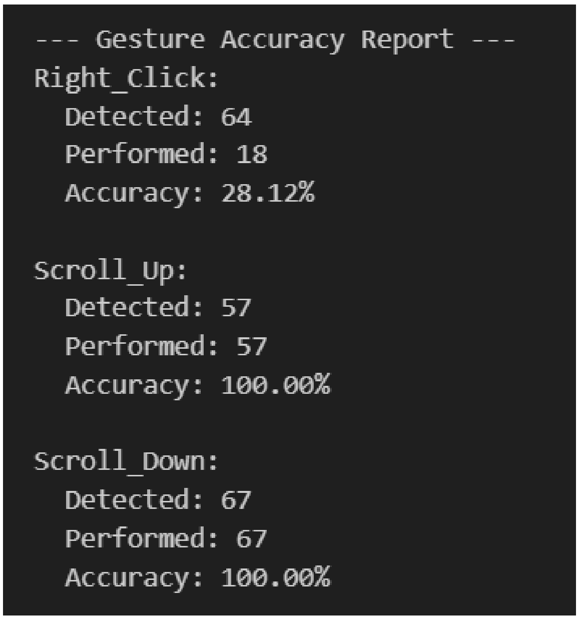
5. **Feedback Display**:
 Display the current action (like "Mouse Control", "Scrolling Up", etc.) on the webcam feed.

6. **Gesture Performance Report**:
 At the end of the session, the system prints the detection and success rate for each gesture.

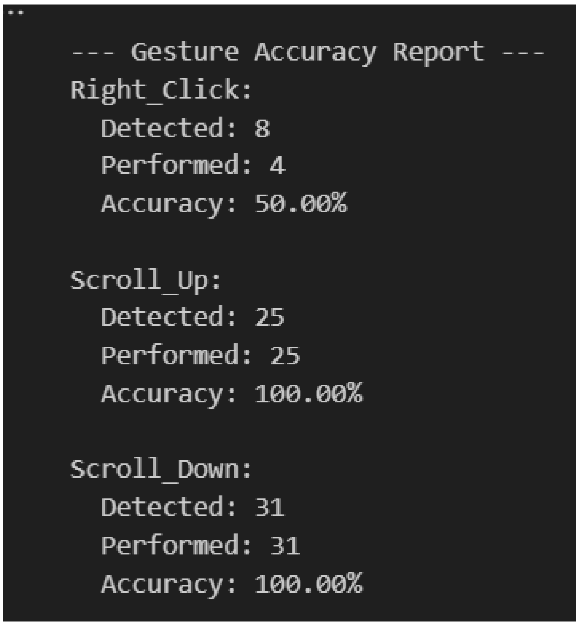
Results

Gesture Accuracy Report:

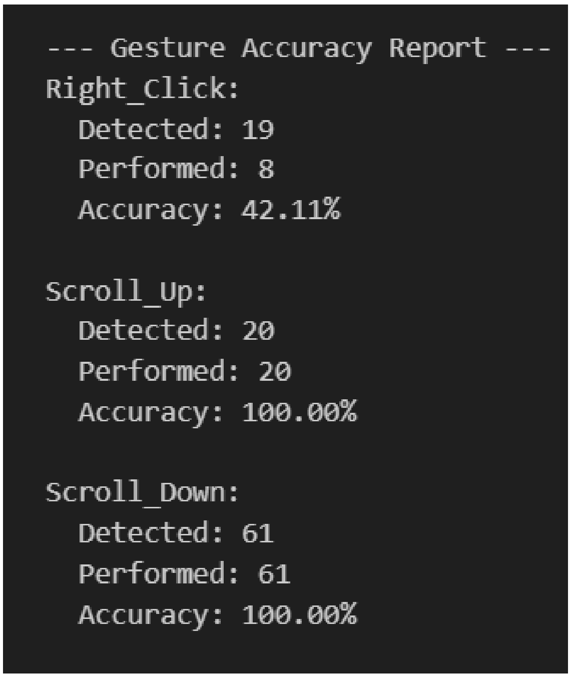
Gesture	Accuracy
Right Click	40%
Scroll Up	100%
Scroll Down	100%



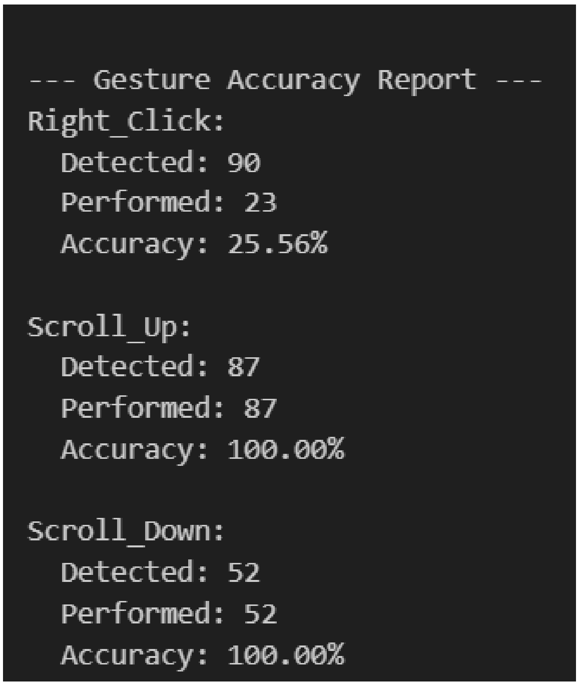
```
--- Gesture Accuracy Report ---
Right_Click:
  Detected: 64
  Performed: 18
  Accuracy: 28.12%

Scroll_Up:
  Detected: 57
  Performed: 57
  Accuracy: 100.00%

Scroll_Down:
  Detected: 67
  Performed: 67
  Accuracy: 100.00%
```



```
--- Gesture Accuracy Report ---
Right_Click:
  Detected: 8
  Performed: 4
  Accuracy: 50.00%

Scroll_Up:
  Detected: 25
  Performed: 25
  Accuracy: 100.00%

Scroll_Down:
  Detected: 31
  Performed: 31
  Accuracy: 100.00%
```



```
--- Gesture Accuracy Report ---
Right_Click:
  Detected: 19
  Performed: 8
  Accuracy: 42.11%

Scroll_Up:
  Detected: 20
  Performed: 20
  Accuracy: 100.00%

Scroll_Down:
  Detected: 61
  Performed: 61
  Accuracy: 100.00%
```



```
--- Gesture Accuracy Report ---
Right_Click:
  Detected: 90
  Performed: 23
  Accuracy: 25.56%

Scroll_Up:
  Detected: 87
  Performed: 87
  Accuracy: 100.00%

Scroll_Down:
  Detected: 52
  Performed: 52
  Accuracy: 100.00%
```

Conclusion

This project successfully demonstrates a **contactless mouse control system** using **computer vision Techniques**. Real-time detection of hand gestures enables users to interact with their system efficiently. The system achieves high accuracy for scrolling gestures but has some challenges in right-click detection, suggesting areas for improvement.

Future Scope

- Improve right-click detection accuracy with better landmark analysis or machine learning models.
- Add support for additional gestures like drag-and-drop, double-click, zoom in/out.
- Extend the system for **gesture-controlled games** or **robot control**.
- Make it platform-independent and integrate with mobile devices.

References

- MediaPipe Documentation: https://mediapipe.readthedocs.io/en/latest/solutions/hands.html
- OpenCV Documentation: https://docs.opencv.org/4.x/index.html
- PyAutoGUI Documentation: https://pyautogui.readthedocs.io/en/latest/index.html

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