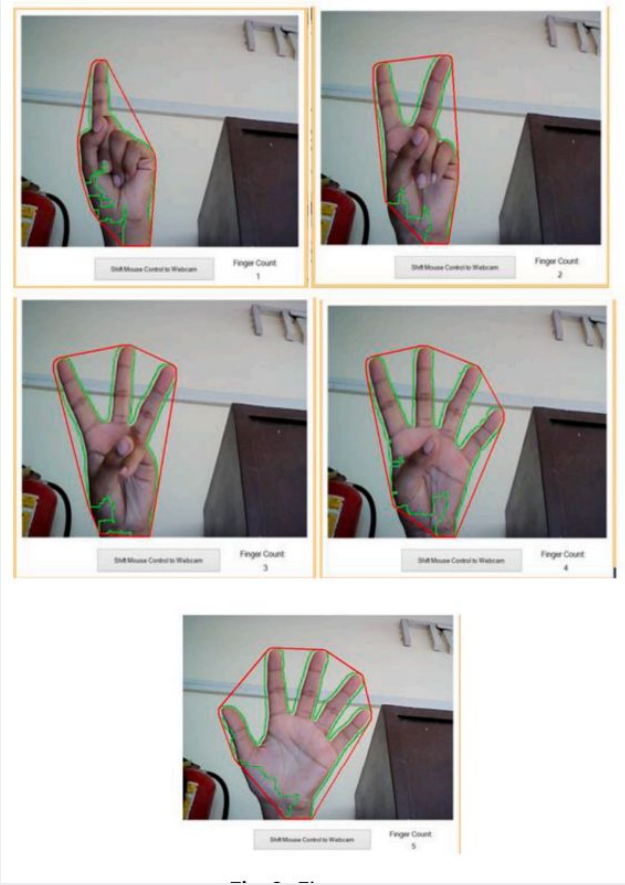
Human Computer Interaction using Computer-vision technique

(CS323-Computer Vision)

By- Shubham Soni
CS22B1053



INTRODUCTION: Why This Project?

- 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 CV technique.

What Does the Project Do?

Uses webcam to track hand gestures in real-time.

The system can do:

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

Objectives

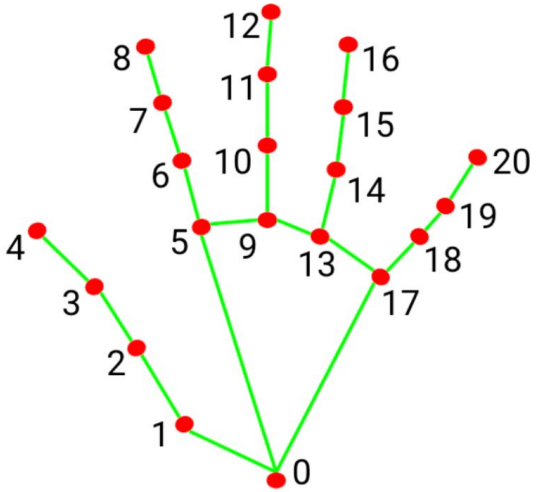
- Develop a **contactless** computer interaction system.
- Use computer vision techniques(mediapipe) to track hand landmarks.
- Implement real-time mouse control based on hand gestures.
- Achieve reasonable gesture recognition accuracy.

Tools and Technologies Used

Tool/Technology	Purpose
OpenCV	Image Processing and Webcam Input
MediaPipe	Hand Tracking and Landmark Detection (pre-trained Library)
PyAutoGUI	Mouse Movement and Click Simulation

Technique – MediaPipe Based Gesture Control

Using MediaPipe for Hand Tracking(Hand-Landmark)



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Methodology

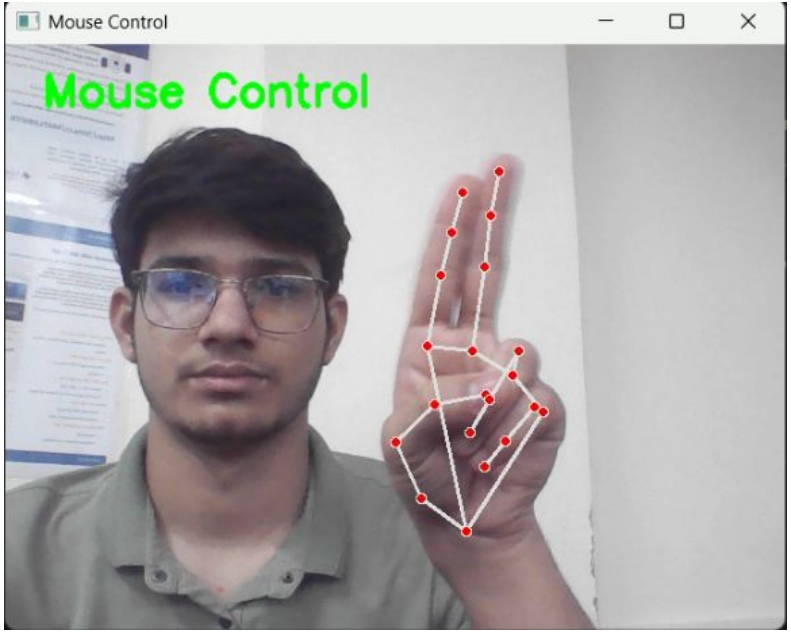
- **Webcam Initialization**:
  Capture live video feed using OpenCV.

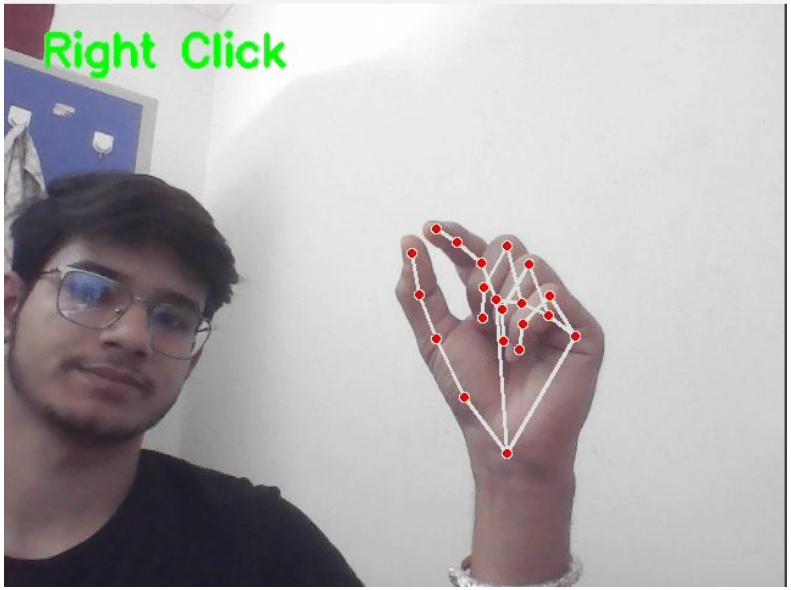
- **Hand Tracking Setup**:
  Initialize MediaPipe’s Hand module to detect hand landmarks.

- **Gesture Detection**:

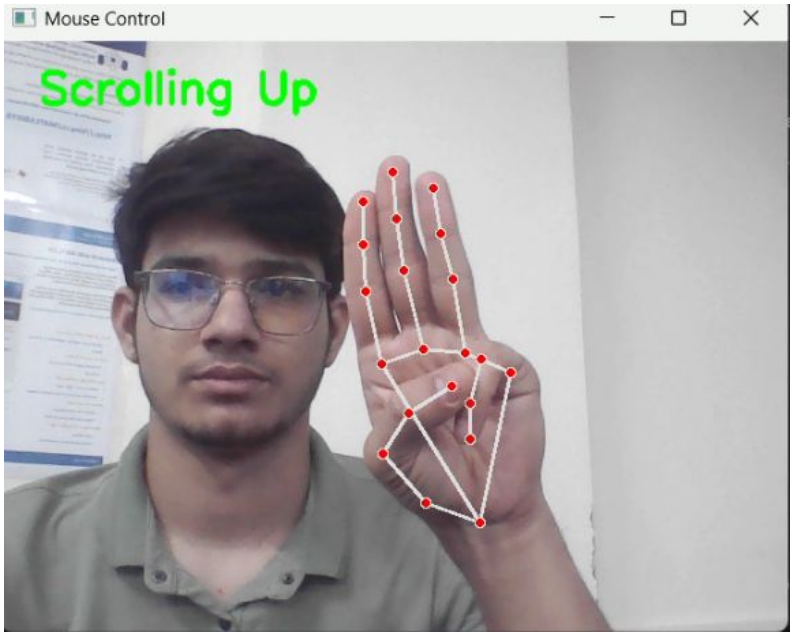
Gesture Detection

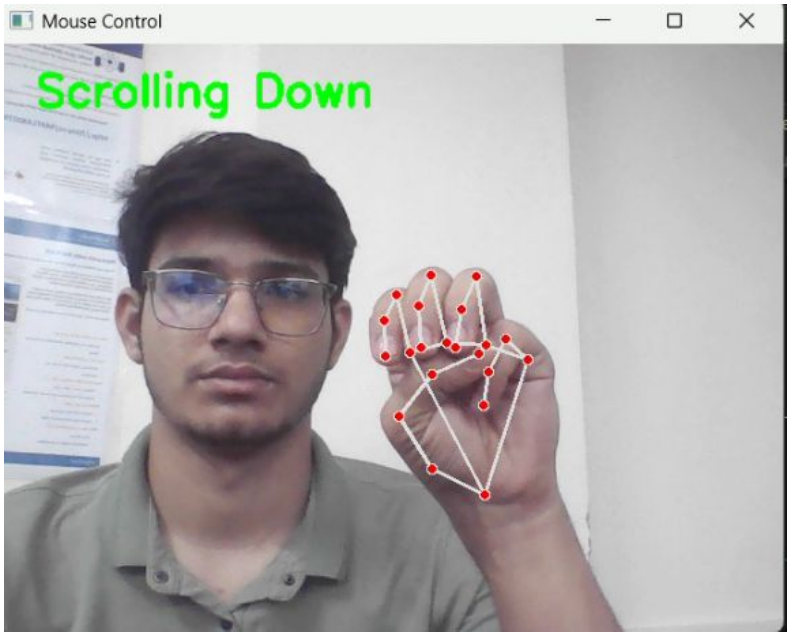
Cursor movement , Right click





Scroll up - Scroll down





Accuracy

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

Testing Accuracy

```
--- 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:

- Developed a **contactless mouse control system** using computer vision.
- Real-time hand gesture detection for efficient interaction.
- High accuracy in scrolling gestures.
- Challenges remain in right-click detection; needs improvement.

Future Work:

- Improve **right-click** detection accuracy.
- 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.

Thank You