Savitribai Phule Pune University

A

Project Report

On

“Virtual Mouse Using Python”

Submitted by

Mr. Swapnil Rajendra Take

UNDER THE GUIDANCE BY

Prof. Ghadge R.A.

DEPARTMENT OF COMPUTER ENGINEERING

VISHWABHARATI ACADEMY’S COLLAGE OF ENGINEERING
SAROLA BADDI

AHMEDNAGAR 414201

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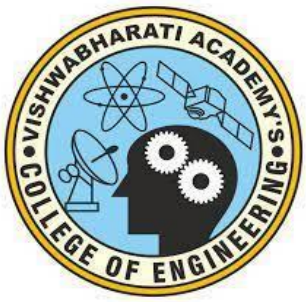

DEPARTMENT OF COMPUTER ENGINEERING

VISHWABHARATI ACADEMY'S COLLAGE OF ENGINEERING

Sarola Baddi, Ahmednagar

CERTIFICATE

This is to certify that **Swapnil Rajendra Take** has successfully completed his Report on **"Virtual Mouse Using Python"** at **Vishwabharti Academy's College of Engineering, Ahmednagar** in the partial fulfillment of the Graduate Degree course in T.E. at the Department of Computer Engineering, in the academic Year 2021-2022 Semester-VI as prescribed by the Savitribai Phule Pune University

Prof. Ghadge R.A	Prof. Joshi S.G.	Prof. Dhongde V.S.
Project Guide	**Head of Department**	**Principal**

Date:
Place: Ahmednagar

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Mr. Swapnil Rajendra Take

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1. Abstract

This project promotes an approach for the Human Computer Interaction (HCI) where cursor movement can be controlled using a real-time camera, it is an alternative to the current methods including manual input of buttons or changing the positions of a physical computer mouse. Instead, it utilizes a camera and computer vision technology to control various mouse events and is capable of performing every task that the physical computer mouse can.

The Virtual Mouse colour recognition program will constantly acquiring real-time images where the images will undergone a series of filtration and conversion. Whenever the process is complete, the program will apply the image processing technique to obtain the coordinates of the targeted colours position from the converted frames. After that, it will proceed to compare the existing colours within the frames with a list of colour combinations, where different combinations consists of different mouse functions. If the current colours combination found a match, the program will execute the mouse function, which will be translated into an actual mouse function to the users' machine.

2. Introduction

With the development technologies in the areas of augmented reality and devices that we use in our daily life, these devices are becoming compact in the form of Bluetooth or wireless technologies. $is paper proposes an AI virtual mouse system that makes use of the hand gestures and hand tip detection for performing mouse functions in the computer using computer vision.

Main objective of the proposed system is to perform computer mouse cursor functions and scroll function using a web camera or a built-in camera in the computer instead of using a traditional mouse device. Hand gesture and hand tip detection by using computer vision is used as a HCI with the computer. With the use of the AI virtual mouse system, we can track the fingertip of the hand gesture by using a built-in camera or web camera and perform the mouse cursor operations and scrolling

Function and also move the cursor with it. While using a wireless or a Bluetooth mouse, some devices such as the mouse, the dongle to connect to the PC, and also, a battery to power the mouse to operate are used, but in this paper, the user uses his/her built-in camera or a webcam and uses his/her hand gestures to control the computer mouse operations. In the proposed system, the web camera captures and then processes the frames that have been captured and then recognizes the various hand gestures and hand tip gestures and then performs the particular mouse function.

3. Algorithm Used for Hand Tracking

For the purpose of detection of hand gestures and hand tracking, the MediaPipe framework is used, and OpenCV library is used for computer vision. The algorithm makes use of the machine learning concepts to track and recognize the hand gestures and hand tip.

MediaPipe :

MediaPipe is a framework which is used for applying in a machine learning pipeline, and it is an opensource framework of Google. The MediaPipe frame- work is useful for cross platform development since the framework is built using the time series data. The MediaPipe framework is multimodal, where this framework can be applied to various audios and videos. The MediaPipe framework is used by the developer for building and ana- lyzing the systems through graphs, and it also been used for developing the systems for the application purpose. The steps involved in the system that uses MediaPipe are carried out in the pipeline configuration. The pipeline created can run in various platforms allowing scalability in mobile and desktops.

The MediaPipe framework is based on three fundamental parts; they are performance evaluation, framework for retrieving sensor data, and a collection of components which are called calculators [11], and they are reusable. A pipeline is a graph which consists of components called calculators, where each calculator is connected by streams in which the packets of data flow through. Devel- opers are able to replace or define custom calculators anywhere in the graph creating their own application. The calculators and streams combined create a data-flow dia- gram; the graph (Figure 1) is created with MediaPipe where each node is a calculator and the nodes are connected by streams Single-shot detector model is used for detecting and recognizing a hand or palm in real time. The single-shot detector model is used by the MediaPipe

OpenCV :

OpenCV is a computer vision library which contains image-processing algorithms for object detection. OpenCV is a library of python programming language, and real-time computer vision applications can be developed by using the computer vision library. The OpenCV library is used in image and video processing and also analysis such as face detection and object detection.

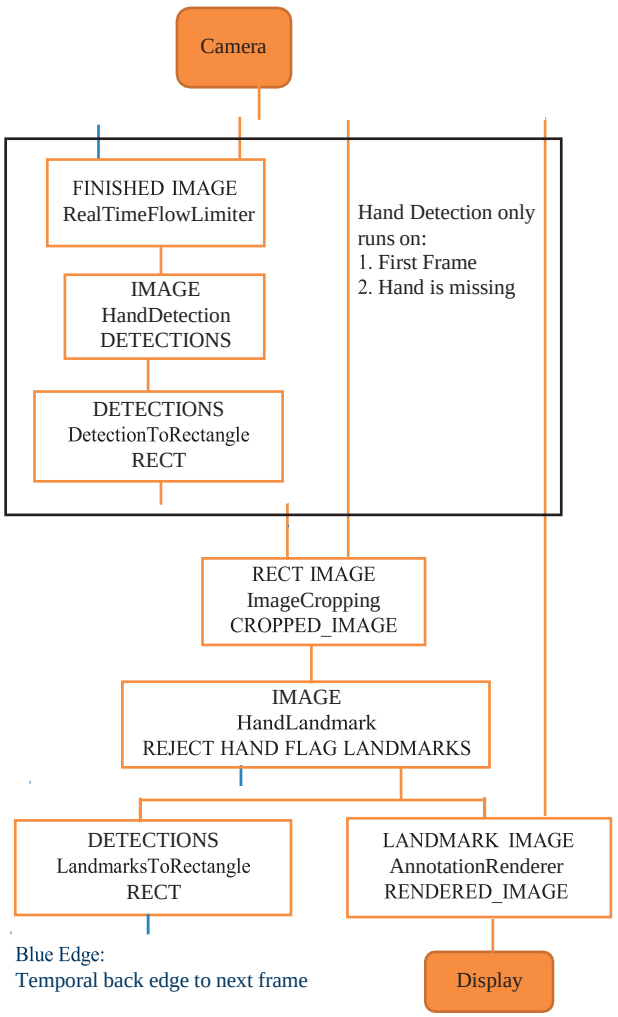
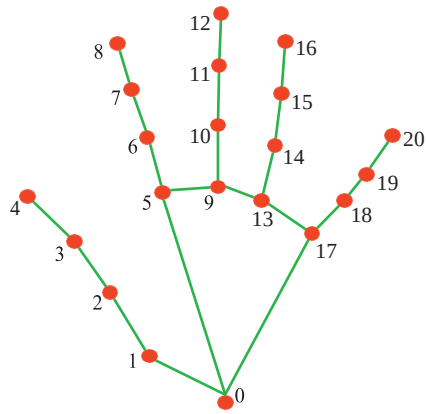


Figure 1: MediaPipe hand recognition graph



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

Figure 2: Co-ordinates or land marks in the hand

4. S/W & H/W Requirement

Software Requirement:

- Python 3.10
- Visual Studio

Hardware Requirement:

- Processor – Intel Pentium
- Motherboard- Intel Chipset Motherboard
- RAM- 128MB
- Web Cam

5. Methodology

The various functions and conditions used in the system are explained in the flowchart of the real-time AI virtual mouse system in Figure 3. Camera Used in the AI Virtual Mouse System. The proposed AI virtual mouse system is based on the frames that have been captured by the webcam in a laptop or PC. By using the Python computer vision library OpenCV, the video capture object is created and the web camera will start capturing video, as shown in Figure 4.

The web camera captures and passes the frames to the AI virtual system Capturing the Video and Processing. The AI virtual mouse system uses the webcam where each frame is captured till the termination of the program. $e video frames are processed from BGR to RGB color space to find the hands in the video frame by frame as shown in the following code:

```
def findHands(self, img, draw = True):
imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
self.results = self.hands.process(imgRGB)
```

(Virtual Screen Matching) Rectangular Region for Moving through the Window. $e AI virtual mouse system makes use of the transformational algorithm, and it converts the coordinates of fingertip from the webcam screen to the computer window full screen for controlling the mouse. When the hands are detected and when we find which finger is up for performing the specific mouse function, a rectangular box is drawn with respect to the computer window in the webcam region where we move throughout the window using the mouse cursor, as shown in Figure 5.

Detecting Which Finger Is Up and Performing the Particular Mouse Function. In this stage, we are detecting which finger is up using the tip Id of the respective finger that we found using the MediaPipe and the respective co-ordinates of the fingers that are up, as shown in Figure 6, and according to that, the particular mouse function is performed.

Mouse Functions Depending on the Hand Gestures and Hand Tip Detection Using Computer Vision. For the Mouse Cursor Moving around the Computer Window. If the index finger is up with tip Id = 1 or both the index finger with tip Id = 1 and the middle finger with tip Id = 2 are up, the mouse cursor is made to move around the window of the computer using the AutoPy package of Python, as shown in Figure 7.

For the Mouse to Perform Left Button Click. If both the index finger with tip Id = 1 and the thumb finger with tip Id = 0 are up and the distance between the two fingers is lesser than 30px, the computer is made to perform the left mouse button

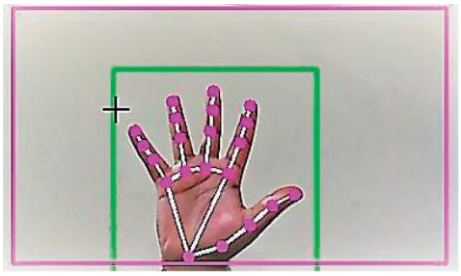


Figure 4: Capturing video using the webcam (computer vision).

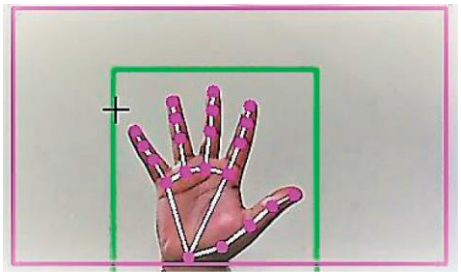


Figure 5: Rectangular box for the area of the computer screen where we can move the cursor

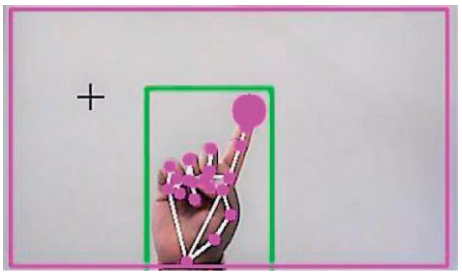


Figure 6: Detection of which finger is up.

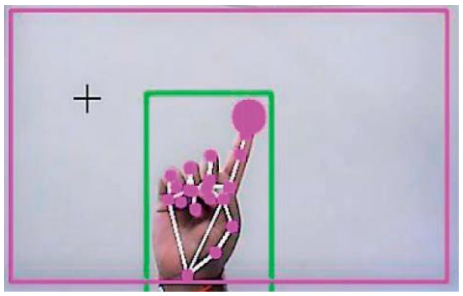


Figure 7: Mouse cursor moving around the computer window.

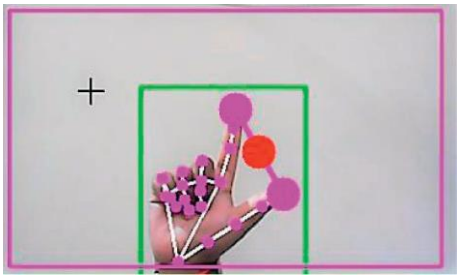


Figure 8: Gesture for the computer to perform left button click.

Figure 9: Gesture for the computer to perform left button click

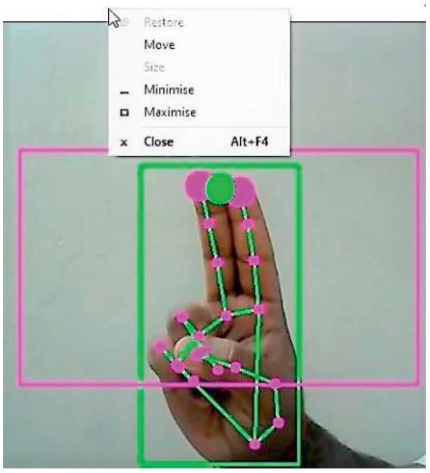


Figure 10: Gesture for the computer to perform right button click.

lesser than 40 px, the computer is made to perform the right mouse button click using the pynput Python package, as shown in Figure 10. For the Mouse to Perform Scroll up Function. If both the index finger with tip Id = 1 and the middle finger with Tip Id = 2 are up and the distance between the two fingers is greater than 40 px and if the two fingers are moved up the page, the computer is made to perform the scroll up mouse function using the PyAutoGUI Python package, as shown in Figure 11.

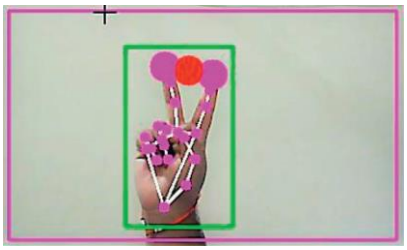


Figure 11: Gesture for the computer to perform scroll up function

For the Mouse to Perform Scroll down Function. If both the index finger with tip Id = 1 and the middle finger with tip Id = 2 are up and the distance between the two fingers is greater than 40px and if the two fingers are moved down the page, the computer is made to perform the scroll down mouse function using the PyAutoGUI Python package, as shown in Figure 12.

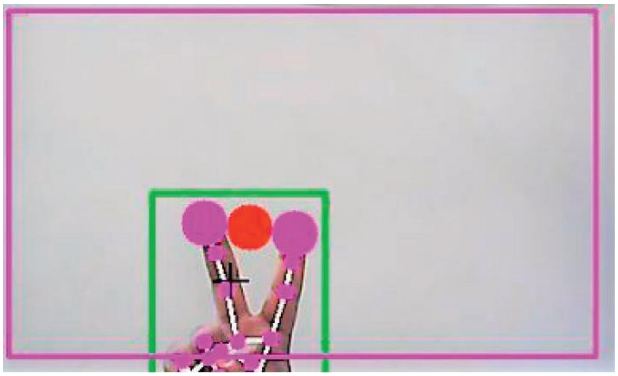


Figure 12: Gesture for the computer to perform scroll down function.

For No Action to be Performed on the Screen. If all the fingers are up with tip Id = 0, 1, 2, 3, and 4, the computer is made to not perform any mouse events in the screen, as shown in Figure 13.

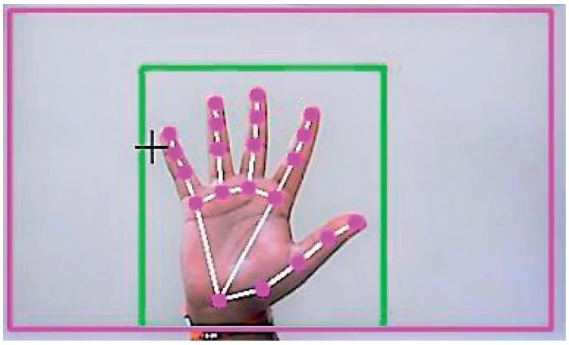
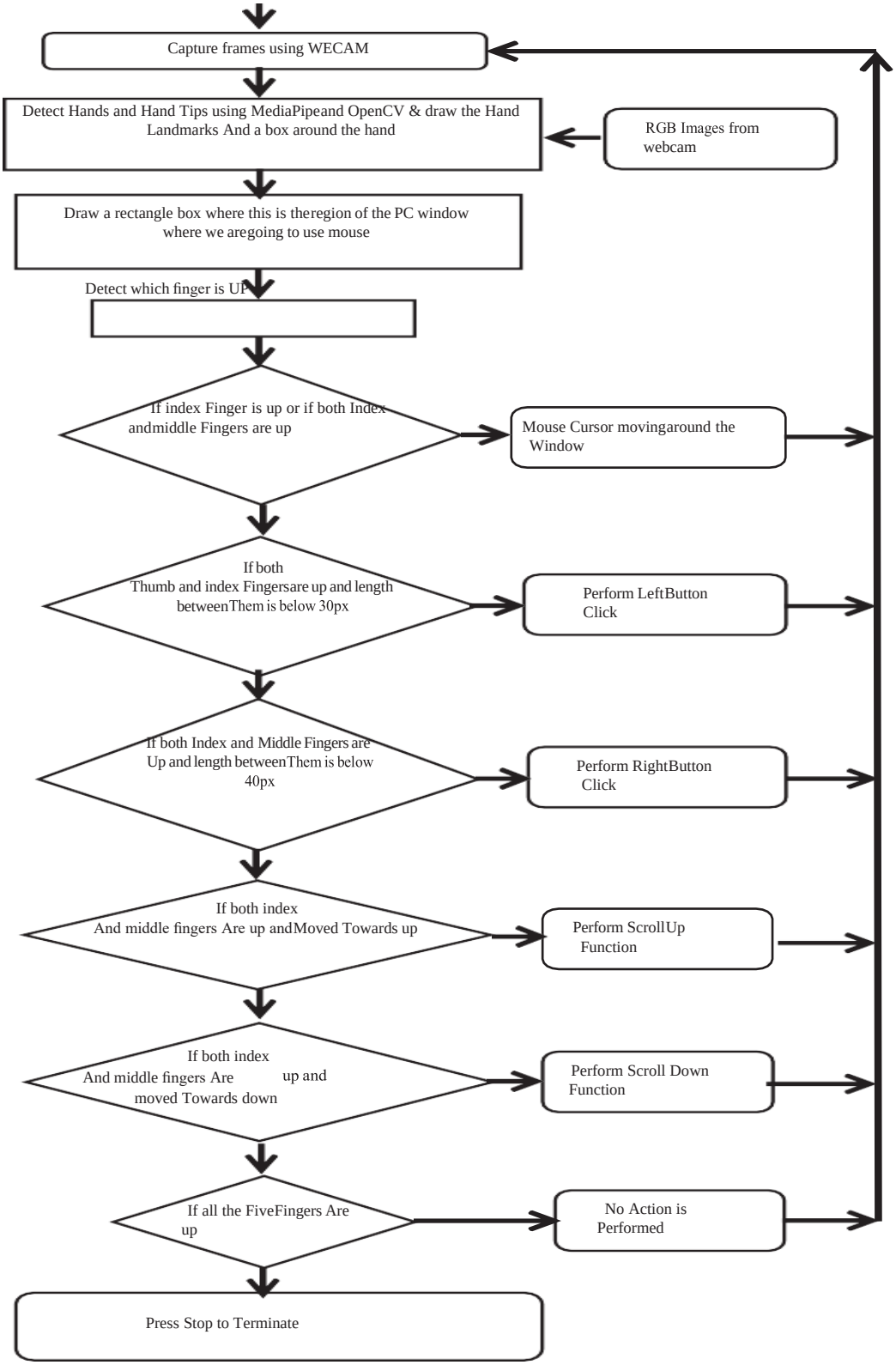
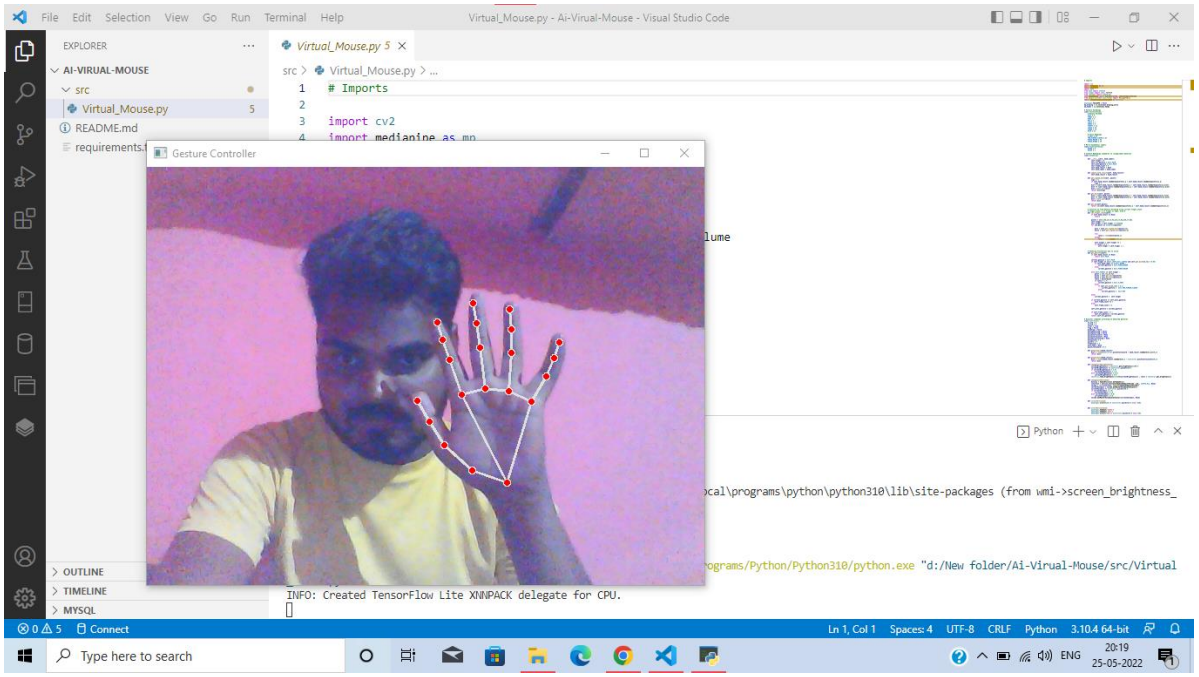


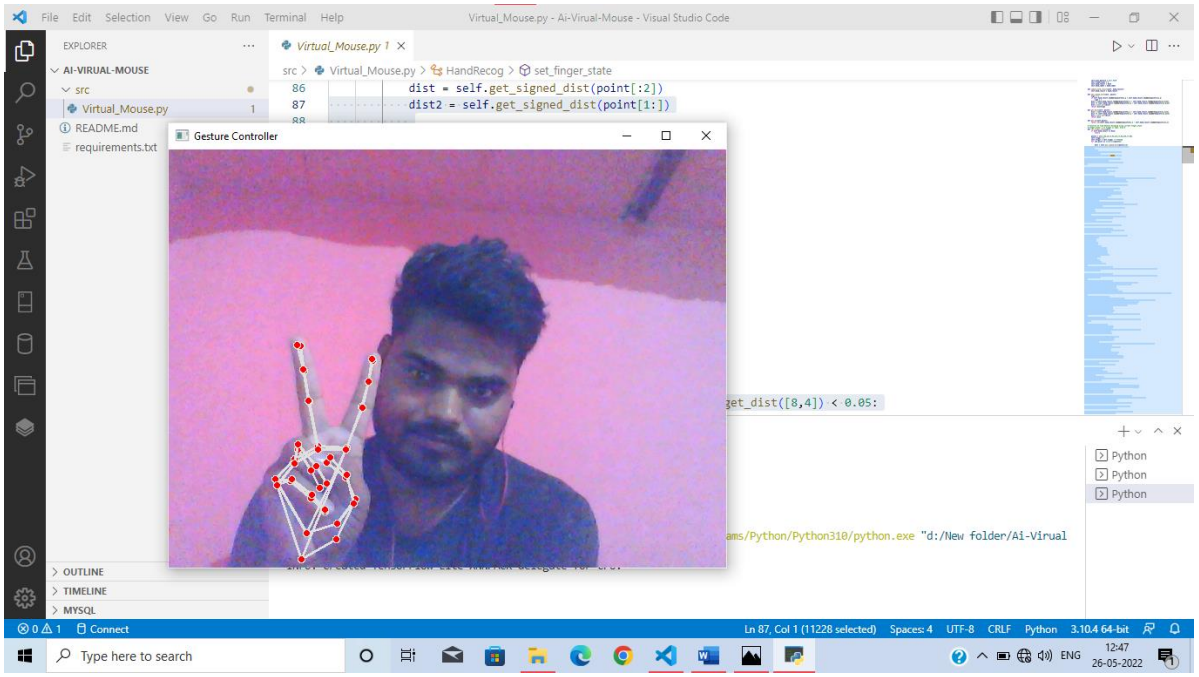
Figure 13: Gesture for the computer to perform no action.

6. Flowchart


Capture frames using WECAM
Detect Hands and Hand Tips using MediaPipeand OpenCV & draw the Hand Landmarks And a box around the hand
RGB Images from webcam
Draw a rectangle box where this is theregion of the PC window where we aregoing to use mouse
Detect which finger is UP
If index Finger is up or if both Index andmiddle Fingers are up
Mouse Cursor movingaround the Window
If both Thumb and index Fingersare up and length betweenThem is below 30px
Perform LeftButton Click
If both Index and Middle Fingers are Up and length betweenThem is below 40px
Perform RightButton Click
If both index And middle fingers Are up andMoved Towards up
Perform ScrollUp Function
If both index And middle fingers Are up and moved Towards down
Perform Scroll Down Function
If all the FiveFingers Are up
No Action is Performed
Press Stop to Terminate

7. Screenshot





8. Applications

The AI virtual mouse system is useful for many applications. it can be used to reduce the space for using the physical mouse, and it can be used in situations where we cannot use the physical mouse. The system eliminates the usage of devices, and it improves the human-computer interaction.

Major applications:

(i) The proposed model has a greater accuracy of 99% which is far greater than the that of other proposed models for virtual mouse, and it has many applications

(ii) Amidst the COVID-19 situation, it is not safe to use the devices by touching them because it may
result in a possible situation of spread of the virus by touching the devices, so the proposed AI virtual
mouse can be used to control the PC mouse functions without using the physical mouse

(iii) $e system can be used to control robots and automation systems without the usage of devices

(iv) 2D and 3D images can be drawn using the AI virtual system using the hand gestures

(v) AI virtual mouse can be used to play virtual realityand augmented reality-based games without the
wireless or wired mouse devices

(vi) Persons with problems in their hands can use this system to control the mouse functions in the
Computer

(vii) In the field of robotics, the proposed system like HCI can be used for controlling robots

(viii) In designing and architecture, the proposed system can be used for designing virtually for prototyping

9. Future Scope

The proposed AI virtual mouse has some limitations such as small decrease in accuracy of the right click mouse function and also the model has some difficulties in executing clicking and dragging to select the text. These are some of the limitations of the proposed AI virtual mouse system, and these limitations will be overcome in our future work. Furthermore, the proposed method can be developed to handle the keyboard functionalities along with the mouse functionalities virtually which is another future scope of Human-Computer Interaction (HCI) and AI.

10. Conclusion

The main objective of the AI virtual mouse system is to control the mouse cursor functions by using the hand gestures instead of using a physical mouse. The proposed system can be achieved by using a webcam or a built-in camera which detects the hand gestures and hand tip and processes these

Frames to perform the particular mouse functions. From the results of the model, we can come to a conclusion that the proposed AI virtual mouse system has performed very well and has a greater accuracy compared to the existing models and also the model overcomes most of the limitations of the existing systems. Since the proposed model has greater accuracy, the AI virtual mouse can be used for real-world applications, and also, it can be used to reduce the spread of COVID-19, since the proposed mouse system can be used virtually using hand gestures without using the traditional physical mouse.

The model has some limitations such as small decrease in accuracy in right click mouse function and some difficulties in clicking and dragging to select the text. Hence, we will work next to overcome these limitations by improving the finger tip detection algorithm to produce more accurate results

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