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# Virtual Mouse using Python

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**ABSTRACT:** This study presents an innovative method by using a real-time camera to control mouse movement of a computer. Our concept is to use a camera and computer vision technologies to manage mouse tasks (clicking and scrolling), and we show how it can accomplish most of the things that the current mouse devices can. In human-computer interactions, hand gesture recognition is a crucial way of giving inputs. This is possible with Python libraries such as OpenCV and MediaPipe as they have algorithms to detect hands in a video captured by the webcam. As we can see, there are many new technological advancements occurring, such as biometric authentication, which we see frequently in our smart phones; similarly, hand gesture recognition is a modern way of human computer interaction, in which we can control our system by showing our hands in front of a webcam, and hand gesture recognition can be useful for people of all types.

**KEYWORDS:** Python, Mouse Movements, Hand Gestures, OpenCV.

## I. INTRODUCTION

The future of computers relies on wireless means of communication between humans and computers. Computer vision gives the ability to a machine to scan the environments and gain an input via an optical module. Since a long time, computer inputs were given to a computer by using various peripherals viz. keyboard, mouse, etc. In computer vision, computers use digital images from cameras, videos and deep learning models by which machine can accurately identify and then react to what they “see”.

In this project, we are using computer vision to gain images from a camera and interpret these images as inputs to the computer mouse. By simply moving your hand in front of the camera the computer will gain the inputs of moving the mouse pointer according to the motion of hand. Furthermore, inputs like left mouse button, right mouse button and scroll wheel actions can be given by various hand gestures.

## II. LITREATURE REVIEW

Ghodichor et. al. in their research paper implemented colour recognition algorithms which were used to give inputs to the computer. They used a red and blue colour tape which was stuck on their finger and use the colour recognition and conversion for mouse functions. This technology was targeted to assist individuals who were unable to use their limbs and control the mouse. The vision was good but practical implementation raised various other barriers like needing extra accessories (various coloured tapes), plain backgrounds and perfect lighting[1]. Manne Vamshi Krishna et. al. imposed that all the mouse movements can be carried out without any compromising the accuracy. For this there is a technique where colour coordinates come in the picture. In this project they used the green color tape on the finger and with these two fingers the whole computer can be accessed. Different gestures were used for different actions like right click, left click, double click, drag and drop, zoom in – zoom out, etc. To establish effective and convenient colour tracking, a black glove with coloured tape on it and a calibration step was implemented, in which users select colours for various functions that do not all fall within the same RGB value range[2]. Vantukala Vishnu Teja Reddy et. al. described a method for controlling the mouse pointer by using a camera and colour detection. This project involved identifying different coloured caps on the fingertips and tracking them. For the same effect, different hand gestures might be used instead of coloured caps. Single left-click, double left-click, right-click, and scrolling are all mouse-controlled operations. For various operations, different combinations of coloured caps are utilized[3]. Faiz. Khan et. al. The implementation of our proposed work using object identification, marker motion tracking, and PyAutoGUI was effective, and the movement of the mouse and click events was achieved with high precise accuracy. This resulted in improved Human-Computer Interaction (HCI). They can just utilise any coloured object at their disposal. The major goal is to eliminate the usage of any physical device and rely solely on the web cam that comes standard with the

laptop. There are no additional fees [4]. Varun et. al. imposed that the system working conditions are based on Anaconda Environment interface design, with OpenCV, Numpy libraries and some of the sub packages of these libraries. Camera resolution is 1920\*1080 and with 40fps. While the device is on and when the module is started, it will open a window for the camera which would take input from the user. This model was designed for colour recognition and interpreting commands given to the system the gestures given by the user to make an input for the computer. At the same time, the mouse pointer movement will be captured and will operate without any human interaction [5].

### III. EXISTING SYSTEM & LIMITATIONS

In the History of computer vision mouse pointers were controlled by the camera detecting a particular color and tracing its movement in the camera's field of view. A colored paper was stuck on the finger and the movements of this color was taken as the input for mouse pointer. Different colored papers on fingers were used to give inputs for various mouse functions. The flaw in this method was that the colors in the background of the hand were also captured and taken as an input which make this function ineffective. This was overcome by using black glove and sticking colored papers in such a way that the colors were clearly visible on the black background. But this system works properly with the only disadvantage that a black glove and colored paper were required for the proper functioning.

### IV. PROPOSED SYSTEM

In this project our aim is to remove the additional requirements (gloves, colored tape, etc.) and only use our bare hand to control various functions of the mouse. This is possible by using Python's openCV and mediapipe libraries. Mediapipe library uses a hand detection model to detect any hand present in the camera's field of view. Mediapipe library also has hand landmark model which assigns 20 key points on the hand. We will use these key points to give different inputs when particular points on the hand are moved.

### V. TECHNICAL SPECIFICATIONS

Software: - Windows 10, Pycharm IDE  
Language: - Python (version 3.7.9)  
Packages / Libraries: - OpenCV, Mediapipe, Autopy

Hardware: - Computer/Laptop with a Camera  
minimum 4GB RAM (Recommended 8GB RAM)  
CPU - Intel i5 or AMD Ryzen 5

### VI. METHODOLOGY

Mediapipe library uses a hand detection model to detect any hand present in the camera's field of view. Mediapipe library also has hand landmark model which assigns 20 key points on the hand (Fig. 1.1). We will use these key points to give different inputs when particular points on the hand are moved.

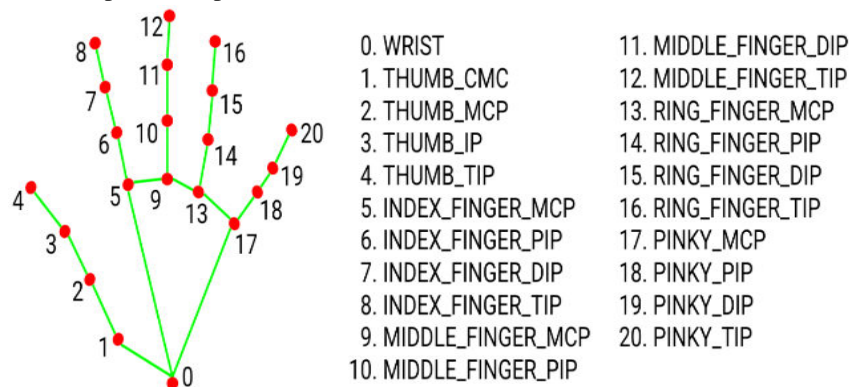


Fig 1.1 Hand Landmarks

For example, referring to fig.1.1, point 8 can be set as the master point which will control the movement of the mouse. If the distance between point 4 and 12 goes below 0.5cm the program will give an input of left mouse button click to the computer and similarly if the distance between points 4 and 16 goes below 0.5cm the program will give an input of right mouse button click to the computer and just like this we can make functions for double click and audio controls. The program works in the following steps:

The Virtual Mouse program makes use of a camera. The suggested AI virtual mouse technology is based on frames collected by a laptop or computer's webcam. The video capture object is constructed using the python computer vision library OpenCV, and the web camera will begin capturing video. The frames are captured by the web camera and sent to the AI virtual system.

1. The Virtual Mouse program uses a webcam where each frame is captured until the end of the program. As shown below, the video image is processed from the BGR to the RGB color space and finds the hand in the video frame by frame. This is a property of the Mediapipe library where it is used to make the borders of the hand easily visible and jot points over the hand.

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

2. The Virtual Mouse program uses Autopy to control the mouse movements by converting the coordinates of your fingertips from the webcam screen to the resolution of a full-screen computer window. A rectangular box is drawn for the computer window in the webcam area. The mouse pointer moves according to the point on the hand in the window.
3. The pink dot on the tip of the index finger is used to move the mouse cursor on the screen.

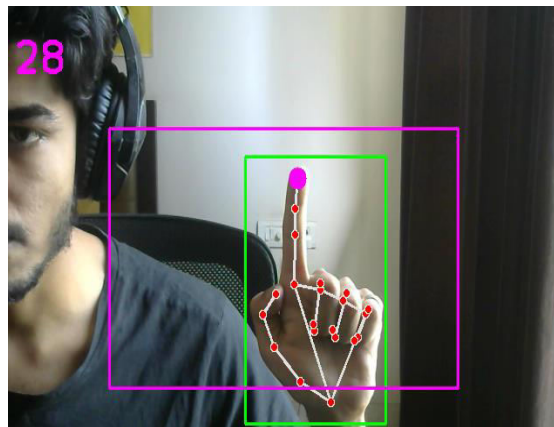


Fig 1.2 Hand Landmarks with mouse following the tip of index finger

4. For right click, when thumb tip touches the ring finger tip input of the right click will be given.

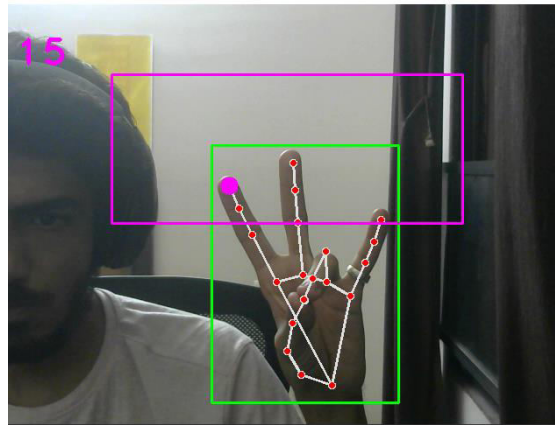


Fig 1.3 Mouse right-click gesture

5. For left click, when the thumb tip touches the middle finger tip input of the left click will be given.

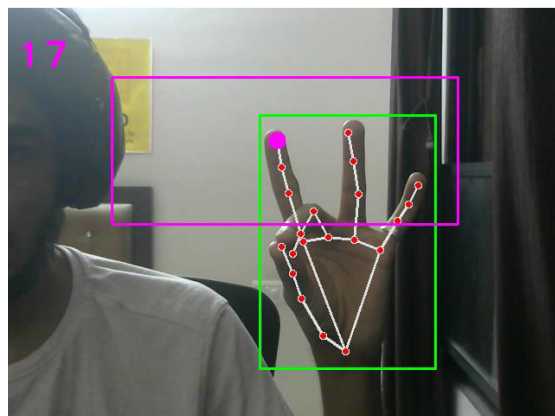


Fig 1.4 Mouse left-click gesture

6. For Double click, when the thumb tip touches the pinky tip input of the double click will be given.

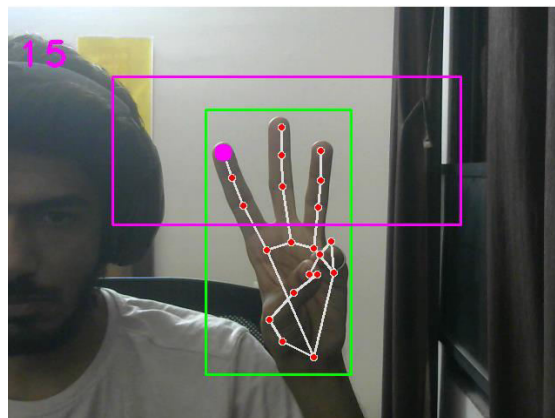


Fig 1.5 Mouse double-click gesture

7. For audio gesture, when 4 fingers are down and thumb is extended, the tip of the thumb will be the master point and if it is raised the audio will increase and decrease if the tip goes down.

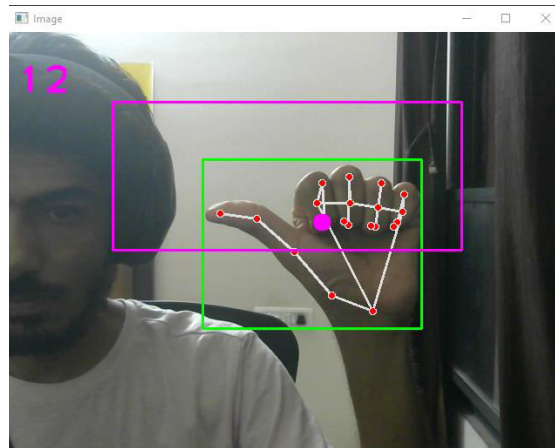


Fig 1.6 Audio-control gesture

## VII. APPLICATIONS

The Virtual Mouse program can be used for a variety of purposes; it can be used to save space while using a real mouse and in situations where we can't use a physical mouse. The approach reduces the need of devices while also improving human-computer interaction.

### Important applications include:

- The Virtual Mouse program can control PC mouse functionalities without the need for a physical mouse without the use of gadgets, this approach may be utilized to control robots and automation systems.
- Hand motions can be used to draw 2D and 3D pictures with the virtual system. Removing the requirement of wireless or cable mouse devices, AI virtual mouse can be utilized to play virtual reality and augmented reality games.
- This technology can be used by those who have difficulty using their hands to handle the computer's mouse functionalities.
- The proposed system of Human-Computer Interaction, can be utilized to control robots in the field of robotics the proposed method can be used for virtual prototyping in designing and architecture.

## VIII. FUTURE WORK

The suggested Virtual Mouse program has some flaws, such as a tiny loss of precision when using the left click mouse function, and the model has some issues with multiple clicks being registered with a single gesture. These are some of the drawbacks of the proposed virtual mouse technology, which will be addressed in future study. Furthermore, the proposed technology can be improved to virtualize keyboard and mouse functionality, which is another future application of Human-Computer Interaction (HCI).

## IX. RESULTS & CONCLUSION

The Virtual Mouse program's main goal is to control mouse cursor functionalities with hand gestures rather than utilizing a hardware mouse. The proposed system can be implemented by employing a webcam or a built-in camera to detect and process hand gestures and hand tips in order to perform certain mouse actions. We can conclude from the model's results that the suggested Virtual Mouse program worked extremely well and has a higher accuracy than existing models that included gloves and color detection techniques.

As the proposed model is accurate to a certain level, the Virtual Mouse program can be utilized in real-world applications, and it can also be used to minimize the spread of viruses and diseases, because the proposed mouse system can be used virtually without the usage of a typical physical mouse. The model has a few flaws, such as a tiny loss in precision when using the mouse functions and some difficulties selecting text by clicking and dragging. As a result, we will attempt to improve the fingertip detecting algorithm in order to produce more accurate results



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