



# AI Virtual Mouse Using Open CV Python

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**Abstract:** Today's world is all about the automating of eliminating physical tasks, boring task and task that requires more efforts to complete it. As people know that technology is really advanced and enhancing day by day, so they are moving to AI based Application in order to perform their day-to-day task with ease and in more organized way and more prominently to save their time, energy and money. Many such examples are already around us like Smartphone which can only unlock when your face matches to registered face here it eliminates our effort to enter password and we all know that this kind of smartness from phones is really helpful for humans. Thus, this project is focused on to make our devices more interactive and to make the devices operational with minimal physical contact. In this Project, we will try to build an interactive AI Virtual mouse which can be operated by human hand gestures this will allow us to control our computer with fingers and hand gestures just like what we do with the physical mouse.

The mouse is one of the wonderful inventions of Human-Computer Interaction (HCI) technology. Currently, wireless mouse or a Bluetooth mouse still uses devices and is not free of devices completely since it uses a battery for power and a dongle to connect it to the PC. In the proposed AI virtual mouse system, this limitation can be overcome by using webcam or a built-in camera for capturing of hand gestures and hand tip detection using computer vision. The algorithm used in the system makes use of the machine learning algorithm. Based on the hand gestures, the computer can be controlled virtually and can perform left click, rightclick, scrolling functions, and computer cursor function without the use of the physical mouse. The algorithm is based on deep learning for detecting the hands.

**Index Terms** - Gesture recognition, Open CV, Python, virtual mouse, hand gesture, AI.

## I. INTRODUCTION

Image processing, a division of signal processing, can consists of an image or a video as input and output as an image or various parameters of it. Gesture recognition and tracking is a kind of image processing process. In recent times, a number of gesture recognition techniques have been proposed. Hand tracking has several applications including motion capture, human-computer interaction and human behavior analysis. Several types of sensors and detection gloves are used for hand motion detection and tracking. Instead of using more expensive sensors simple web cams can identify the gesture and track the motion.

The main objective is to find the solution for the finger tracking in the real world and the control of cursor of a computer is still performed physically. There may be some difficulty in most of the applications to control the mouse physically. We can make use of web cam and with the help of some algorithms; we can control the cursor operations without touching the mouse physically. This work presents the implementation and analysis of real time tracking of fingers which involves in making a gesture so that gestures can be used in various applications of mouse like movement, single click, double click, and right click, scrolling.

Basically, it can be done in two methods of identifying fingers. One is by using colored fingertips; other is by using bare fingers and hand gestures. We can identify gestures using neural networks. Color identification and tracking is simpler than using algorithms like neural networks. We use some color tip on fingers to identify and then detect the motion of the color by background subtraction and improving this for bare finger gesture tracking without any use of colored tips. This involves processing of a running video using image processing algorithms and then track the fingers.

## II Objective:

- To control mouse cursor using AI based application in real time to provide the user with the same experience like hardware mouse.
- Developing an independent system that will help humans to interact with computer without having any physical connection.

- The objective is to develop and implement an alternative system to control a mouse cursor. The alternative method is hand gesture recognition using webcam and color detection method. The ultimate outcome of a system which recognizes hand gesture and controls mouse cursor using color detection method of any computer.
- The main objective of the proposed AI virtual mouse system is to develop an alternative to the regular and traditional mouse system to perform and control the mouse functions, and this can be achieved with the help of a web camera that captures the hand gestures and handtip and then processes these frames to perform the particular mouse function such as left click, right click, and scrolling function.

### III Significance:

Video conferencing is very popular nowadays. For this reason, most of the computer users use a webcam on their computer and most of the laptops have a built-in webcam. The proposed system which is webcam based, might be able to eliminate the need of a mouse partially. The process of interaction with a computer using hand gesture is a very interesting & effective approach to HCI (Human-Computer Interaction). There is some really good research on this interest. The hand gesture recognition technology is also popular in sign language recognition.

### IV. Literature Review:

There are some related works carried out on virtual mouse using hand gesture detection by wearing a glove in the hand and also using color tips in the hands for gesture recognition, but they are no more accurate in mouse functions. The recognition is not so accurate because of wearing gloves; also, the gloves are also not suited for some users, and in some cases, the recognition is not so accurate because of the failure of detection of color tips. Some efforts have been made for camera-based detection of the hand gesture interface.

Cursor control application using hand gesture is used in many ways, but most of the time, it requires of wearing a Data Glove. This reduces the efficiency of performance between the user and the system. And system complexity is also an issue in this process. There could be two possible gesture recognitions for HCI, one is hardware based & another one is computer vision based. One of the early hardware-based systems was proposed by Quam (1990) in which, the user had to wear a bulky Data Glove to use the system [13]. Though this method gives a high accuracy control, it is very difficult to use as some gestures are not meant for everyone and also very impractical for mass users in the everyday world.

In 2010, Chen Chiung Hsieh and Dung-Hua Liou proposed a paper "A Real-Time Hand Gesture Recognition System Using Motion History Image" [14] based on adaptive skin color model & motion history image (MHI). In their work they used an adaptive skin color model and a motion history image-based hand moving direction detection method. The prime limitation of the paper is a problem with working for more complicated hand gestures recognition.

In 2011, Chang-Yi Kao and Chin-Shyurng Fahn published a paper "A Human-Machine Interaction Technique: Hand Gesture Recognition Based on Hidden Markov Models with Trajectory of Hand Motion" [15] that is basically learning based interaction between human & machine. Their work is very accurate but it worked only in high configuration computers.

In 2013, Angel, Neethu. P.S proposed a paper named "Real Time Static and Dynamic Hand Gesture Recognition" [16] in which design, develop and study a practical gesture recognition that can be used in a variety of human-computer interaction applications framework for real-time. But, it was unable to work at a complex background and was computable only under good light.

In 2013, Ashwini M. Patil, Sneha U. Dudhane, Monika B. Gandhi proposed a paper titled "Cursor Control System Using Hand Gesture Recognition" [17] where they developed a machine-user interface which implements hand gesture recognition using simple computer vision and multimedia techniques. But a major limitation is before working with gesture comparison algorithms, skin pixel detection and hand segmentation from stored frames needs to be done.

In 2014, Abhik Banerjee & Abhirup Ghosh proposed "Mouse Control using a Web Camera based on Color Detection" [18] titled paper where the methodology is Hand gestures were acquired using a camera based on color detection technique. The limitations of their work are the operating background has to be light and no bright colored objects are present. It works well on certain computers of high configuration.

In 2016, Yimin Zhou, Guolai Jiang & Yaorong Lin published "A novel finger and hand pose estimation technique for real-time hand gesture recognition" [19] based on directly extract fingers from salient hand edges. Considering the hand geometrical characteristics, the hand posture is segmented and described based on the finger positions, palm center location and wrist position. But this method is only compatible with high configuration computer machines.

In 2016, Pooja Kumari, Saurabh Singh & Vinay Kr. Pasi developed “Cursor Control using Hand Gestures” [20] is based on multiple color bands where different colors perform different actions. The number of colors is the key to perform mouse functions. But, multiple colors were used to control the system. It is relied on the number of colors to perform a function instead of different gestures.

In 2017, Aashni Haria, Archana sri Subramanian, Nivedhitha Asok kumar, Shristi Poddar, Jyothi S Nayak developed “Hand Gesture Recognition for Human-Computer Interaction” [21] based on background extraction and contours detection system. But it is very slow to work with. In 2018, Abhilash SS, Lisho Thomas, Naveen Wilson, Chaithanya C published a paper on “Virtual Mouse Using Hand Gesture” [22] which designed to work with the color detection system, functions works on the number of colors detected. But it can perform only a few mouse actions, and does not work without static background.

In 1990, Quam introduced an early hardware-based system; in this system, the user should wear a Data Glove [23]. The proposed system by Quam although gives results of higher accuracy, but it is difficult to perform some of the gesture controls using the system. Dung-Hua Liou, Chen Chiung Hsieh, and David Lee in 2010 [24] proposed a study on “A Real-Time Hand Gesture Recognition System Using Motion History Image.” The main limitation of this model is more complicated hand gestures.

## V. PROPOSED SYSTEM ARCHITECTURE

The methods used in each & every part of the system proposing in this paper are explained separately.

**Camera:** The system works on the frames captured by the webcam on the computer machine or built-in camera on a laptop. By creating the video capture object, the system will capture video using webcam in real-time. In order to use a single camera with this system the device index would be “0”. To add additional camera device index would be 1, 2 and so on. This camera will capture frame by frame and will pass it to the system.

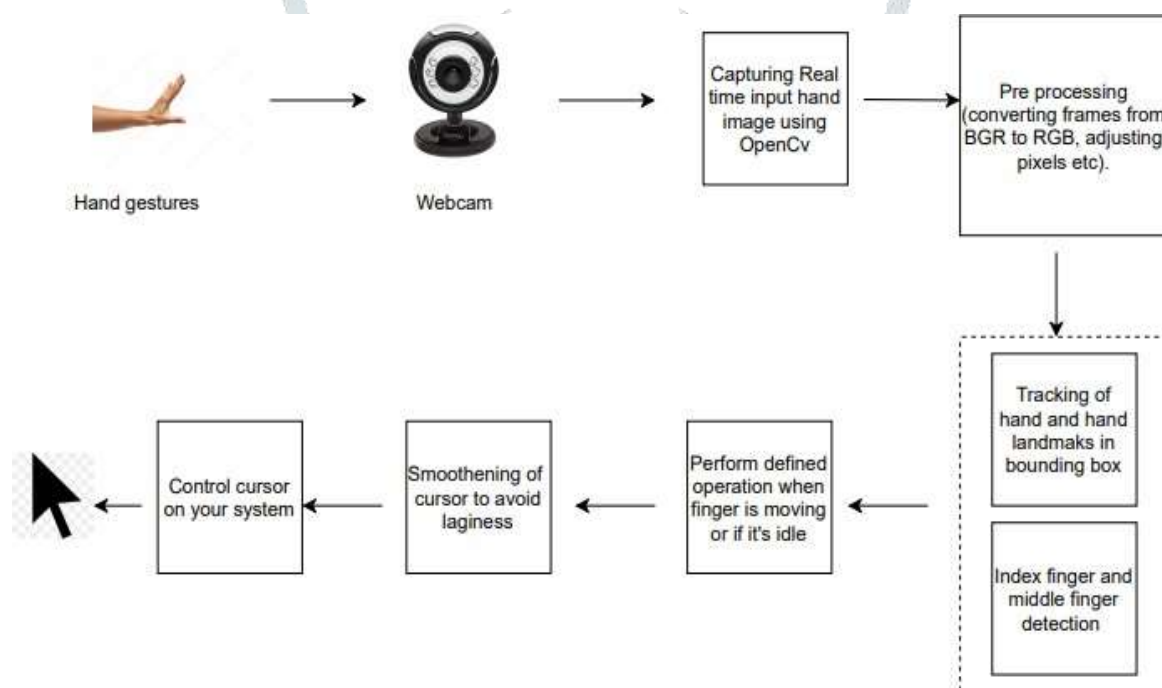


Fig : System Flow Diagram

**Capturing:** By using an infinite loop, the webcam captures each and every frame till the program termination. The frames from the real-time video are processed from BGR to HSV color space.

In this proposed system, color detection is done by detecting color pixels of fingertips with color caps from the frames that were captured by the webcam. This is the initial and fundamental step of the proposed system. The outcome of this step will be a grayscale image, where the intensity of the pixels differs the color cap from the rest of the frame and the color cap area will be highlighted. Then rectangle bounding boxes (masks) will be created around the color cap and the color cap will be tracked. The gesture will be detected from the tracking of these color caps.

## VI. 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, omicron like disease etc., 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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