
VIRTUAL MOUSE USING HAND GESTURES

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ABSTRACT

In Human Computer Interaction (HCI), the finest invention is the mouse. Even though a wireless mouse or the Bluetooth mouse is in demand today, it still lacks in many fields like cost and power. This paper, therefore, puts forward a modern approach to regulate the mouse movements using a real-time camera with the help of the hand. It does not require any electronic device. Different hand gestures are used for various operations like swiping, clicking, scrolling, and dragging. Python and OpenCV will be used for the execution of the software. NumPy, Autopy and MediaPipe are the dependencies, which will be used for the execution of the system.

Keywords: Human-Computer Interaction (HCI), Hand Gestures, Movement Tracking, OpenCV, Image Processing, Augmented Reality.

I. INTRODUCTION

The Hand gesture technology is applied in many different fields in today's world of automation, including medical applications, industry applications, IT hubs, banking sectors, and so on. This idea is based on the common notion of using hand gestures to manage a laptop or computer. The Human Machine Interface (HMI) is a hardware and software system that aids in the communication and exchange of information between the humans and the machine. As part of HMI devices, we commonly employ numerous indicators such as LEDs, Switches, Touch Screens, and LCDs. Hand Gestures are another unique means of communicating with devices such as robots or computers. Each gesture is modelled using either static model information or a dynamic system that is linear in parameters. Instead of using numerous devices such as keyboards, mice, joysticks, and so on, we may now simply utilize hand movements/hand gestures to control the laptop's functionalities.

We will thus be using Hand Gesture control system which will allow users perform many functions. Recognition takes place in real-time, with only a tiny amount of processing time and memory required. We investigate which motions are appropriate, how to recognize them, and which orders they should control. Myriads of technological advancements are occurring in today's society, such as natural language processing, biometric authentication, and face detection, which can be found on our tablets, iPads, computers, and smartphones. Similarly, Hand Movement Identification is a modern form of Human-Machine Interconnection, in which the system's mouse cursor could be controlled simply by placing our figures in front of the computer's web camera.

II. METHODOLOGY

Object Tracking In this paper, we'll make A Virtual Mouse which uses python, OpenCV, Autopy and MediaPipe framework for its functionality. We'll go step by step on how this system was made:

ALGORITHMS used to track Hand Gestures:

1. OpenCV

OpenCV stands for Open-Source Computer Vision which is a library in which is written in C++ used for Computer Vision. It is cross-platform and free to use. It provides real-time GPU acceleration features which are used in wide areas like 3D and 2D feature toolkits, Faces and gesture recognition systems.

2. Autopy:

Autopy is a cross-platform GUI automation module in python which keeps the track of our fingertips. It tells us whether a finger is up or down in 0 or 1 output format. OpenCV visualizes output from this and makes a proper frame of an image.

3. MediaPipe:

MediaPipe is a cross-platform framework which is used for building multimodal pipelines in ML and is an open-source framework made available by google. MediaPipe Hands Model makes hand detection possible by taking thousands of previous inputs and learning precise detection of hands. MediaPipe Hands can form the basis for sign language understanding and hand gesture control. It can also enable the overlay of digital content of the physical world in augmented reality (AR).

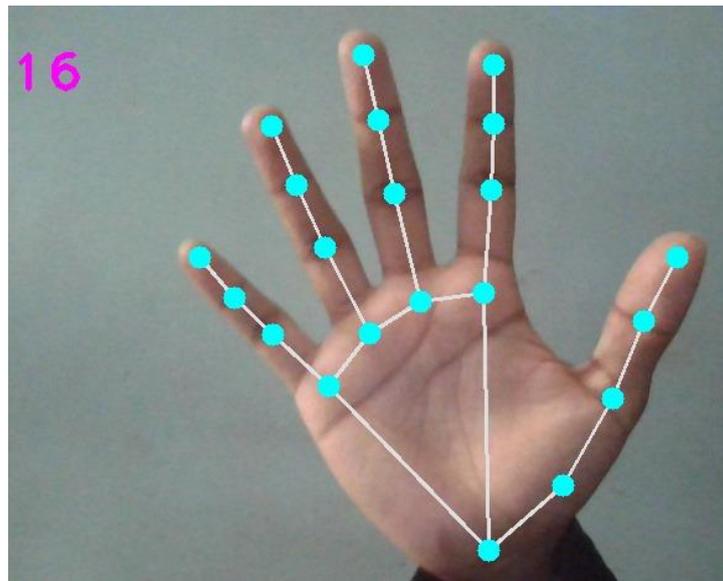


Fig.1. Hand Tracking

It uses Machine Learning (ML) to mark 21 3D landmarks of a hand just from a single frame. MediaPipe Hands uses a number of models which are available in an ML pipeline. A Hand Landmark Model operates on the cropped image region and a Palm Detection Model operates on the whole image and returns an oriented hand bounding box used for the hand detection process respectively. The pipeline created can run in various platforms allowing scalability in mobile and desktops.

PROCESS

A. Creating the space for the system and getting the necessary libraries

We use pycharm for creating our project. We initialize our working space and install all of our necessary libraries and frameworks (OpenCV, Mediapipe, Autopy) in pycharm. Then we import them as we make start writing the code for our project.

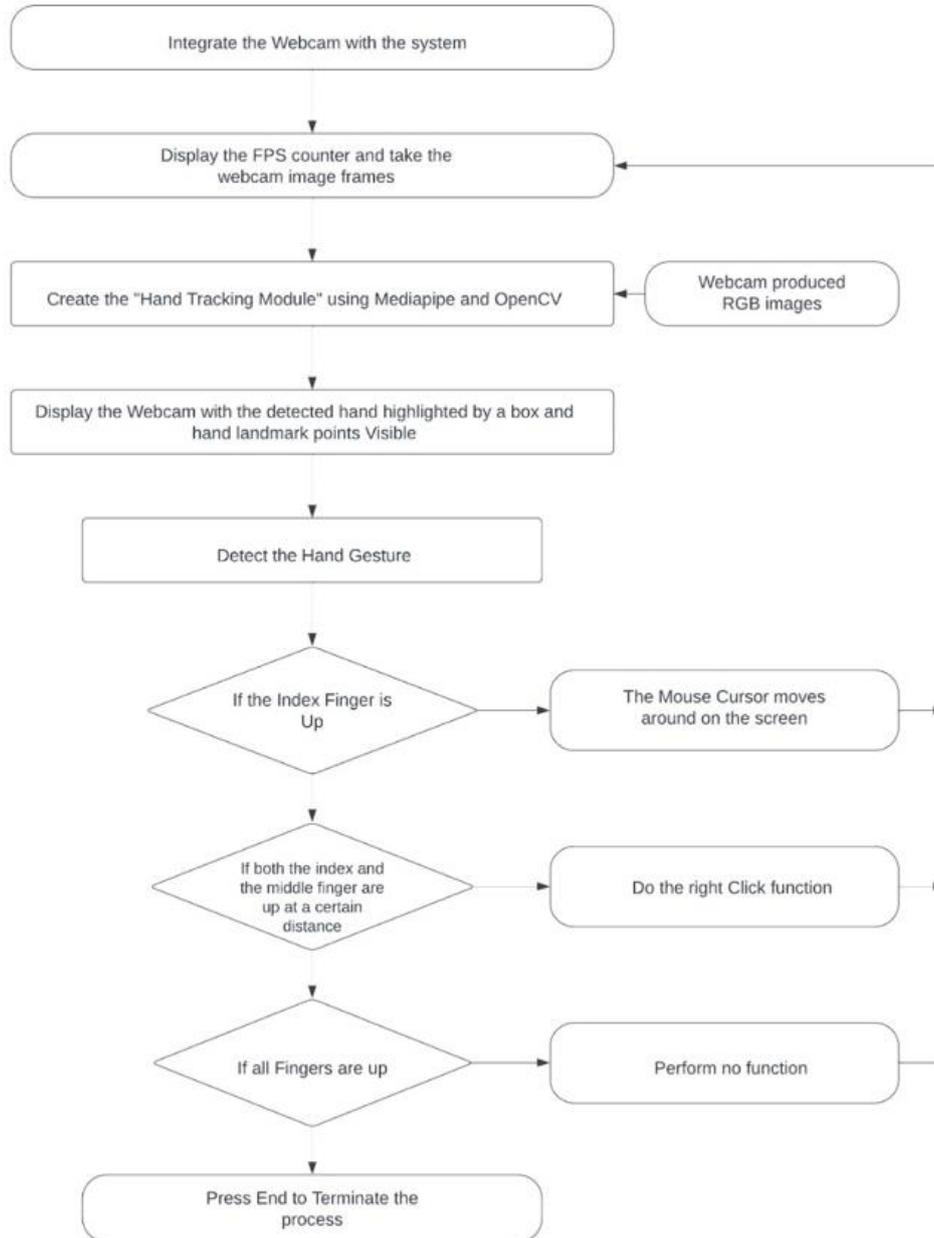


Fig.2. Process Flowchart

B. Getting the webcam ready and showing the framerate:

In this step, we initialize the primary webcam of our system to open and function according to our requirements. While writing the code, we give the default “0” value in the webcam code otherwise respective “1, 2 or 3”, depending on the number of the capturing device. After this, we write a simple code which gives up the real-time frames of the webcam which is displayed on the screen. This helps to check how smooth the video is and make it smoother, the less response time it takes for the device to take the user input and act accordingly.

C. Making the Hand tracking module:

After the video-capturing device is set, we start by writing the code for hand detection. Hand Detection includes getting the necessary 21 landmark points of the hand which helps in getting the position of the fingers respectively. We use Mediapipe for this process as it makes it easier for us to work due to its pre-trained models. We set values for different characteristics such as maximum hands, model complexity, model confidence, and tracking confidence which is an important part as it gives us the working rate of the model. We

then set and adjust the value of our appearance of the hand tracking system and see if it is convenient for the user (e.g.: we check whether the lines showing hand tracking are clearly visible or not).

After this, we use the coordinate system to give coordinate values for our fingers which are stored in the form of an array. Smoothing techniques are applied to make the working of the module much smoother than the original. We then check whether the given code is appropriately working according to the code and make the small minor adjustments necessary. We can add functionalities like making the tracking lines on our palm visible or invisible whichever way is convenient. The figure below depicts the flowchart of the system.

D. Embedding the Mouse Functionalities in the hand tracking system:

Here, we define the various functionalities of a mouse in our hand-tracking system. This is done by defining various hand gestures for certain functions.

(Example:

a. Index finger up: Gives the normal mouse movement of a mouse.

b. Index and middle finger up at a certain distance: Gives the clicking function of the mouse)

This is possible only after we define the proper distance and coordinates for the proper finger functionalities. The model works as per the given functions with high accuracy.

III. LITERATURE SURVEY

track the movement Monali Shetty, , Manthan K. Bhatkar, and Ofrin P. Lopes 2020 proposed a study on “Virtual Mouse Using” at the 2020 5th International Conference on Communication and Electronics Systems (ICCES). A system has been proposed to recognize objects and perform the mouse function, which includes the movement of the mouse cursor, the drag, and click [1]. This system allows the user to navigate the system cursor using their hand-bearing color caps or tapes that the computer webcam tracks and perform mouse operations. But only a few mouse functions are performed. [1]

Five authors - Siddhika Aher, Bhairavi Brahme, Chhaya Upadhyay, Debajyoti Mukhopadhyay, and Megha Gupta 2019 proposed a study on “An Experimentation to Simulate Mouse Movement using Hand Gestures based on Human-Computer Interaction” in the International Journal of Computer Applications. This paper proposes a new approach for controlling mouse movement using a real-time camera. Image processing is performed on each frame of that video to detect the color and mouse tasks are performed. The limitation is it depends on various colors to perform mouse functions.

ChenChiung Hsieh, Dung-Hua Liou, and David Lee 2010 proposed a study on “A Real-Time Hand Gesture Recognition System Using Motion History Images.” In this paper, a face-based adaptive skin color model and a motion history image-based hand-moving direction detection method were proposed.

An adaptive skin color model based on face detection is utilized to detect skin color regions like hands. To classify the dynamic hand gestures, a simple and fast motion history image-based method is developed. The limitation of this model is the analysis of the tricky hand gestures used.

Balamurugan. C1, Arumuga Kumar. M2, Arun Mozhi. N3 and Deepak. P4 proposed a study on “HCI SYSTEM WITH HAND GESTURE” in the International Research Journal of Engineering and Technology (IRJET). This project represents a concept of controlling our video display with the assistance of hand gestures, which relies on one in each of the studies of Human-Computer Interaction. The target was to develop a Machine Learning application that will communicate with any digital device with fewer hardware needs and victimization of an indoor camera that act as a detector to capture the gestures. The limitation was it was complex to understand the model in real-life.

IV. SUMMARY

The purpose of this project is to develop a virtual mouse that can be controlled using hand gestures. The mouse will be able to track the movement of the user's hand and convert it into cursor movement on the screen. The mouse will also be able to click and double-click by detecting specific hand gestures.

This project will require the use of a camera to track hand gestures. The user's hand will be needed to be in front of the camera to work properly. The camera will be used to track the movement of the hand and convert it into cursor movement on the screen. Computer vision Python libraries like Autopy, OpenCV, and MediaPipe will

be used for hand tracking. The algorithms will first track and then convert the hand gestures into respective operations on the screen.

V. CONCLUSION

The Virtual Mouse Using Hand Gestures project is created so that the classic computer mouse can be used without an actual physical device or surface. Using a webcam to track hand gestures and then convert them into responding cursor actions. The project its early stages, but the team is hopeful that the Virtual Mouse will eventually be able to replace the traditional computer mouse. The project has the potential to help people with limited mobility or who are unable to use a traditional mouse.

VI. REFERENCES

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