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**AI VIRTUAL MOUSE USING OPENCV****Shrinidhi Chintamani\*<sup>1</sup>, Rutuja Bhad\*<sup>2</sup>, Nikhil Deokar\*<sup>3</sup>,****Kalyani Kadam\*<sup>4</sup>, Prof. Abhale B.A\*<sup>5</sup>****\*<sup>1,2,3,4,5</sup>Department Of Information Technology, S. N. D. College Of Engineering &  
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**ABSTRACT**

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 employing 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, right click, scrolling functions, and computer cursor function without the use of the physical mouse. The algorithm is based on deep learning for detecting the hands.

Hence, the proposed system will avoid COVID-19 spread by eliminating the human intervention and dependency of devices to control the computer. Python programming language is used for developing the AI virtual mouse system, and also, OpenCV which is the library for computer vision is used in the AI virtual mouse system. In the proposed AI virtual mouse system, the model makes use of the MediaPipe package for the tracking of the hands and for tracking of the tip of the hands, and also, Pyinput, Autopy, and PyAutoGUI packages were used for moving around the window screen of the computer for performing functions such as left click, right click, and scrolling functions.

The results of the proposed model showed very high accuracy level, and the proposed model can work very well in real-world application with the use of a CPU without the use of a GPU.

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**I. 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. This 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. The 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 [1] 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.

**Project Aim:**

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 hand tip and then processes these frames to perform the particular mouse function such as left click, right click, and scrolling function.

**Problem Statement:**

The projected AI virtual mouse using hand signal structure could in like manner be familiar with beat issues inside the spot like things where there isn't any space to use a genuine mouse and set up for individuals who have issues in their grip and don't appear, apparently, to be prepared to manage a real mouse. Moreover, the COVID circumstance, it isn't safeguarded to include the devices by reaching them as an eventual outcomes of it's intending to achieve what is happening of spread out of the disease by reaching the contraptions, that the projected AI virtual mouse could in like manner be adjusted vanquished these issues since hand sign and hand

Tip disclosure is used to manage the device mouse limits by using a camera or a characteristic camera like webcam. While using a remote or a Bluetooth mouse, a couple of devices especially like the mouse, the contraption to connect with the pc.

## II. LITERATURE SURVEY FOR PROBLEM IDENTIFICATION AND NEED OF PROJECT

The current construction is contained a nonexclusive mouse and track pad screen control framework, as well as the mishap of a hand development control structure. The utilization of a hand development to get to the screen from a nice ways is unimaginable. No matter what how it is basically attempting to execute, the degree is just restricted in the virtual mouse field. The current virtual mouse control structure contains direct mouse tasks utilizing a hand attestation framework, in which we have some control over the mouse pointer, left click, right snap, and drag etc The utilization of hand confirmation in the future won't be utilized. Despite how there are a gathering of frameworks for hand certification, the construction they utilized is static hand attestation, which is just a confirmation of the shape made by the hand and the meaning of activity for each shape made, which is restricted to a few depicted activities and makes a great deal of unsettling influence. As progression drives, there are something else and more decisions rather than utilizing a mouse. Coming up next are a piece of the techniques that were used:-

1) Camera Used in the Virtual Gesture Mouse project: Open- CV is python vision library that contains Associate in the organized AI virtual mouse structure depends upon the edges that are gotten by the camera in Associate in nursing passing computer.

2) Providing Input: Pictures in Computer Vision are portrayed as associations of numbers watching out for the discrete eclipsing or power values present in each picture pixel. Each picture is considered as information displayable in various ways, whether as collections of pixel values or either complex plots keeping an eye on the course of pixel powers.

3) Moving hand through the Window using rectangular area: The AI virtual mouse structure uses the informative algorithmic rule, and it changes over the co-ordinates of tip from the camera screen to the pc window full screen for the mouse. 4) Detect the Finger tips and doing the Mouse Cursor improvements 5) In this construction, AI mouse is police evaluation that finger is up deceiving the spot co-ordinate of the particular finger that it'll found abuse the Media-Pipe and along these lines the specific bits of the fingers that region unit up, and according to that, the authentic mouse perform is played out its assignments. Regardless, all of the systems under has its own game plan of checks. The usage of the head or eyes to control the cursor constantly can be risky to one's prosperity. This can induce different issues with flourishing. While using a touch screen, the client ought to stay aware of their accentuation on the screen constantly, which can cause drowsiness. By taking a gander at the going with systems, we want to make another endeavor that won't hurt the client's prosperity

**Need of project:** The PC mouse is one of the wondrous developments of people in the field of Human-Computer Interaction (HCI) innovation. In new age of innovation, remote mouse or a contact less mouse actually utilizes gadgets and isn't liberated from gadgets completely, since it utilizes power from the gadget or might be from outside power sources like battery and gain space and electric power, likewise during COVID pandemic it is encouraged to make social separating and keep away from to contact things which gave by various people groups. Inside the projected AI virtual mouse utilizing hand signal framework, this constraint might be resolve by involving advanced camera or sacred camera for perceive the hand motions and fingers recognition abuse PC machine vision. The algorithmic rule used in the framework utilizes the man-made consciousness and AI algorithmic rule. Upheld the hand signals, the gadget might be controlled pretty much and might do left click, right snap, looking over capacities, and PC gadget pointer perform while not the utilization of the genuine mouse.

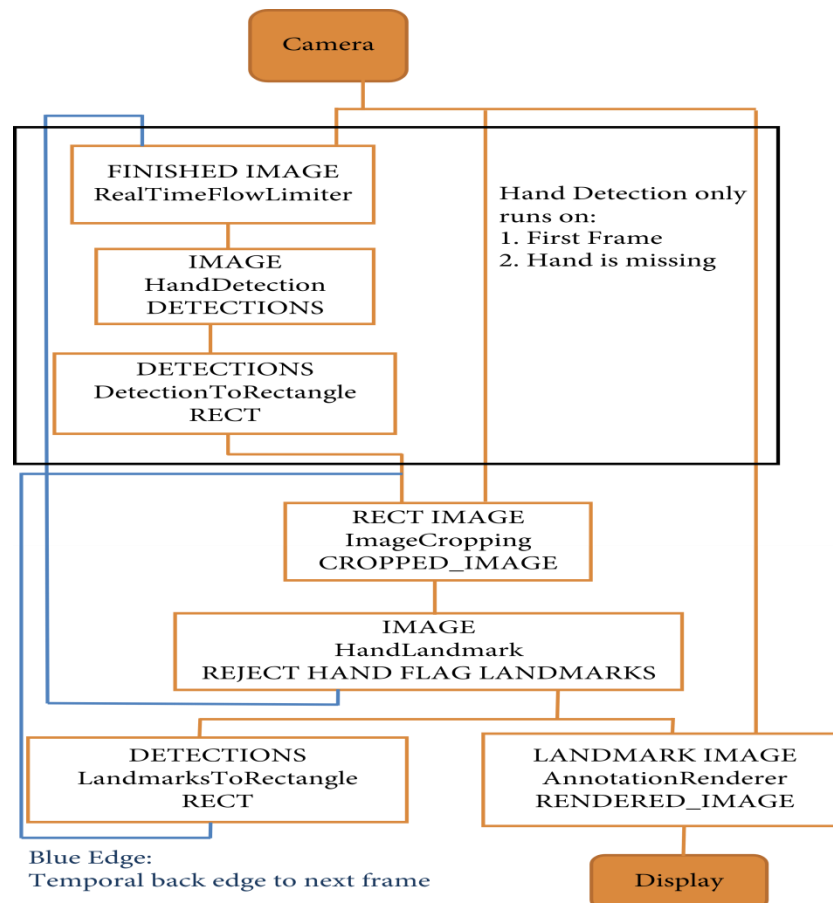
### Algorithm Used, Proposed system/ MODEL

#### 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 [7–10]. 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 framework 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 [11]. The MediaPipe framework is used by the developer for building and analyzing 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. Developers 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 diagram; the graph (Figure 1) is created with MediaPipe where each node is a calculator and the nodes are connected by streams



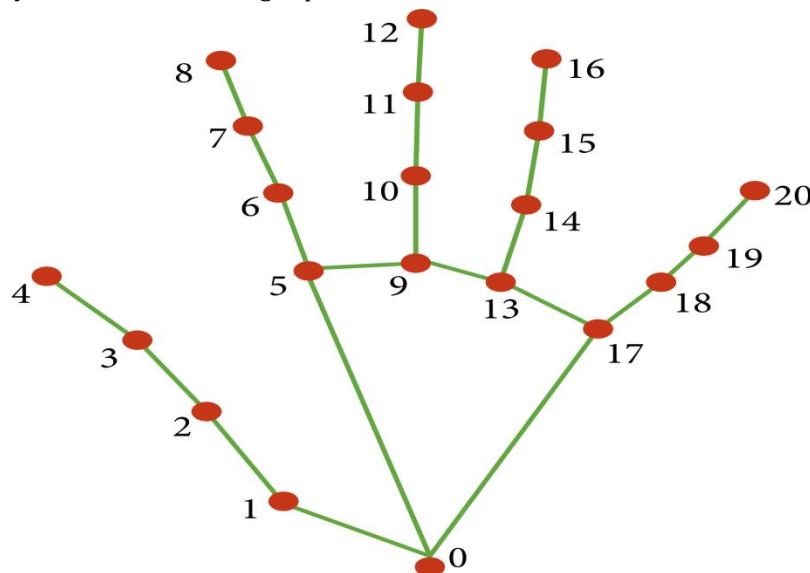
## Open-CV MODULE

PC vision is an interaction by which we can comprehend the pictures and recordings how they are put away and how we can control and recover information from them. PC Vision is the base or generally utilized for Artificial Intelligence. The primary Open-CV form was 1.0. Open-CV is delivered under a BSD permit and thus it's free for both scholar and business use. It has C++, C, Python and Java connection points and supports Windows, Linux, Mac OS, iOS and Android. At the point when Open-CV was planned the fundamental center was continuous applications for computational productivity.

## III. METHODOLOGY

Pre-processing or to be specific picture handling is an earlier advance in PC vision, where the objective is to change over a picture into a structure reasonable for additional investigation. Instances of tasks, for example,

openness rectification, shading adjusting, picture sound decrease, or expanding picture sharpness are exceptionally significant and very consideration requesting to accomplish adequate outcomes. For this article, I propose to introduce a part of the typically used picture taking care of methodology using an outstandingly notable Computer Vision library, Open-CV. I'll endeavor to portray immediately the manner by which each movement works and spotlight more on dealing with the point even more basically, giving you all the code you truly need so you have a functioning experience of the material.



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

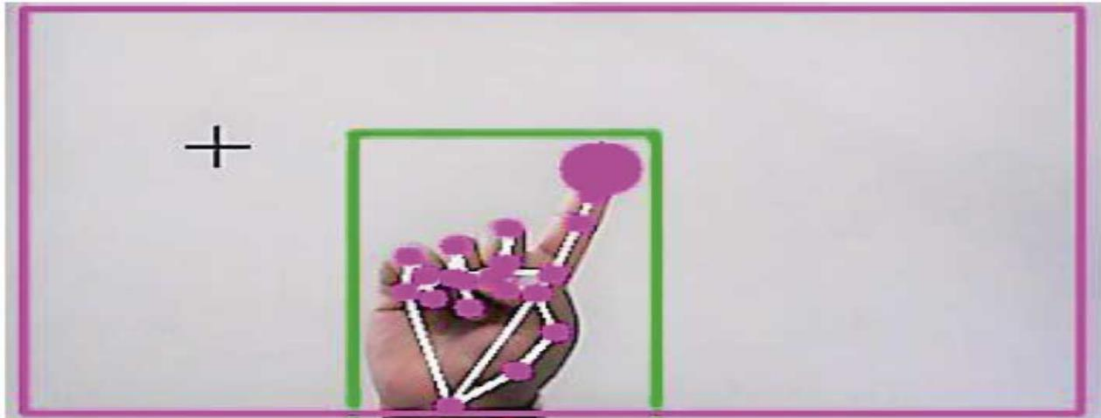
### The Camera Used in the AI Virtual Mouse System

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,

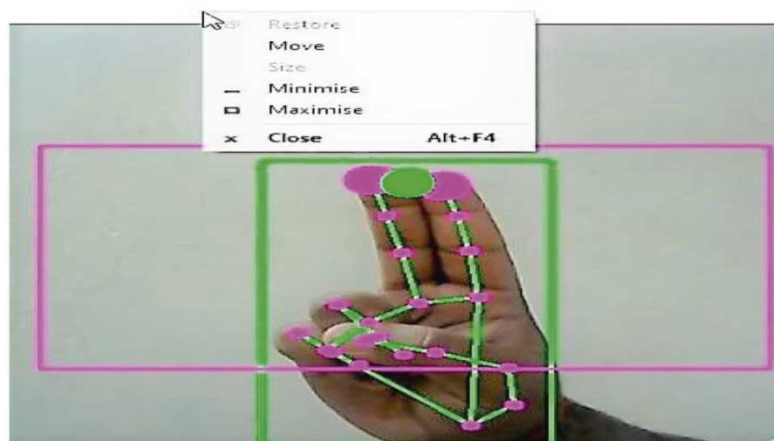


### Detecting Which Finger Is Up and Performing the Particular Mouse Function

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.

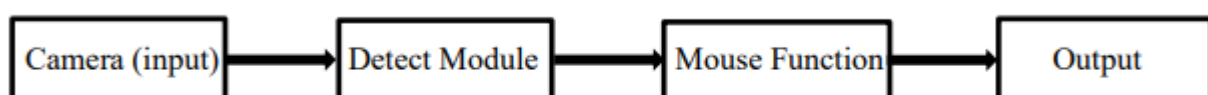


**For the Mouse to Perform Right Button Click-**If both the index finger with tip Id = 1 and the middle finger with tip Id = 2 are up and the distance between the two fingers is lesser than 40 px, the computer is made to perform the right mouse button click using the pynput Python package



### Proposed System/model-

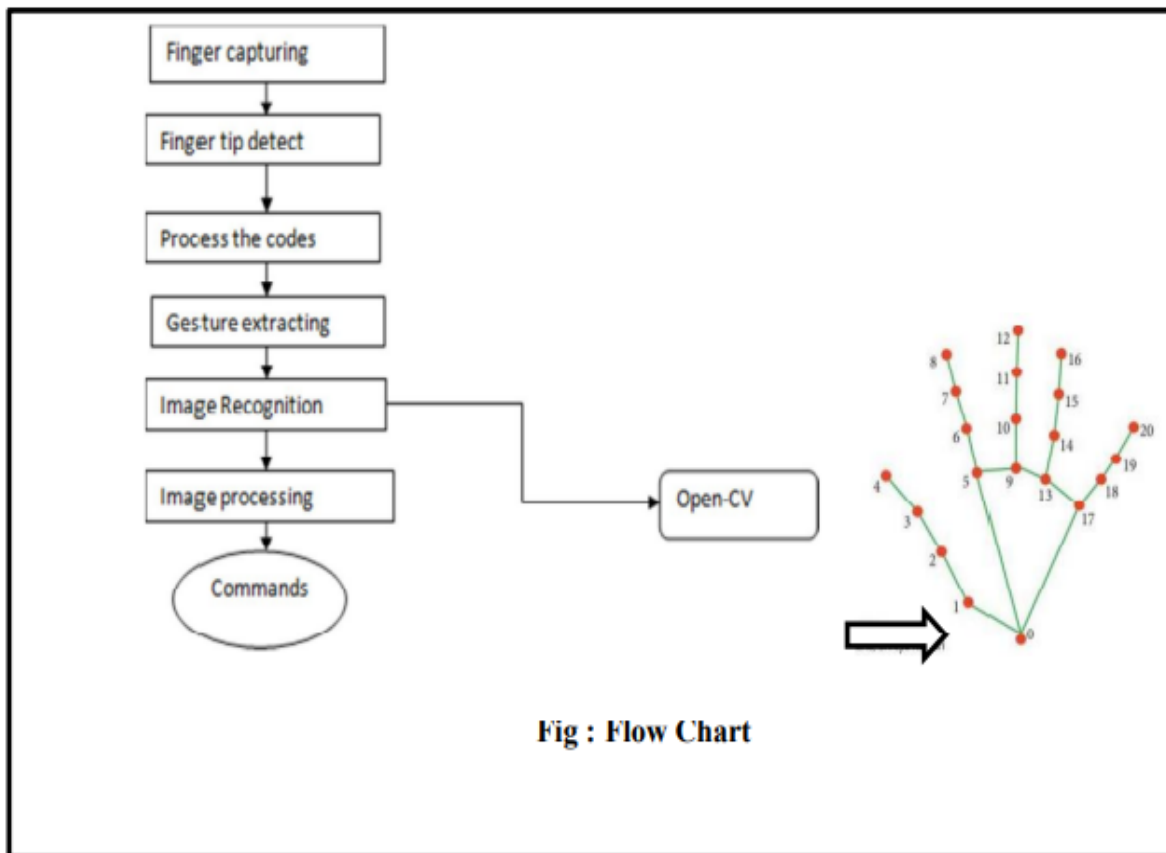
For the characteristic of area of hand signals and hand development, the Media Pipe system is utilized, and Open-CV library is utilized for PC machine vision the standard purposes the AI contemplations to keep and see the hand developments and fingertip.



Pre-processing or to be specific picture handling is an earlier advance in PC vision, where the objective is to change over a picture into a structure reasonable for additional investigation. Instances of tasks, for example, openness rectification, shading adjusting, picture sound decrease, or expanding picture sharpness are exceptionally significant and very consideration requesting to accomplish adequate outcomes.

For this article, I propose to introduce a part of the typically used picture taking care of methodology using an outstandingly notable Computer Vision library, Open-CV. I'll endeavor to portray immediately the manner by which each movement works and spotlight more on dealing with the point even more basically, giving you all the code you truly need so you have a functioning experience of the material.

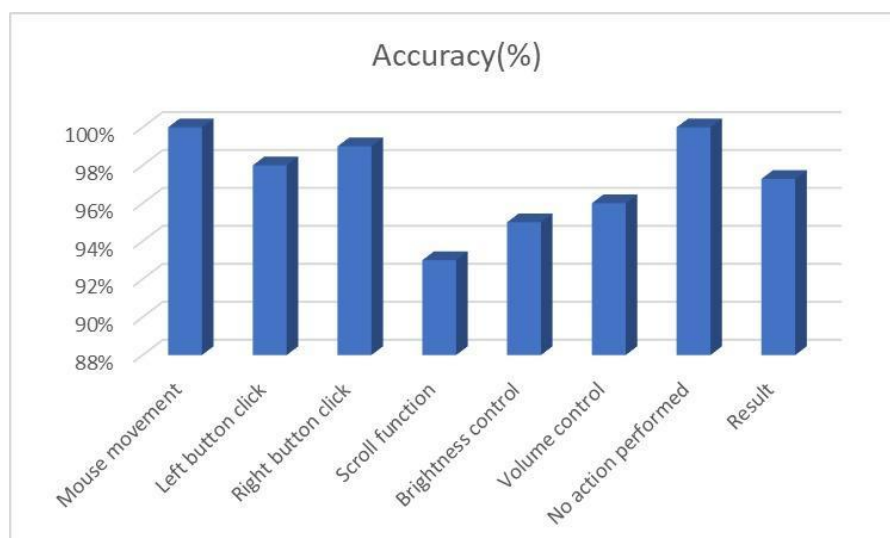




**Fig : Flow Chart**

#### IV. PERFORMANCE ANALYSIS

In the proposed AI virtual mouse system, the concept of advancing the human-computer interaction using computer vision is given. Cross comparison of the testing of the AI virtual mouse system is difficult because only limited numbers of datasets are available. The hand gestures and finger tip detection have been tested in various illumination conditions and also been tested with different distances from the webcam for tracking of the hand gesture and hand tip detection. An experimental test has been conducted to summarize the results shown in Table .The test was performed 25 times by 4 persons resulting in 600 gestures with manual labelling, and this test has been made in different light conditions and at different distances from the screen, and each person tested the AI virtual mouse system 10 times in normal light conditions, 5 times in faint light conditions, 5 times in close distance from the webcam, and 5 times in long distance from the webcam, and the experimental results are tabulated in Table.



## V. 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) The 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 reality- and 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.

## 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-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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