A Practical Ai-Based Approach For Mouse Pointer Actions

P Muthulakshmi[1], Varsha S[2], Saranya D[3]
[1] Asst prof, Dept of Artificial Intelligence & Data Science
[2, 3]Dept of Information Technology
[1, 2, 3] Meenakshi Sundararajan Engineering College

Abstract- *The computer is one of technology's marvellous and intriguing discoveries that has greatly benefited people in every field. The state of computer technology nowadays is already advancing rapidly and contemporary. Yet, this suggested system will make technology easier for people to use. In this paper, a computer vision-based AI virtual mouse system is proposed that uses hand motions and hand tip detection to perform mouse functionalities. The proposed system's primary goal is to replace the use of a standard mouse device with a web camera or a computer's built-in camera to execute computer mouse cursor and scroll capabilities. The AI virtual mouse system was created using the Python programming language and also makes use of the OpenCV computer vision package. The MediaPipe package is used in the proposed AI virtual mouse system to track the hands and the tips of the hands. The PyAutoGUI package was also used to move around the computer's window screen and perform functions like left and right clicks and scrolling. The project's algorithmic rule makes use of artificial intelligence and man-made consciousness. By using hand signals, the device may be handled pretty easily and execute functions like left, right clicks and PC device pointer actions without the usage of a real mouse.*

Keywords- virtual mouse, hand gesture recognition, image processing, Hand Landmark.

I. INTRODUCTION

A mouse is a pointing device that recognises motions in two dimensions in relation to a surface. In order to manipulate the Graphical User Interface (GUI) on a computer platform, this movement is translated into the movement of a pointer on a display. Modern technology has produced several different sorts of mice, including the mechanical mouse, whose movements are controlled by a firm rubber ball that rotates when the mouse is moved. Later on, the optical mouse was developed, which switched out the hard rubber ball with an LED sensor. Since the release of a mobile device with touch-screen technology, people have begun to demand that the same technology be used on all other modern devices, including desktop computers. Although touch-screen technology for desktop computers currently exists, the cost can be considerable. Therefore, an alternative to the touch screen might be a virtual human-computer interaction device that uses a webcam or other picture-capturing device to replace the actual mouse.

This study suggests a computer vision-based artificial intelligence (AI) virtual mouse system that uses hand gestures and hand tip detection to emulate mouse actions. With the help of gestures, every task can be completed with this application, making using the computer easier. The main objective of the proposed system is to substitute a web camera or a built-in camera in the computer for the use of a conventional mouse device to control computer mouse pointer actions. With the aid of the AI virtual mouse system, we may use a built-in camera or a web camera to watch the fingertip of a hand gesture, perform mouse cursor actions, perform scrolling, and move the cursor along it.

The suggested system uses a web camera to take pictures, analyse those pictures, identify different hand gestures and hand tip gestures, and then carry out the relevant mouse action. It is fair to say that the virtual mouse will soon take the place of the conventional physical mouse in the near future, as people strive to live in a world where all technological devices can be operated and interacted with remotely without the need for any peripheral devices like remote controls, keyboards, etc. Not only does it offer ease, but it also saves money.

This AI virtual mouse system was created using the Python programming language and also makes use of the OpenCV computer vision package. The MediaPipe package is used by the model in the proposed AI virtual mouse system to track the hands and the tips of the hands, and the PyAutoGUI package was also used to move around the computer's window screen and perform actions like left- and right-clicking and scrolling.

II. RELATED WORK

To solve the challenges faced in mouse detection and movement, a lot of research work is being carried out. Here are a few related studies focused on virtual mice that employ hand motion location by wearing them among the hands and also use coloured tips among the hands for motion recognition, but their mouse functions are no more precise. Wearing gloves causes the recognition to be less accurate; certain users may not be able to use the gloves; and occasionally, the failure to detect colour tips causes the recognition to be less accurate. There have been some attempts to detect the hand gesture interface using a camera.

Prof. Monali Shetty, Christina A. Daniel, Manthan K.Bhatkar, Ofrin P. Lopes, proposed a study on "VIRTUAL MOUSE USING OBJECT TRACKING " [1],This system uses hand gestures to virtually perform mouse operations. In this system, the user wants to wear a coloured cap while performing mouse actions. The system uses a web camera to capture frames, and the frames are converted into HSV images to detect the object in the frame. Based on the object position, the corresponding mouse function is performed. The system Accuracy With non-plain Background is only 40%

Gajendra Moroliya, Sahil Patwekar, Gopnarayan, proposed a study on "VIRTUAL MOUSE USING HAND GESTURE " [8],In this system, the user wants to wear a coloured tap while performing mouse actions. The system uses a web camera to capture video, and video is divided into image frames based on the FPS. After that, the image is flipped. The flipped image is converted into a grayscale image. After it was converted into a binary image, and Matlab is used to control the cursor movement.faces difficulties in getting stable results because of the variety of different colours and skin tones among human races.

Joy Guha, Shreya Kumari, Prof. Shiv Kumar Verma, proposed a study on “AI VIRTUAL MOUSE USING HAND GESTURE RECOGNITION"[3], They proposed a system that uses hand gestures that are captured from a webcam, and the model makes use of the MediaPipe package for the tracking of the hands. Also, PyAutoGUI packages were used for performing mouse functions. It has only limited functionality sunch as left and right click.

Jayakrishna R, P swarnalatha, proposed a study on "VIRTUAL MOUSE" [6],They have used three different color caps and acquired the results for various mouse functionalities. Identification of colored caps on the fingertips and their tracking is involved in this work. Accuracy on a high-brightness background: 30%

So our proposed work will overcome this drawback with increased accuracy in detection.

III. MODULES

This section briefly covers the dataset description, preprocessing, deep learning models.. Fig. 1 shows the workflow diagram of the methodology followed in this study.

A. Mediapipe

An open source framework from Google called MediaPipe is used for applying in a machine learning pipeline. Due to the fact that the MediaPipe framework is based on time series data, it is beneficial for cross-platform development. The multimodal MediaPipe framework can be used with a variety of audio and video files. The MediaPipe framework is employed by the developer when creating and analysing systems using graphs as well as when creating systems for application-related purposes. The pipeline configuration is used to carry out the processes in the MediaPipe-using system. The built-in scalability of the pipeline allows it to be used on both desktops and mobile devices. The three core components that make up the MediaPipe architecture are performance evaluation, a system for obtaining sensor data, and a group of reusable pieces known as calculators. A pipeline is a graph made up of units called calculators that are connected to one another by streams via which data packets pass. In order to create their own application, developers can add, remove, or redefine custom calculators anywhere in the graph.

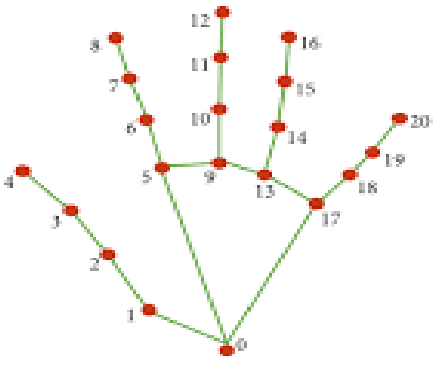

Figure 1: Co-ordinates or land marks in the hand.

Real-time detection and identification of a hand or palm is accomplished using a single-shot detector model. The

MediaPipe employs a single-shot detector concept. Because it is simpler to learn palms, the hand detection module initially trains a model for palm detection. Additionally, tiny items like palms or fists respond substantially better to the nonmaximum suppression. As shown in Figure 1, a model of hand landmark entails finding 21 joint or knuckle coordinates in the hand region.

2. OpenCV

Object detection image processing algorithms can be found in the OpenCV computer vision library. Real-time computer vision applications can be created by utilising the computer vision library, OpenCV, which is a part of the Python programming language. The OpenCV package is used for face and object detection as well as other analysis tasks in the processing of images and videos.

3. Pyautogui

The automation library PyAutogui for Python supports keyboard and mouse control. Using a Python script, it is simpler for us to automate keyboard and mouse clicks in order to establish interaction with another application. It has a lot of features.

IV. METHODOLOGY

The following explanations provide an overview of the system's many circumstances and functions.

A. Read frames from a webcam

The webcam on a laptop or PC has recorded frames that are the foundation of the proposed AI virtual mouse system. The web camera will start recording video and send the frames to the system after a video capture object is built using the Python computer vision package OpenCV.

B. Processing the frames

To identify the hands in the frame, the video frames are converted from BGR to RGB.

C. Draw landmark for captured hand using media pipe

The AI virtual mouse system recognises hand motions in real time and outputs the results together with the hand landmarks that were discovered. Draw the identified landmarks on the image using media pipe's draw_land marks function. Utilising the transformational method, this system transforms the fingertip coordinates from the webcam screen to the full-screen computer window for manipulating the mouse.

D. Detecting hand gesture

Using the tip ID of the specific finger that we located using the MediaPipe and the corresponding co-ordinates of that finger, we are determining which finger is up at this point.

E. Mouse operations Depending on the Hand Gestures

1. Cursor Moving around the Computer Window- If both index and middle fingers are up with tip IDs of 3, 12, and the distance between the fingers is greater than 0.1 (v gesture), then it performs the cursor moving operation as shown in Figure 3.
2. Left Button Click If the middle finger is up and the tip ID is 12, then it performs a left button click operation as shown in Figure 6.
3. Right Button Click – If the index finger is up and the tip ID is 3, then it performs a right button click option as shown in Figure 8.
4. Double Click – If the index and middle fingers are up and closed to each other with the tip ID 3, 12, then it performs a double-click operation as shown in Figure 4.
5. Drag and Drop - if the index and middle fingers are bent with the tip ID 3, 12, then it performs a drag and drop operation.
6. Select all - The first gesture is used to perform a select-all function as shown in Figure 4.
7. Volume control and scroll operation - The pinch gesture is used to control the volume and brightness and also perform scroll functions. If the pinch gesture moves vertically, then it performs volume control as shown in Figure 7.

V. EXPERIMENTAL RESULTS AND EVALUATION

The idea of employing computer vision to advance human-computer interaction is presented in the suggested AI virtual mouse system.

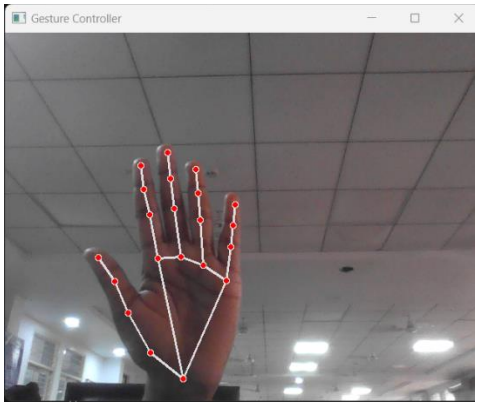

Figure 2: Still action

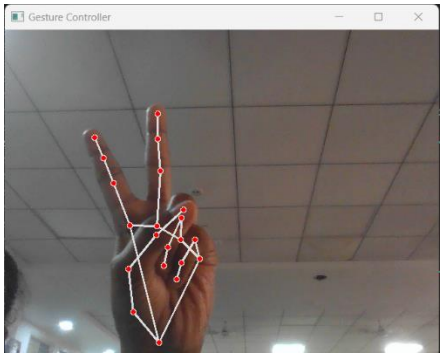

Figure 3: Cursor Movement

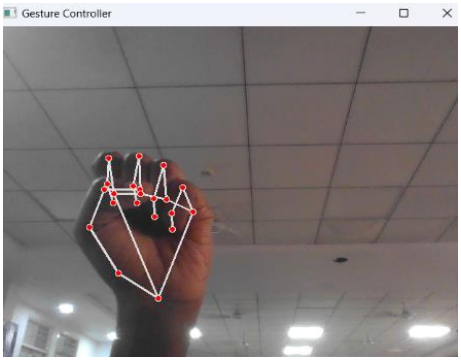

Figure 4: Select all

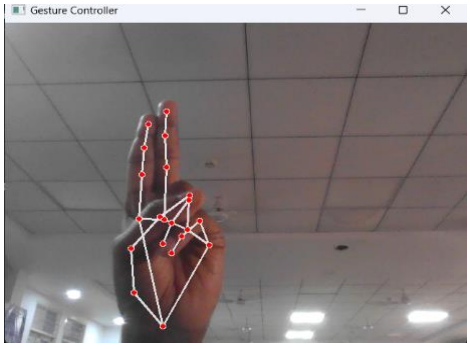

Figure 5: Double Click

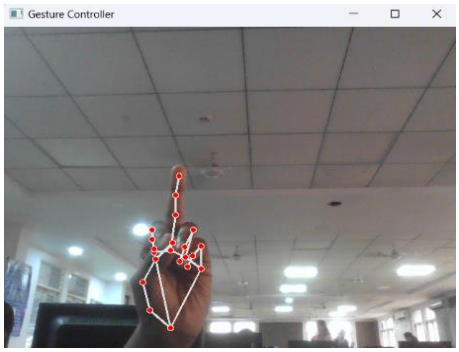

Figure 6: Left Click

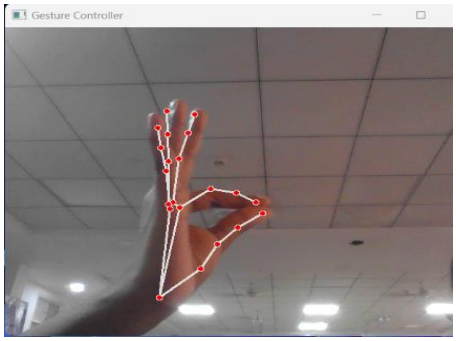

Figure 7: Volume control

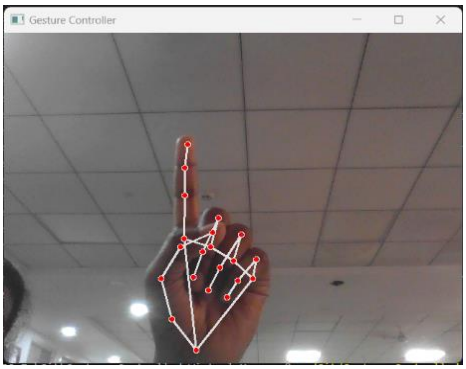

Figure 8: Right click

There aren't many datasets available, making it difficult to evaluate the AI virtual mouse system. In an effort to evaluate their capabilities under various lighting circumstances, the webcam has been positioned at different distances from the user to monitor hand gestures and detect finger tips. Five persons performed the test 20 times, giving 700 hand labelled motions. The test was run in a variety of lighting and viewing distances. The experiment's results are depicted in the figure 9.

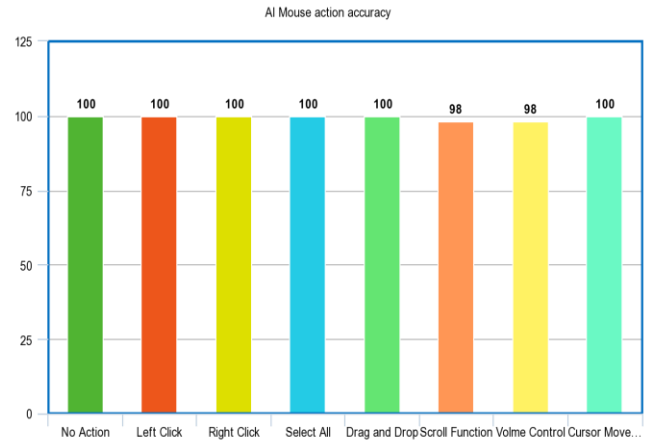

Figure 9: AI mouse action accuracy

REFERENCES

[1] Prof. Monali Shetty, Christina A. Daniel, Manthan K.Bhatkar, Ofrin P. Lopes,"Virtual Mouse Using Object Tracking", Issue July 22,2020 at 16:08:03 UTCfrom IEEE Xplore.

[2] Vantukala VishnuTeja Reddy1 , Thumma Dhyanchand2 , Galla Vamsi Krishna3,Satish Maheshwaram4,"Virtual Mouse Control Using Colored Finger Tips andHand Gesture Recognition", Issue on June 01,2021 at 09:48:13 UTC from IEEEXplore.

[3] Joy Guha1, Shreya Kumari, Prof. Shiv Kumar Verma,"AI Virtual Mouse UsingHand Gesture Recognition", Volume 10 Issue IV Apr 2022.

[4] Pulkit Garg[1], Riya Shrivastava[2], Abhishek Saran Sagar[3], Faraj Chishti[4]"VIRTUAL MOUSE USING HAND GESTURE", Volume 6, Issue 5 May2019.

[5] S. Shriram ,B. Nagaraj ,J. Jaya ,S. Shankar, and P. Ajay "Deep Learning-BasedReal-Time AI Virtual Mouse System UsingComputer Vision to Avoid COVID-19 Spread", Published 25 October 2021

[6] Jayakrishna, p swarnalath, "Virtual Mouse", Volume 8, Issue 12 December2021.

[7] Saniya Khan, Dnyaneshwari Bagekar, Abhishek Chauhan, Prof.DeveshreeWankhede, "Virtual Mouse Using Hand Gesture", Volume 9, Issue 5 May 2021.

[8] Gajendra Moroliya, Sahil Patwekar, Gopnarayan,"Virtual Mouse Using Hand Gesture", May 2018, Volume 5, Issue 5

[9] Kabid Hassan Shibly, Samrat Kumar Dey, Md. Aminul Islam, Shahriar Iftekhar Showrav, "Design and Development of Hand Gesture Based Virtual Mouse", 2019 IEEE