



Virtual Mouse using Artificial Intelligence

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Abstract : This paper is an excellent example of Human computer interaction where the user can perform actions of a mouse without using any external hardware mouse, we can achieve this by adapting various artificial intelligence algorithms and python libraries. The working of this system starts when we first assign gestures into the machine as input values eg; scroll up and down, click and double clicks and drag and drop etc, user can select gestures as per his/her choices then these assigned gestures are recorded using webcam so by this the data is filmed and actions are performed in the machine virtually. This saves the cost of the external mouse and also provides users with privilege of operating the machine easily.

Keywords - Artificial Intelligence, Gesture assigning, Human computer interaction, Python libraries, Virtual Mouse.

I. INTRODUCTION

This model and paper solve various previous problems of the external mouse where users had to buy them and have to constantly click and move the external mouse which can sometimes hurt or damage the users' hands and fingers. This drawback is avoided by using this system which as discussed operates the machine virtually by using a virtual mouse and also avoids other issues of external mouse and thereby providing us the efficient and cost-free technique, and still now the researches always make an effort to increase the qualities of this virtual mouse systems as the organizations consider this system very useful.

The main aim of this system is to enhance the daily use of an external mouse for the daily computer users which helps them to smoothly and quickly perform the operations and also give the users a gift of the new AI techniques and rules. By just installing a basic webcam and some essential algorithms we can build this superb setup of a virtual mouse for our machine which ensures that user is having a good time while operating the machine using the system and is facing no issues, although a lot of researchers has found this system as an amazing power of AI and spite, they suggest a user of this system must have basic knowledge of AI and other essential libraries required for installing and running the system.

The other requirements are a proper machine because heavy programming languages and modules need and take up big storage, compatible OS and inbuilt advanced machine properties, so before adapting this system we must check for the basic and advanced modules of the machine to install this system.

II. LITERATURE SURVEY

The research shows the application of a virtual mouse which is an advanced form of an external mouse which establishes a great comfort for operating the machine and thereby, the virtual mouse using AI tackles several other issues regarding the operations of the mouse. It brings up a bit of easy and proper nice. implementation which is much more efficient as compared to other techniques and methods in different researches, because as in other researches there are complex and lengthy lists of requirements of materials other external stuff for operating the machine, Whereas, in this research we provide an efficient and quite easy way to develop the system, by avoiding the materials and adapting more logical modules and methods so as to use them in the correct form and correct place. Here the system runs only with the help of fingers of user i.e. by hand detection, then user assigns gestures

as the inputs values for example: scroll up down, click, double clicks and drag and drops such gestures are stored inside the system also the user can give its desired finger movements as its gestures as per comfort level of operating so it also gives the choice to user for gesture formation and as for next the webcam plays a major role as it records the finger and hand movements of the user by which the system reads and tries to recognize the gesture played by user and matches them with stored gestures and after each successful match the system reads and fetches the gestures for operating the machine and for every gesture the same cycle takes place. This allows the user to operate at its own demand and comfort level also avoiding the need of an external hardware mouse which also saves cost and time and thus we call it a virtual mouse system. The observations made during building the system are clear and helpful as it teaches about different modules and applicative ways of exploring AI into a machine. As discussed, it saves a lot of material, money and time which helps the user to invest time in adapting such advantageous techniques. By means, the users learn about the new modules and algorithms of it and apply their own logics and efforts to bring out such systems for making technologies easier to understand and operate. The system is built indeed using AL, OpenCV. Hand tracking module and other well-known libraries of python which lets the user to perform mouse actions virtually by just imitating gestures in front of a webcam and recording them in system to run those gestures and by which we can handle the machine virtually i.e., by without even touching the screen or needing any external mouse. The technique in our research ensures that the user doesn't have to use any other equipment or other external stuff because a lot of different techniques and methods are available in the field of AI, but they all need one or the other external tools or equipments for adapting virtual mouse and has very complex structures because of their methods. Some methods need the stickers on fingers for performing gestures, while others require facial movements and so on are the techniques which are very complex for installing and running the machine. Deep learning based AI virtual mouse for Computer vision, 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 a 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[1]. This paper proposes a way to control the position of the cursor with the bare hands without using any electronic device. While the operations like clicking and dragging of objects will be performed with different hand gestures. The proposed system will only require a webcam as an input device. The software that will be required to implement the proposed system are OpenCV and python. The output of the camera will be displayed on the system's screen so that it can be further calibrated by the user[2]. Real time virtual mouse using RGB-D images, In this work, we propose a novel virtual-mouse method using RGB-D images and fingertip detection. The hand region of interest and the center of the palm are first extracted using in-depth skeleton-joint information images from a Microsoft Kinect Sensor version 2, and then converted into a binary image. Then, the contours of the hands are extracted and described by a border-tracing algorithm. The K-cosine algorithm is used to detect the fingertip location, based on the hand-contour coordinates. Finally, the fingertip location is mapped to RGB images to control the mouse cursor based on a virtual screen. The system tracks fingertips in real-time at 30 FPS on a desktop computer using a single CPU and Kinect V2 [3]. Mouse cursor control based on hand gestures

The apparition on market of the low-cost webcams with, at least, satisfactory qualities open up new directions regarding the implementation of human computer interaction (HCI) interfaces. The paper presents a HCI interface for mouse cursor control. The purpose of the implemented solution is to control the mouse cursor by user hand gestures captured through a webcam. For improving the gesture recognition based on the fluctuation of illuminance levels the finger strips color detection was used. The results reveal the good behavior of the system in low light conditions[4]. In human-computer interaction, a virtual mouse implemented with finger tip recognition and hand gesture tracking based on image in a live video is one of the studies. In this paper, virtual mouse control using fingertip identification and hand gesture recognition is proposed. This study consists of two methods for tracking the fingers, one is by using colored caps and other is by hand gesture detection. This includes three main steps that are finger detection using color identification, hand gesture tracking and implementation on on-screen cursor. In this study, hand gesture tracking is generated through the detection of the contour and formation of a convex hull around it. Features of hands are extracted with the area ratio of contour and hull formed[5]. An interactive model of virtual mouse by Researchers around the world is now focused on making Our devices more interactive and try to make the devices operational with minimal physical contact. In this research, we propose an interactive computer system which can operate without any physical keyboard and mouse. This system can be beneficial to everyone, especially to the paralyzed people who face difficulties to operate

physical keyboard and mouse. We used computer vision so that the user can type on a virtual keyboard using a yellow-colored cap on his fingertip, and can also navigate to the mouse controlling system. Once the user is in mouse controlling mode, the user can perform all the mouse operations only by showing a different number of fingers. We validated both modules of our system by a 52 years old paralyzed person and achieved around 80% accuracy on average. Deep Learning-Based Real-Time AI Virtual Mouse System Using Computer Vision to Avoid COVID-19 Spread, The AI virtual mouse system's main goal is to control mouse cursor functionalities using hand gestures rather than a hardware mouse. The proposed system can be realized by using a webcam or a built-in camera that detects and interprets hand motions and hand tips in order to perform specific mouse actions. We can conclude from the model's results that the suggested AI virtual mouse system worked extremely well and has a higher accuracy than existing models, and that the model also solves most of the constraints of existing systems. The AI virtual mouse can be utilized in real-world applications because the proposed model is more accurate, and it can also be employed in simulations[6]. Virtual Mouse using Hand Gestures, Our natural ways of communication: body language and speech, should be reflected in our computers and technology. Intelligent robots that can work alongside computers are now being developed, making Human-Computer Interaction (HCI) more pleasant (HCI). On the other hand, our suggested project aims to create a hand gesture-based system that allows users to control desktop mouse motions. A desktop webcam is used by our system to identify hand gesture movements. The idea is to use a simple camera instead of a classic or standard mouse to control mouse cursor functions. The Virtual Mouse provides an infrastructure between the user and the system using only a camera. It allows a user to engage with a machine without the use of any mechanical or physical equipment, and it even lets the user control the machine[7]. Virtual Mouse using Hand Gesture and Color Detection, Bluetooth hardware and a Bluetooth dongle must be installed on the computer to utilise a wireless mouse. There will be no such constraints with the proposed system, which will instead rely on gesture recognition. Object detection, picture processing, and colour recognition using "Sixth sense technology" are the major technologies used in this research. Sixth sense technology is a collection of wearable gadgets that serve as a gesture-based interface between the physical and digital worlds. The goal is to move the mouse cursor on the screen without using any hardware, such as a mouse, and just by using finger movements, which is known as gesture recognition. In this research, we offer a novel Human Computer Interaction (HCI) approach in which cursor movement is controlled in real time[8]. Design and Development of Hand Gesture Based Virtual Mouse, Since the development of computer technology, the technique for constructing a process of human-computer interaction has evolved. The mouse is a fantastic tool. HCI (Human-Computer Interaction) technology is a new invention. Despite the fact that wireless or Bluetooth mouse technology is still being developed, That technology isn't entirely devoid of devices. a wireless mouse Battery power and a connecting dongle are required. The presence of additional electronics in a mouse makes it more difficult to use. Make use of it. This limitation is not met by the proposed mouse technology. This virtual mouse system based on HCI is proposed in this paper. Hand motions and computer vision With the use of a camera, I was able to catch certain gestures and color-processed video from a built-in camera or a webcam Techniques for segmentation and detection The user will have the ability to with which you can control some of the computer's cursor functionalities[9]. Virtual Mouse Using Hand Gesture, In this modern era of technology, Human Computer Interaction (HCI) has become one of the most essential undertakings. Many things have changed in this world as a result of new technology, yet there are still a few things that remain the same. The Computer System is one of the better examples one can give. The same computerized gadgets that were employed previously are still utilized in today's computer systems. However, by utilizing HCI, we may replace these electronic gadgets with the most up-to-date technology available. This study focuses on human-computer interaction (HCI) with computerized devices such as the mouse. We shall be able to eliminate the use of external and digital devices by using this gesture, movement [10] . A Review on Virtual Mouse Using Hand Gesture and Color Detection, Intelligent machines that may be utilized in conjunction with computers are being developed these days, which aid in friendly Human-Computer Interaction (HCI). For disabled people, using a mouse and keyboard might be uncomfortable and inconvenient at times. The answer for impaired people to handle the computer is a virtual mouse or keyboard system of computers In recent years, various technologies have been applied to develop the virtual mouse. In this case, we attempted to offer a review of various virtual mouse technologies[11]. Because of its wide range of applications and capacity to efficiently connect with machines via human-computer interaction, the hand gesture recognition system has gotten a lot of attention in recent years. A survey of modern hand gesture recognition systems is offered in this study. The most important aspects of Hand gesture recognition systems are faced with a variety of obstacles. Examine the most modern methods. A technique

for recognising postures and gestures was also demonstrated. Summary of hand gesture research findings. Methods, datasets, and a comparison of the various steps of gesture recognition are also provided[12]

III. METHODOLOGY

The research paper promotes a method whereby a real-time camera can be used to control cursor movements using Human Computer Interaction (HCI). This is an alternative to the current methods, which involve manually pressing buttons or changing the cursor's position. Of a physical computer mouse. Instead, it utilizes a camera and computer vision technology to control various mouse events and is capable of performing every task that the physical computer mouse can. The computer technologies continue to grow and the importance of Human Interaction computers is also increasing. Creating a virtual human interactive device such as a mouse using a webcam. The system takes various ways of providing for adoption of virtual mouse technique also researches were made to apply the system using various ways and methods.

To simplify the process of the review we have divided the working and the methodology into four phases which simplifies the understanding of the working and also the implementation:

1. Detection
2. Tracking
3. Pixel Positioning
4. Movement and clicks required.

The phase of detection includes object detection, hand detection, 21 landmarks detection and fingertip detection. The virtual mouse gestures recognition program will constantly acquire real-time images where the images will undergo a series of filtration and conversion. Upon completion of the conversion process, the program applies image processing techniques to determine the coordinates of the target position which is called tracking.

After that, it will proceed to compare the existing positions within the frames with a list of hand Landmarks taken from media pipe module, where different combinations consist of different mouse functions if the current combination found a match, the program will execute the mouse function, which will be translated into an actual mouse function to the user's machine. Following the mapping of pixel position takes place, the setting of cursor positions just happens after this phase which helps in the production of mouse movements and the clicks which are required for the successful implementation.

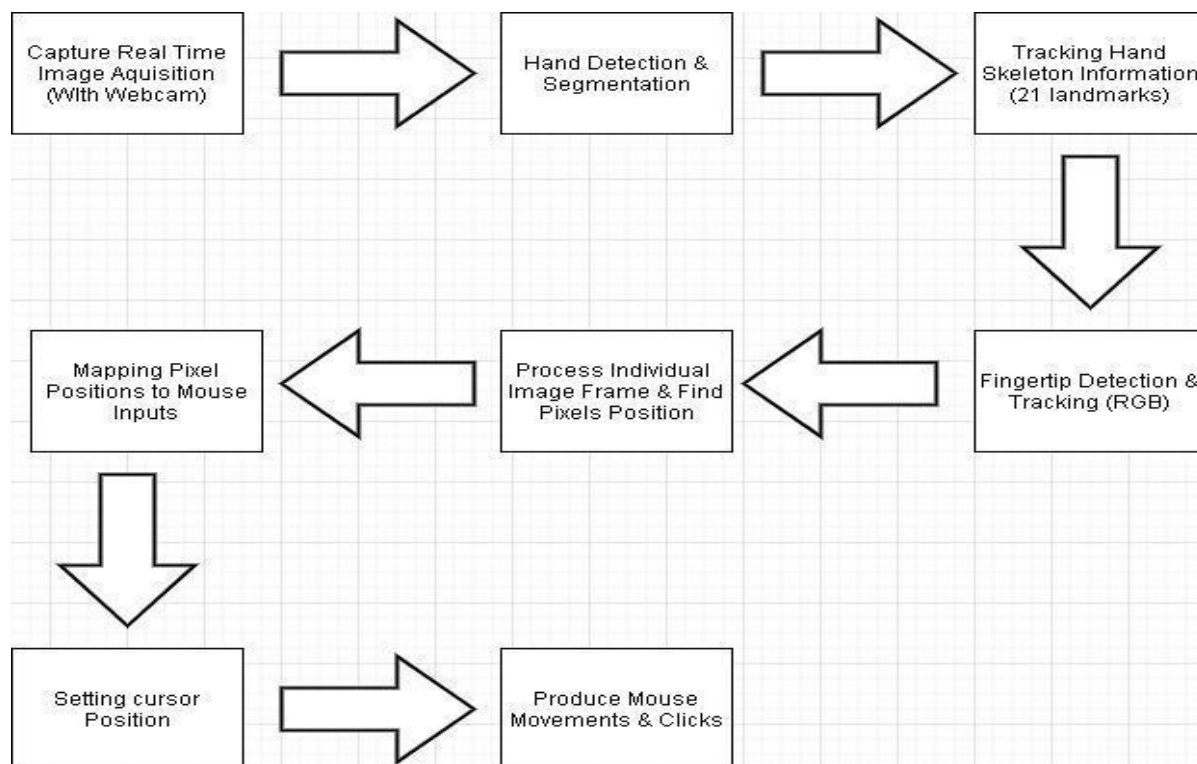


Fig.1 Block Diagram

Above figure shows the block diagram of the proposed system. The block diagram has a webcam which captures hand inputs, takes up image frames which are converted to fix frame values and sets current location of the controller, using them mouse actions are performed.

IV. ALGORITHMS AND IMPLEMENTATION

ALGORITHMS:

Basic algorithms and libraries like OpenCV, NumPy, media pipe etc. are used and must be installed in the implementation process, and for working an external webcam is installed for recording the touch, types and scribbles of the user and according to that the mouse cursor controller will perform the actions. Our project focuses on the implementation and designing and demonstration of the virtual mouse which detects hand gestures patterns instead of physical mouse and it also demonstrates hand tracking and hand detection to run operations in which the system used in our project detects 21 landmarks and converts xyzy coordinates in picture pixels to get the location of the specific landmark.

The algorithm for the proposed system is as follows:

- Step 1. Import all necessary packages (OpenCV, Mediapipe, Time, numpy, autopy)
- Step 2. Set the webcam resolutions
- Step 3. Find hand landmarks and get Tip of fingers.
- Step 4. Check which fingers are up and assign gestures.
- Step 5. Assign those gestures to Moving or Clicking modes for the mouse controller.
- Step 6: Convert coordinates into pixels for clear image framing.
- Step 7: Move the mouse and check proper working and framing.
- Step 8: Test gestures actions using given values and check working of clicking and moving modes.
- Step 9: Find distance between fingers
- Step 10: Set frame rate for proper frames and smoothening.
- Step 11: Now, Display the screen, use gestures and operate the mouse controller.

IMPLEMENTATION:

This chapter provides the partial implementation and the screenshots of the results. In partial implementation successfully installed webcam and other essential system modules and libraries. Also designed and developed a Hand Tracking Module using python module which will be the highlight of this project.

```
import cv2
import mediapipe as mp
import time #to check the framerate

cap = cv2.VideoCapture(0) #to create video object

mpHands = mp.solutions.hands # for hand detection
hands = mpHands.Hands() #check parameter
mpDraw = mp.solutions.drawing_utils

pTime = 0
cTime = 0

while True:
    success, img = cap.read()
    imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    results = hands.process(imgRGB)
    #print(results.multi_hand_landmarks)
```

Fig. 2 shows the code used to open the webcam so that object detection following hand detection will take place.

```
def __init__(self,
             static_image_mode=False,
             max_num_hands=2,
             min_detection_confidence=0.5,
             min_tracking_confidence=0.5):
    """Initializes a MediaPipe Hand object.
```

Fig.3 code shows the parameters required for detecting hands using 21 landmarks.



Fig.4 shows the 21 landmarks used in the model.

```
import cv2
import mediapipe as mp
import time #to check the framerate

class handDetector():
    def __init__(self, mode = False, maxHands = 2, detectionCon = 0.5, trackCon = 0.5):
        self.mode = mode #craet an object and have its own variable
        self.maxHands = maxHands
        self.detectionCon = detectionCon
        self.trackCon = trackCon
        self.mpHands = mp.solutions.hands # for hand detection
        self.hands = self.mpHands.Hands(self.mode, self.maxHands, self.detectionCon, self.trackCon) # check parameter
        self.mpDraw = mp.solutions.drawing_utils

    def findHands(self, img, draw = True):
        imgRGB = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        self.results = self.hands.process(imgRGB)
        # print(results.multi_hand_landmarks)

        if self.results.multi_hand_landmarks:
            for handLms in self.results.multi_hand_landmarks:
                if draw:
                    self.mpDraw.draw_landmarks(img, handLms, self.mpHands.HAND_CONNECTIONS) # will draw connections in tracking points
```

Fig.5 shows the color intended to give specific landmarks according to the requirements.

```
def main():
    pTime = 0
    cTime = 0
    cap = cv2.VideoCapture(0) # to create video object
    detector = handDetector()
    while True:
        success, img = cap.read()
        img = detector.findHands(img)
        lmList = detector.findPosition(img)
        if len(lmList) != 0:
            print(lmList[4])

        cTime = time.time() # will give current time
        fps = 1 / (cTime - pTime)
        pTime = cTime

        cv2.putText(img, str(int(fps)), (10, 70), cv2.FONT_HERSHEY_PLAIN, 3, (255, 0, 255), 3)

        cv2.imshow("Image", img)
        cv2.waitKey(1)
```

Fig.6 code shows the Frame Rate Per second {FPS} on the webcam output

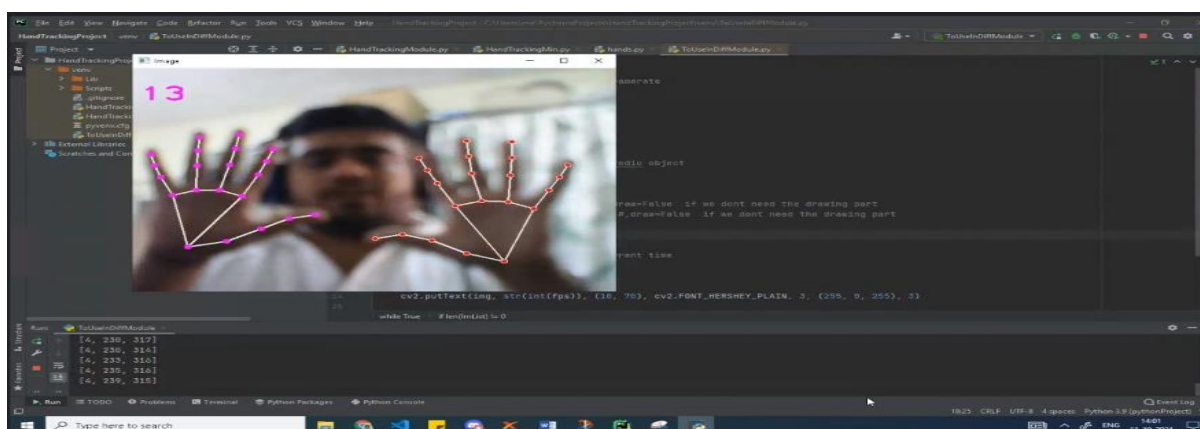


Fig.7. input shows the tracking of hands and the colored landmarks

V. CONCLUSION

A virtual gesture control mouse is a system that uses a real-time camera to guide the mouse cursor and do its duty. Mouse navigation, icon selection, and features and duties such as left, right, double click, and scrolling were all implemented. To do mouse indicator motions and icon selection, this system uses image comparison and motion detection technology. Based on the results, we may assume that if we supply enough light and a good camera, the algorithms will operate in any domain. In this proposed system will become more organized as a result. More functionality, including interaction in multiple windows, increasing and shrinking windows, closing windows, and so on, will be merged in the future using the palm and multiple fingers. The project's goal was to make machines more interactive and sensitive to human behavior. The main purpose of this study was to create a technology that is both inexpensive and portable, and that can run on any standard operating system. By detecting the human hand and moving the pointer in the direction of the human hand, the suggested system is utilized to control the mouse pointer. Simple mouse functions such as left-clicking, dragging, and cursor movement are controlled by the system.

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