Virtual Mouse Using OpenCV And VNC

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Abstract- *Virtual Network Computing (VNC) plays a significant role in advanced remote access by allowing users to remotely control another computer or virtual machine over a network connection and applies to real-world entities [1]. Virtual remote command refers to the potential to remotely control a computer or virtual machine using software that provides a graphical interface. One of the key advantages of controlling a virtual remote is that it allows users to interact with the remote system as if they were physically present at the remote location. We made a proposal relying on "Hand Gesture Recognition". It tracks hand movements and recognizes the gestures to perform the mouse tasks. Hand gesture recognition technology uses computer vision algorithms and machine learning techniques to analyze and interpret the movements of the human hand.*

Keywords- VNC, web camera, Media-pipe, Hand-gestures, Open CV, Object Tracking

I. INTRODUCTION

A computer mouse is an input-pointing device that is used to control the cursor on a computer screen. It typically has two or more buttons and a scroll wheel used to navigate and interact with graphical user interfaces (GUI's) and other applications. The virtual mouse eventually takes up the area of the conventional track-pad. Since it is a hardware device, it too can last time within which it is functional, and after that time we must change the mouse. As technology advances, everything, including voice detection, becomes visualized. The spoken tongue is recognized and converted into writing using speech recognition. Thus, in the future, speech recognition and eye tracking, which are both used to operate the mouse pointer using eye movements, could both substitute computers.

In today's digital age, technology has transformed the way we interact with our devices. One such innovation is the virtual mouse, which allows users to control their computers without the need for a physical device. Using OpenCV and VNC, this cutting-edge technology offers a unique and intuitive way to navigate and interact with your computer from a distance. Whether for accessibility reasons, convenience, or just pure novelty, the virtual mouse offers a novel and exciting approach to computing that is sure to impress. In this era of remote work and digital connectivity, the virtual mouse is a tool that is both timely and useful, and it's sure to become an increasingly important part of our technological landscape.

Goal of the Project:

The content of this project is to provide an accurate rate of gesture movement for future enhancement using a virtualized mouse to have better accessibility in upcoming events to enhance its performance in future usage. The goal of a project for a virtual mouse using OpenCV and VNC is to create a software application that allows users to control their computer mouse pointer and perform mouse-related actions without the use of a physical mouse. This project typically involves using the OpenCV library to capture the video stream from a camera, tracking the user's hand movements in real-time, and mapping those movements to the computer mouse pointer's movements. The Virtual Network Computing (VNC) protocol is used to transmit the mouse actions to the remote computer.

By creating a virtual mouse, users can perform mouse-related actions even if they are not in front of their computer or if they have difficulty using a physical mouse. This project has various applications, including accessibility for people with disabilities, gaming, and virtual reality.

II. IDENTIFY,RESEARCHANDCOLLECT IDEA'S

In the existing system, a computer mouse is an input tool that facilitates pointing and interaction with the object being directed at. There are many different styles of operations that are currently popular, including the mechanical mouse, which is made of a single rubber ball that can spin in any direction and control the movements of the cursor. Eventually, the optical mouse takes the area of the mechanical mouse. The existing system are our traditional hardware mouse devices either wired or wireless to control the cursor. This means the actual hardware device is required. Also, the touchpad in laptops and touchscreen devices require a user to touch the surface. Other existing virtual mouse control system consists of a simple mouse operation that uses colored tips like red, green, and blue color. These colored fingers act as an object that the web-cam senses to perform actions and then image processing techniques are applied to them. Some existing system use

Disadvantages:

- There will always be limitations of the mouse as the mouse is a hardware input a number of fingers to perform specific operations (for eg. 1 finger for left click, 2 fingers for right-click, 3 for double click). Such system are more complex and difficult for the user to user device and there can be some problems like mouse click not functioning properly.
- The mouse is a hardware device like any other physical object even the mouse will have a durability time within which is functional and after its durability time we have to change the mouse

III. STUDIESAND FINDINGS

The proposed system provides a significant improvement in accuracy andusability, compared to existing virtual mouse systems. Participants reported ahigh level of satisfaction with the system and found it easy to use There is nospecific algorithm that we have used for the virtual mouse but there are some pythonsinbuilt modules that will help in the processing of this system. So the modules which we will be using are OpenCV, Media pipe, and Numpy. It also describes that there is no specific algorithm used for a virtual mouse, but certain Python libraries can aid in processing this system. These libraries include import cv2, import pyautogui, import time, import 32winapi. OpenCV is a computer vision library that provides tools for image and video analysis. Media pipe is a framework for building perception pipelines that can process streams of multi model data. NumPy is a library for numerical computations in Python. Autopy is a library for simulating mouse and keyboard inputs. Time is a module for working with time and dates in Python, and Math is a module for mathematical operations. Together, these modules can be used to build a virtual mouse system.

As the technology increase everything becomes virtualized. Such as speech recognition, Speech Recognition is used for recognition and translation of the spoken language into text. Thus, Speech Recognition can replace keyboards in the future, Similarly, Eye Tracking which is used to control themouse pointer with the help of our eye. Eye Tracking can replace mouse in the future. Gestures can be in any form like hand image or pixel image or any human given pose that require less computational difficulty or power for making the devices required for the recognition to make work. Different techniques are being proposed by the companies for gaining necessary information/data for recognition handmade gestures recognition models. Some models work with special devices such as data glove devices and color caps to develop a complex information about gesture provided by the user/human.

Advantages:

- Virtual Mouse using Hand gesture recognition allows users to control mouse with the help of hand gestures. System's webcam is usedfor tracking hand gestures.
- Computer vision techniques are used for gesture recognition. Open-CV consists of a package called video capture which is used to capture data from a live video.
- Main thing we need to identify are the applications the model is going to develop so the development of the mouse movement without using the system mouse.

System Architecture:

There are three major components for the structural part of the system which contain Image processing, Cursor control, and feature extraction [8]. The movement of the user can be detected in the video format input with help of a camera in the concept based on the processing image features [9]. The hand motion pose of the users can be located by implementing some algorithms in the language Python in-built libraries to observe and execute the desired output which is expected by clients.

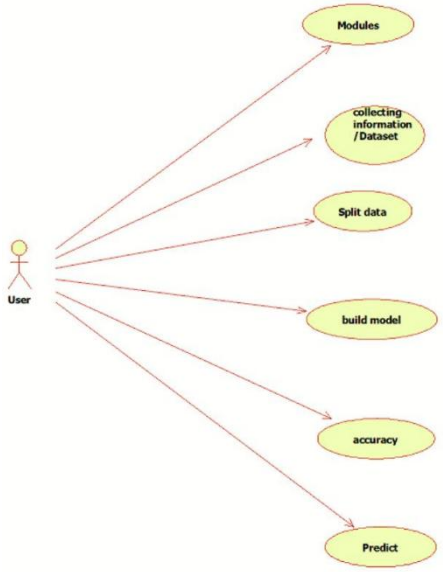

Figure1: USE CASE DIAGRAM

The use case diagram of the figure 1 explains the various phases are involved are modules, dataset, split data, Build model, Accuracy, Predict.

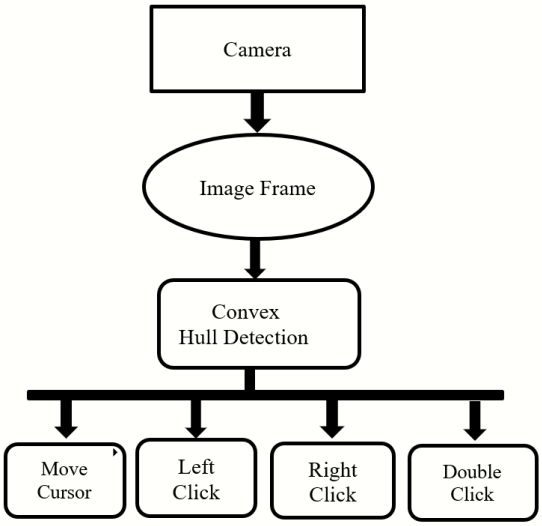

Figure2: System Architecture

Figure 2 explains how the process of the virtual mouse using OpenCV and VNC are done. Using Convex-Hull detection, first-step images are observed through the camera and next step specific operation are done.

- Step 1: User or Clients give the inputs like co-ordinates or mortal skills nothing but hand movements through the web-camera of the system.
- Step 2: By observing the hand movement or hand gestures of the user or clients the next step will be done.
- Step 3: By using Convex-Hull Detection, it locates the location or points or landmarks of the particular finger or given input to perform required tasks.
- Step 4: when the location of the hands are locates successfully ,the required or specific task or operation will be executed.

Design Details:

The system will be taking the real-time video input from the webcam and converting it into array form to find the coordinates of the frame. These coordinates will help the program to locate the fingers in an accurate position and detect which fingers are raised. By identifying which finger is up system will perform certain functions assigned like moving clicking.

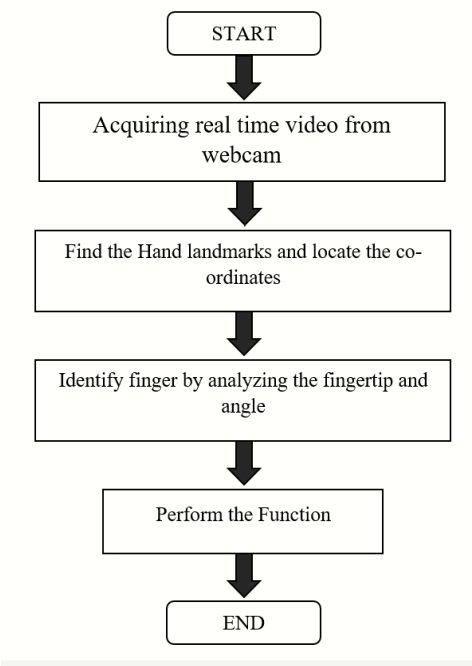

Figure: 3 Working system

The Flowchart diagram of the working system explains how the project is implemented with first step starts the project.

- Next stage of the diagram goes through acquiring real-time video from the web-camera.
- Third stage is to find the hand landmarks and locate the coordinates.
- Fourth Stage is to identify the finger by analyzing the fingertips and the location.
- Final stage is to perform the function or executed the required tasks.

Methodology:

The methodology of the Virtual Mouse using OpenCV and VNC are through some types of phrases to execute it. There are

- Capturing Video
- Find hand landmarks
- Get the tip of the index and middle finger
- Check which fingers
- Convert the coordinates to get the correct positioning
- Implement the functions

i. Capturing video :

The use of the OpenCV module is to capture the realtime video using a webcam which acts as an input for further processing.

ii. Find hand landmarks :

Using Python libraries like CV2 and Media Pipe we coded the program to locate the hand landmarks. After recognizing hand it will locate points as shown in the figure.

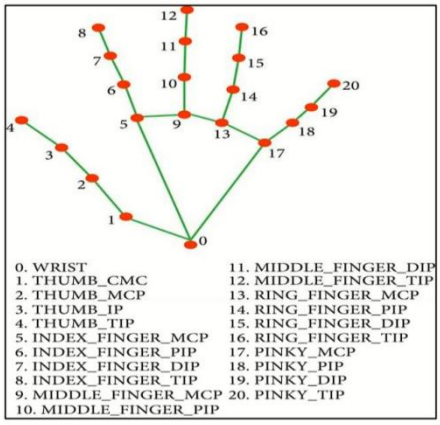

Figure 4: Hand mark Location

iii. Get the tip of the index and middle finger :

We also included different functions in a library named “HandTrackingModule” for simplicity. This module includes the functions for detecting hands, locating fingers, counting which fingers are up, finding the distance between fingers, etc

iv. Check which fingers:

1) Open palm hand

It is used to control the cursor of a virtual mouse using Open CV and VNC. Using open palm hand, we can detect and track the movement of the cursor to perform any operation.

2) Index finger and thumb finger

Using both fingers of the Index and Thumb, we can perform the click operation. When the Index finger and Thumb finger are touched at that movement the click operation is done or executed.

v. Convert the coordinates to get the correct positioning:

Accurate location tracking of the cursor on the screen is important for the exact working of the mouse.

vi. Implement the functions :

By locating the coordinates and tracking the fingers we perform the mouse functions virtually i.e without any physical contact with the device.

vii. Frame rate :

Frame rate helps us to check if the movements of the cursor are smooth or not.

Module Description:

Image Processing Module :

The camera plays a mighty role because it observes or captures or records input of the video to work on the module of image processing, with some algorithms of open CV to get the outcomes to match the user's expectation [4]. The methods undergo some filters to go on like finding perfect algorithms, and adjusting some camera settings to achieve it [5]. The performance of this project is easy because essential things like libraries of the OpenCV and module of image play a marvel role to discover the user's motion. An image processing module for a virtual mouse using OpenCV and VNC can be designed to enable users to control their mouse pointer using hand gestures captured by a camera.

OpenCV, an open-source computer vision and machine learning library, can be used to process the images captured by the camera in real-time, detect hand gestures, and track their movements. This module can be designed to recognize different hand gestures such as moving the hand to the left, right, up or down, and closing or opening the fingers.

VNC (Virtual Network Computing) can be used to establish a remote desktop connection between the computer and the camera-equipped device, such as a smartphone or a tablet, that captures the hand gestures. This allows users to control the mouse pointer on their computer screen using the hand gestures detected by the camera. Overall, this image processing module can provide a more intuitive and natural way for users to interact with their computer, particularly for those who have limited mobility or cannot use a traditional mouse.

Feature Extraction Module:

The module which is named like features extraction modules uses the common algorithms to decode the video format as the feed to get that output [7]. This module has a few techniques, hand gestures movement with basic algorithms, and labeled information are trained to make unique output for the project.

A feature extraction module for a virtual mouse using OpenCV and VNC can be designed to identify and extract relevant features from the hand gestures captured by a camera, and convert them into meaningful control signals for the virtual mouse.

OpenCV, an open-source computer vision and machine learning library, can be used to process the images captured by the camera in real-time, detect the location of the hand, and extract features such as the hand's size, shape, and orientation. These features can then be analyzed and transformed into corresponding mouse control signals, such as cursor movement, left or right clicks, and scrolling.

VNC (Virtual Network Computing) can be used to establish a remote desktop connection between the computer and the camera-equipped device, such as a smartphone or a tablet, that captures the hand gestures. This allows users to control the mouse pointer on their computer screen using the extracted features of their hand gestures.

Overall, this feature extraction module can provide a more precise and accurate way for users to interact with their computer using hand gestures, and can be particularly useful for individuals with physical disabilities who may have difficulty using a traditional mouse.

Cursor Control Evaluation :

The production of this scheme can be gained by important modules which are called cursor control modules. It assists us to command the mouse cursor [8]. The movements of the cursor like quick responses, right-pop, and left-pop, are more cursor-related limiting factors by getting signals from extracted features that come out as the output for a particular feed-in. The PyAutoGUI libraries are preowned donate the wide scale to the entry of function to own the mouse indicator [9].

A cursor control evaluation module for a virtual mouse using OpenCV and VNC can be designed to assess the accuracy and precision of the cursor movement generated by the hand gesture-based control system.

OpenCV, an open-source computer vision and machine learning library, can be used to capture hand gestures in real time and track the movement of the cursor on the screen. This module can then evaluate the accuracy of the cursor movement by comparing the actual cursor position with the expected position based on the hand gesture input.

The cursor control evaluation module can provide feedback to the user on the accuracy and precision of their hand gesture-based cursor control, and identify any areas for improvement. This module can also be used to fine-tune the hand gesture detection and feature extraction algorithms to optimize the performance of the virtual mouse system.

Overall, this cursor control evaluation module can help ensure that the virtual mouse system is responsive, accurate, and easy to use, providing an effective alternative to traditional mouse control for users with physical disabilities or other mobility issues.

IV. CONCLUSION

The future and scope for Virtual Mouse using OpenCV and VNC are vast and promising. With advancements in computer vision technology, the accuracy of hand tracking is likely to improve, resulting in even more precise control of the cursor. Additionally, the integration of machine learning algorithms could enable the virtual mouse system to learn and adapt to individual user behavior and preferences, making it even more intuitive and user-friendly. The scope for Virtual Mouse using OpenCV and VNC extends beyond just the control of the computer cursor. It can also be used to control other devices, such as smartphones and tablets, using hand gestures. Furthermore, the potential for Virtual Mouse technology to be integrated into virtual and augmented reality systems could revolutionize the way users interact with digital environments. As for the future, it is possible that Virtual Mouse technology could become mainstream, with widespread adoption by businesses and individuals alike. In conclusion, the future and scope for Virtual Mouse using OpenCV and VNC are exciting and full of possibilities, with endless potential for innovation and advancement.

Traditional mouse can face some difficulties while using them. To overcome this, we introduced the virtual mouse concept which is an affordable thing and the best solution for people to access it in future trends. Implementing this concept is easy because we are using the in-built thing web-camera on computers or laptops, default Python libraries, and huge users can access it. At the wind-up of the study of the result, we came to know that the virtual mouse is -the best and only alternative to the traditional mouse in the future. It

develops human interaction with computers and helps us to improve the lifestyle leading generation which will lead to gaining more time and reducing the human effect.

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