Virtual Mouse using Hand Gestures

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ABSTRACT:Even today, many people still find interacting with computers and hardware to be an unpleasant experience, despite the development of input devices over decades. Computers and hardware should be tailored to our natural modes of communication: Body language and speech. Intelligent machines that can work alongside computers are now being developed, allowing for friendlier Human-Computer Interaction (HCI). Our proposed project, on the other hand, intends a hand gesture-based system that allows users to control desktop mouse movements. To detect hand gesture movements, our system makes use of a desktop webcam. The goal is to control mouse cursor functions with a simple camera rather than a traditional or standard mouse device. Using only a camera, the Virtual Mouse provides an infrastructure between the user and the machine. It enables the user to interact with a machine without the need for any mechanical or physical devices, and even allows to control mouse functions.

KEY WORDS: Human Computer Interaction, Python, Color Detection, Web camera, Hand Gestures.

I. INTRODUCTION

Within the past few years, as computer technology continues to develop, people want more compact electronic devices. Human Computing Interaction (HCI), particularly gesture recognition and object recognition, is becoming increasingly important. In our project, we introduce a method for controlling the mouse system using a video device (Mouse tasks). In today's world, most cell phones communicate with the user via touch screen technology. However, this technology is still prohibitively expensive for use on desktops and laptop computers.

Generally, a gesture is a symbol for physical or emotional behaviour. It consists of both body and hand gestures. Gestures can be used to communicate between humans and computers. Human-computer interaction (HCI) began in the early 1980s as a field of study and practice. The name "virtual mouse" conveys a clear idea about our project. The virtual mouse establishes a virtual connection between the user and the machine without the use of any hardware. This gesture recognition system can capture and track the fingertips of a person wearing a color cap with a webcam, and the system detects the hand's color and movements and moves the cursor along with it.

Our vision was to develop a virtual mouse system that uses a Web camera to communicate with the device in a more user-friendly way, as an alternative to using a touch screen.

II. LITERATURE SURVEY

The current system is comprised of a generic mouse and trackpad monitor control system, as well as the absence of a hand gesture control system. The use of a hand gesture to access the monitor screen from a distance is not possible. Even though it is primarily attempting to implement, the scope is simply limited in the virtual mouse field.

The existing virtual mouse control system consists of simple mouse operations using a hand recognition system, in which we can control the mouse pointer, left click, right click, and drag, and so on. The use of hand recognition in the future will not be used. Even though there are a variety of systems for hand recognition, the system they used is static hand recognition, which is simply a recognition of the shape made by the hand and the definition of action for each shape made, which is limited to a few defined actions and causes a lot of confusion.
As technology advances, there are more and more alternatives to using a mouse.

The following are some of the techniques that were employed:

A) Head Control: A special sensor (or built-in webcam) can track head movement to move the mouse pointer around on the screen. In the absence of a mouse button, the software's dwell delay feature is usually used. Clicking can also be accomplished with a well-placed switch.

B) Eye Control: The cost of modern eye gaze systems is decreasing. These enable users to move the pointer on the screen solely by moving their eyes. Instead of mouse buttons, a dwell delay feature, blinks, or a switch are used. The Tobii PCEye Go is a peripheral eye tracker that lets you use your eyes to control your computer as if you were using a mouse.

C) Touch Screens: Touch screens, which were once seen as a niche technology used primarily in special education schools, have now become mainstream. Following the success of smartphones and tablets, touch-enabled Windows laptops and all-in-one desktops are becoming more common. Although this is a welcome new technology, the widespread use of touch screens has resulted in a new set of touch accessibility issues.

However, each of the methods below has its own set of disadvantages. The use of the head or eyes to control the cursor regularly can be hazardous to one's health. This can lead to a number of problems with health. When using a touch screen, the user must maintain their focus on the screen at all times, which can cause drowsiness.
By comparing the following techniques, we hope to create a new project that will not harm the user's health.

III. SYSTEM OVERVIEW

In our project, we attempted to control mouse cursor movement and click events using a color detection approach based on a camera. It's a system that performs image processing, retrieves needed details, and then adds them to the computer's mouse interface using predefined notations.

The code is written in Python, and it employs the cross-platform image processing module OpenCV as well as the Python-specific library PyAutoGUI to implement mouse actions. Only the three colored finger caps are extracted from the real-time video captured by the webcam.

Their centers are calculated, and the action to be taken is determined based on their relative positions.

IV. METHODOLOGY

The system can be broken down in four main modules.
Below are the modules:

1) Image Acquisition:
We need a sensor for the system to detect the user's hand movements. As a sensor, the computer's camera is used. The webcam captures real-time video at a fixed frame rate and resolution determined by the camera's hardware. If necessary, the system allows you to change the frame rate and resolution. When the camera takes a picture, it inverts it. The pointer image moves to the right, and versa if we move the color pointer to the left. It is similar to the picture we get when we stand before a mirror, but it is used to avoid the picture flickering.
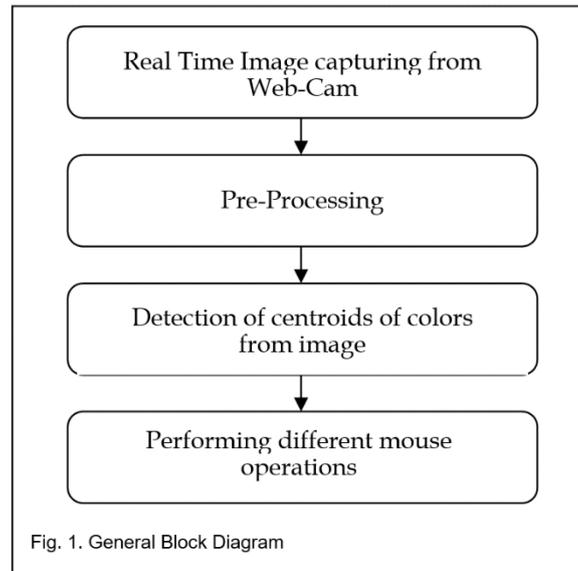
2) Color Filter:
The computational complexity of a grey picture is less than a colorful one. This transforms the image into a grey image. All necessary operations were performed once the image was converted to greyscale. Then you have to subject a noise filter, smoothing, and threshold.

3) Color detection:
In the entire procedure, this is the most important step. The three-color object is detected by subtracting the tilted color channel suppressed from the tilted grey image. This creates a picture where the object detected appears as a grey patch, enclosed in black space.

4) Hand Gesture:
After completing the previous modules, the mouse movement, left-click, right-click, drag/select, scroll up and scroll down will be carried out with color caps or tapes on our fingers.

A) Block Diagram

Fig. 1. General Block Diagram

B) Working

Following are the steps in working of our project:

1) Capturing real time video using Web-Camera:
We will need a sensor to detect the user's hand movements in order for the system to work. As a sensor, the computer's webcam is used. The webcam records real-time video at a fixed frame rate and resolution determined by the camera's hardware. If necessary, the system's frame rate and resolution can be changed.

2) Converting the video captured into HSV format:
The video has also been converted into HSV (hue, saturation, meaning, also called HSB), an alternative representation of the RGB color model created by computer graphics researchers to better reflect the perception of colored characteristics by human vision.

Fig 2: HSV Image

3) Each image frame is processed separately:
Following the capture of the video, it goes through a brief pre-processing stage before being processed one frame at a time.

4) Conversion of each frame to a greyscale image:
A grayscale image has a lower computational complexity than a coloured image. It also aids in faster colour calibration without the use of external noise. All the necessary operations were carried out after the image was converted to grayscale.

5) Calibrate the color ranges:
The device enters the calibration mode after the above steps, which assigns each colour according to the HSV rule to its colour hue, saturation or value values. Every colour already has its predetermined values. For accurate colour detection, the user can adjust the ranges. In the diagram below you can clearly see the variety of values used to detect every colour cap.
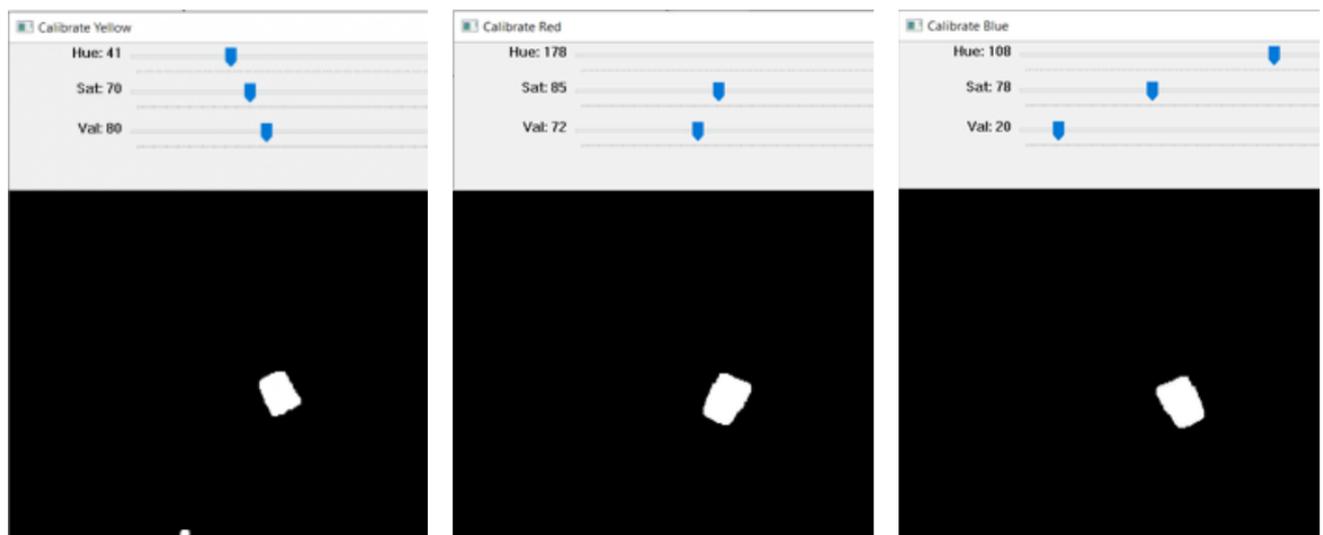

Fig 3: Calibration mode

6) Calculate the image's centroid by locating the image's region.
To guide the mouse pointer, the user must first choose a point whose coordinates can be sent to the cursor. The device can monitor cursor movement using these coordinates. As the object travels around the frame, these coordinates change over time.
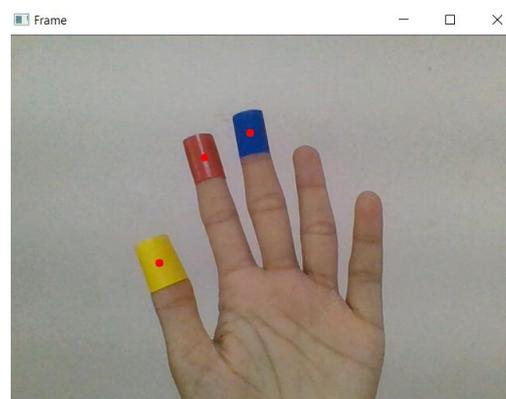

Fig 4: Centroid Detection

7) Tracking the mouse pointer.

After determining the coordinates, the mouse driver is accessed and the coordinates are sent to the cursor. The cursor positions itself in the required position using these coordinates. As a result, the mouse moves proportionally across the screen as the user moves his hands across the camera's field of view.

8) Simulating the mouse actions.

To create the control actions in simulation mode, the user must make hand gestures. The computation time is reduced due to the use of colour pointers.

V. RESULTS

Following are the results of various hand gestures that result into mouse operations.
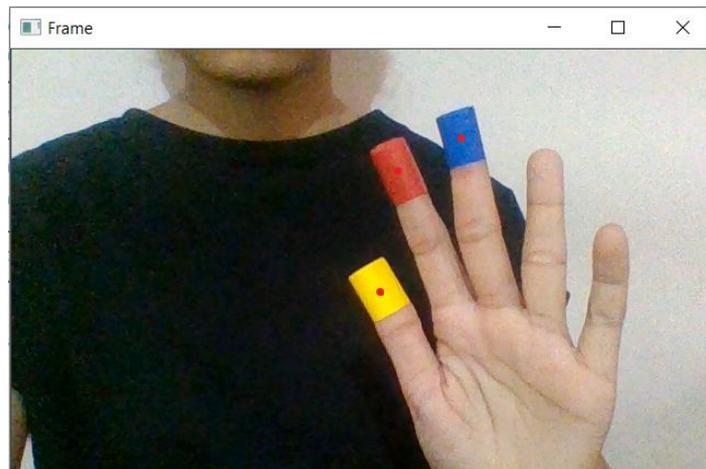
A) Free Cursor Movement

Fig 5: Free cursor movement

B) Left Click and Right Click

Fig 6: Left Click

Fig 7: Right Click

C) Drag and Select

Fig 8: Drag/ Select

D) Scroll Up and Scroll Down

Fig 9: Scroll Up

Fig 10: Scroll Down

VI.CONCLUSION AND FUTURE WORK

A Web camera is running on the mouse cursor. This will also lead to new levels of human-computer interaction (HCI), which does not require physical contact with the device. This machine can perform all mouse tasks centered on color recognition. This device is capable of being useful for interacting with contactless input modes. For people who don't use a touchpad, it's helpful. The architecture of the device proposed would dramatically change people's interactions with computers. Everyone is compatible with the Webcam, the microphone, and the mouse. It would eliminate the need for a mouse completely.

It can also be used in gaming or any other independent application. Free movement, left-click, right-click, drag/select, scroll-up, scroll-down are all operations that can be performed using only gestures in this Multi-Functional system. The majority of the applications necessitate additional hardware, which can be quite costly. The goal was to develop this

technology as cheaply as possible while also using a standardized operating system.Various application programmes can be written specifically for this technology in order to create a wide range of applications with minimal resources.

VII. ACKNOWLEDGEMENT

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