AI VIRTUAL MOUSE

A PROJECT REPORT
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ABSTRACT

This project promotes an approach for the Human-Computer Interaction (HCI) where cursor movement can be controlled using a real-time camera, it is an alternative to the current methods including manual input of buttons or changing the positions of a physical computer mouse. Instead, it utilizes a camera and computer vision technology to control various mouse events and can perform every task that the physical computer mouse can.

The Virtual Mouse color recognition program will constantly be acquiring real-time images where the images will undergo a series of filtration and conversion. Whenever the process is complete, the program will apply the image processing technique to obtain the coordinates of the position of the targeted colors from the converted frames. After that, it will proceed to compare the existing colors within the frames with a list of color combinations, where different combinations consist of different mouse functions. If the current colors combination found a match, the program will execute the mouse function, which will be translated into an actual mouse function for the users' machine

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PROJECT BACKGROUND

➢ Introduction

With the development of 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 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 functions 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 an HCI 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 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 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. In the proposed system, the web camera captures and then processes the frames that have been captured and then recognizes the various hand gestures and hand tip gestures, and then performs the mouse function.

Python programming language is used for developing the AI virtual mouse system, and 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 the tip of the hands, 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 a very high accuracy level, and the proposed model can work very well in real-world applications with the use of a CPU without the use of a GPU.

➢ Literature Review

The proposed AI virtual mouse system can be used to overcome problems in the real world such as situations where there is no space to use a physical mouse and for the persons who have problems with their hands and are not able to control a physical mouse. Also, 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 the spread of the virus by touching the devices, so

the proposed AI virtual mouse can be used to overcome these problems since hand gestures and hand Tip detection is used to control the PC mouse functions by using a webcam or a built-in camera.

• To design a virtual mouse that detects hand gesture patterns instead of a physical mouse.

• We use colored tips for detection which are captured by webcam.

• Here, the colored fingertip acts as an object that the webcam senses.

• The camera is positioned such that it recognizes the moment of fingertips and performs the operations of the mouse.

• The utilization of virtual mouse appears in space-saving situations or in movement situations.

➢ Research Objective and issues

• 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 mouse function such as left-click, right-click, and scrolling function.

• The purpose of this project is to develop a Virtual Mouse application that targets a few aspects of significant development. For starters, this project aims to eliminate the need needs of have a physical mouse while being able to interact with the computer system through a webcam by using various image processing techniques. Other than that, this project aims to develop a Virtual Mouse application that can be operated operate kinds of surfaces and d environments. The following describes the overall objectives of this project:

• To design to operate with the help of a webcam. The Virtual Mouse application will be operational with the help of a webcam, as the webcam are responsible to capture the images in real time. The application would not work if there were no webcam detected.

• To design a virtual input that can operate on all surfaces. The Virtual Mouse application will be operational on all surface and indoor environment, as long the users are facing the webcam while doing the motion gesture.

• To program the camera to continue capturing the images, which the images will be analyzed, by using various image processing techniques. As set above, the Virtual Mouse application will be continuously capturing the images in real-time, where the images will be undergoing a series of processes, this includes HSV conversion, Binary Image conversion, lt and pepper noise filtering, and more.

- To convert hand gesture/motion into mouse input that will be set to a particular screen position. The Virtual Mouse application will be programmed to detect the position of the defined colours where it will be set as the position of the mouse pointers. Furthermore, a combination of different colors may result in triggering diverse types of mouse events, such as the right/left clicks, scroll up/down, and more.

➢ Scope

Virtual Mouse will soon be introduced to replace the physical computer mouse to promote convenience while still being able to accurately interact with and control the computer system. To do that, the software requires to be fast enough to capture and process every image, to successfully track the user's gesture. Therefore, this project will develop a software application with the aid of the latest software coding technique and the open-source computer vision library also known as the OpenCV. The scope of the project is as below:

- For most laptop touch pad is not the most comfortable and convenient.

- Virtual mouse, known as Virtual Multitask Mouse.

- This is real time application.

- User friendly application.

- This project removes the requirement of having a physical.

The process of the application can be started when the user's gesture was captured in real time by the webcam, which the captured image will be processed for segmentation to identify which pixels values equals to the values of the defined colour. After the segmentation is completed, the overall image will be converted to Binary Image where the identified pixels will show as white, while the rest are black. The position of the white segment in the image will be recorded and set as the position of the mouse pointer, thus resulting in simulating the mouse pointer without using a physical computer mouse. The software application is compatible with the Windows platform. The functionality of the software will be coded with C++ programming language code with the integration of an external library that does the image processing known as the OpenCV.

The Virtual Mouse application is expected to replace the current methods of utilizing a physical computer mouse where the mouse inputs and positions are done manually. This application offers a more effortless way to interact with the computer system, where every task can be done by gestures. Furthermore, the Virtual Mouse application could assist the motor-impaired users where he/she, could interact with the computer system by just showing the correct combination of colours to the webcam.

CONCEPT AND TECHNIQUE

➢ Research Methodology

For this project, we'll be using the Agile Software Development methodology approach in developing the application. The stated approach is an alternative to the traditional waterfall model that helps the project team respond to unpredictability through incremental and iterative work. It promotes adaptive planning, evolutionary development, early delivery, and continuous improvement, and encourages rapid and flexible response to change. The following describes the principles of the Agile Software Development methodology:

- Satisfy the customer by early and continuous delivery of workable software.

- Encourage changes in requirements.

- Workable software is delivered frequently.

- Continuous collaboration between the stakeholders and the developers.

- Projects are developed around motivated individuals.

- Encourage informal meetings.

- Operational software is the principal measure of progress.

- Sustainable development, able to maintain a constant pace.

- Continuous attention to technical excellence and good design

- Simplicity

- Self-organizing teams

- Regular adaption to changing circumstance

The reason for choosing this methodology is that the Virtual Mouse is still considered to be at the introduction stage, which means it still requires a great deal of extensive research and development before it could make it into the market. Therefore, this project requires a thorough yet iterative planning and requirements gathering where the lifecycle will be continually revisited to re-evaluate the direction of the project and eliminate the ambiguities in the process of development, ad at the same time welcome changes of requirements, which promotes adaptability and flexibility. Furthermore, due to the Virtual Mouse application being more towards serving the users, this project requires continuous customer collaboration, as, as they are essential for gathering the proper requirements in all aspects. Therefore, the agile methodology is the ideal approach for developing the project.

The Virtual Mouse Colour Recognition requires being able to recognize most of the colours provided by the users with high accuracy, consistency, and minimal performance impact on other processes. However, the recognition results may vary whenever the qualities of the captured frames have changed, as they may be affected by the different situations in terms of environment, brightness, and weather. The following describes the situations which may result in false detection and/or any other problem that may occur during the recognition phase:

a) The real-time images are taken under dark or bright environment conditions.

b) The real-time images are taken in a colour conflict background.

c) The users interact with the program at near or far distances.

d) The real-time images are rotated in a clockwise or anti-clockwise rotation to achieve greater accuracy and consistency throughout the whole recognition cycle, a plan is required to be implemented for the program to perform flawlessly.

The aim of this paper is to implement a computer application that uses alternative methods to control keyboard and mouse cursors for the rehabilitation of people who are suffered from a stroke so that they can recover from the side effects. Therefore, we propose a new keyboard and mouse cursor control system based on the vision and recognition technique, utilizing hand gestures recorded from a webcam.

➢ Conceptual review

As modern technology of human-computer interactions become important in our everyday lives, varieties of mouse of all kinds of shapes, and sizes were invented, from a casual office mouse to a hard-core gaming mouse. However, there are some limitations to this hardware as they are not as environmentally friendly as it seems. For example, the physical mouse requires a flat surface to operate, not to mention that it requires a certain area to fully utilize the functions offered. Furthermore, some of this hardware is completely useless when it comes to interact with the computers remotely due to the cable length limitations, rendering it inaccessible.

There are traditional approaches for virtual keyboard and mouse systems which are usually based on eye gestures. Our literature review focuses on the research works on virtual keyboard and virtual mouse which were published in Elsevier, Springer, ACM (AWS Certificate Manager) Digital Library, IEEE Digital Library etc.

In 2016, S. Shetty et al. constructed a virtual mouse system using color detection. They used a webcam for detecting mouse cursor movement and click events using OpenCV built-in functions. A mouse driver, written in java, is quired as well. This system fails to perform well in the rough background. P. C. dhe et al. expanded a method for mouse-free cursor control where mouse cursor operations are controlled by using hand fingers. They have collected hand gestures via webcam using color detection principles. The built-in function of the Image Processing Toolbox in MATLAB and a mouse driver, written in java, is used in this approach. The pointer was not too efficient on the air as the cursor was very sensitive to the motion.

G. Sahu et al. built a system for controlling a mouse pointer using a webcam that controls the volume of the media player, and PowerPoint slides and can make or end a call. They used RGB color tapes to recognize the user's finger. In 2019, K. Hassan et al. presented a system to design and develop a hand gesture-based virtual mouse. They captured different gestures via webcam and performed mouse functions according to the gestures. This system achieved 78%-90% accuracy. The system does not work efficiently in a complex or rough background. As we can see from the reviewed literature, previous systems include either a virtual keyboard or a virtual mouse. Those systems can't fully eliminate the need for a mouse and keyboard completely. This work aims to build an interactive computer system that can be operated without any physical mouse.

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, 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 are more alternatives to using a mouse.

➢ FEATURES AND RESEARCH OUTCOMES

•   Features such as enlarging and shrinking windows, closing window, etc. by using the palm and multiple fingers are our future scope for this project.

•   In the future, we plan to add more features such as enlarging and shrinking windows, closing windows, etc by using the palm and multiple fingers.

•   We can also open the browser or any drives (C: /D:/E: etc) with the help of hand gestures instead of moving the cursor.

The Virtual Mouse application is expected to replace the current methods of utilizing a physical computer mouse where the mouse inputs and positions are done manually. This application offers a more effortless way to interact with the computer system, where every task can be done by gestures. Furthermore, the Virtual Mouse application could assist the motor-impaired users where he/she could interact with the computer system by just showing the correct pattern of fingers to the webcam.

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.

Skin detection can be defined as detecting the skin colour pixels in an image. It is a fundamental step in a wide range of image processing applications such as face detection, hand tracking and d gesture recognition. Skin detection using colour information has recently gained a lot of attention since it is computationally effective and provides robust information against scaling, rotation and partial occlusion. Skin detection using colour information can be a challenging task, since skin appearance in images is affected by illumination, camera characteristics, background and ethnicity. In order to reduce the effects of illumination, the image can be converted to a chrominance colour space, which is less sensitive to illumination changes. A chrominance colour space is one where the intensity information (luminance), is separated from the colour information.

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