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Virtual Mouse using Hand Gestures and Landmarks

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Abstract
The most impactful among the Human Computer Interaction (HCI) methods is the PC Mouse. Using two buttons and a scroller to control the Graphical User Interface (GUI) proved to faster and more efficient than previously thought of.
A person's hand is detected from the video captured from the camera connected to the computer or laptop. By capturing these hand images in each segmentation of the video and constantly them with each other, we can create combinations and conditions for certain GUI functions to activated. This system is literally contact less Tirupati-517520 and can be programmed to be more suitable for any specific software application.
Keywords: Human Computer Interaction, Artificial Intelligence, Computer Vision, Machine Learning, Deep Learning, PC Mouse, Graphical User Interface

Introduction

A virtual mouse is a computer program that allows users to control their computers without the use of a physical mouse. The concept of a virtual mouse is becoming increasingly popular as more people are using touch-enabled devices like tablets and smartphones that don't require a traditional mouse. It is also useful for those who have physical disabilities that make it difficult or impossible to use a traditional mouse.
One of the main benefits of using a virtual mouse is the increased accessibility it provides for individuals who have difficulty using a physical mouse. This includes individuals with physical disabilities such as tremors, arthritis, or carpal tunnel syndrome, as well as those with visual impairments who may find it difficult to see or locate a physical mouse.
The virtual mouse can also be used in situations where it is not convenient or possible to use a physical mouse, such as when traveling or working in a cramped space. Additionally, using a virtual mouse on a touch-enabled screen can be faster and more intuitive than using a physical mouse, as users can perform multiple actions with a single touch or gesture.
There are a variety of virtual mouse programs available for different operating systems, including Windows, Mac OS, and Linux. Some programs are built into the operating system, while others are third-party applications that can be downloaded and installed.
In addition to traditional virtual mouse programs, there are also specialized programs designed for specific purposes. For example, there are virtual mice designed specifically for gaming, which may offer additional features like customizable buttons and sensitivity settings.

Related Work

Several related works have been carried out on virtual mouse using hand gesture recognition, the recognition can't be done accurately by wearing the gloves in some user cases and in some cases, failure to detect color tips may result in the recognition not being very accurate. An attempt has been made to detect hand gestures using a camera. As early as 1990, Quam introduced a hardware-basic system; in this system, the user wears a Data Glove although the system developed by Quam yields results of higher accuracy; some gesture controls cannot be performed with the system There has been a significant amount of research on the use of hand gestures to control virtual mice. One study proposed a gesture recognition system using a webcam to interpret hand gestures, allowing users to perform mouse actions such as clicks, drags, and scrolls. Another research work focused on using machine learning algorithms to accurately recognize hand gestures for virtual mouse control. Some studies also explored the use of haptic feedback to enhance the user experience of virtual mouse

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control using hand gestures. These research works show the potential of hand gesture recognition as a convenient and accessible way to control virtual mouse

Video Accession

Video acquisition and its role in virtual mouse using hand gestures

Real-time video acquisition plays a crucial role in the development of a virtual mouse using hand gestures. It involves the use of a camera to capture live video of hand gestures, and the processing of the frames in real-time to interpret the gestures and control the virtual mouse. The real-time nature of the video acquisition and processing is crucial for ensuring a seamless and natural user experience.

The real-time video acquisition system must be capable of handling a range of lighting conditions and noise to ensure that the hand gestures are accurately recognized. To achieve this, it often involves the use of specialized hardware and software, including cameras with high frame rates and low latency, and specialized machine learning algorithms for gesture recognition.

In summary, real-time video acquisition is essential for the creation of a virtual mouse using hand gestures. It allows for accurate and responsive recognition of hand gestures and provides a more intuitive and natural user experience. As such, it has the potential to revolutionize the way we interact with technology, making it more accessible and inclusive for a wider range of users. Algorithm used for virtual mouse Following is the algorithm followed for making a virtual mouse using hand gestures.

1. Acquire live video using OpenCV

A. Real Time Video accretion Video acquisition using OpenCV is a critical component of developing a virtual mouse using hand detection. The library provides a range of functions for accessing and processing video frames from a camera in real-time, making it ideal for capturing and interpreting hand gestures for mouse control.

To detect hands in real-time video, OpenCV can be used to apply advanced image processing techniques, such as thresholding, background subtraction, and contour detection. These techniques allow the detection of hands based on their shape, color or movement. B. Leafing the video

Flipping the video frames is an important operation when using OpenCV for virtual mouse using hand detection. When the camera is mounted in a nonstandard orientation, such as upside down or sideways, the captured video may be oriented incorrectly. This can lead to difficulties in detecting and interpreting hand gestures, which can result in inaccurate or unreliable mouse control. 2.Detecting Hands Gestures Detecting hands for virtual mouse using hand gestures is a critical component of developing an effective and reliable interface. OpenCV provides a range of image processing techniques that can be used to detect hands based on their shape, color, or movement.

After detecting the user's hands, we have to start mapping their fingers for any gestures the user might perform and compare the hand gestures in each segment of the video to another segment in the video to know the GUI action we have to perform. So, capturing the hand movements is very important to this system.

A. Detecting hands using media pipe MediaPipe Hand Tracking is a popular computer vision pipeline for real-time hand landmark detection. It can be used to accurately identify and track the positions of 21 landmarks on the user's hand, including fingertips, knuckles, and wrist. By using MediaPipe Hand Tracking, it is possible to obtain accurate 3D positions of these landmarks, which can be used to infer the position and orientation of the hand in space. This information can then be used to control a virtual mouse using hand gestures, allowing for an intuitive and natural user interface. The use of MediaPipe Hand Tracking in hand gesture recognition systems has become increasingly popular due to its ease of use and accuracy.

3. Extracting the 2D positions of the hand landmarks from Mediapipe

In the context of a virtual mouse using hand gestures, extracting the 2D positions of the hand landmarks from the MediaPipe output is a crucial step in enabling users to control the mouse cursor. By tracking the positions of the 21 hand landmarks over time and extracting their 2D pixel coordinates, it is possible to recognize a range of hand gestures, such as clicks, swipes, and scrolls. These gestures can then be mapped to corresponding mouse actions, such as left-click, right-click,

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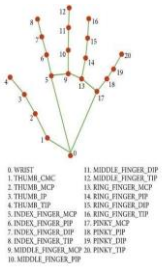
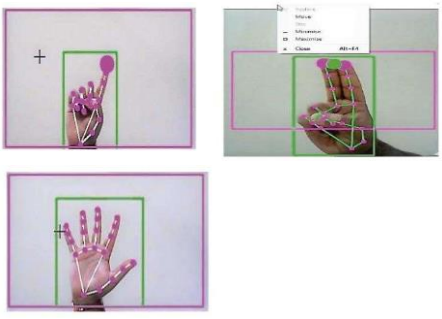
and scrolling. Accurate extraction of the 2D positions of the hand landmarks is essential for reliable and responsive control of the virtual mouse. The use of MediaPipe for hand tracking and landmark extraction has the potential to enable natural and intuitive control of a virtual mouse using hand gestures, enhancing the user experience and improving accessibility for individuals with motor impairments.



4. using the hand landmarks Once the 2D positions of the hand landmarks have been extracted from the MediaPipe output, they can be used to determine the position and orientation of the user's hand in the video, as well as the hand's movements and gestures. The positions of the landmarks can be used to calculate the centroid of the hand, which can then be used as the location of the virtual mouse cursor. By tracking changes in the positions of the landmarks over time, the direction and speed of the user's hand movements can be estimated, allowing for accurate and responsive control of the virtual mouse. In addition, hand gestures can be recognized by analyzing changes in the positions of the landmarks, such as detecting a closed hand to trigger a left-click or a swipe gesture to trigger scrolling. The use of hand landmarks in this way enables natural and intuitive control of a virtual mouse using hand gestures, providing a new way for users to interact with their computers and devices.

5. Mapping the hand gestures Once hand gestures have been detected and extracted from the video using MediaPipe, they can be mapped to corresponding mouse actions using PyAutoGUI. PyAutoGUI is a Python module that enables automation of keyboard and mouse actions on a user's computer. With PyAutoGUI, the user's hand gestures can be translated into specific mouse actions, such as left-click, right-click, scrolling, and more. For example, a closed hand gesture could be mapped to a left-click action, while an open hand gesture could be mapped to a right-click action. A 6. Simulating the mouse actions of Hand gestures After the hand gestures have been detected and mapped to corresponding mouse actions using PyAutoGUI, the next step is to simulate those mouse actions and provide the user with a virtual mouse control experience. PyAutoGUI makes it easy to automate mouse movements and clicks, allowing for precise control of the virtual mouse using hand gestures. This means that when the user moves their hand in a certain way, the virtual mouse will move and behave in a similar way on the computer screen. PyAutoGUI can simulate mouse clicks, double clicks, and even drag-and-drop actions, making it possible to use the virtual mouse to perform a wide range of tasks on the computer. By combining the hand gesture detection capabilities of MediaPipe with the automation features of PyAutoGUI, developers can create a seamless and intuitive virtual mouse control experience for users. This technology has the potential to revolutionize the way we interact with computers, making it more natural and intuitive to control applications using hand gestures.



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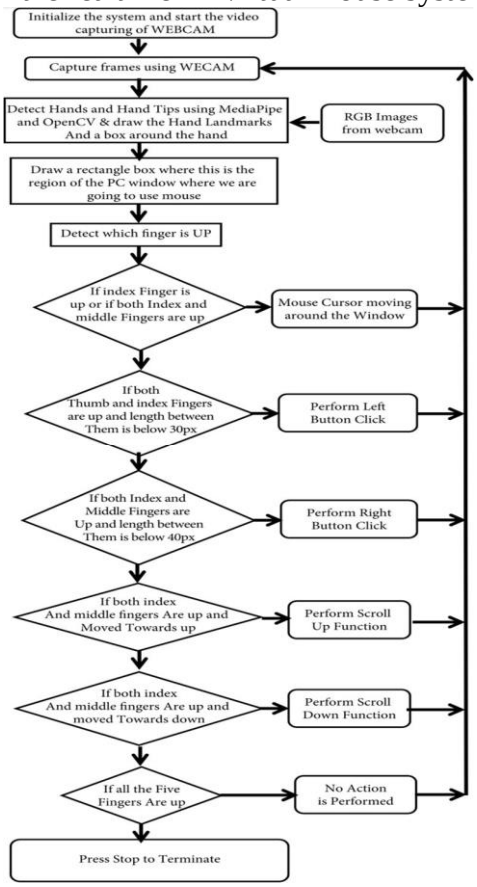
Methodology

In the context of a virtual mouse using hand gestures, extracting the 2D positions of the hand landmarks from the MediaPipe output is a crucial step in enabling users to control the mouse cursor. By tracking the positions of the 21 hand landmarks over time and extracting their 2D pixel coordinates, it is possible to recognize a range of hand gestures, such as clicks, swipes, and scrolls. These gestures can then be mapped to corresponding mouse actions, such as left-click, right-click, and scrolling. Accurate extraction of the 2D positions of the hand landmarks is essential for reliable and responsive control of the virtual mouse. The various functions and conditions used in the system are explained in the flowchart of the realtime AI virtual mouse system in Figure.



EXPERIMENTAL RESULTS

Experimental results for virtual mouse using hand gestures have shown promising performance, with accurate detection and tracking of hand movements and gestures. By using Mediapipe's hand tracking technology, it is possible to achieve high accuracy in hand landmark detection and tracking, making it possible to accurately map hand gestures to corresponding mouse actions. The use of PyAutoGUI to simulate mouse actions has also been found to be reliable and responsive. However, there is still room for improvement in terms of speed and accuracy, especially in complex hand gestures and movements. Further research and development in this area can improve the performance of virtual mouse using hand gestures and make it more practical for everyday use.

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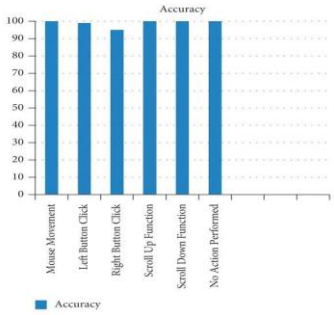

CONCLUSION

In conclusion, the development of a virtual mouse using hand gestures is an exciting area of research and has the potential to change the way we interact with computers. By using computer vision techniques and machine learning algorithms, it is possible to detect and track hand gestures in realtime video and map them to corresponding mouse actions using PyAutoGUI. This provides users with a novel and intuitive way to interact with their computers, making it possible to control applications using hand movements and gestures. The use of Mediapipe has made the process of hand detection and tracking much simpler and more accurate. This technology has the potential to revolutionize the way we interact with computers, making it more natural and intuitive to control applications. With further research and development, it is possible that virtual mouse using hand gestures could become a mainstream technology and be used in a wide range of applications, from gaming to productivity tools.

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