Hand Gestures Based Cursor Control

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***Abstract*—** Scientists and researchers worldwide are currently developing ways to make our electronic devices more user- friendly and less reliant on physical interaction. In line with this trend, our team has proposed an interactive computer system that can function without the need for a traditional mouse. Instead, we plan to leverage the power of cameras and computer vision technologies to manage tasks that would typically require a mouse, such as clicking and scrolling. Our aim is to demonstrate how this system can replicate all the functionality of existing mouse devices, without requiring the physical use of one. To achieve this, we will be utilizing programming languages such as Python and cutting-edge computer vision software like OpenCV. These tools will be instrumental in helping us to build a system that can interpret visual input from a camera, translate it into commands, and execute them in real-time. By doing so, we hope to create a more intuitive and user-friendly way of interacting with our devices, without the limitations of traditional mouse devices.

Keywords: Human-Computer Interaction (HCI), MediaPipe,OpenCV, Hand Gestures

I. Introduction

A virtual mouse is a tool that allows users to perform the functions of a traditional mouse cursor through the recognition of hand gestures. This technology leverages the natural and intuitive movements of the human hand to control and manipulate digital interfaces, without the need for physical devices like a mouse or trackpad. The system uses a Convolutional Neural Network (CNN) model to identify and recognize various features of an image or video frame, such as hand shape and movement. This neural network is trained on a large dataset of hand gesture images, allowing it to accurately and reliably classify hand gestures and map them to corresponding mouse functions. The development of this virtual mouse system represents a significant advancement in machine learning and computer vision technology, as it enables seamless and intuitive human-computer interaction without the need for additional hardware or devices. This has the potential to greatly enhance the accessibility and usability of digital interfaces for a wide range of users, including those with physical disabilities or limitations. In summary, this project demonstrates the power and potential of machine learning and computer vision technologies to revolutionize the way we interact with digital devices and interfaces. By leveraging the natural movements and gestures of the human hand, virtual mouse technology offers a more intuitive, seamless, and accessible way to navigate and control digital environments.

II. LITERATURE SURVEY

Several research studies have explored the use of hand gestures to control mouse functions and navigate computer systems. One proposed system uses color caps or tapes on the user's hand, which are tracked by a computer webcam to perform basic mouse functions such as cursor movement, clicking, and dragging. However, this system is limited in its functionality, as it can only perform a few mouse functions. Another study proposes a real-time camera-based approach for controlling mouse movement, where image processing is performed on each frame of video to detect colors and perform mouse tasks. However, this approach is also limited in that it depends on various colors to perform mouse functions, which may not be practical in all settings. A different research study proposes a method for detecting hand movements and controlling mouse functions based on a face-based adaptive skin color model and motion history image-based hand-moving direction detection. The adaptive skin color model is used to detect skin color regions, such as the hands, while a motion history image-based method is developed to classify dynamic hand gestures. However, the limitation of this approach is that it may struggle to analyze more complex hand gestures. A different research study proposes a method for detecting hand movements and controlling mouse functions based on a face-based adaptive skin color model and motion history image-based hand-moving direction detection. The adaptive skin color model is used to detect skin color regions, such as the hands, while a motion history image-based method is developed to classify dynamic hand gestures. However, the limitation of this approach is that it may struggle to analyze more complex hand gestures. Overall, these research studies demonstrate the potential for using hand gestures to control mouse functions and navigate computer systems. However, they also highlight some of the limitations and challenges in developing effective and practical systems. Future research may focus on overcoming these limitations, such as developing more advanced algorithms for gesture recognition, or exploring alternative input modalities beyond hand gestures.

III.ISSUES IDENTIFIED

Virtual mouse technology has recently been developed that utilizes hand gesture detection to control a computer mouse. This technology involves the use of a glove that is worn on the hand and color markers placed on the fingers to detect and interpret hand gestures. However, the popularity of this technology is not accurate due to the requirement of wearing gloves, which can be uncomfortable and not suitable for all users. Additionally, the detection of color markers can be unreliable, leading to inaccuracies in gesture recognition. Current models of this technology only offer basic features such as scrolling and selecting, limiting the overall functionality of the virtual mouse. Virtual mouse technology is a new and innovative way to control a computer mouse without the need for a physical mouse or touchpad. This technology uses hand gesture detection, which involves interpreting the movements and gestures of the hand to control the cursor on the computer screen. To enable this technology, a glove is worn on the hand, and color markers are placed on the fingers. The glove captures the movement of the hand and transmits it to the computer, where the gestures are recognized and translated into cursor movements. Despite the potential benefits of this technology, there are some drawbacks that limit its popularity. One of the major issues is the requirement of wearing a glove. While this may not seem like a big deal, some users find the gloves to be uncomfortable and cumbersome. This is especially true for those who need to use the virtual mouse for extended periods, such as office workers or gamers. The discomfort caused by the gloves can be a significant barrier to adoption, limiting the popularity of this technology. Another issue with virtual mouse technology is the detection of color markers. While these markers are used to help recognize hand gestures, they can be unreliable. The markers can become faded or smudged, making it difficult for the computer to accurately interpret the hand movements. This can result in inaccurate cursor movements or even complete failure of the technology to recognize gestures. These issues can be frustrating for users and can limit the overall usefulness of the virtual mouse.

IV. PROPOSED SYSTEM

The primary goal of this proposed AI virtual mouse system is to improve user experience by providing a more intuitive and natural way of interacting with the computer. The traditional mouse system can be challenging to use for some users, especially those with physical disabilities or mobility impairments. The virtual mouse system addresses this issue by enabling users to perform mouse functions through hand gestures, which can be more comfortable and accessible for some users.

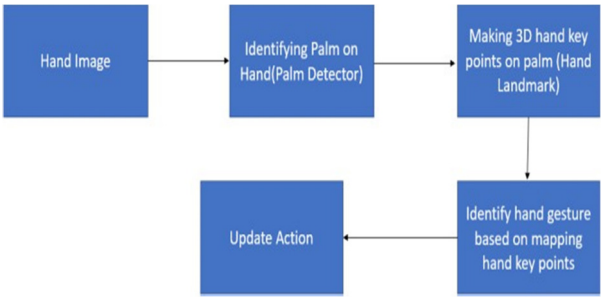
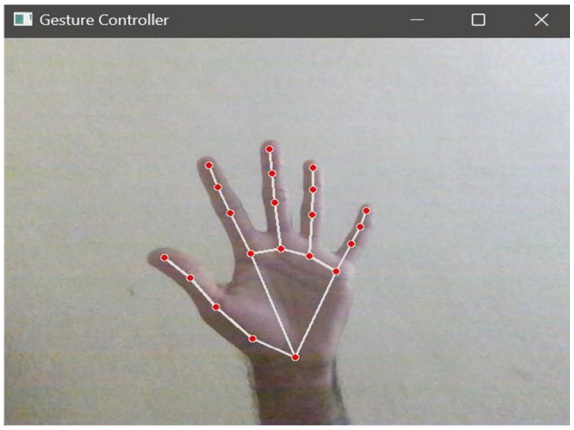


Figure 1: Architecture Diagram

To achieve this goal, the virtual mouse system relies on a web camera to capture images of the user's hand movements. The images are then processed to recognize specific hand gestures, which are mapped to corresponding mouse actions. For example, a user may perform a "click" gesture by making a fist, while a "scroll" gesture can be executed by moving the hand up or down. The virtual mouse system also includes additional features such as drag and drop and multiple select. These features are designed to provide users with more advanced functionality, similar to what is available with a traditional mouse. The drag and drop feature allows users to move files and folders by dragging them with a hand gesture, while multiple select enables users to select multiple items simultaneously. The development of this virtual mouse system represents an exciting advancement in human-computer interaction. By leveraging AI technology to recognize and interpret hand gestures, this system provides users with a more intuitive and accessible way to interact with their computer. As more advanced features are added, such as those for drag and drop and multiple select, the virtual mouse system has the potential to become a viable alternative to the traditional mouse system for many users.

V. RESULT AND DISCUSSION



1. NEUTRAL GESTURE

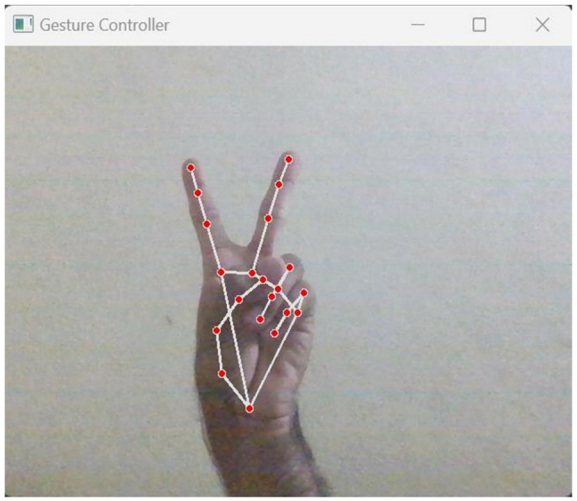


Fig.2. Move Cursor

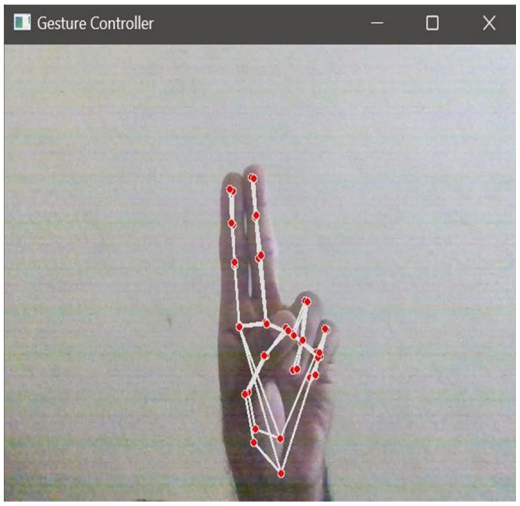


Fig.5. Double Click

Fig.6. Scrolling

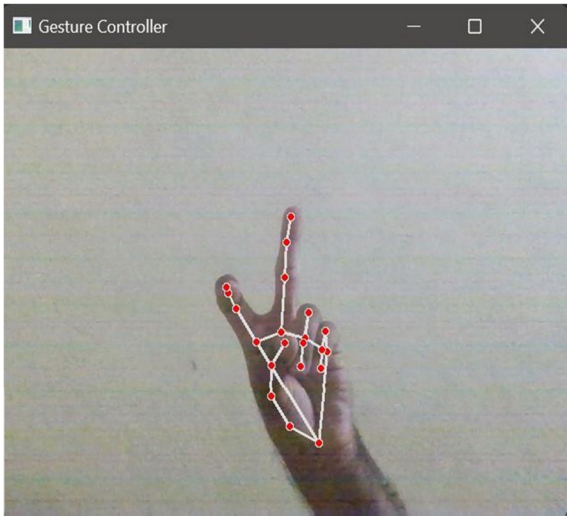


Fig.3. Left Click

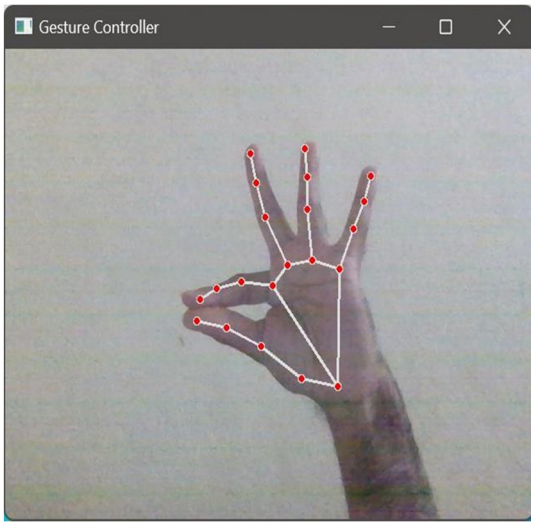


Fig.7. Drag Drop and Multi Select

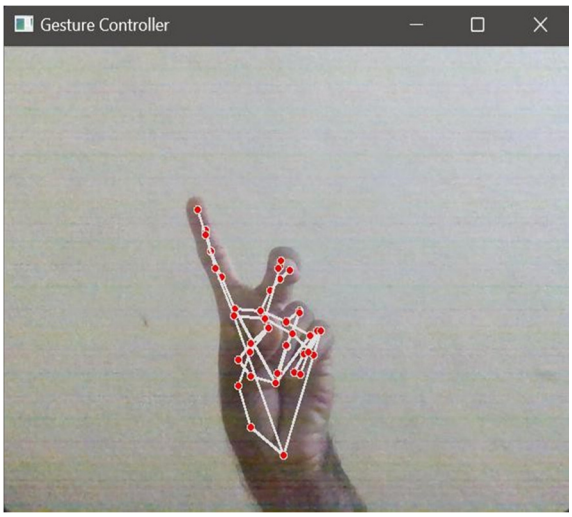
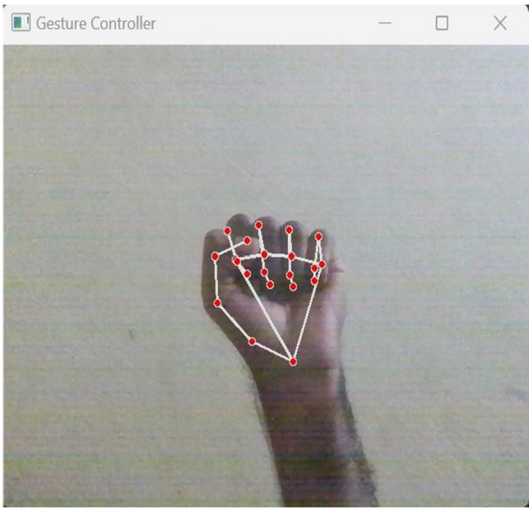


Fig.4. Right Click



VI. CONCLUSION

The proposed virtual AI mouse is a computer vision-based solution that aims to replace the traditional physical mouse. It utilizes a web camera installed on a computer to detect and interpret hand gestures and movements, which are then processed by a machine learning algorithm to execute mouse functions like cursor movement, left and right clicks, and scrolling. Instead of relying on a physical device to interact with a computer, users can now use hand gestures to perform tasks. The virtual AI mouse uses computer vision technology to capture images of the user's hand movements and analyze them to interpret the intended action. The virtual AI mouse is a versatile solution that can replace the traditional mouse in various scenarios. For instance, users with physical disabilities can benefit from using the virtual AI mouse as it eliminates the need for physical dexterity. Additionally, users who prefer touchless interactions can utilize this technology to avoid contact with physical surfaces. The success of the virtual AI mouse depends on the accuracy and efficiency of the computer vision technology and machine learning algorithm. The web camera must capture high-quality images of the user's hand gestures, and the algorithm must accurately interpret them to perform the intended mouse function. The virtual AI mouse is an innovative solution that can revolutionize how we interact with computers. It is an excellent example of how technology can make our lives easier and more accessible.

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