International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

AI VIRTUAL MOUSE

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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 is capable of performing every task that the physical computer mouse can.

The Virtual Mouse Gesture recognition program will constantly acquiring real-time images where the images will undergone 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 targeted Hand gesture position from the converted frames. After that, it will proceed to compare the existing gesture within the frames with a list of gesture tip combinations, where different combinations consists of different mouse functions. If the current gesture combination found a match, the program will execute the mouse function, which will be translated into an actual mouse function to the users' machine.

1 . INTRODUCTION

With the development 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 the 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 function 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 a Human Computer Interaction (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 also 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 also, a battery to power the mouse to operate are used, but in this paper, the user uses built-in camera or a webcam and uses 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 particular mouse function. Some devices, such as the mouse, the dongle to connect to the PC, and a battery to power the mouse to operate are used when using a wireless or Bluetooth mouse, but in this paper, the user uses his/her built-in camera or a webcam and uses hand gestures to control the computer mouse operations. In the proposed system, the web camera captures and then processes the captured frames, recognizing various hand gestures and hand tip gestures before performing the specific mouse function.

Python programming language is used for developing the AI virtual mouse system, and also, OpenCV which is the library for computer vision is used in the AI virtual mouse system the model makes use of the MediaPipe package for the tracking of the hands and for tracking of 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 very high accuracy level, and the proposed model can work very well in real-world application with the use of a CPU without the use of a GPU.

Objective

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 particular mouse function such as left click, right click, and scrolling function.

Problem Description and Overview

The proposed AI virtual mouse system emerges as a groundbreaking solution, addressing a spectrum of real-world challenges. One of its key advantages lies in

its ability to navigate environments where physical space constraints render the use of a traditional mouse impractical. This innovation extends its utility to scenarios where individuals face difficulties in hand control, providing an inclusive solution for those with motor impairments. Moreover, the system becomes particularly relevant in the context of the ongoing COVID-19 pandemic. In a time where minimizing physical contact with devices is crucial to prevent the potential spread of the virus, the AI virtual mouse stands out as a safer alternative.

By harnessing hand gesture and hand tip detection through a webcam or built-in camera, users can interact with their devices without the need for direct physical contact. This not only addresses hygiene concerns but also aligns with the evolving norms of touch-free interactions, contributing to a safer and more resilient technological landscape.

The system's adaptability to diverse use cases underscores its versatility. Whether in a crowded space, a medical setting, or in the hands of individuals with physical limitations, the proposed AI virtual mouse emerges as a viable and accessible solution, reaffirming its potential to revolutionize the way we interact with technology in the face of real-world challenges.

Navigating the Digital Landscape

Navigating the digital landscape takes on a new dimension with the introduction of the AI virtual mouse. This innovative concept transcends the conventional boundaries of input devices, offering a paradigm shift in how users interact with digital interfaces. Unlike traditional mice or touchpads, the AI virtual mouse harnesses the power of artificial intelligence to interpret and respond to user gestures, making the navigation experience more intuitive and responsive. By leveraging advanced algorithms and computer vision, this technology recognizes hand or finger movements as input commands, eliminating the need for physical devices. It introduces a dynamic and adaptive approach to navigating through digital spaces, catering to a diverse range of user preferences and behaviors. As we delve into the era of AI-driven virtual mice, the digital landscape becomes not just a space to be navigated but a dynamic canvas where users can seamlessly interact, opening new possibilities for a more efficient, inclusive, and user-centric computing experience.

From Concept to Reality

Tracing the evolution of the AI virtual mouse from its conceptual roots to its real-world applications, The journey of the AI virtual mouse from concept to reality represents a remarkable evolution in the realm of human-computer interaction. What once existed as a conceptual idea, pushing the boundaries of traditional input devices, has now materialized into a tangible and innovative technology. The realization of the AI virtual mouse showcases the relentless pursuit of creating more intuitive and efficient ways for users to interact with digital interfaces. From the early stages of ideation to the development of sophisticated algorithms, this journey underscores the commitment to enhancing accessibility and user experiences in the digital landscape. The concept's transition into reality reflects not only advancements in artificial intelligence but also a profound shift in how we navigate and engage with computers. As this technology continues to mature, it holds the promise of revolutionizing the way we interact with digital environments, offering a glimpse into a future where the fusion of artificial intelligence and navigation systems seamlessly integrates into our daily computing experiences.

2 . LITERATURE SURVEY

A literature survey on AI virtual mouse technology reveals a rich landscape of research and development in the field of human-computer interaction and gesture recogniton. Various studies have explored the integration of artificial intelligence with virtual mouse systems, aiming to enhance user experiences and accessibility. Researchers have delved into computer vision techniques, machine learning algorithms, and gesture recognition to enable precise and intuitive control of virtual cursors. These investigations have sought to address challenges related to latency, accuracy, and adaptability, with an emphasis on real-time responsiveness for applications such as gaming and augmented reality. Moreover, studies have highlighted the potential of AI virtual mouse systems to benefit individuals with physical disabilities by providing alternative input methods. As AI continues to evolve, the literature underscores the ongoing pursuit of innovative solutions and improved user interfaces in the realm of virtual mice, contributing to more immersive and efficient interactions in the digital landscape.

Human Computer Interaction

Human-computer interaction (HCI) is a multidisciplinary field that examines the interaction between humans and computers. It focuses on designing and evaluating user interfaces to optimize the user experience. HCI researchers explore how users interact with software and hardware, striving to create intuitive and efficient interfaces. This field encompasses various aspects, from usability testing to accessibility considerations, ensuring that technology is accessible to all users, regardless of abilities or disabilities. HCI plays a pivotal role in shaping the design of websites, mobile apps, and software applications, seeking to enhance user productivity and satisfaction. In an increasingly digital world, the study of HCI continues to evolve, driven by the goal of creating technology that aligns seamlessly with human needs and behaviors.

2.1 Gesture Recognition

Gesture recognition technology is a dynamic and evolving field that enables computers to interpret and respond to human gestures and movements. It encompasses a range of applications, from touchless interfaces and virtual reality to sign language recognition and gaming consoles. Advanced sensors, such as depth cameras and accelerometers, are often employed to capture and analyze gestures accurately. Machine learning algorithms play a central role in identifying and interpreting gestures, making it possible to recognize intricate hand movements or body poses. As gesture recognition technology continues to advance, it offers the promise of more intuitive and immersive human-computer interactions, with applications across various industries and daily life.

2.2 Existing System

Physical Mouse (Wired): Wired mice use a cable to connect to the computer. They respond quickly and are suitable for tasks like gaming. They don't need batteries since they use the computer's power.

Fig 2.1: Wired mouse

Wireless Mouse (Bluetooth): Wireless mice have no cables, allowing for free movement.

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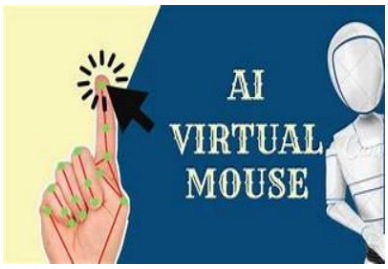
They require batteries or charging, so battery management is necessary. There might be a slight delay in response when moving them, and other devices can interfere with their signals. Wireless mice tend to be more expensive due to their technology. They may not work with all devices and the setup process can be a bit tricky. Some models have power-saving to extend battery life.

Fig 2.2: Wireless mouse

2.3 Proposed System

The proposed system for an AI virtual mouse represents an innovative approach to human-computer interaction, offering a user-friendly and accessible means of navigating digital interfaces. This system leverages artificial intelligence, machine learning, and computer vision technologies to interpret hand or finger movements as input commands for controlling the virtual cursor on a screen. By eliminating the need for physical input devices, the AI virtual mouse enhances convenience and flexibility, particularly in contexts where traditional mice or touchpads may be impractical or inaccessible.



The technology can benefit individuals with physical disabilities, offering an inclusive and empowering alternative for interacting with digital devices. With applications extending to virtual reality, augmented reality, the proposed system promises to revolutionize the way we interact with technology. Ongoing development and integration with emerging technologies hold the potential for even more sophisticated and natural user experiences.

3 . SYSTEM DESIGN

System design is the second phase of the software life cycle. The system goes through logical and physical state of development. The user oriented performance specification is extended into a design specification, while designing the needed system. The design phase begins when the Requirement

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Specification document for the software to be developed is available. When the Requirement Specification activity is entirely in the problem domain, design is the first step to move from the problem domain to the solution domain. Design is essentially the bridge between the requirements specification and the final solution for satisfying these requirements

3.1 Input Design

Input design is the process of converting a user-oriented description of the inputs to a computer-based business system into a programmer-oriented specification. The design decision for handling input specify how data are accepted for computer processing. Input design is a part of overall design that needs careful attention. The collection of input data is considered to be the most expensive part of the system design. Since the inputs have to be planned in such a way so as to get the relevant information, extreme care is taken to obtain the pertinent information. The goal of designing input data is to make data entry as easy, logical and free from errors as possible.

3.2 Output Design

The output design phase of the system design is concerned with the conveyance of information to the end users in user-friendly manner. The output design should be efficient, intelligible so that the system relationship with the end user is improved and thereby enhancing the process of decision making. Efficient and well-defined output design improves the relation of the system and the user. The primary considerations in the design of the output are the requirement of the information and the objective of the end user.

3.3 Data Flow Design

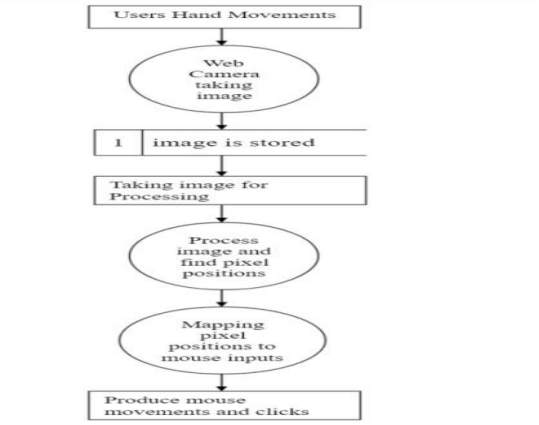

Fig 3.1: Data Flow Diagram

3.4 Unified Modeling Language (UML)

3.4.1 Use Case Diagram

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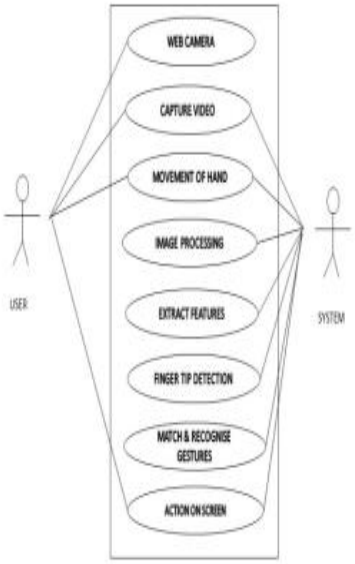

Fig 3.2: Use Case Diagram

4 . OUTPUT SCREENS

Fig 4.1: Cursor Movement

Cursor is assigned to the midpoint of index and middle fingertips. This gesture moves the cursor to the desired location. Speed of the cursor movement is proportional to the speed of hand.

Fig 4.2: Left Click Gesture for single left click

RIGHT CLICK

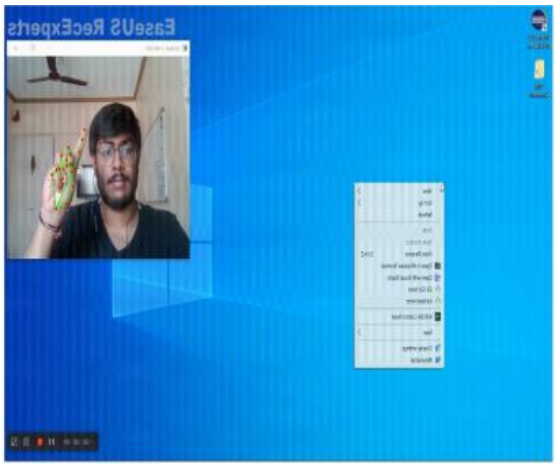

Fig 4.3: Gesture for single right click

SCROLLING

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Fig 4.4: Gesture for Scrolling

Dynamic Gestures for horizontal and vertical scroll. The speed of scroll is proportional to the distance moved by pinch gesture from start point. Vertical and Horizontal scrolls are controlled by vertical and horizontal pinch movements respectively.

DRAG AND DROP

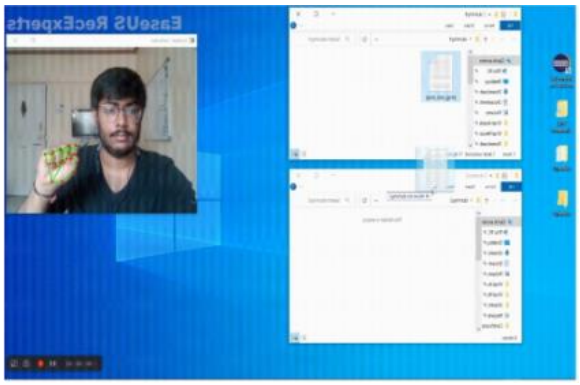

Fig 4.5: Drag and Drop

Gesture for drag and drop functionality. Can be used to move/tranfer files from one directory to other.

BRIGHTNESS CONTROL

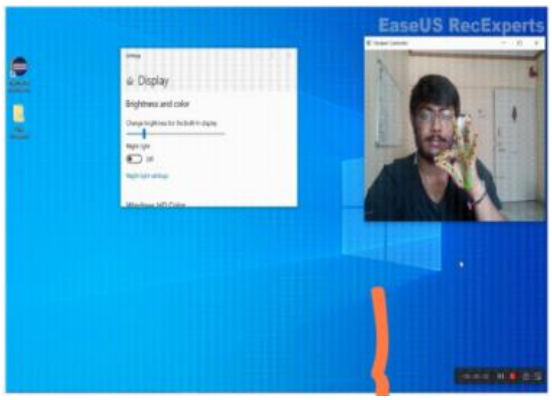

Fig 4.6: Gesture for Brightness Control

Dynamic Gestures for Brightness control. The rate of increase/decrease of brightness is proportional to the distance moved by pinch gesture from start point.

5 . CONCLUSION

The main objective of the AI virtual mouse system is to control the mouse cursor functions by using the hand gestures instead of using a physical mouse. The proposed system can be achieved by using a webcam or a built-in camera which detects the hand gestures and hand tip and processes these frames to perform the particular mouse functions.

From the results of the model, we can come to a conclusion that the proposed AI virtual mouse system has performed very well and has a greater accuracy compared to the existing models and also the model overcomes most of the limitations of the

existing systems. Since the proposed model has greater accuracy, the AI virtual mouse can be used for real-world applications, and also, it can be used to reduce the spread of COVID-19, since the proposed mouse system can be used virtually using hand gestures without using the traditional physical mouse.

The model has some limitations such as small decrease in accuracy in right click mouse function and some difficulties in clicking and dragging to select the text. Hence, we will work next to overcome these limitations by improving the finger tip detection algorithm to produce more accurate results.

6 . FUTURE ENHANCEMENT

The proposed AI virtual mouse has some limitations such as small decrease in accuracy of the right click mouse function and also the model has some difficulties in executing clicking and dragging to select the text. These are some of the limitations of the proposed AI virtual mouse system, and these limitations will be overcome in our future work.

Furthermore, the proposed method can be developed to handle the keyboard functionalities along with the mouse functionalities virtually which is another future scope of Human-Computer Interaction (HCI).

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