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AI Virtual Mouse to Enhance User Experience and Increase Accessibility

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Abstract

In today's Z generation era to do all kinds of task smoothly and doing human machine interaction in smarter ways the role of intelligent computer mice and its peripherals are crucial. In our research work we integrate different kinds of sensors who are going to interact with environment and take input like accelerometers, gyroscopes along with various optical units for better access and efficient responsiveness. Foremost important task of these sensors is to take an input related to movement and collect data from environment. This input can be analyzed based by AI agent to check functionality like sensitivity of cursor, commands based on gesture and predictive typing of the sensors that are working or not. This works shows how based on experience; mouse is excelling and works as per the users' requirements. Based on user behavior this framework becomes mature gradually[1]. Users get personalized experience as mouse had an ability to automatically change/refine the gesture and improve the sensitivity to capture users changing preferences and hand movements. Significant work of this research is ease-of-use design where users get rid of fatigue or strain coming due to continuous observations and monitoring. Energy efficient and ergonomic are main outcomes of this work. When system reaches to downtime AI mouse will be in energy saving mode automatically, which preserves lot of energy. Problem of lag coming is also solved due to the wireless connectivity with elevated output and enhanced flexibility. different kinds of computing tasks can be performed using a virtual mouse with AI-enriched technology, which provides great usability and efficiency, thus ensuring overall user satisfaction with this framework.

Keywords: AI Virtual Mouse, Hand Gesture Recognition, OpenCV, Object Tracking, User Interfaces

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1. Introduction

In current scenario AI has been evolved in rapid manner where technology like agentic AI which interact with users by using Virtual mouse [2]. In earlier days, physical mouse id preferred which is changed by virtual mouse using this program. Face movements and postures are controlled by using this framework. This kind of digital mouse uses ML techniques to observe and decode these face movements and postures of the users without using out traditional wired mouse [3]. Main significant use of this virtual mouse is for physically challenged people who have restricted locomotion or proficiency with respect to their hands or arm. With the use of this kind of the system makes life easier and enhance the quality of life of physical disabled people [4]. The important and foremost benefits of the system are to make technology easily available to people who have some kind of physical challenges. Another significant use of virtual mouse which can excel the usability in great extent. Such a system not only enhance the usability of disabled people but also all kind of users get benefited in terms of ease of use and functionality enrichment. Such a system can be easily framed and installed on any digital device. To make such a system not a special kind of instrument or hardware is required. People can directly download and access such kind of framework with does not require great technological proficiency. This system is cost effective and attractive which is available to large number of users in quick succession. See the figure 1where AI Based virtual mouse is used to enhance visual feedback of the user hand movements.

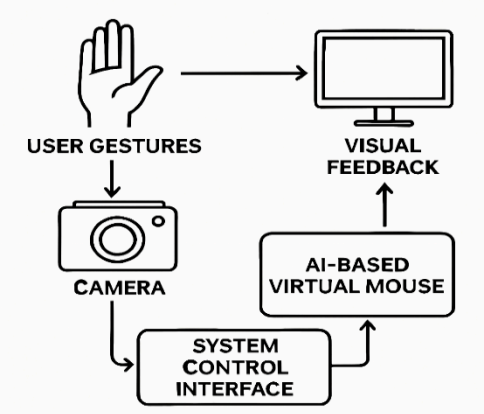

Fig.1 AI-Based Virtual Mouse

Apart from these benefits this system has some challenges also like accuracy and precision may be not up to the level. Due to high dependency on machine learning techniques interpretation of

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the postures and facial expression may vary or sometimes misguiding. Most important technical difficulty arises

2. **Literature Review:** Literature review with respect to AI virtual mouse in listed in table1.

Table 1: Literature Review

Research Paper Title	Authors	Year	Description
AI Mouse: An Artificial Intelligent Mouse for Efficient Web Navigation	Singh et al.	2012	Developed an AI mouse that uses machine learning algorithms to predict user behavior and improve web navigation efficiency.[5]
AI Mouse Navigation Control Based on Fuzzy Logic and Multi-Level Perception	Wu et al.	2015	Proposed an AI mouse navigation control system using fuzzy logic and multi-level perception to improve the accuracy of mouse movements.[7]
An AI mouse based on bio-inspired algorithms for enhanced web browsing	Chaudhary et al.	2016	Developed an AI mouse that uses bio-inspired algorithms to predict user behavior and enhance web browsing experience.[8]
An AI mouse system using deep learning for hand gesture recognition	Liu et al.	2017	Developed an AI mouse system that uses deep learning algorithms to recognize hand gestures for mouse control, improving accessibility for people with disabilities.[6]
Design and Implementation of a Smart Mouse Based on Artificial Intelligence	Han et al.	2018	Developed a smart AI mouse that uses machine learning and computer vision techniques to improve navigation efficiency and accuracy.[10]
AI Mouse: A Machine Learning-Based Mouse for Intelligent Navigation	Chen et al.	2019	Developed an AI mouse that uses machine learning algorithms to predict user behavior and improve navigation efficiency in computer games.[9]
An Intelligent Computer Mouse System Based on Deep Learning	Li et al.	2020	Developed an intelligent computer mouse system using deep learning algorithms to improve the accuracy and efficiency of mouse movements.[11]

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AI Mouse with Hybrid Intelligence for Accurate Cursor Control	Ma et al.	2021	Proposed an AI mouse with hybrid intelligence, combining rule-based and machine learning algorithms to improve cursor control accuracy.[12]

3. Methodology

Above design framework has been divided into 2 phases, namely hardware part and software part. Hardware part comprises digital cameras whereas software part considers open-source platforms, computer vision library like OpenCV, threading and virtual mouse.
Hardware Part: Camera: Considering an input in terms of audio or video typically recorded by the webcam, Software Part: Open-Source Platform: Media Pipe which is open-source, cross-platform used to develop good quality instantaneous multimedia applications. Input attributes consider audio, image or video to generate pre-build models. This open-source platform supports all kinds of platforms like windows/Linux etc., mobile OS, embedded system etc.
Open-Source Library: Open-Source library like OPENCV able to process real time data like videos, images and audios etc. It is well supported by C++ and Python languages.
Virtual Mouse: It can be used for interacting purpose and very useful for disabled & all users.

4. RESULTS AND DISCUSSION

Capturing Video Frames Using Camera -The OpenCV library in Python provides tools for capturing video frames from a camera, which can be used as data input for an AI virtual mouse system. The camera captures video frames, which are essentially images, at a certain frame rate. These frames are then processed by the AI algorithms to interpret user gestures or commands and generate corresponding cursor movements or actions.
Processing The Collected Frames -The web camera would continue to capture video frames until the underlying program or application that utilizes the camera is closed or explicitly stops the frame capture process. This allows the AI virtual mouse system to continuously process the incoming video frames, interpret user input, and generate corresponding cursor movements or actions in real-time.

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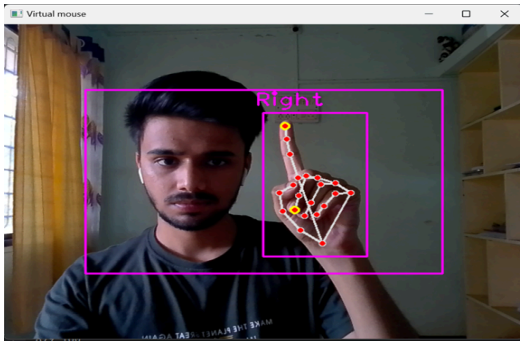

Fig 2: the movement of cursor with index finger

Recognizing The Gesture- MediaPipe, along with other computer vision techniques, can analyze the video frames captured from the camera to detect the hand and fingers, and estimate the 21 coordinates that represent the key points on the hand, such as fingertips, knuckles, and palm. These coordinates can then be used as input data for the gesture recognition algorithm (Refer 2).

Moving around using the virtual mouse - Once the hand is detected in the video frames using OpenCV, a rectangular window can be drawn around the hand to isolate it from the background. The coordinates of the fingertips within this Window can then be calculated using a transformation algorithm to map the coordinates from the video frame to the screen coordinates of the computer system. By tracking the fingertips within the rectangular window, the system can interpret the hand gestures based on the position and movement of the fingertips. When only index fingers are open and other fingers are closed, then we can move our hands to move cursors[14].

Left click-By measuring the distance between the tips of the index finger and the middle finger in the video frames and comparing it to a threshold value of approximately 40 pixels, the system can determine if the fingers are brought closer together in a way that indicates a left click gesture. Once the left click gesture is recognized, the virtual mouse system can then trigger a left click action. (Refer Fig.3)

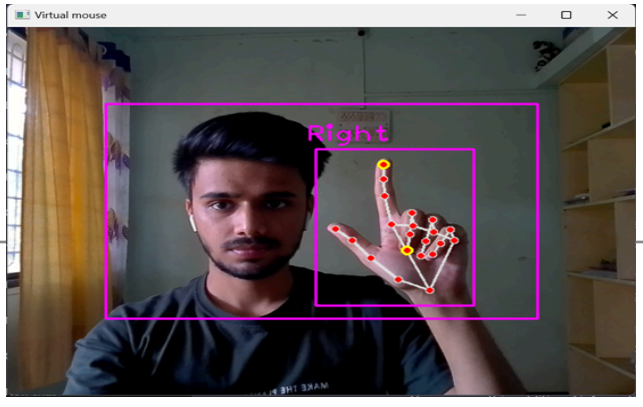

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Fig 3: left click operation using thumb and index finger

Right click operation - By measuring the distance between the tips of the index finger and the middle finger in the video frames and comparing it to a threshold value of 40 pixels, the system can determine if the fingers are brought together in a way that aligns the hand marks and indicates a right click gesture [13,15]. Once the right click gesture is recognized, the virtual mouse system can then trigger a right click action, such as simulating a right mouse button press and release event. (Refer fig.4)

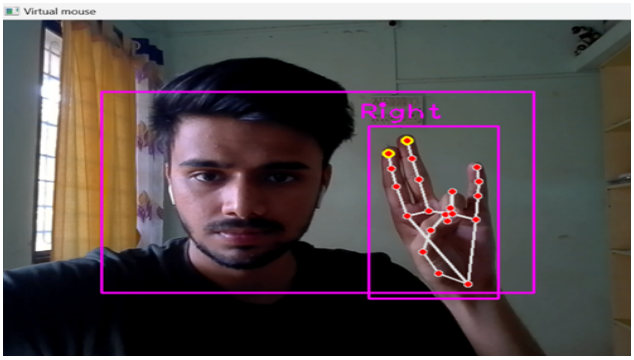

Fig 4: right click operation with index, middle and little finger

Zoom in_– we can zoom a page by taking index of fingers of both hands away from each other such that distance between tip of the index finger is greater than 100 cm (refer fig.5)

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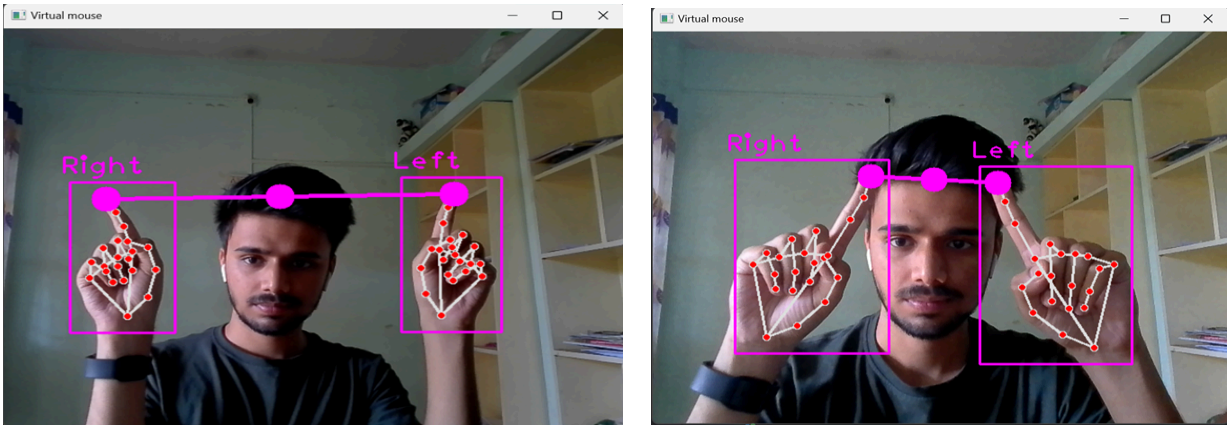

Fig.5: zoom in operation by taking two index fingers away

5. Conclusion

The primary goal of the proposed virtual AI mouse is to provide a replacement for the traditional physical mouse that performs mouse functions with the aid of a computer vision enabled device that is equipped with a web camera and recognizes fingers and hand gestures and processes the captured frames before using a machine learning algorithm to carry out the defined mouse functions, such as moving the cursor, right clicking, left clicking, and scrolling function.

Future Scope

The future scope of AI-powered virtual mouse technology is expected to be vast and transformative. As AI continues to advance and become more sophisticated, virtual mouse applications are likely to see significant improvements in terms of accuracy, ease of use, and functionality. Here are some potential areas of future development for AI virtual mouse technology.

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