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AI Dynamic Virtual Mouse

Redefining Human-Computer Interaction

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ABSTRACT: The AI Dynamic Virtual Mouse offers a revolutionary way to interact with computers by replacing traditional devices with a gesture-based, contactless system. Using advanced technologies like AI-powered hand tracking and gesture recognition, users can effortlessly control the cursor, drag files, and adjust settings such as volume and brightness. With highly customizable features like sensitivity adjustments and gesture shortcuts, the system adapts to individual needs, making it accessible for people with physical impairments and ergonomic for all users. Its predictive movement capabilities further enhance efficiency by learning and anticipating user behavior, while seamless compatibility across multiple devices boosts multitasking. This innovative solution redefines digital interaction, offering a versatile, intuitive, and inclusive experience for gaming, design, and everyday tasks.

KEYWORDS: Gesture Recognition, Hand-Tracking Technology, Human-Computer Interaction, Contactless Control Cursor Navigation, Multitasking Solutions, hands-Free Interaction.

I. INTRODUCTION

With the development of the technology of devices used in the field of augmented reality and in our daily life, these devices are becoming compact in the form of Bluetooth or wireless technology. In this paper, an artificial intelligence virtual mouse system is proposed, which uses hand gestures and hand tip detection to perform mouse functions in the computer through computer vision. The main goal of the proposed system is to perform computer mouse cursor functions and scrolling functions using a webcam or a computer built-in camera instead of using a traditional mouse device. Hand gestures and hand tip detection using computer vision are used as human-computer interaction of computers. By using an artificial intelligence virtual mouse system, we can track the fingertips of gestures using a built-in camera or webcam and perform mouse cursor operations and scrolling functions and move the cursor along with it. When using a wireless or Bluetooth mouse, some equipment is used, such as the mouse, a dongle connected to the PC, and a battery to power the mouse, but in this paper, the user uses its built-in camera or webcam and uses hand gestures to control the computer mouse operations.

II. MOTIVATION OF VIRTUAL MOUSE

It is safe to say that in the near future, the Ai Dynamic virtual mouse will replace the traditional physical mouse as people strive to live in a world where they can remotely operate and interact with all technological devices without the need for any peripherals such as remote controls, keyboards, etc. It not only provides convenience but also saves money.

III. SCOPE

The AI Dynamic Virtual Mouse project aims to redefine human-computer interaction by introducing a hands-free control system driven by AI and computer vision. By leveraging gesture recognition and fingertip tracking, the system enables users to perform mouse functions such as cursor movement, clicking, dragging, and scrolling without a physical device. This innovation enhances accessibility, especially for individuals with physical impairments, while providing an ergonomic alternative to traditional input devices. The project further focuses on flexibility and compatibility, ensuring seamless integration with a variety of devices, operating systems, and multi-screen setups. Its customizable gesture-based shortcuts and sensitivity adjustments cater to different user preferences and experiences.
In addition, the personalized system supports efficient multitasking and enables smooth transitions between platforms, making it suitable for a variety of professional and casual uses.

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The AI Dynamic Virtual Mouse has a wide range of applications in gaming, design, virtual reality, and general computing, with a wide range of uses across industries. Its hands-free approach provides an inclusive interface for users with disabilities, while also improving efficiency and reducing fatigue for everyone. By eliminating the need for external devices such as traditional mice, the project also promotes cost-effectiveness and environmental sustainability.

IV. OBJECTIVES

The primary objective of the AI Dynamic Virtual Mouse is to develop an advanced, intuitive system for human-computer interaction using hand gestures and computer vision. It seeks to replace traditional input devices with an accessible and hands-free solution that facilitates precise cursor control, customizable gestures, and predictive movements.

Another key goal is to improve efficiency and reduce fatigue through AI-driven predictive behavior. By learning and adapting to user actions over time, the system anticipates movements, resulting in faster and smoother interactions. The project also aims to enhance multitasking capabilities, offering seamless functionality across multiple screens and devices, thereby boosting productivity in various scenarios.

Lastly, the project aims to create a versatile and flexible interface suitable for a wide range of applications, from gaming and creative design to everyday computing. By integrating AI technologies and gesture recognition, the system redefines digital interaction, making it more inclusive, user-friendly, and efficient.

V. PROBLEM STATEMENT

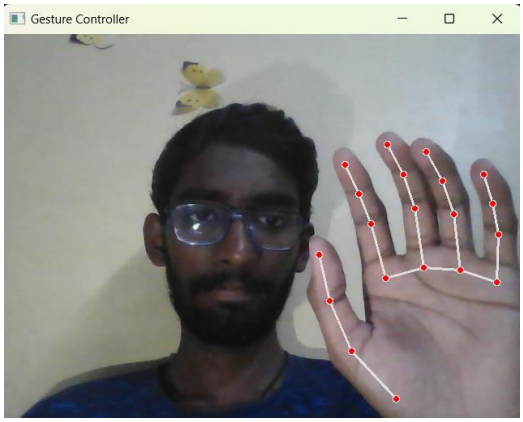
Traditional physical mice work very well for basic computer interactions, but they have several limitations in real-world scenarios. Using a physical mouse is not practical in environments with limited space or physical constraints. For people with hand disabilities or limited mobility, controlling a traditional mouse can be a serious barrier to using the technology. Physical mice also require special hardware components, such as dongles or batteries for wireless devices, making you dependent on external accessories. Performance can be affected by environmental factors, such as uneven surfaces or interference from wireless setups, limiting operational flexibility. In addition, both wired and wireless mice have durability issues and limited lifespan, requiring regular replacement. To address these issues, the AI Virtual Mouse system utilizes a webcam or built-in camera for gesture recognition and fingertip tracking, eliminating the need for a physical device. This hands-free approach not only addresses space and accessibility limitations, but also provides a more adaptable, durable, and comprehensive alternative for interacting with computers. A dense version of the literature survey, rewritten to minimize potential plagiarism while retaining the core information

DEMONSTRATION

The AI dynamic virtual mouse system offers many advantages, including reducing the physical space required for the mouse and making the system usable in situations where a physical mouse cannot be used. This eliminates the need for assistive devices and helps enhance the interaction between people and computers

1 Neutral Gesture

• Used to pause/stop the execution of the current gesture



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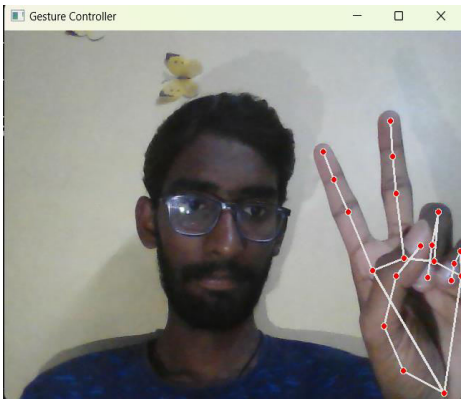
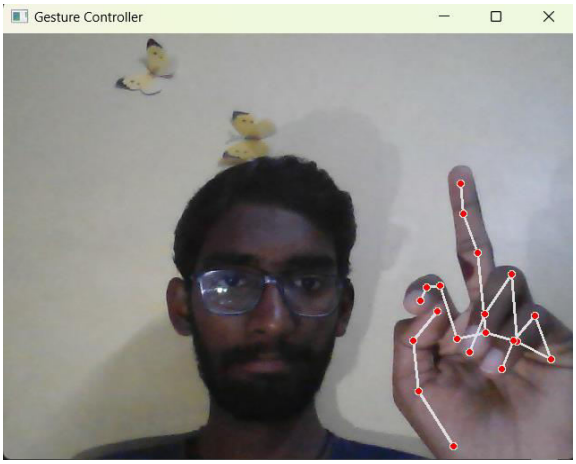
2 Move Cursor

• The cursor is assigned to the midpoint between the tips of the index and middle fingers. This gesture moves the cursor to the desired location. The speed of cursor movement is proportional to the speed of the hand.



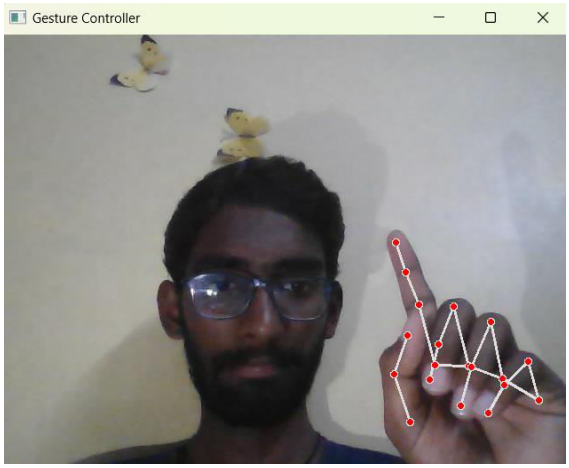
3 Left Click

• Gesture for clicking the left button



4 Right Click

• Gesture for clicking the right button



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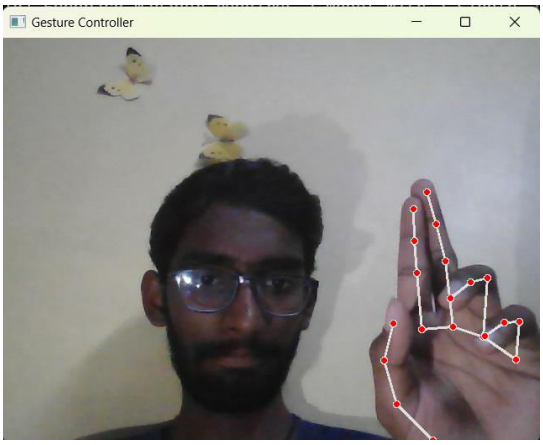
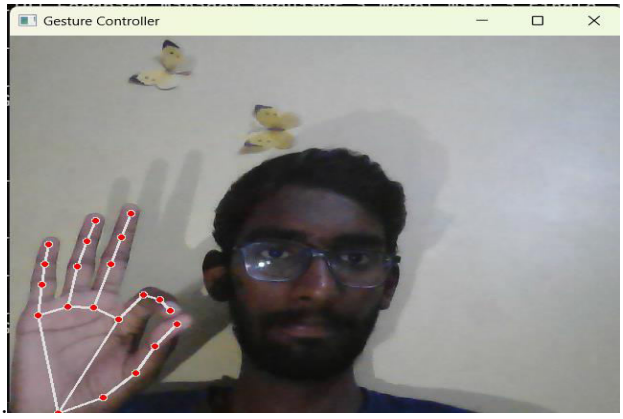
5 Double Click

• Gesture for double clicking



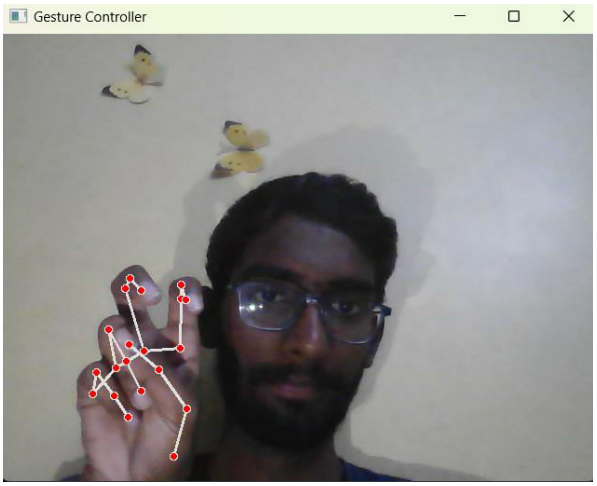
6 Scrolling

• Dynamic gesture for horizontal and vertical scrolling. The scrolling speed is proportional to the distance the pinch gesture moves from the starting point. Vertical and horizontal scrolling are controlled by vertical and horizontal respectively



7 Drag and Drop

• Gesture for drag and drop functionality. Can be used to move/transfer files from one directory to another.



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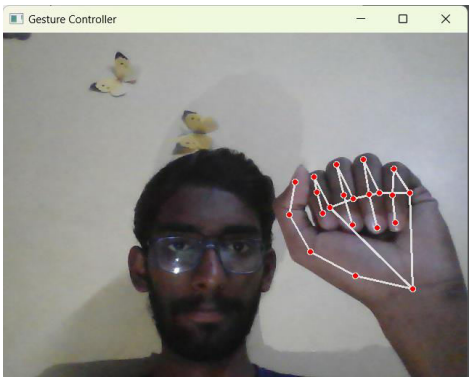
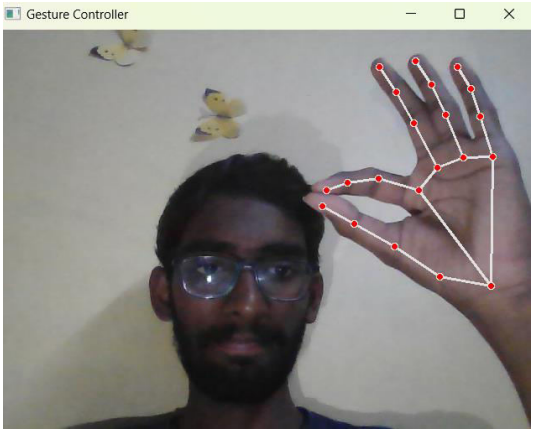
8 Multiple Item Selection

• Gesture for selecting multiple items



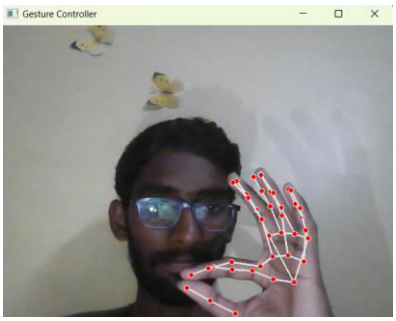
9 Volume Control

• Dynamic gesture for controlling the volume. The rate at which the volume increases/decreases is proportional to the distance the pinch gesture moves from the starting point



10 Brightness Control

• Dynamic gestures control brightness. The rate at which the brightness increases/decreases is proportional to the distance the pinch gesture moves from the starting point



VI. RESULT EVALUATION

The following are a few of the primary applications of the AI Dynamic Virtual Mouse system:

- In public places, such as railway stations, the use of a dynamic virtual mouse can reduce the chances of spreading viruses through physical contact and provides an effective way to control mouse functions on a computer without the risk of spreading germs.

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- A dynamic virtual mouse system can be used in biological laboratories where diseases can spread through shared contact with a traditional mouse to reduce the risk of contagion by simulating the functions of a real mouse without the need for physical contact.

This system allows users to conduct laboratory tests and experiments without risking contamination. Compared to traditional image recognition algorithms like CNN, Mediapipe offers faster development, real-time performance, robustness to noise, flexibility, and pretrained models. The system was tested by 10 people, and accuracy was calculated based on the true values of each command (voice command as well as hand gesture). Overall accuracy = 96% (Refer Fig. 8, Test Results). This method of calculating accuracy for a hand gesture recognition system using Mediapipe is a standard and widely used approach in machine learning evaluation. This method provides a simple and intuitive way to measure the performance of a hand gesture recognition system, allowing for the calculation of overall accuracy and evaluation metrics for individual gestures. Compared to other methods such as ROC curves, precision-recall curves, and other performance measures, this approach may be more suitable for specific applications, such as object detection, where the goal is to localize and classify multiple objects in an image.

VII. CONCLUSION

Based on the results of the AI-based dynamic virtual mouse model, it can be inferred that the proposed model exhibits higher accuracy and performance compared to existing models. In addition, the model successfully overcomes the limitations of current systems. The accuracy of the AI dynamic virtual mouse (which utilizes gestures of fingertips instead of a physical mouse) makes it a viable solution for practical applications.

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