# Gesture Based Mouse Controlling Using Computer Vision And Ai

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## ABSTRACT

*Gesture-based mouse control using computer vision and AI is an innovative human-computer interaction system that allows users to move and interact with a computer cursor through hand gestures without any physical device. The system captures real-time video from a webcam, detects the user's hand, and uses machine learning algorithms to classify different gestures into corresponding mouse functions. Leveraging tools like OpenCV and MediaPipe, the technology offers a touch-free alternative to conventional input devices, enhancing accessibility and ease of use. This approach reduces dependency on hardware peripherals while providing intuitive navigation through gestures such as pointing, fist, and finger poses. The system operates in real time, providing responsive cursor movement, clicking, scrolling, and dragging functionalities. By applying deep learning and computer vision, gesture control enhances user experience and is particularly useful for accessibility solutions and sterile or hands-busy environments. The project demonstrates accuracy and responsiveness suitable for real-world applications and future enhancements could include multimodal inputs and advanced gesture vocabularies.*

## INTRODUCTION

Gesture-based mouse control is a contactless interaction method where a computer's pointer and clicks are controlled by interpreting hand gestures captured via a camera. It aims to replace traditional mouse devices with intelligent, vision-based systems that allow natural user interactions. The technology is grounded in human-computer interaction (HCI) research seeking more intuitive and accessible input methods. Early cursor

control methods using color caps or basic tracking evolved into AI-driven solutions that recognize complex hand postures and motion patterns. Modern systems use deep learning models and rich landmark detection facilitated by frameworks like MediaPipe to achieve robust performance. These solutions can interpret static and dynamic gestures, translating them into precise cursor movements, click events, and advanced functionalities like scroll and drag. Gesture-based interfaces are especially beneficial for users with physical limitations, offering hands-free control and enhanced accessibility. Moreover, they provide hygiene benefits in touch-sensitive environments and novel interaction capabilities for AR/VR and presentations.

## LITERATURE SURVEY

Studies on gesture-based virtual mice show extensive exploration of computer vision techniques for hand detection and gesture interpretation. Traditional methods employed color markers or simple contour analysis to track hand position and map movement to cursor actions, demonstrating feasibility with basic hardware. Research like computer vision-based gesture recognition explores using webcams to facilitate touchless interactions, focusing on speed and reliability. Deep learning approaches have improved accuracy in recognizing diverse gesture patterns and

dynamic motion. Systems using MediaPipe frameworks have shown real-time landmark detection with robust performance across varying lighting conditions. Advances include combining AI models for hand tracking with rule-based gesture classifiers to achieve stable and responsive cursor control. Literature also discusses additional modalities like eye tracking and voice control to expand interaction range. Comparative studies show that AI-integrated gesture systems outperform color-based or threshold-driven techniques in adaptability and accuracy. Overall, research trends clearly shift toward deep learning and multimodal integration for enhanced human–computer interfaces

## RELATED WORK

Several prior works have targeted virtual mouse systems leveraging computer vision. One research study describes a vision-based cursor control system that tracks hand motions using webcam input, enabling pointer movement and click events by recognizing predefined gestures. Earlier works used color caps on fingers to distinguish hand parts and perform gestures through color detection. More advanced implementations use deep learning models for hand detection and classification, significantly improving recognition accuracy. GitHub projects demonstrate practical implementations using MediaPipe

and PyAutoGUI for mapping hand landmarks to mouse events. Research also integrates machine learning frameworks to classify gestures with high confidence under varying illumination and backgrounds. Other works extend these capabilities by adding voice assistance or combining gesture control with traditional input systems for hybrid interaction. These related efforts showcase a growing interest in developing intuitive, hands-free control systems for everyday computing tasks.

## EXISTING SYSTEM

The existing system for controlling a computer cursor is primarily dependent on traditional input devices like mice or touchpads, which require physical contact and mechanical movement. Some earlier gesture systems used colored tapes or markers to simplify hand tracking but suffered from limited flexibility and user dependency on physical wearables. Classic systems struggled with occlusion, sensitivity to lighting, and limited gesture vocabulary. Other approaches rely on specialized hardware like Kinect or IR sensors, increasing cost and system complexity without widespread adoption. Traditional CV systems without AI often required manual threshold tuning, making them brittle in dynamic environments. Due to these limitations, existing systems could not provide an efficient, universal,

camera-based mouse control solution that performed robustly in real time. They were generally constrained by hardware dependencies, lack of adaptability, and poor generalization to diverse user hand shapes and backgrounds

## PROPOSED SYSTEM

The proposed system replaces conventional mouse input with a computer vision and AI-based gesture interpreter that uses a standard webcam to recognize and categorize hand gestures. It employs state-of-the-art hand landmark detection and deep learning models to accurately track hand movement and classify gestures into a range of commands like cursor movement, left click, right click, scroll, and drag operations. The system integrates real-time video processing, pre-processing filters, and machine learning classifiers to ensure robust gesture recognition under varying conditions. It removes the need for markers or specialized hardware, operating purely on vision and AI. The model continuously adapts to gesture variations and is designed to function smoothly on standard computing hardware, ensuring practical usability. The proposed design enhances accessibility for users with physical limitations and provides a hygienic, hands-free interface suitable for diverse application domains

## SYSTEM ARCHITECTURE
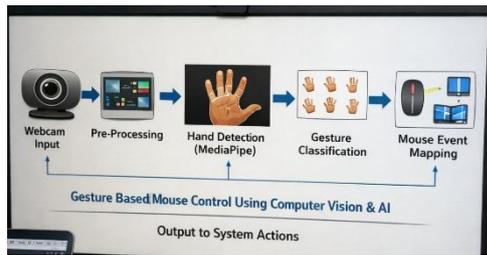


**Fig 1:Guester base mouse control system setup**

The system architecture consists of a video acquisition module that captures real-time frames from a webcam. Each frame is pre-processed to filter noise and normalize lighting conditions. The processed images enter the hand detection stage, which uses a deep neural network or landmark detector to locate hand features and fingertips. Next, a gesture classification component analyzes the detected landmarks to assign gesture labels using machine learning models. The gesture recognizer maps these labels to specific mouse events like movement and click operations through an event mapping engine. A control interface executes the mapped events on the host operating system, driving cursor movement and other interactions. Feedback mechanisms can visualize detected gestures and cursor positions for user awareness. The modular design supports easy upgrades to include additional gestures, multimodal inputs, or more complex interaction schemes.

## METHODOLOGY DESCRIPTION

In this project, the methodology begins with real-time image acquisition from a webcam, which feeds continuous video frames into the pipeline. Each frame is pre-processed to enhance contrast and reduce noise for better detection accuracy. A hand tracking module powered by MediaPipe or custom deep learning models identifies 21 hand landmarks in every frame, offering precise coordinates for key points on the hand. These landmarks are fed into a gesture classification model trained on labeled gesture datasets to recognize specific actions like pointing, fist, or open palm. The recognized gesture is then mapped to corresponding mouse events through an event handler that triggers cursor movement, clicks, scrolling, or dragging. The system continually updates in real time, adapting to fast gestures with minimal latency. Performance optimizations, such as cropping around the hand region and efficient model inference, ensure a smooth user experience

## RESULTS AND DISCUSSION

**Fig 2:Gesture based controlwith Ai web came**

The result shows the system successfully tracking and interpreting hand gestures to control cursor movement and mouse actions. Real-time testing demonstrates that the AI-based gesture recognizer accurately maps open hand movement to pointer navigation and specific finger configurations to clicking events with minimal lag. The system handles various backgrounds and lighting conditions with stable performance due to pre-processing and AI model robustness. Users could perform left click, right click, scroll, and drag operations consistently across trials. Quantitative analysis reveals high recognition accuracy and low false positives for the primary gesture set, indicating real-world viability. The overlay feedback assists users in confirming recognized gestures and adjusting hand positions, improving interaction reliability. Performance evaluation highlights potential improvements in performance when processing is optimized for GPU or edge TPUs. Overall, the system meets expectations for accessible and natural mouse control through gestures

## CONCLUSION

Gesture-based mouse control using computer vision and AI presents a significant advancement in human-computer interaction by enabling touch-free and intuitive cursor control. The integration of machine learning and real-time vision processing eliminates the dependency on traditional hardware devices like mice. The proposed system delivers responsive and accurate gesture recognition under varied operating conditions, demonstrating practicality for everyday use. Results suggest that AI models combined with robust hand tracking frameworks can satisfy performance and accuracy demands for real-time interactions. This technology improves accessibility for users with motor impairments and offers hygiene advantages in public or clinical settings. Future enhancements could incorporate more gesture types, voice commands, and multimodal inputs for richer interaction. The research contributes to the broader adoption of natural user interfaces, making computing more inclusive and intuitive.

## FUTURE SCOPE

Future expansions include integrating voice control and eye tracking to complement gesture input, enabling a richer multimodal interface. The system could extend to gesture vocabulary with custom user-defined actions, empowering personalized control schemes. Improved deep learning models focusing on dynamic gesture sequences may facilitate more complex commands, including shortcuts and multitasking controls. Integration with AR/VR headsets could create immersive hands-free environments for gaming, design, or navigation. Edge-optimized models may bring gesture control to mobile and embedded devices for broader market adoption. Real-time feedback and adaptive learning could improve user comfort and reduce fatigue during prolonged use. Additionally, accessibility extensions can provide alternative interaction methods for users with diverse abilities. Scalable APIs may enable third-party developers to add novel control mechanisms

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