# Chapter 3
# AI-Powered Virtual Mouse Control Through Hand Gestures With Computer Vision

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## ABSTRACT

*This article introduces an Artificial Intelligence (AI) enabled virtual mouse system that utilizes hand gestures and fingertip detection to operate computer mouse functions through AI and computer vision techniques. It serves as a convenient alternative to traditional physical mouse, offering users increased flexibility and accessibility in navigating and controlling their devices. In this article, the proposed work uses three modules such as OpenCV, MediaPipe and PyautoGUI to create the virtual mouse system. OpenCV library is used for its real-time computer vision functionality to help us to capture the hand using the web camera. The MediaPipe framework is used to detect the hand region using KLT Tracking Algorithm and then*

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*the K-cosine border tracking algorithm is used to identify various types of hand gesture movements to mimic the computer mouse cursor movement and scrolling operations. The PyAutoGUI module is used to perform appropriate mouse actions based on the recognized hand gestures.*

## 1. INTRODUCTION

A virtual mouse is a software-based solution that simulates the functionality of a physical mouse on a computer or electronic devices. It provides user with an alternative input method. This software-based solutions often come bundled with accessibility featuring in operating systems, enabling user to customize the behavior of virtual mouse to his specific needs and preferences. Physical mouse has proven to be invaluable for persons with physical difficulties or impairments. The ability of a virtual mouse to eliminate a physical mouse is one of its advantage, this makes it especially helpful in scenarios where there is a lack of space or when a physical mouse is impractical S. Vasanthagokul et al. (2022).

In this article, the proposed work uses modules such as OpenCV, mediapipe and PyautoGUI to create the virtual mouse system. OpenCV is used for its computer vision to help us capture the hand using the web camera of the computer, mediapipe is used to detect the hand using KLT Tracking Algorithm and then the K-Cosine Algorithm to the system is applied, K-cosine border tracking algorithm is used to identify the hand gesture and after applying the algorithm, PyAutoGUI is used to perform the mouse actions. This system will definitely help the people in making the metaverse a better place. This system can and will be used in the Augmented and Virtual Reality world. Image processing is a branch of computer science and engineering that deals with the manipulation, analysis, and interpretation of digital images. It involves using various algorithms and techniques to enhance, modify, or extract information from images. Image processing plays a vital role in numerous applications, including medical imaging, remote sensing, surveillance, and computer vision.

One of the interesting applications of image processing is the development of a virtual mouse. A virtual mouse is a software-based alternative to the traditional physical mouse. It allows users to control the cursor on a computer screen using hand gestures or other input methods without the need for a physical mouse. The concept of a virtual mouse involves using image processing techniques to track and interpret the movements of the user's hand or other input devices in real-time. The system captures video or image data from a camera or sensor, which is then processed to detect and track the position and motion of the hand or input device. This information is used to control the movement of the cursor on the screen, simulating