International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.48047/INTJECSE/V15I5.8 ISSN: 1308-5581 Vol 15, Issue 05 2023

AI VIRTUAL MOUSE

[1] Joshi Padma, [2] Kirsagar Akash,[3] Buddula Raghuram, [4] Gundla Sathvika,
[5] G chethan kumar reddy
[1] Associate Professor, Department of CSE, Sreyas Institute of Engineering and Technology, Telangana, India.
[1] padmajoshi2015@gmail.com
[2,3,4,5] Department of CSE, Sreyas Institute of Engineering and Technology, Telangana, India
[2] kirsagarakash123@gmail.com , [3] *buddularaghuram@gmail.com* ,[4] sathvikkagundla@gmail.com ,[5] gchethanreddy7586@gmail.com

Abstract
we present an approach for Human computer Interaction (HCI), where we have tried to control the mouse cursor, movement and click events of the mouse using hand gestures. Hand gestures were acquired using a camera based on colour detection technique. This method mainly focuses on the use of a Web Camera to develop a virtual human computer interaction device in a cost effective manner. As the computer technology is growing up, the importance of human computer interaction is rapidly increasing. Most devices use Touch screen technology which cannot be affordable to all the applications. A virtual human based Computer interactive module such as virtual mouse, can be an alternative way for the traditional touch screen.
In the current situation where we are adjusting our living while being in the pandemic, a touch-less mouse controller will be useful to eliminate the risk of spreading infection through touch on public service devices. In this project, we have created an AI-based Mouse Controller. It will first detect the hand landmarks, then track and then perform functions. We have also applied smoothing techniques to make it more usable. The virtual mouse will be operated without touching any device or screen. The domain of the project is AI/ML. The programming language used is mainly Python. This system is based on the concept of computer vision.
Keywords: AI Virtual Mouse, Hand Recognition, OpenCV, Mediapipe, Object Tracking.

I INTRODUCTION

In this high-tech world, it's almost impossible to imagine life without computers. The invention of computers is one of the greatest humankind inventions. Computers have become an essential part of almost everyday use for individuals of every age. In daily life, we interact many times with computers to make our work easier. Thus ,Human-Computer Interaction (HCI) has become a hot topic for research.
In our daily life, vision and gestures are important approaches for communication among human beings, and the same role is played by the mouse in Graphical User Interface (GUI) based computers. So, a combined methodology can be used to make a better interactive system for Human-Computer Interaction. Computer vision techniques can be an alternative way for the touch screen and create a virtual human-computer interaction device using a webcam .In this project, a finger tracking-based virtual mouse application will be designed and implemented using a regular webcam. To implement this, we will be using the object tracking concept of Artificial Intelligence and the OpenCV module of Python.

An AI Virtual Mouse is an innovative technology that allows users to control the mouse cursor on a computer screen using artificial intelligence (AI) and various input methods, often in a way that enhances accessibility or offers novel interaction experiences. This technology offers a diverse range of applications and has the potential to significantly improve the way people interact with computers and digital devices

Key features and components of an AI Virtual Mouse system typically include:

- **Input Mechanisms**:

AI Virtual Mouse systems can utilize various input mechanisms such as eye-tracking, head-tracking, gesture recognition, voice control, brain-computer interfaces (BCIs), or even virtual reality controllers.

Users can control the mouse cursor through these inputs, providing alternative means of interaction beyond traditional mice and touch pads.

• **Artificial Intelligence:**

AI algorithms and models are at the core of these systems. They process the input data and determine the appropriate movement of the cursor on the screen. AI can adapt to user behavior, improve accuracy over time, and offer a more natural and personalized experience.

• **Accessibility**:

AI Virtual Mouse technology is often employed to assist individuals with disabilities. It can empower those with mobility issues, allowing them to use computers more effectively, and can provide a means of communication and control for individuals who may have limited physical mobility.

• **Gaming and Virtual Reality:**

AI Virtual Mouse systems are also used in gaming and virtual reality applications to create immersive and interactive experiences. They enable users to control in-game actions and navigate virtual environments with precision and natural movements.

• **Customization:**

These systems can be tailored to individual preferences and needs. Users can adjust the sensitivity, responsiveness, and control parameters to match their specific requirements.

• **Research and Development**:

AI Virtual Mouse technology is a subject of ongoing research and development, with advancements in AI and computer vision continually improving the accuracy and capabilities of these systems. Researchers and developers are exploring new ways to integrate AI and input technologies.

• **Market Applications:**

Beyond accessibility and gaming, AI Virtual Mouse technology is also finding applications in healthcare, education and various industries where precise and intuitive control of computers and digital devices is beneficial

II LITERATURESURVEY

AI virtual mouse technology involves examining research in the field of AI-driven cursor control systems. Key areas of interest include gesture-based interaction, eye-tracking control, brain-computer interfaces, machine learning algorithms, and user experience. Relevant studies encompass "Gesture-Based Human-Computer Interaction Techniques for Virtual Mouse Control" (R. Karkar, 2014), "EyesWeb: Toward Gaze-Controlled Virtual Reality" (G. Cucchiara, 2009), and "Brain-Computer Interface-Based Virtual Mouse Cursor Control" (X. Yun, 2019). These papers explore diverse methods for virtual mouse control, such as gesture recognition, gaze tracking, and brain-computer interfaces. Usability and application aspects are covered in "User Experience Evaluation of a Gaze-Controlled User Interface for Smart Glasses" (T. Yolcu, 2016) and "Assistive Technology for Motor Skills Rehabilitation" (S. Koenig, 2016). Additionally, HCI principles and computer vision techniques contribute to this emerging field. Conducting a thorough survey is vital for staying updated on the latest advancements in AI virtual mouse technology. Machine Learning and AI Algorithms: Techniques like deep learning, neural networks, and computer vision play a crucial role in AI virtual mice. Resources such as "Deep Learning for Computer Vision" (Polikar, 2016) offer insights into AI algorithms applicable to cursor control.

User Experience and Usability: Evaluation of user experience and usability is critical. "User Experience Evaluation of a Gaze-Controlled User Interface for Smart Glasses" (Yolcu et al., 2016) and "Evaluating the Usability of Brain-Computer Interfaces" (Schreuder et al., 2011) provide insights into the usability of these systems.

A Neural Network-Based System for Controlling a Virtual Mouse Using Brain Signals" Authors: Lebedev, M. A., & Nicolelis, M. A. L.Published in: IEEE Transactions on Biomedical Engineering, 2006.This paper explores the use of brain-computer interfaces for virtual mouse control

Eye Tracking for Human-Computer Interaction" Author: Duchowski, A. T.Published in: Foundations and Trends® in Human-Computer Interaction, 2007.This comprehensive book chapter covers the

fundamentals of eye tracking, which is a crucial input method for AI virtual mouse systems."Virtual Reality for Enhanced Ecological Validity and Experimental Control in the Clinical, Affective and Social Neurosciences" Authors: Parsons, T. D., Gaggioli, A., & Riva, G.Published in: Frontiers in Human Neuroscience, 2017.

This article discusses the use of virtual reality and virtual mice in the context of clinical and affective research.

"Voice Interaction Design: Crafting the New Conversational Speech Systems"

Author: Porcher, R. Published in: Apress, 2015. This book provides insights into the design and development of voice-controlled virtual mouse systems.

"Virtual Reality for Computer-Assisted Surgery" Authors: Rea, F., Calvo, G., Barresi, G., et al.

Published in: IEEE Computer Graphics and Applications, 2016.

The paper discusses the use of virtual reality and virtual mouse systems in computer-assisted surgery. "A Survey of Eye Tracking Methods for Virtual Reality"Authors: Moro, C., Štromberga, Z., & Raikos, A.

Published in: Journal of Medicine and Life, 2017. This review article provides an overview of eye tracking methods, which are integral to AI virtual mouse systems. Control of a Virtual Mouse in a Virtual Environment Using EEG-Based Classification" Authors: Hong, K. S., Khan, M. J., & Hong

III EXISTINGSYSTEM

The existing system consists of the generic mouse and track pad system of monitor controlling and the non availability of a hand gesture system. The remote accessing of monitor screen using the hand gesture is unavailable. Even-though it is largely trying to implement the scope is simply restricted in the field of virtual mouse. The existing virtual mouse control system consists of the simple mouse operations using the hand recognition system, where we could perform the basic mouse operation like mouse pointer control, left click, right click, drag etc. The further use of the hand recognition is not been made use of. Even-though there are a number of systems which are used for hand recognition, the system they made used is the static hand recognition which is simply recognition of the shape made by hand and by defining an action for each shape made, which is limited to a number of defined actions and a large amount of confusion. The existing systems are our traditional hardware mouse devices either wired or wireless to control the cursor. This means the actual hardware device is required. Also, the touchpad in laptops and touch screen devices requires a user to touch the surface.

Other existing virtual mouse control system consists of a simple mouse operation which uses colored tips like red, green, and blue color. These colored fingers act as an object that the web-cam senses to perform actions and then image processing techniques are applied to them. Some existing systems use numbers of fingers to perform the specific operations (for eg. 1 finger for left click, 2 fingers for right-click, 3 for double click). Such systems are more complex and difficult for the user use.

IV PROBLEM STATEMENT

This AI virtual mouse can be made use of in places where using a physical mouse is not feasible such as moist or wet conditions, to aid people who can’t handle a device and where there isn’t ample space for using a mouse and to eliminate the need of mouse and cable altogether. In view of the pandemic, there arises a need to avoid high-contact surfaces, out of which the mouse is one. In order to eliminate the need to avoid contact, the system provides an intuitive way to interact with the computer system with the use of hand-gestures and finger tips to emulate mouse-like functions such as scrolling, clicking, and pointing.

Design and develop an AI virtual system capable of performing specific tasks or providing services autonomously or semi-autonomously, utilizing AI techniques such as natural language processing, machine learning, computer vision, and other relevant technologies. The system should be able to interact with users through natural language or other intuitive interfaces, understand user intents, adapt and learn from user interactions, and provide intelligent responses or actions to fulfill user requests or requirements. The specific tasks or services that the AI virtual system aims to accomplish can vary widely, ranging from virtual assistants for answering questions, managing schedules, or controlling smart devices, to chat bots for customer support, recommendation systems, virtual medical assistants, and more. The problem

statement would need to be refined to match the exact objectives and functionality of the AI virtual system in question.

V PROPOSED SYSTEM

Using the current system even-though there are a number of quick access methods available for the hand and mouse gesture for the laptops, using our project we could make use of the laptop or web-cam and by recognizing the hand gesture we could control mouse and perform basic operations like mouse pointer controlling, select and deselect using left click, and a quick access feature for file transfer between the systems connected via network LAN cable. The project done is a "Zero Cost" hand recognition system for laptops, which uses simple algorithms to determine the hand, hand movements and by assigning an action for each movement.

• Input Modalities:

Incorporate multiple input modalities, such as gesture recognition, eye-tracking, brain-computer interfaces, or a combination thereof. Users can choose their preferred input method.

• Data Acquisition:

Utilize sensors and devices (e.g., cameras, eye trackers, EEG sensors) to capture user input data. These sensors should collect information about gestures, eye movements, or brain signals, depending on the chosen input modality.

• Data Processing:

Implement AI and machine learning algorithms to process and interpret the input data. For gesture recognition, this may involve computer vision techniques, while eye-tracking data could be analyzed to determine cursor movement. In the case of BCIs, advanced signal processing and neural networks could be employed.

• User Intent Recognition:

Develop algorithms that can recognize user intentions, such as moving the cursor, clicking, dragging, or performing other actions. Machine learning models can be trained to classify user input into these categories.

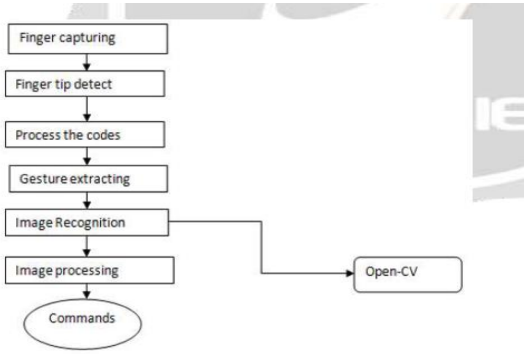
• Cursor Control:

Translate the recognized user intentions into cursor movements on the screen. Ensure smooth and accurate control, regardless of the chosen input modality.

Advantages

- Eliminates the need for physical mouse
- Reduces physical strain
- Making the interaction with computers
  More intuitive and user-friendly
- Hand gestures are more intuitive and can
  Be quickly grasped by users

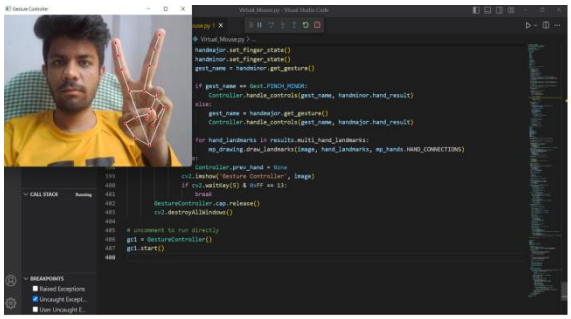
VI METHODOLOGY

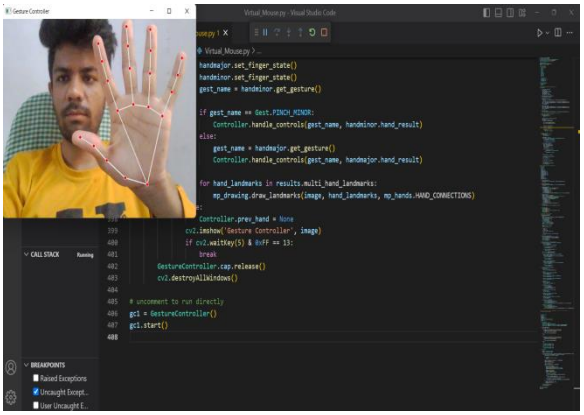


Within the methodology, the technique utilized in every issue of the system might be defined one at a time. They are the following subsections:

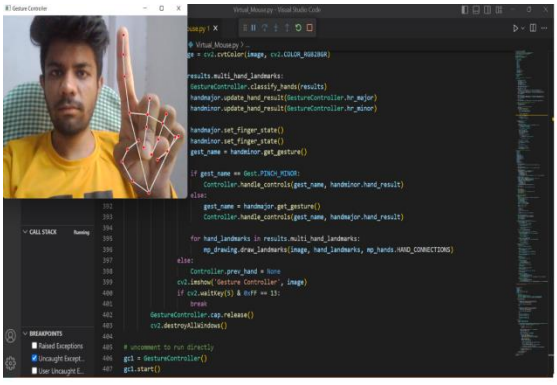
Open-CV is python vision library that contains Associate in the organized AI virtual mouse system depends upon the edges that are gotten by the camera in Associate in nursing passing PC. Pictures can be conveyed in concealing layered with 3 channels , Grayscale with pixel values fluctuating from 0 (dull) to 255 (white), and two fold portraying dim or white characteristics (0 or 1) specifically.

VII RESULTS

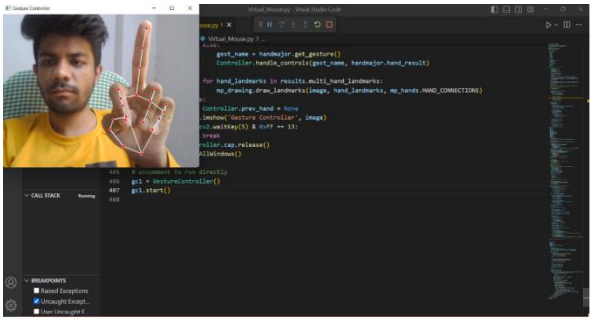




No Cursor Movement



Left Click



Right Click

VIII 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

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