



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 11, November 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Virtual Mouse: Revolutionizing User Interaction

Dhumal Yadnesh¹, Shaikh Gulfam², Shaikh Afjal³, Marathe Prasad⁴, Prof. Sweety Wanave

U.G. Student, Department of Computer Engineering, Shri Chhatrapati Shivaji Maharaj College of Engineering

Ahmednagar, India

Associate Professor, Department of Computer Engineering, Shri Chhatrapati Shivaji Maharaj College of Engineering

Ahmednagar, India

ABSTRACT: A virtual mouse is a software-based emulation of a physical computer mouse, designed to provide users with a convenient and intuitive way to interact with their digital devices. This innovative technology eliminates the need for a physical mouse, allowing users to control their computers or other devices using gestures, touchscreens, or other input methods. Virtual mice have become increasingly popular in touchscreen devices, virtual reality environments, and remote desktop applications, offering enhanced flexibility and accessibility in the digital realm. In this brief introduction, we will explore the various aspects and applications of virtual mice.

In human-computer interaction, virtual mouse implemented with fingertip recognition and hand gesture tracking based on image in a live video is one of the studies. In this paper, virtual mouse control using fingertip identification and hand gesture recognition is proposed. This study consists of two methods for tracking the fingers, one is by using colored -caps and other is by hand gesture detection. This includes three main steps that are finger detection using color -identification, hand gesture tracking and implementation on on-screen cursor. In this study, hand gesture tracking is generated through the detection of the contour and formation of a convex hull around it. Features of hands are extracted with the area ratio of contour and hull formed. Detailed tests are performed to check this algorithm in real world scenarios

KEYWORDS: RGB-D Images, Fingertip detection and tracking, Fingertip-gesture-based interface, Human-Computer Interaction (HCI)

I. INTRODUCTION

In today's rapidly evolving technological landscape, the seamless interaction between humans and machines is increasingly vital. With the advent of augmented reality and the proliferation of compact and wireless devices, there is a growing need for innovative human-computer interaction (HCI) systems that can bridge the gap between our physical world and the digital realm. This paper introduces a ground breaking AI virtual mouse system that leverages the power of computer vision and hand gesture recognition to redefine how we interface with computers.

Traditionally, human-computer interaction has heavily relied on physical peripherals such as the mouse and keyboard. These input devices have served us well for decades, but as our devices become smaller, more portable, and integrated with augmented reality features, the need for alternative methods of HCI has become increasingly evident. Our proposed AI virtual mouse system is a significant step towards a more intuitive, efficient, and immersive mode of computer control.

The primary objective of this research is to offer users an alternative means of controlling their computers, eliminating the need for traditional mouse devices. By utilizing computer vision and hand gesture recognition, this system allows users to interact with their computer using nothing more than a built-in camera or a readily available webcam. This approach not only simplifies the user experience but also contributes to reducing the clutter of additional hardware, such as wireless or Bluetooth mice, dongles, and batteries.

The AI virtual mouse system presented in this paper relies on cutting-edge technologies, including Python programming and the OpenCV library for computer vision. These tools enable the computer to interpret and respond to hand gestures with remarkable accuracy. By tracking the fingertip of the user's hand, the system can effectively simulate mouse cursor operations and scrolling functions. Furthermore, the use of the MediaPipe package enhances the precision of hand tracking, and various packages enable seamless window navigation, encompassing left and right-click functions, as well as scrolling. One of the key advantages of this AI virtual mouse system is its potential to be deployed on standard CPUs, obviating the need for dedicated GPUs. This cost-effective and accessible approach ensures that a broader range of users can benefit from this innovative HCI technology without requiring high-end computer hardware.

In this paper, we will delve into the technical details of the AI virtual mouse system, elucidating the methods and algorithms used for hand gesture and hand tip detection. We will present the results of our experiments, demonstrating the high accuracy and reliability of the system, and discuss its real-world applications and potential impact on HCI. By the end of this paper, readers will gain a comprehensive understanding of this groundbreaking technology and its potential to revolutionize how we interact with computers. We anticipate that the AI virtual mouse system presented here will contribute significantly to the evolution of HCI and play a pivotal role in shaping the future of human-computer interactions in an era where compact and wireless devices are becoming increasingly prevalent.

II. RELATED WORK

gesture-based control: using cameras or sensors to track hand movements or gestures, enabling users to control a cursor or interact with a virtual environment without a physical mouse. **brain-computer interfaces (bci):** research explores the use of brain signals to control a cursor or interact with a virtual environment, allowing individuals with limited mobility to navigate digital spaces. **haptic feedback systems:** these systems simulate the sense of touch, allowing users to "feel" virtual objects or surfaces, enhancing the interaction experience. **machine learning and ai:** techniques have been developed to predict and adapt to user behaviors, improving the accuracy and responsiveness of virtual mouse control. **virtual reality and augmented reality:** integration of virtual mice within vr/ar environments, providing users with interactive control mechanisms in simulated spaces.

With the development technologies in the areas of augmented reality and devices that we use in our daily life, these devices are becoming compact in the form of Bluetooth or wireless technologies. This paper proposes an AI virtual mouse system that makes use of the hand gestures and hand tip detection for performing mouse functions in the computer using computer vision. The main objective of the proposed system is to perform computer mouse cursor functions and scroll function using a web camera or a built-in camera in the computer instead of using a traditional mouse device. Hand gesture and hand tip detection by using computer vision is used as a HCI with the computer. With the use of the AI virtual mouse system, we can track the fingertip of the hand gesture by using a built-in camera or web camera and perform the mouse cursor operations and scrolling function and also move the cursor with it. While using a wireless or a Bluetooth mouse, some devices such as the mouse, the dongle to connect to the PC, and also, a battery to power the mouse to operate are used, but in this paper, the user uses his/her built-in camera or a webcam and uses his/her hand gestures to control the computer mouse operations. In the proposed system, the web camera captures and then processes the frames that have been captured and then recognizes the various hand gestures and hand tip gestures and then performs the particular mouse function. Python programming language is used for developing the AI virtual mouse system, and also, OpenCV which is the library for computer vision is used in the AI virtual mouse system. In the proposed AI virtual mouse system, the model makes use of the MediaPipe package for the tracking of the hands and for tracking of the tip of the hands, and also, some packages were used for moving around the window screen of the computer for performing functions such as left click, right click, and scrolling functions. The results of the proposed model showed very high accuracy level, and the proposed model can work very well in real-world application with the use of a CPU without the use of a GPU.



III. METHODOLOGY

A. Module:

1. Python:

Python programming language is used for developing the AI virtual mouse system, and also, OpenCV which is the library for computer vision is used in the AI virtual mouse system. In the proposed AI virtual mouse system, the model makes use of the MediaPipe package for the tracking of the hands and for tracking of the tip of the hands, and also, Pynput, Autopy, and PyAutoGUI packages were used for moving around the window screen of the computer for performing functions such as left click, right click, and scrolling functions. The results of the proposed model showed very high accuracy level, and the proposed model can work very well in real-world application with the use of a CPU without the use of a GPU

2. Mediapipe:

MediaPipe is a framework that is used for applying in a machine learning pipeline, MediaPipe framework is multimodal, where this framework can be applied to various audios and videos. The MediaPipe framework is used by the developer for building and analyzing the systems through graphs, and it has also been used for developing the systems for application purposes.

3. OPENCV:

OpenCV is a computer vision library that contains image-processing algorithms for object detection OpenCV is a library of Python programming language, and real-time computer vision applications can be developed by using the computer vision library. The OpenCV library is used in image and video processing and also analysis such as face detection and object detection

4. PYAUTOGUI:

Python's pyautogui is a package that allows users to create scripts that can simulate mouse movements, click on objects, send text, and even use hotkeys. While not as elegant a solution as Selenium, pyautogui can be used to bypass systems that put up blocks against automated browser use. In this article, I will show you the basics of pyautogui through a web scraping example. We will be using pyautogui to create a Python script that will open a web browser, navigate to a specific Wikipedia article, and copy and paste the data from a table on that web page.

B. Hardware Interfaces:

Ram: 4 GB

Laptop

Web-Cam

C. Software Interfaces:

Operating System: Windows 10

Programming Language: Python

PYAUTOGUI

OPENCV

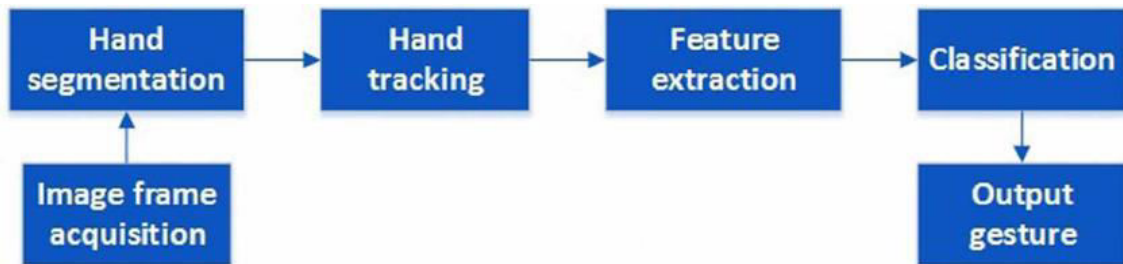
MEDIAPIPE

D. Assumptions and Dependencies:

In this system used for Handicapped People

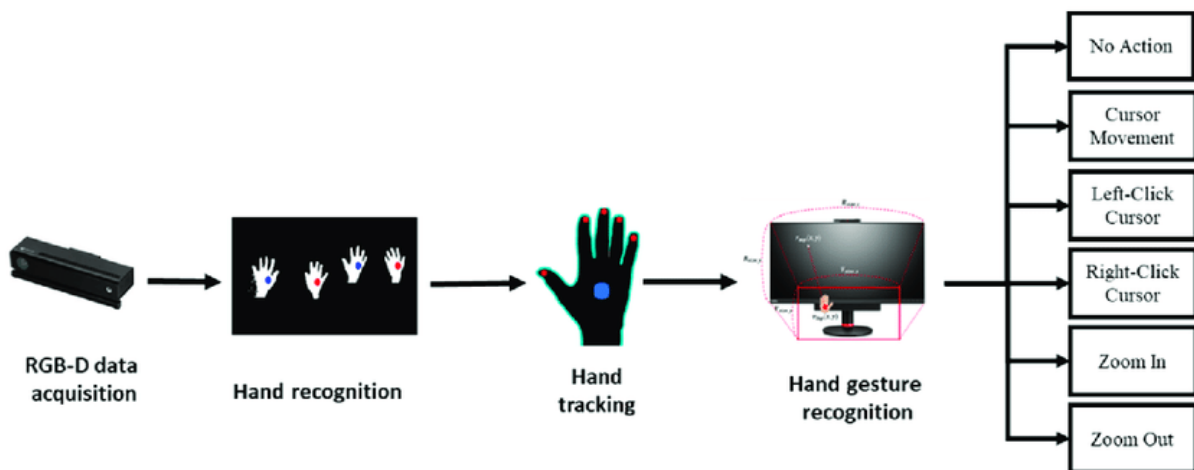
E. System Design:

1. System Architecture:



2. Data flow Diagram:

In Data Flow Diagram, we Show that flow of data in our system in DFD0 we show that base DFD in which rectangle present input as well as output and circle show our system, In DFD1 we show actual input and actual output of system input of our system is text or image and output is rumor detected likewise in DFD 2 we present operation of user as well as admin.



F. Overall Description:

The overall diagram of the system is depicted in. It is divided into two methods; ‘fingertip detection’ using colored caps and ‘gesture recognition’. It involves the interfacing of the video, processing the images by background subtraction. Background subtraction helps in neglecting the steady objects considering only foreground objects. Fingertip detection involves the color identification, circle identification and guessing the fingers. Gesture recognition involves skin color identification, contour detection and convex hull formation and then guessing the gesture. Respective mouse operation can be done accordingly.

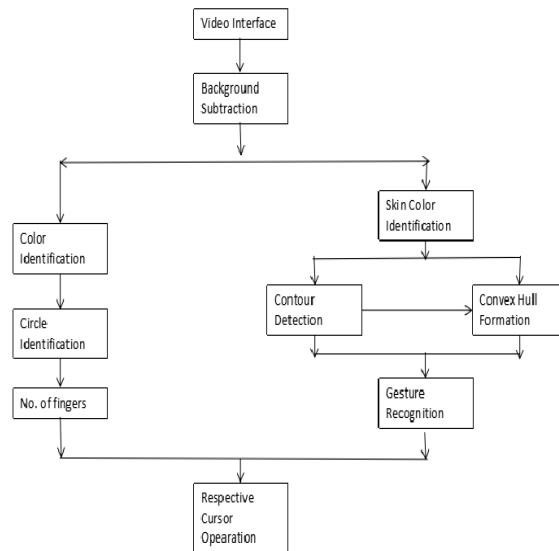


Fig 1. Overall system block diagram

1. Colour Caps:

This includes four stages to get the finger gesture from the real time fed live video. They are namely videoextraction, background subtraction, colour identification and circle identification.

1) Video Extraction: Initially, the video taken by web cam is taken using the Video Capture function in OpenCV library. The extracted video has a size of 512x512 pixel. Then, from the video, a frame is extracted which is used for further processing of the image. The optimum number of frames that are extracted per second are 12. The extracted frame image is in BGR(Blue, Green, Red) format. This image is converted to HSV(Hue, Saturation, value) format using BGR to HSV conversion function of OpenCV.

2) Background Subtraction: The frame image extracted contains multiple objects in it. But only the foreground that contains the hand with colour caps is required for processing. Hence, the background has to be neglected. So, background subtraction algorithm from OpenCV is required for the extraction of foreground objects. In background subtraction algorithm, the present frame image is compared with a 21st prior frame image in the past. The objects that had no motion in 20 or higher frames are considered to be the background objects and hence neglected. Since, the motion of the color caps is always present while performing the mouse operations, they are considered as the foreground objects. The shadows of the hand in the frame image are neglected using the command word detect shadows in background subtraction algorithm. After background subtraction algorithm, we get a masked greyscale image containing the foreground objects. The bit-wise 'and' of this greyscale image with the original frame image gives the background subtracted image.

2. Gesture Recognition:

Identification of fingers can be done through smoothening of frames using bilateral filter function, then subtracting the background of images. Each frame is then checked with the color range and there contours function is used to obtain bounding shape of the palm and convex hull is formed using convex hull function

Contours function is used to get the outline along the palm of a hand. It can be done by checking the color of the palm with the mentioned color range and then an approximate boundary of palm is detected and drawn accordingly which gives an outline of the palm as contour. Convex envelope of a set A of points is the smallest convex that contains A. Convex hull technique is used to get the hull of the entire contour formed. In this, the points on the contour are checked such that all the points are inside the hull with the extreme, outer most points as some of the points on the hull.



Figure : Gesture Recognition (1)

Fig. (1) represents the normal image of a palm. Fig. (2) represents HSV image formed from the normal image. represents the image for finger detection where green lines are contours along the palm and red lines are obtained after convex hull technique



Figure: Gesture Recognition (2)

3. Mouse Control:

Mouse Control is performed with the help of pyautogui library. The functionalities of mouse that are performed in the project are cursor control, left click, left double click, right click, up scrolling and down scrolling. Three fingers are used for the mouse control operations in case of color caps. Those three fingers are index, middle finger and ring finger. Blue colored cap is inserted on index finger. Green color cap is inserted on middle finger and red color cap is inserted on ring finger.

In case of hand gesture mouse control, various hand gestures that includes all five fingers of the bare hand are used for mouse control operations. 1) Cursor Control: In case of color caps, blue color alone is used for the movement of cursor. Green and red caps are closed. While using hand gesture recognition technique, index finger is used for cursor control.

IV. EXPERIMENTAL RESULTS

In the proposed AI virtual mouse system, the concept of advancing the human-computer interaction using computer vision is given. Cross comparison of the testing of the AI virtual mouse system is difficult because only limited numbers of datasets are available. The hand gestures and finger tip detection have been tested in various illumination conditions and also been tested with different distances from the webcam for tracking of the hand gesture and hand tip detection. An experimental test has been conducted to summarize the results shown in Table 1. The test was performed 25 times by 4 persons resulting in 600 gestures with manual labelling, and this test has been made in different light conditions and at different distances from the screen, and each person tested the AI virtual mouse system 10 times in normal light conditions, 5 times in faint light conditions, 5 times in close distance from the webcam, and 5 times in long distance from the webcam, and the experimental results are tabulated in the following fig.

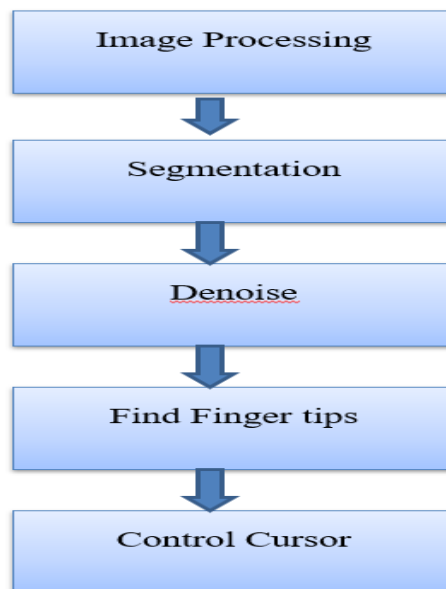


Fig. Proposed System

1. Advantages:

- In Proposed we can perform many windows commands as compare to existing system.
- Reduce hardware cost by eliminating use of mouse.
- Convenient for user not comfortable with touchpad / traditional mouse.
- The framework maybe useful for controlling different types of games and other application controlling through user defined gestures.
- Less reliability on the physical devices mouse or keyboard.
- Highly efficient.
- Time savvy.

2. Disadvantages:

- Initial cost of system may be high
- High level of coding.
- Any fault in software can lead to system inefficiency.

3. Application:

Assistive Technology: Assistive technology refers to tools, devices, software, or equipment designed to help people with disabilities or limitations perform tasks that might otherwise be challenging or impossible.

Gaming: A virtual mouse can be used for gaming as a way to control in-game actions, movement, and camera orientation. This technology is especially useful in scenarios where traditional hardware mice may not be available or practical.

Virtual Reality (VR) and Augmented Reality (AR):

VR: Virtual Reality is a technology that creates immersive, computer-generated environments in which users can interact and experience. It typically involves the use of a head-mounted display (HMD) or VR goggles to completely immerse the user in a digital world.

AR: Augmented Reality overlays digital information onto the real world. It blends the physical and digital realms, enhancing the user's perception of the real world with computer-generated elements.

AR can be experienced through smartphones, tablets, smart glasses, and headsets. Popular examples include Pokémon GO and Snapchat filters.

Gesture-Based Presentations: Gesture-based presentations are a modern and interactive approach to delivering presentations or controlling multimedia content. Instead of using traditional slide clickers or remote control, presenters use hand gestures to navigate through their slides, videos, or other digital content.

4. Future Scope:

The AI virtual mouse uses computer vision techniques to track hand movements and translates them into cursor movements on the screen. The system is designed to be intuitive and user-friendly, allowing users to interact with their computer without the need for a physical mouse.

V. CONCLUSION

The Virtual Mouse project has successfully bridged the gap between traditional mouse input and innovative virtual control, offering enhanced flexibility and accessibility for users. Its intuitive interface, precise tracking, and user-friendly design promise a promising future for intuitive computer navigation. As technology continues to evolve, this project paves the way for more intuitive and immersive human-computer interactions.

REFERENCES

- 1 K. Müller, P. Merkle, and T. Wiegand, "3-D video representation using depth maps," Proc. IEEE, vol. 99, no. 4, pp. 643–656, Apr. 2011.
- 2 P. Merkle, A. Smolic, K. Müller, and T. Wiegand, "Efficient prediction structures for multiview video coding," IEEE Trans. Circuits Syst. Video Technol., vol. 17, no. 11, pp. 1461–1473, Nov. 2007.
- 3 High Efficiency Video Coding, document Rec. ITU-T H.265, International Telecommunications Union Standard, April 2013.
- 4 G. J. Sullivan, J. M. Boyce, Y. Chen, J.-R. Ohm, C. A. Segall, and A. Vetro, "Standardized extensions of High Efficiency Video Coding (HEVC)," IEEE J. Sel. Topics Signal Process., vol. 7, no. 6, pp. 1001–1016, Dec. 2013.



- 5 P. Merkle, A. Smolic, K. Müller, and T. Wiegand, “Multi-view video plus depth representation and coding,” in Proc. IEEE Int. Conf. Image Process. (ICIP), vol. 1, Sep. 2007, pp. I-201–I-204.
- 6 P. Merkle et al., “The effects of multiview depth video compression on multiview rendering,” Signal Process., Image Commun., vol. 24, nos. 1–2, pp. 73–88, Jan. 2009.
- 7 P. Merkle, C. Bartnik, K. Müller, D. Marpe, and T. Wiegand, “3D video: Depth coding based on inter-component prediction of block partitions,” in Proc. Picture Coding Symp. (PCS), May 2012, pp. 149–152.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 **6381 907 438** **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details