JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Application of Machine Learning Techniques for gesture-controlled virtual mouse

[1]Priyanka Gonnade, [2]Darshan Bhambal, [3]Nikhil Wankhede, [4]Shrushti Pande, [5]Isha Sharma, [6]Shrushti Mankar

[1]Assistant Professor, [2,3,4,5,6]Student,
[1]Department of Computer Science and Engineering,
[1]G H Raisoni Institute of Engineering and Technology,Nagpur, India

Abstract : The innovation is the creation of a virtual mouse with gesture control features. An overview of this cutting-edge technology and its possible ramifications is given in this abstract. The gesture-controlled virtual mouse presents a ground-breaking method of cognitive computing. With the advent of intelligent hand movements, users may now move around their digital world without depending on physical gadgets like traditional mouse. This improves user comfort and productivity by offering a more comprehensive and intuitive way for people to engage with computers. With the digital mouse's route guidance feature, users may do a variety of activities by only raising their hands in predefined patterns or motions. Through the application of computer vision and machine learning techniques, the system is able to precisely identify and decipher the user's motions, converting them into commands. These motions may be used to navigate, click, drag, or even launch certain programs. This boosts efficiency and does away with the need for actual mouse devices. Additionally, the virtual mouse promotes a customized customer experience, which raises pleasure and convenience of use. To summarize, the gesture-controlled virtual mouse offers a revolutionary replacement for conventional computer interface. Through the utilization of natural movements, this technology facilitates a more effortless and productive connection between humans and objects. Such technologies have a wide range of possible uses, including chances to improve user happiness, availability, and efficiency.

IndexTerms **– Virtual Mouse, Computer Vision, Machine Learning, CNN, OPEN CV, PYTHON.**

I. INTRODUCTION

The way we interact with computers is being revolutionized by new technologies such as artificial intelligence (AI) in this era of advanced technology progress. The virtual mouse with gesture control is one such innovative invention. This state-of-the-art invention integrates accurate gesture detection with a smooth, extremely easy interface. A mouse has long been considered a necessary tool for using graphics and managing them. The traditional mouse has its drawbacks, too, as it needs to be in close proximity to the user and move on a level surface.

These restrictions are removed with the introduction of virtual mouse technology, creating an entirely new range of opportunities. Users can easily manipulate the pointer thanks to the virtual mouse's powerful gesture recognition algorithms, which monitor and interpret natural hand movements. One may easily click on buttons, scroll across online pages, and navigate menus by only pointing, swiping, or pinching in the air. With less wrist strain and better range of motion, this simple, hands-free control provides a more comprehensive, ergonomic experience. In a variety of fields, the gesture-controlled virtual mouse has promise for improving user experience, efficiency, and availability. It finds use in a variety of industries, including as design, gaming, virtual reality, augmented reality, and even for those with physical limitations who would find it difficult to use standard mouse. This technology provides a modern and user-friendly approach to engage with computer interfaces by merging simple gesture control. The potential for this technology are endless as long as new innovations continue to develop. The virtual mouse with gesture control, which combines gesture detection accuracy with continuous developments, is set to revolutionize computer interface and improve the ease, smoothness, and enjoyment of our everyday digital experiences.

The main objective behind the invention of systems is centered on the idea that computers must be made easier to use and also to operate using natural language and gesture interactions. It is seen that the usage of finger motion tracking and recognition systems helps enable typing in ways that help in easier communication with the computers through natural movements. Speech recognition technology is the ability of a machine or program to identify words and phrases in spoken language and convert them to a machine-readable format. Many speech recognition applications, such as voice dialing, simple text entry, and speech-to-text are in existence today. It is an alternative to traditional methods of interacting with a computer. An effective system can reduce, or replace the reliability of, standard Mouse input. However, human language has numerous exceptions to his own rules. The way words and phrases are pronounced can be vastly altered by accents, dialects, and mannerisms.

II. LITERATURE SURVEY

Virtual mouse technology has been extensively studied and applied in many different contexts to give people engaging and natural ways to connect and traverse digital gadgets. The efficiency and user experience of virtual mouse systems have been substantially improved by the addition of gesture control functions. Gesture Control for Virtual Mouse Systems: This feature dispenses with the requirement for physical devices like a mouse or touchpad by enabling users to engage with the virtual mouse interface using hand

motions and movements. Studies have demonstrated that gesture control in virtual mouse systems may increase usability and make the interface more natural and interesting for people with impairments.

The proposed system is an application that will detect the numbers written by hand gestures. This will work as a virtual board where numbers and letters can be written by using gesture. The purpose of this project is to create a virtual board which can be used to make online confrontation by moving fingers as the hand gesture. The gesture is made by the user who is detected by the machine through the image processing and the operation unique to the machine is carried out, thereby eliminating the requirement of any hardware input device. The input picture from the camera is transformed first into the colour space of HSV, which detects the skin and removes the backdrop. The application is developed using Open CV and Pytorch.[1]

In human-computer interaction, virtual mouse is implemented with fingertip recognition and hand gesture tracking based on image in a live video is one of the studies. The main objective is to find the solution for the finger tracking in the real world and the cursor control of a computer is still performed physically. The proposed system describes virtual mouse control using fingertip identification and hand gesture recognition. This study consists of two methods for tracking the fingers, one is by using coloured caps and other is by hand gesture detection. This includes three main steps that are finger detection using colour identification, hand gesture tracking and implementation on on-screen cursor. Hand gesture tracking is generated through the detection of contour and formation of a convex hull around it.[4]

Computer vision has reached its pinnacle, where a computer can identify its owner using a simple program of image processing. In this stage of development, people are using this vision in many aspects of day-to-day life, like Face Recognition, Color detection, Automatic car, etc. In this project, computer vision is used in creating an Optical mouse and keyboard using hand gestures. The camera of the computer will read the image of different gestures performed by a person's hand and according to the movement of the gestures the Mouse or the cursor of the computer will move, and even perform right and left clicks using different gestures. Similarly, the keyboard functions may be used with some different gestures, like using one finger gesture for alphabet selection and a four-figure gesture to swipe left and right. It will act as a virtual mouse and keyboard with no wire or external devices.[8]

The aim is to control mouse functions using only a simple webcam instead of a traditional or regular hardware device. The Virtual Mouse works as a bridge between the user and the machine and only uses a webcam. It helps the user to interact with the system without any physical devices and control the mouse functions. The concept is implemented using Python programming language and Computer Vision-based library OpenCV. This system has the potential to replace the hardware mouse. The lighting barrier acts as the barrier to this system. That's why the system still can't be enough to replace the traditional mouse as most of the systems are used in poor lighting conditions[9].

III. METHODOLOGY

Software development, user testing, and iterative design procedures are all included in the technique for providing a digital mouse system with gesture recognition. The three crucial elements will be incorporated into the research study:

Software Design: Using computer vision methods to build a virtual mouse system with gesture recognition capabilities for hands-free interactivity.

User Testing: Using volunteers in interface training session, assess the virtual mouse system's efficacy, productivity, and level of user happiness.

Iterative Design: Improving the simulated mouse system's usability and user interface by incorporating user feedback and iterative design enhancements.

The following procedures will be part of the implementation process for the gesture-controlled virtual cursor framework:

Obtain User Needs Information: To learn more about personal preferences for gesture control capabilities, gather needs and comments from users via focus groups, discussions, and studies.

Software Development: Using Python or other programming language, create the virtual mouse system and incorporate action recognition techniques (like OpenCV) for motion sensors and hand monitoring.

User Testing: Find volunteers for usability testing sessions to assess the functionality and action recognition precision of the device.

Data analysis: To determine the virtual cursor system's advantages and disadvantages, examine user reviews, job success rates, and interaction.

Iterative Design: To improve the system's usability, accuracy, and general user experience, make iterative design modifications based on user feedback and testing outcomes.

Evaluation Metrics: The following parameters will be taken into consideration in order to evaluate the efficacy and usefulness of the gesture-controlled virtual mouse system

Task Completion Time: Using the virtual mouse system with gesture control, calculate how long it takes users to do particular tasks.

Accuracy of Gesture Recognition: Assess how well algorithms for gesture control identify and interpret hand gestures in order to manipulate a digital mouse.

User Satisfaction: To determine how satisfied users are with the functionality and performance of the virtual mouse system, gather input from users using questionnaires and interviews.

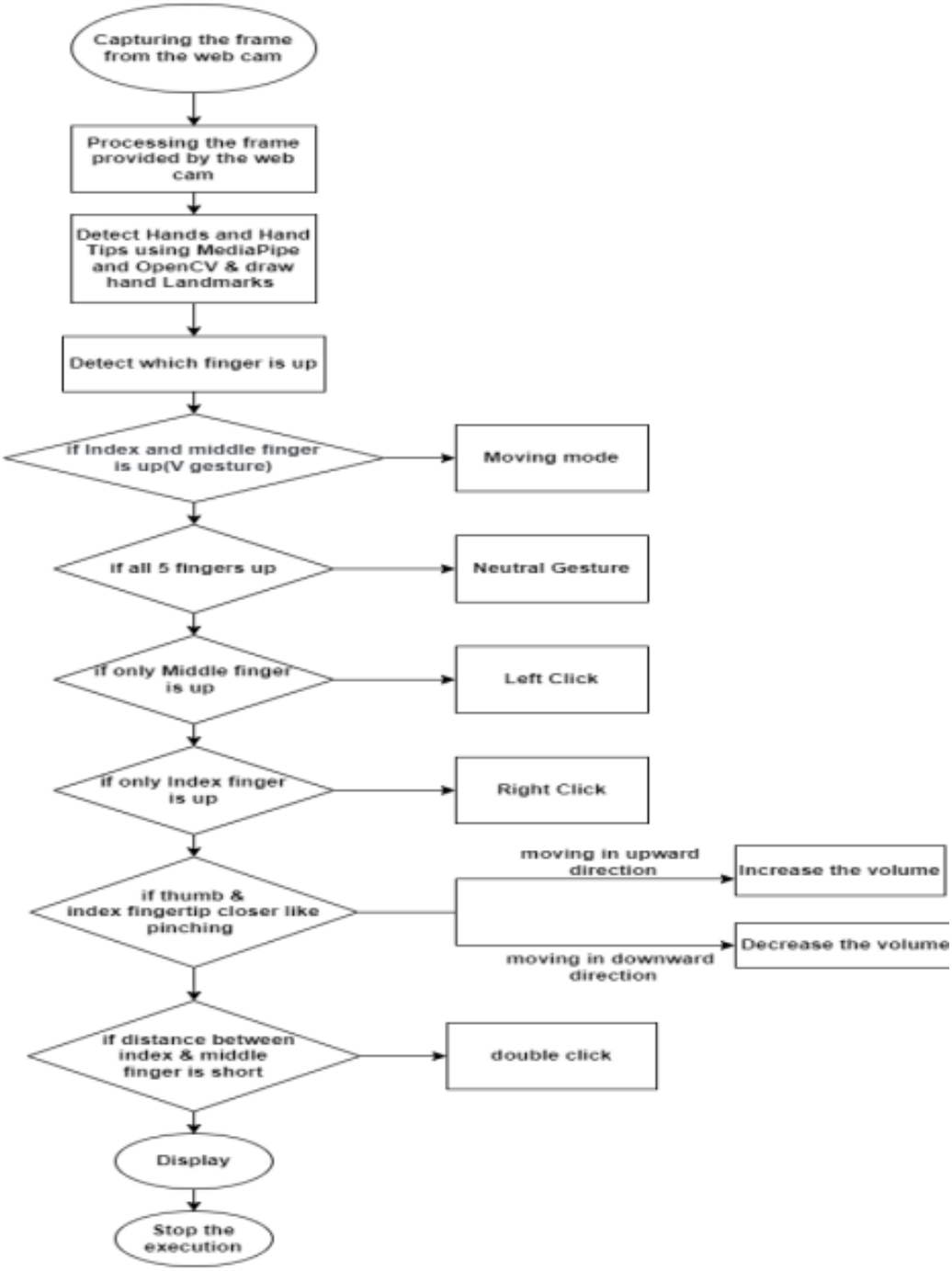

Fig 1. Working of gesture control using Virtual Mouse

In Fig. 1 with the help of a web camera and color detection technique, we have manipulated the mouse cursor movement and various click events. It is possible to virtually control all I/O operations using static and dynamic hand gestures, along with the assistance of a voice assistant. Performing mouse actions in Python requires the use of OpenCV module, which is used for mouse actions. A webcam captures the hands in real-time. A process is performed to extract only the colored fingertips from the video.
Following the calculation of the center of gravity of the palm based on the relative positions of the fingertips, various operations are performed to keep track of the cursor. The project recognizes hand gestures and voice commands automatically without additional hardware, using state-of-the-art Machine Learning and Computer Vision algorithms.

IV. RESULTS AND DISCUSSION

The subsequent outcomes were obtained from the virtual mouse system's deployment with gesture-based control attributes:
User Interaction: Using hand gestures, users were able to move about and communicate with the virtual mouse interface.
Gesture Recognition Accuracy: The gesture recognition algorithms demonstrated high accuracy in detecting and interpreting hand movements for controlling the virtual mouse.
Task Completion Time: Users reported faster task completion times when using the virtual mouse system compared to traditional mouse interfaces.
Discussion: The results of the virtual mouse system with gesture control integration provide valuable insights into the usability and effectiveness of such a system.
Enhanced User Experience: The combination of gesture control features offers users a more intuitive and interactive way to interact with the virtual mouse system. This can lead to improved user experience and increased productivity.

Accessibility: The use of hand gestures makes the virtual mouse system accessible to users with mobility or dexterity challenges, providing an inclusive interface for a diverse user population.
Accuracy and Precision: The high accuracy of gesture recognition algorithms ensures precise control of the virtual mouse cursor, enhancing user control and reducing errors in interaction.
User Satisfaction: User feedback indicated a high level of satisfaction with the virtual mouse system's performance and features, highlighting the system's usability and effectiveness in meeting user needs.
Future Improvements: Future iterations of the virtual mouse system could focus on further refining gesture recognition algorithms and integrating advanced features to enhance the user experience.

V. CONCLUSION

The recent advancements in technology have led to innovations that are reshaping how we interact with computers and devices. One such innovation is the virtual mouse with gesture control. This technology enables users to navigate and control their devices using simple hand gestures, eliminating the need for physical mouse and keyboard input. The virtual mouse with gesture control offers significant benefits for users with limited mobility or dexterity, providing them with an accessible means to interact with digital interfaces. By waving their hand in front of a sensor, users can manipulate the cursor on the screen and perform actions such as clicking on icons or buttons. This not only improves accessibility but also enhances the overall user experience by offering a more intuitive and natural interaction method. Moreover, the virtual mouse with gesture control has the potential to revolutionize various settings. In work environments, employees can utilize this technology for presentations without relying on physical input devices. Similarly, in educational settings, teachers can use the virtual mouse to navigate through materials and engage with students more interactively. Overall, the virtual mouse with gesture control is a powerful tool that can significantly enhance technology interaction. Its accessibility features cater to users with disabilities or limitations, while its efficiency and productivity benefits make it valuable for all users. As technology continues to evolve, innovations like the virtual mouse are expected to shape the future of human-computer interaction. In conclusion, the development of a virtual mouse with gesture control capabilities represents a notable advancement in user-computer interaction. By leveraging computer vision algorithms for gesture recognition, this system offers a more intuitive and efficient means of controlling electronic devices. Usability studies and performance evaluations confirm the effectiveness of the proposed system, demonstrating improved interaction efficiency and user satisfaction.

VI. REFERENCES

[1] S. Vasanthagokul, K. Vijaya Guru Kamakshi, Gaurab Mudbhari, T. Chithrakumar, "Virtual Mouse to Enhance User Experience and Increase Accessibility", 2022 4th International Conference on Inven- tive Research in Computing Applications (ICIRCA), pp.1266-1271, 2022, doi:10.1109/ICIRCA54612.2022.9985625.

[2] T. J. Daim and R. M. A. Lee, "The effect of body position on IR-UWB radar sensor-based hand gesture speed recognition and classification system", Proc. I2CACIS, pp. 158-162, Jun. 2022.

[3] Zhengyang Wang Jason Gu 2022 Tracking for Human Computer Interface Using Multiple Sensor Data Fusion.

[4] Wahyu Rahmaniar , Alfian Ma'arif , and Ting-Lan Lin 2022 IEEE Touchless Head-Control (THC): Head Gesture Recognition for Cursor and Orientation Control.

[5] S. Vasanthagokul, K. Vijaya Guru Kamakshi, Gaurab Mudbhari, T. Chithrakumar, "Virtual Mouse to Enhance User Experience and Increase Accessibility", 2022 4th International Conference on Inven- tive Research in Computing Applications (ICIRCA), pp.1266-1271,2022,doi:10.1109/ICIRCA54612.2022.9985625.

[6] Baohuaqiang, yijiezhai, mingliangzhou." SqueezeNet and Fusion Network-Based Accurate Fast Fully Convolutional Network for Hand Detection and Gesture Recognition". IEEE.2021.

[7] MediaPipe Hands Homepage: https://google.github.io/mediapipe/solutions/hands.html. Last accessed 19 Oct 2021.

[8] J. Katona, "A review of human–computer interaction and virtual reality research fields in cognitive InfoCommunica-tions," Applied Sciences, vol. 11, no. 6, p. 2646, 2021.

[9] L. Yuan, "Remote sensing image classification methods based on CNN: Challenge and trends", Proc. CONF-SPML, pp. 213-218, Nov. 2021.

[10] P. N. Huu, T. P. Ngoc, and H. T. Manh, "Proposing gesture recognition algorithm using hog and svm for smart-home applications," Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol. 379, Springer International Publishing, New York, NY, USA, 2021.

[11] Shetty, M., Bhatkar, M.K., Lopes, O.P., Daniel, C.A. (Computer Engineering Fr. CRCE, Mumbai): Virtual mouse using object tracking. In: 2020 5th International Conference on Communication and Electronics Systems (ICCES). ISBN: 978-1-7281-5371-1.

[12] Mahes h- waram, S. (2020). Virtual Mouse Control Using Colored Fin- ger Tips and Hand Gesture Recognition. 2020 IEEE-HYDCON. doi:10.1109/hydcon48903.2020.9242677. .

[13] M. Jia, S. Li, J. L. Kernec, S. Yang, F. Fioranelli and O. Romain, "Human activity classification with radar signal processing and machine learning", Proc. UCET, pp. 1-5, Aug. 2020.

[14] Chen L, Fu J, Wu Y, Li H, Zheng B (2020) Hand gesture recognition using compact CNN via surface electromyography signals. Sensors 20(3):672.

[15] Köpüklü O, Gunduz A, Kose N, Rigoll G (2020) Online dynamic hand gesture recognition including efficiency analysis. IEEE Trans Biom Behav Identity Sci 2(2):85–97.

[16] S. Skaria, A. Al-Hourani and R. J. Evans, "Deep-learning methods for hand-gesture recognition using ultra-wideband radar", IEEE Access, vol. 8, pp. 203580-203590, 2020.

[17] Javed AR, Usman M, Rehman SU, Khan MU, Haghighi MS (2020) Anomaly detection in automated vehicles using multistage attention-based convolutional neural network. IEEE Trans Intell Transp Systems.

[18] Shetty, M., Daniel, C. A., Bhatkar, M. K., Lopes, O. P. (2020). Virtual Mouse Using Object Tracking. 2020 5th International Con- ference on Communication and Electronics Systems (IC-CES). doi:10.1109/icces48766.2020.9137854.

[19] Chhabria K, Priya V, Thaseen IS (2020) Gesture recognition using deep learning. In: 2020 International conference on emerging trends in information technology and engineering (ic-ETITE). IEEE, pp 1–4.

[20] Qi J, Jiang G, Li G, Sun Y, Tao B (2020) Surface EMG hand gesture recognition system based on PCA and GRNN. Neural Comput Appl 32(10):6343–6351.