iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.71568

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

AI Virtual Mouse

Anuj Malik[1], Kartik Sharma[2], Rohit Negi[3], Joney Kumar[4], Punit Mittal[5], Dr. Swati Sharma[6]
Dept. Computer Science and Information Technology, Meerut Institute of Engineering and Technology, Meerut, India

Abstract: The AI Virtual Mouse is a revolutionary touchless replacement to standard computer mice that prioritizes hygiene and simplicity in an increasingly health-conscious world. Even while wireless mice do away with cable-related problems, they still require physical contact, which might spread germs, especially in offices where workstations are shared. By using an external or built-in camera on a computer to record and analyze hand and finger movements in real time, this state-of-the-art technology leverages computer vision and machine learning to do away with the need for touch. The AI Virtual Mouse accurately recognizes hand features using deep neural networks, allowing it to perform basic mouse activities including clicking, scrolling, and pointer navigation without requiring human interaction. This idea, which uses OpenCV in Python, enhances hygiene by significantly reducing the risk of contamination linked to high-touch surfaces while simultaneously improving user experience by doing away with the requirement for physical peripherals.
Keywords: Python, virtual mouse, AI, MediaPipe, OpenCV.

I. INTRODUCTION

Mice have always been a popular PC input device, and as we approach the brave new world of augmented reality and near-universal wireless technology, unique solutions have emerged to complement these developments. The suggested system acts like a mouse, accepting standard mouse input commands (e.g., click, scroll, and move a cursor) using hand motions and fingertip identification from fingernails using a computer's built-in or extra camera. The innovative device uses computer vision and machine learning techniques to replace physical touch with a pop-up mouse that is more convenient, hygienic, accessible, and smaller than conventional or Bluetooth mice. Python and extra libraries for MediaPipe, Autopy, PyAutogui, and OpenCV were used in its construction. With this technology, you can operate the computer screen without the need for extra gear (such as a USB receiver or batteries) by tracking and interpreting your hand movements. Human-Computer Interaction (HCI) is enhanced, and a stable, high-fidelity program that uses little power is demonstrated. This enables real-world functioning without the need for a powerful GPU. As an illustration of how computer vision-based virtual gadgets might transform how we interact with technology, an artificial intelligence Virtual Mouse system efficiently translates hand movements into keystrokes to enable natural hands-free engagement.

II. LITERATURE REVIEW

Some Researchers have looked into a number of techniques to make virtual mouse control seem more natural, such using color-based gesture recognition or recording finger movements while wearing sleeves. However, these methods are not always reliable. Gloves can further reduce detection accuracy, and color-based systems suffer when the program cannot accurately identify the colors of the fingertip. Despite several studies on the topic, problems with accuracy and consistency persist when using sensors for hand gesture-based controlling [5, 6]. Lee, Liou, and Hsieh [1] presented one of the first approaches utilizing a cursor controller that recognizes hand movements. The problem? It was slower and made real-time interaction difficult since frames had to be saved before processing. A gesture detection system based on motion history was later tried to improve this by Liou, Hsieh, and their colleagues [3], but even it experienced performance issues. Quam [2] took a different tack and used a data glove to recognize motions. Despite its effectiveness, it was inappropriate for daily use due to its reliance on complex hand movements. A cursor control system based on arm gestures was introduced by Vinay et al. [11] at the same time and published in the International Journal of Computers and Applications in 2020. Several bands were given distinct responsibilities by their system, but a major flaw was that each function required a different hue, which isn't always feasible in practice. Thakur [4] created an interface for navigation that blended finger gestures with optics to make things more smooth. The idea was furthered by Gopnarayan et al. [5] and Patil et al. [6], who used machine learning to control a virtual mouse. These techniques have accuracy problems despite their potential, especially when subjected to varying lighting conditions. To improve real-time detection, Fan, Zhang, and Bazarevsky [7] created the MediaPipe architecture, which significantly increased finger tracking's efficacy.

Similarly, Kornyakov et al. [8] used OpenCV to increase the speed and accuracy of gesture detection. Asokkumar et al. [9] highlighted the need of precise motion tracking for an ideal user experience in their investigation of human-computer interactions.

From an application standpoint, Shibly et al. [10] looked at the possibilities of abstract hand gestures for virtual control of mice and even picture manipulation. Vinay [11] expanded this concept by introducing a focused on action pointer command framework. According to Katona [12], who studied neural interaction techniques, brain-computer interfaces could be the next step in interacting with computers. In order to show how hands-free computing can develop in the near future, Dudhane [13] also demonstrated a cursor control system based on hand gestures. Even with these developments, there is still more work to be done in the field of gesture-based virtual mouse technology. In many contexts, real-time responsiveness, accuracy, and adaptability remain significant challenges, making this an intriguing area for more research and advancement.

A. *Among the Applications Are*

This emphasis aims to enhance the capabilities of Intelligence's online cursor system. may be helpful in situations when the conventional mouse cannot be utilized, as well as in minimizing the area used by actual mice based on a focus. The technology enhances human-computer connections and does away with the need for gadgets.

B. *Principal Applications Include*

1) Using equipment when the COVID-19 pandemic is dangerous as it could spread the virus.
2) Using the technology to operate automated systems without the need for extra equipment.
3) AI virtual system that can draw 2D and 3D images with hand gestures.
4) AI-powered virtual mice may be used to play VR and AR games, eliminating the requirement for wireless conventional cable mouse devices.
5) It makes it possible for those who have hand issues to operate the mouse on a computer.
6) Robots in robotics can be operated via HCI-based systems.
7) This approach enables virtual prototyping for architecture and design.

III. DESIGN DETAILS

To ascertain the coordinates of the frame, the system will convert the real-time video input from the camera into array form. The computer can precisely locate and recognize raised fingers using these coordinates. By identifying which finger is up, the system will do certain actions, such clicking or moving.

1) Start: Get things going.
2) Real-time: video from cameras Acquisition: To monitor hand movements, capture live video from the computer's camera.
3) Location of Hand Landmarks and Coordinates: Determine the exact positions (coordinates) of certain points (landmarks) on the hand.
   Identify a Finger by Looking at the Angle and Fingertip: Examine each finger's position and angle to see which is being used.
4) Execute the Activity: This function is responsible for carrying out the associated action (such as a mouse click or scroll) in response to the identified gesture.
5) End: Complete the process.

As demonstrated in figure 1 below, this flowchart explains how to utilize hand gestures to do computer operations without a real mouse.

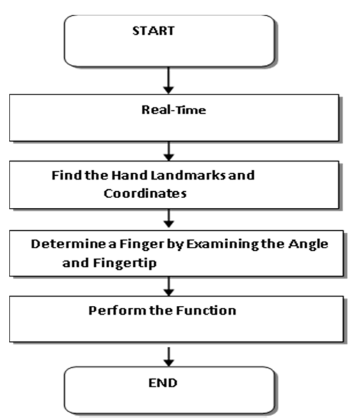

Figure 1 System Operation

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

IV. METHODOLOGY

1) Video capture: The OpenCV module records live video from a camera and uses it as an input for further processing.
2) Find hand landmarks: We wrote the software to find the hand landmarks using Python tools such as MediaPipe and CV2. It will locate 21 spots after hand recognition, as shown in figure 2.

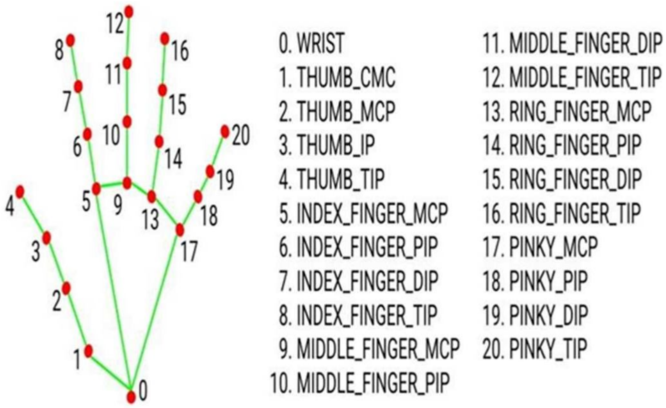

Figure 2 Hand Landmarks

A. Simply place your index and middle fingers at the points of the edges for this one:

In order to simplify matters, we have integrated a number of features into a module named "HandTrackingModule." This module includes functions for identifying fingers, recognizing hands, figuring out which fingers are up, and measuring finger lengths.

B. Identify the fingers that are displayed

Which fingers are raised is decided by the program.

1) An increase in volume: Figure 3 illustrates how the system will increase the loudness if the middle, index, and ring fingers are lifted.

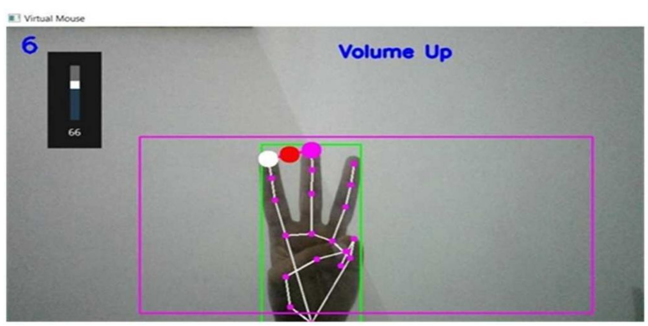

Figure 3 Volume Up

2) Volume Decrease: The system will lower the volume if the little, ring, middle, and index fingers are lifted, as seen in figure 4.

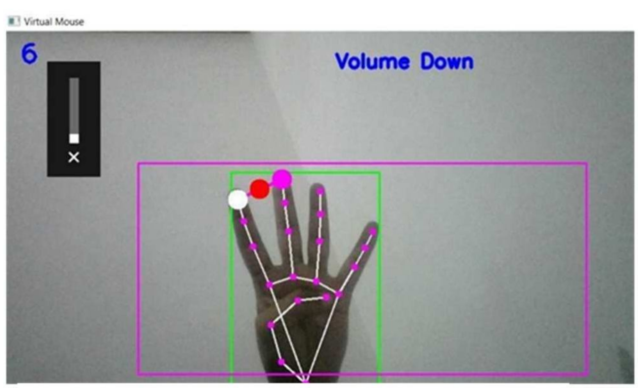

Figure 4 Volume Down

3) Scrolling UP: As seen in figure 5, the computer will scroll upward if each of the fingers are up.

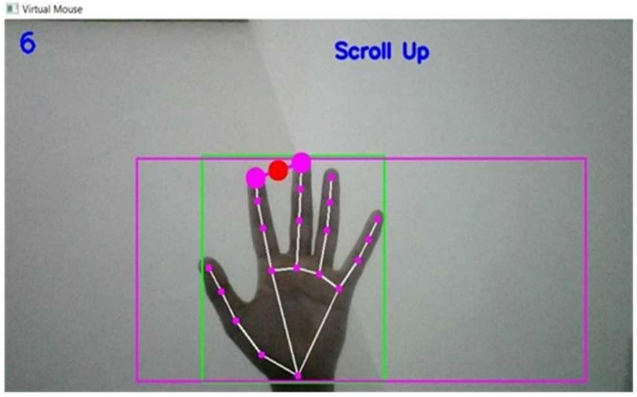

Figure 5 Scroll Up

4) Scrolling Downward: As seen in figure 6, the computer will scroll downward if the thumb is the only thing up.

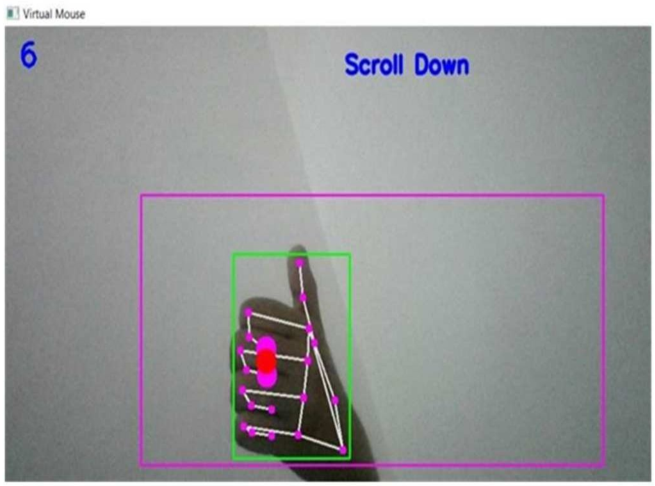

Figure 6 Scroll Down

5) Mouse Motion: As seen in figure 7, the mouse will enter moving mode when only the pointer fingertip is raised, enabling the user to control the tip with their finger.

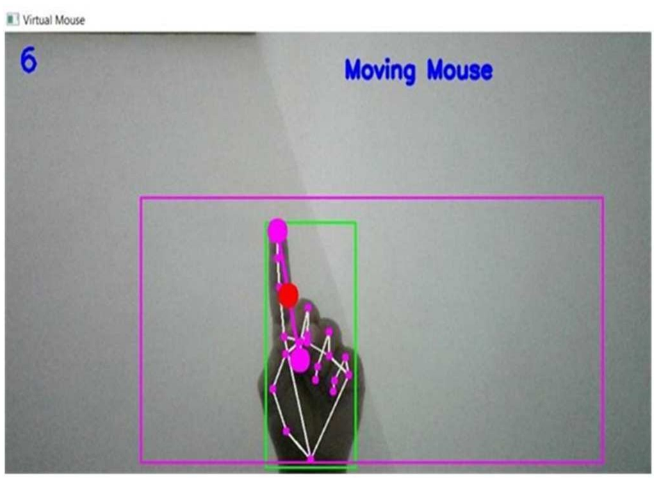

Figure 7 Moving Mouse

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

6) By clicking Mode: As seen in figure 8, the system enters select mode when the middle and index fingers are simultaneously raised.

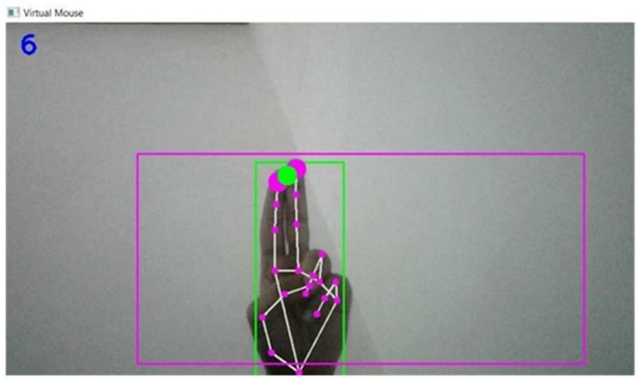

Figure 8 Clicking Mode

To get the precise location, convert the coordinates: The accurate monitoring of the cursor's location on the screen is essential for precise mouse control.
Start using the functions: By using coordinates and finger tracking, we can control the mouse digitally without actually touching the device.
The rate of frames that are: We can tell if the pointer goes smoothly by looking at the frame rate.
Smooth out the numerical values to keep the mouse from jittering: We added a variety of smoothing methods to the cursor to make it easier to operate by keeping an eye on variations in the rate of animation and pointer movement. Display: As seen in picture 9, we also used camera tracking to show proper implementation.

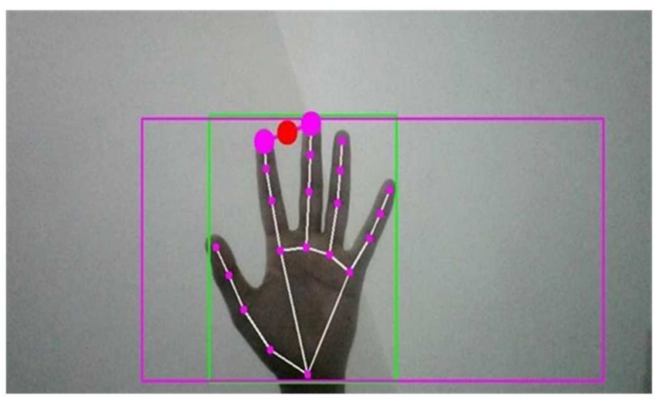

Figure 9 Display

V. RESULTS

The Python-based artificial virtual mouse program removes the need for a real mouse by allowing users to control mouse functions using arm motions. Our system monitors hand movements and converts finger motions into mouse gestures using an integrated camera or webcam.
The AI Virtual Mouse system, which functions similarly to a genuine computer mice employing machine vision to recognize a hand and fingertip motions for crucial mice operations like clicking, scrolling and pointer navigationg is capable of replacing your traditional Computer mouse. This idea replaces the requirement for a hardware mouse with a built-in or external camera that captures and processes real- time hand gestures to control the computer interface. Constructed using Python and tools such as MediaPipe, PyAutoGUI, AutoPy, and OpenCV, the system precisely recognizes hand landmarks and fingertip motions, allowing for seamless user interaction without requiring hardware contact. This model's high accuracy and real-world applicability make it useful for a variety of situations, including some where a GPU is not required. This touchless interaction method provides a more sanitary and efficient choice, especially in shared or public workplaces, and improves Human-Computer Interaction (HCI) by offering a contactless, gesture-based interface for computer operation.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

A. *Details of the user Interface*

The project will launch a graphical user interface (GUI) window. The primary user interface was this GUI, which includes the Virtual Mouse Exit.

The Figure 10 below displays an active educational message changing while the client chooses decisions.

Figure 10 GUI Overview

B. *Client Engagement*

- Activating a Digital Controller: When the user hits the "Digital Mice" button, the machine will reply with the following message refers to "Virtual Mouse is operating... This kind of feedback shows that the virtual mouse feature has been effectively enabled.
- Exit Option: The Exit button allows clients to stop the program gently, as shown in figure 11 as well.

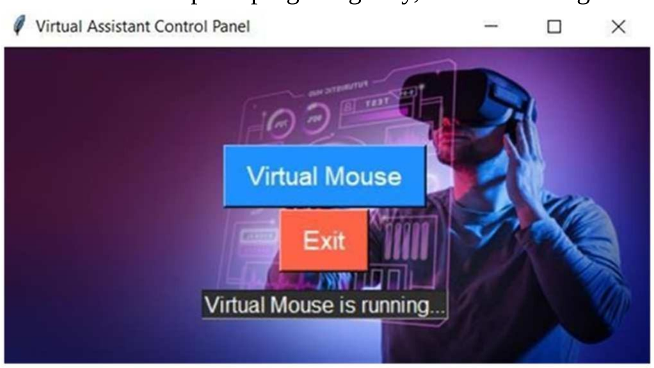

Figure 11 Interaction with Users

C. *Features of an Online Mouse*

- Camera inputs: The camera serves as a user input device and is in charge of identifying and following hand motions in order to enable the computer mice feature.
- Hand Recognition and Finger Movement: It uses advanced computer vision techniques to monitor hands in real time.

For instance, as shown in figure 12, user may map the movement of specific finger locations, such the index finger, to the appropriate mouse function.

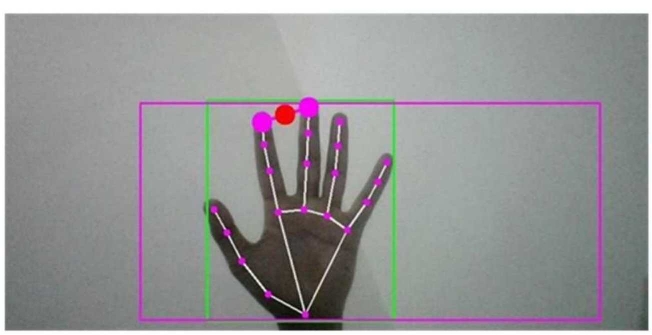

Figure 12 Artificial Cursor Capabilities

- For instance, Cursor Movement: The technology uses the pointer finger to move the cursor. Let us show you an example of a mice feature for touch operation replace that can be readily performed utilizing intuitive, fluid, and user- friendly motions, as shown in Figure 13.

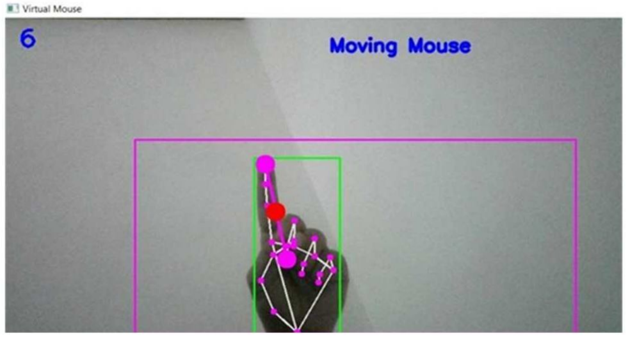

Figure 13 Illustrates the moving click.

VI. FUTURE SCOPE AND CONCLUSION

Currently, there are some limitations that the AI virtual mouse technology face. It also has a tiny decrease in the accuracy of right-clicking, which may at times affect the precision of particular functions. Moreover, the model struggles with click and drag operations—like text selection—which negatively affects work involving continuous drags. Such problems constitute some of the key restricts connected with Intelligence digital mice, and they will serve as inspiration for future advances in our research. The system can also be further developed in future so as to mimic the keyboard and mouse both virtually. This could create new avenues in Human Computer Interaction(HCI). It represents the best potential for future development and use. The use of powerful learning techniques will also improve gesture identification, ensuring that accuracy does not suffer in low light or dense backdrops. Adding further platform support, such as macOS, Linux, and mobile compatibility, would increase the system's adaptability and make it available to a larger range of users. Furthermore, the application of such technologies in AR and VR contexts may result in an extra user-friendly and captivating interface, particularly when it comes to gaming or cooperative virtual workplaces. Voice commands and gestures that may be customized for persons with impairments are examples of upcoming accessibility capabilities. The digital cursor has potential uses in industrial technology and robotics, allowing free of charge and fast operation using gesture- based inputs. A Computer Vision Digital Mice via the Python language and OpenCV is a progress in interaction between humans and computers who avoids contact with input devices and makes certain that there is a means of controlling button motion and go buttons to the application. Using easily accessible gear, such cameras and computer vision, this project shows how simple and user-friendly it can be. The virtual mouse addresses hygiene concerns and can especially helpful in situations where hardware contact must be avoided, such as during a pandemic. Although the system is currently only has basics cursor capabilities, this provides us with a solid foundation upon which to expand in the future.

REFERENCES

[1] D. Lee, D.-H. Liou, and C.-C. Hsieh, "A system for recognizing hand gestures in real time through the use of motion history images," in Proc. 2nd Int. Conf. Signal Process. Syst., IEEE, 2010
[2] D. L. Quam, "The use of a Data Glove for gesture recognition," in Proc. IEEE Symp. Aircraft Technol., vol. 2, pp. 755–760, 1990.
[3] D.-H. Liou, D. Lee, and C.-C. Hsieh, "A live hand position detection device using motion history shots," in Proc. 2nd World Conf. Inf. Process. Syst., vol. 2, no. V2-394, IEEE, July 2010.
[4] S. Thakur, "Computing navigation using fingers and optics," IEEE Study, 2015.
[5] S. P. Gopnarayan, G. Moroliya, and S. Patweka, "Virtual mouse through hand gesture," J. Emerg. Technol. Innov. Res., 2018.
[6] N. Patil, G. Sali, and N. Lokhande, "Mouse with ML and AI on fingertips," Int. Res. Eng. Technol. J., 2019.
[7] G. R. Fan, Z. Zhang, and V. Bazarevsky, "The MediaPipe for right now finger detection on devices," Oct. 9, 2023.
[8] V. Kornyakov and M. Eruhimov, C. K.-M. A. Pulli, and B. Baksheev, "Instantaneous speeds visual recognition with OpenCV," Queue, vol. 10, no. 4, pp. 40–56, 2012.
[9] N. Asokkumar, S. Poddar, A. Haria, A. Subramanian, and J. S. Nayak, "Synopsis for the identification of movements of the hand in interactions between humans and machines," Procedia Comput. Sci., vol. 115, pp. 367–374, 2017.
[10] D. Shibly, D. Islam, and S. Showrav, "Recognition of abstract hand gestures, virtual mouse, photo processing," in Proc. 1st Int. Conf. Adv. Robot. Sci. Eng. Technol. (ICASERT), Dhaka, Bangladesh, 2019, pp. 1–5, doi:10.1109/ICASERT.
[11] K. P. Vinay, "Hold action-oriented pointer command," Int. Encycl. Forensic Account. Data, no. 0975–8887, 2016.
[12] J. P. Katona, "A review of the study domains of interaction between people and computers and virtual realities in neural interaction," Rec. Sci., vol. 11, no. 6, p. 2646, 2021.
[13] S. U. Dudhane, "Hand gesture detection-based cursor control system," Int. J. Adv. Res. Comput. Commun. Eng. (IJARCCE), vol. 2, no. 5, 2013.