TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

Hand Posture Detection and Mouse Controller

Lara Biswas

Shri Ramswaroop Memorial University, Barabanki, India, 225003

KEYWORD

Human Machine Interaction, ML, NLP

ABSTRACT

After the pandemic there is huge shift in technology field. The hand posture detection and mouse are one of those virtual technology research field. The virtual mouse controller has a functionality of the real mouse to let the user communicate with the system. It is a step towards Human Machine Interaction. Although there are different Bluetooth devices that perform the functionality of a mouse but it's not completely physical free. This controller only requires a single hardware (webcam) that captures the frames, analyze them to predict the detection and perform mouse functionality using the gesture of user's hand. This reduces the need of any external device to perform the functionality of the mouse and allows enhancing of computing experience..

1. Introduction

This virtual mouse controller makes the use of hand gestures and hand tip detection to perform the function of a traditional mouse using only a webcam. The webcam captures the frame and process them and by recognizing various hand gestures control the cursor of the mouse on the system in real time. Python programming language is used to develop this software and OpenCV is the library for the computer vision. This model makes the use of Media pipe package for tracking the hand gestures especially the fingertips and Autopy package in python to move the mouse cursor around the window screen of the system performing functions like click, scroll up, scroll down, zoom out, zoom in.

As people strive for a lifestyle in which all electronic gadgets can be managed and interacted with remotely without the usage of peripheral devices, the classic physical mouse is anticipated to be replaced in the not-too-distant future by the virtual mouse. To decide where the user wants the points to be, all that is needed is a camera to take a picture of the user's hand position. This eliminates the need to manually move the actual mouse. A single camera is sufficient to enable users to interact with the computer system using the Virtual Mouse, making it a cost-effective option as well. Some portable computer systems, like the laptop, are already equipped with a built-in webcam. To track fingers as a movable object and using it for mouse function the camera should me set in a right position with a decent amount of light so that it can detect the hand gestures properly. A very important use of this system are for the people who are disabled or handles any neurological problem. With the help of computer vision and mediapipe any part of human body can act as tracking system it can be either an object detection, eye detection, color detection, image classification, image segmentation, interactive segmentation, Pose detection etc.

Corresponding Author: Lara Biswas, Shri Ramswaroop Memorial University, Barabanki, India, 225003
Email: larabiswas1114success@gmail.com

The scope of the project is as below:

- Real time application.
- User friendly application.
- Removes the requirement of having a physical mouse.
- Reduce cost of hardware

The work focuses on identifying the movement of the hand by first extracting the characteristics from human hands and then matching those features and using them to control the mouse function

2. Related Work

A cutting-edge method for computers to comprehend human gesture (Body Language) is gesture recognition. The majority of marker-based gesture recognition mice require at least two different colours of markers to track, which slows down and lags the system. A glove and coloured tips have been used in several similar experiments on virtual mice to detect hand gestures, however the mouse functionalities are not as precise when employing these methods. There have been some attempts to detect the hand gesture interface using a camera.

Chang- Yi Kaoet proposed a Human-Machine Interaction Technique:-learning-based interaction between a computer and a person is basically what hand gesture recognition based on hidden markov models with trajectory of hand motion is. Their work is really exact, but it only functioned on machines with good configuration[2].

J. Katona proposed [3] Cognitive info communications (CogInfoCom) is a young and developing field that aims to combine human cognitive skills with digital technologies. It has already introduced technical developments, such as new types of learning environments, and has contributed to a greater knowledge of how people learn more efficiently.

Chaithanya C, Lisho Thomas, Naveen Wilson, and Abhilash SS in 2018[4] proposed The model detection in "Virtual Mouse Using Hand Gesture" is based on colour. However, very few mouse operations are carried out.

D. L. Quam, in 1990 [5] proposed gesture recognition with the DataGlove. 22 gestures were examined, with finger flexure movements in the first class, finger flexion and hand orientation in the second class, and finger motion in the third class. Four sensors were needed to correctly distinguish one motion from a bunch, depending on the type and quantity of gestures in a group.

Vinay Kr. Pasi, Saurabh Singh, and Pooja Kumari in 2016 [6] proposed “Cursor Control using Hand Gestures” in the IJCA Journal. The method suggests using several bands to carry out various mouse actions. The drawback is that different colours are required to carry out mouse tasks.

Neethu. P.S et al. proposed a Real Time Static and Dynamic Hand Gesture Recognition Create, develop, and research a useful framework for real-time gesture recognition that can be used to many different human-computer interaction applications. However, it could not operate against a complicated backdrop and could only be computed under bright conditions

3. Methodology

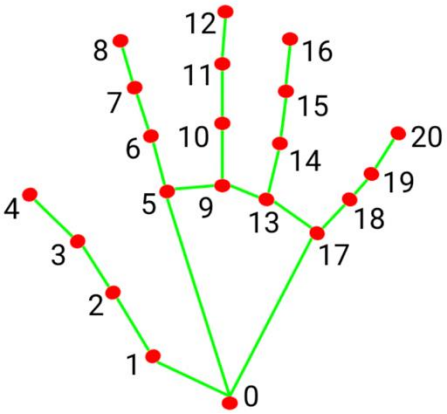
In the proposed method firstly I initialize the system and start the video capturing of the webcam through OpenCV and is Capture function to capture the frames using the webcam . Once the webcam starts to capture the frames , then detect hands and hand tips using Mediapipe framework and Opencv and we also draw the hand landmarks and a box around the hand to limit the excessive movement of the hand into a simple frame box which will the region of the laptop window where the mouse is going to be used . In the condition reason if both index and middle fingers are UP and moved towards up it will perform scroll up function and if both index and middle fingers are up and moved towards down the scroll down function is performed. Then detection of which finger is UP which is the functional start of the project. Two conditions are checked first if the index finger is UP then mouse cursor is moving around the window and if both if index and middle fingers are up and the distance between then is less than 40 then click function is performed. Now for zoom in and zoom out function double click means if middle and index finger are tapped two times it will zoom in the window panel and if double click two times more zoom out function will

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

we performed. The last but not the least the scroll up and down function will we performed by simply clicking the scroll bar in any web page on which this project will be used. If all the five fingers are up no actions will be performed. The various conditions and functions used in the construction of “Pose Detection Mouse Controller” real time are explained in the flowchart .

3.1. Mediapipe

MediaPipe is an opensource framework of Google used for machine learning pipelines. It is multimodal and can be applied to various audios and videos. The framework is based on three fundamental parts: performance evaluation, retrieving sensor data, and a collection of components called calculators. A pipeline is a graph which consists of components called calculators, each connected by streams in which the packets of data flow through. Developers can replace or define custom calculators anywhere in the graph to create their own application [7].



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Fig.1 Hand position

3.2) OpenCV:- OpenCV is a library of programming functions for real time computer vision, which can read image pixels and create real time eye tracking and blink detection. A video is nothing but a series of images that are often referred to as frames. So, all you need to do is loop over all the frames in a video sequence, and then process one frame at a time. OpenCV read, display and write videos from a file, an image sequence and a webcam. With the help of the video capture class in OpenCV[8].

3.3) AutoPy:- A straightforward, cross-platform GUI automation package for Python is called AutoPy. It has tools for managing the mouse and keyboard, detecting colors and bitmaps on the screen, and showing alarms [9].

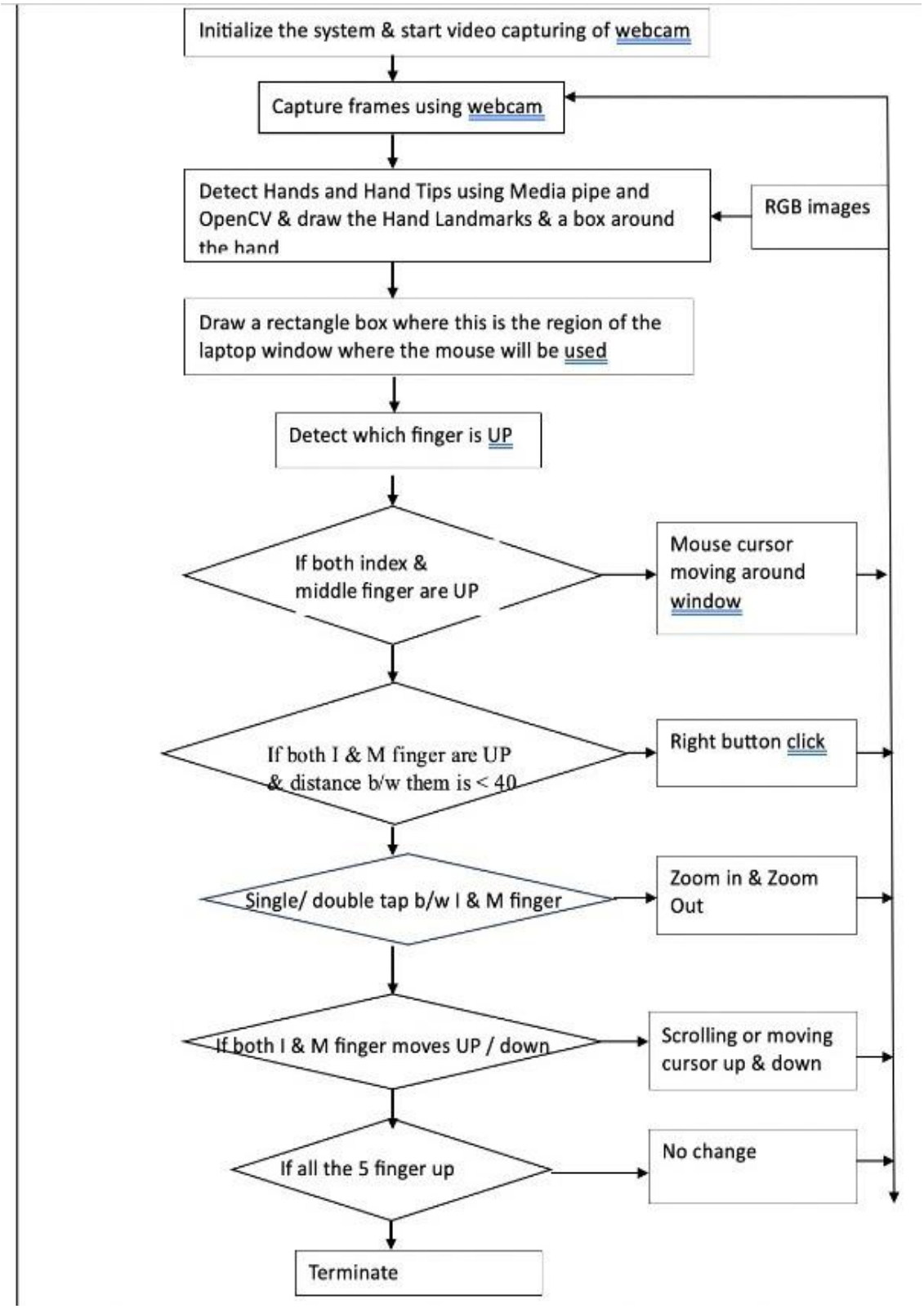


Fig.2: DFD of proposed system

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

The camera used in POSE DETECTION MOUSE CONTROLLER

The proposed AI virtual mouse system is based on the frames captured by a webcam in a laptop or PC. OpenCV is used to create a video capture object and the web camera captures and passes the frames to the AI virtual system.

Capturing video and processing

It capture video frames and process from BGR to RGB colour space to find the frames in each frame.

Hand detection with connection

Detection of 21 landmark using mediapipe.

Fig.3 Detection Hand position and points

FPS: Detection of frequency at which continuous video is being captured.

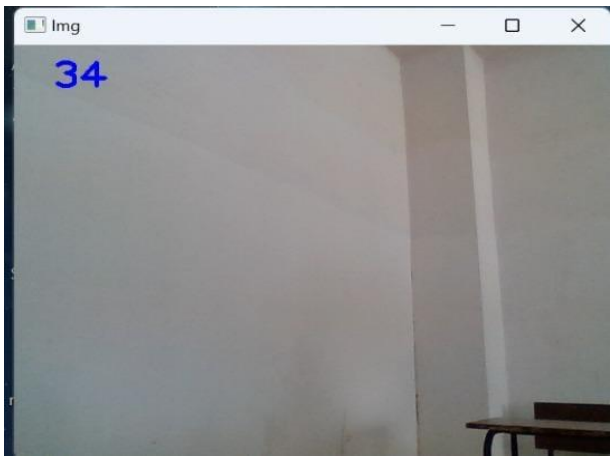


Fig.4No Any hand

Rectangular Region for Moving in window

The transformational method is used by the virtual mouse system to translate fingertip coordinates from the camera screen to the full-screen computer display. A rectangular box is created in relation to the computer window in the camera area when the hands are recognised, allowing the mouse cursor to move through the window.

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

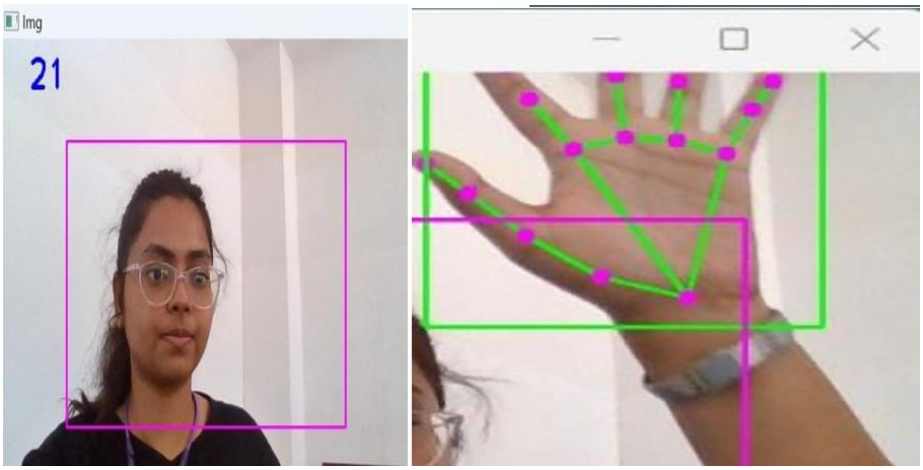


Fig.5 Face detection and finger points detection

Detect which finger is UP

Detect which finger is up by using the tip ID of the fingers found using mediapipe.

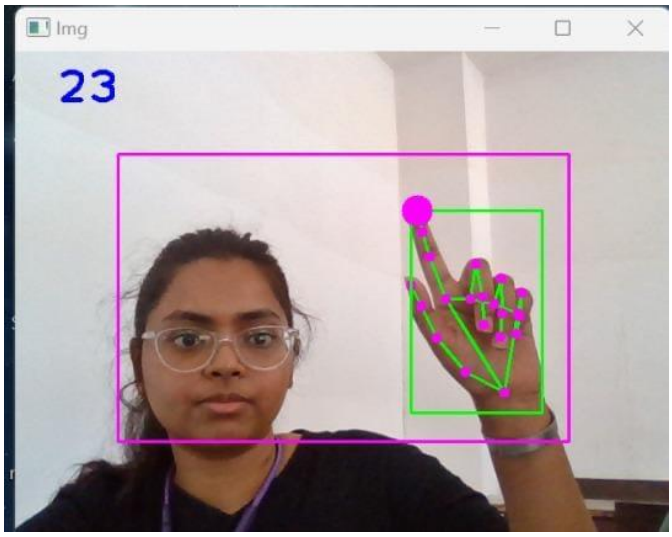


Fig.6 Face and Index finger detection

Mouse to capture Right Button click

The right mouse button clicks if both the index finger and middle finger are up and the distance between them is less than 40px. The pynput Python package is used.

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

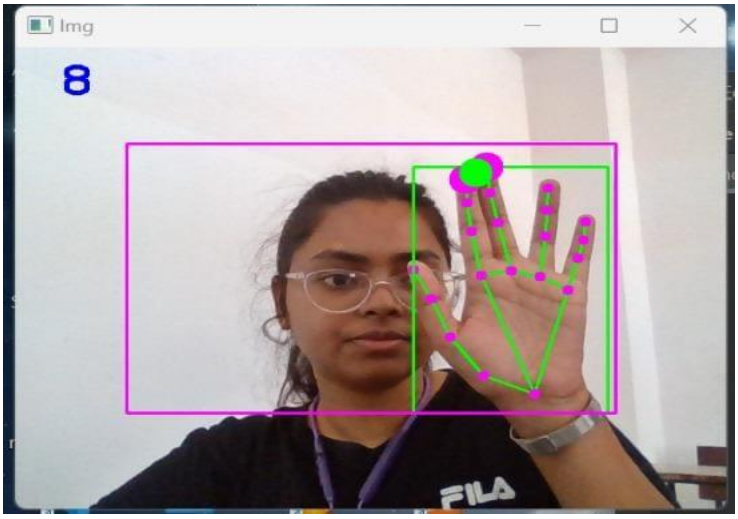


Fig.7: Mouse to capture Right Button click

For the Mouse to Perform Scroll up & down Function

The computer is made to perform the scroll up mouse function using the PyAutoGUI Python package.

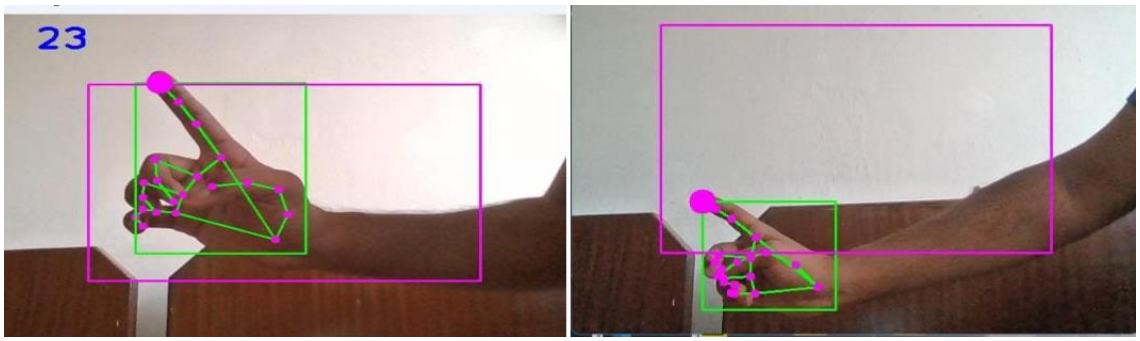


Fig.8 Index pointer detection

Action performed by opening of application on desktop open different applications functions and many more.

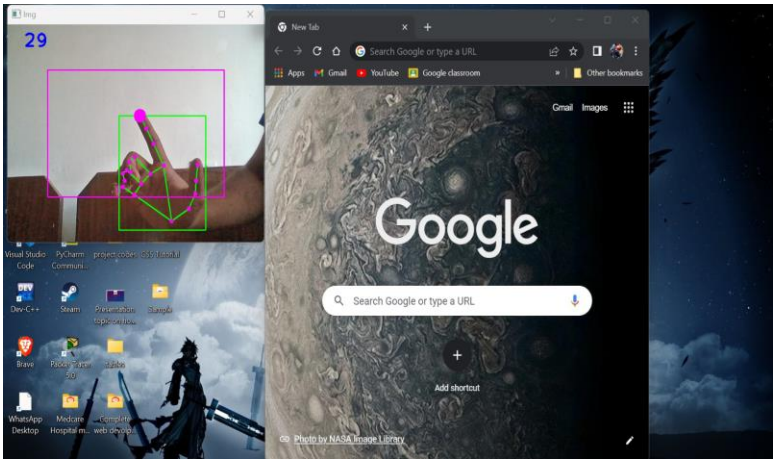


Fig.9 Use index finger as a mouse curser

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.02, I.04 (2023)
https://www.tejasjournals.com/

4. Results

The proposed virtual mouse is a concept of advancing the human-computer interaction using computer vision. 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 was made in different light conditions and at different distances from the screen. 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. It can be seen that the proposed virtual mouse system had achieved an accuracy of about 99%. From this 99% accuracy of the proposed AI virtual mouse system, we come to know that the system has performed well. As seen in Table 1, the accuracy is low for "Right Click" as this is the hardest gesture for the computer to understand. The accuracy for right click is low because the gesture used for performing the particular mouse function is harder. Also, the accuracy is very good and high for all the other gestures. Compared to previous approaches for virtual mouse, our model worked very well with 99% accuracy.

Table 1 Efficiency of Pose Detection Mouse Controller

Hand Tip Gestures	Mouse Function Performed	Success	Failure	Accuracy
Tip ID 1 or both tip IDs 1 and 2 are up	Mouse movement	100	0	100
Tip IDs 1 and 2 are up and the distance between the fingers is <40	Right Button Click	95	5	95
Tip IDs 1 and 2 are up and double click is performed once and twice	Zoom out and zoom in performed	99	1	99
All five tip IDs 0, 1, 2, 3, and 4 are up	No special action performed	100	0	100

5. Application of Pose detection Mouse controller

The AI virtual mouse system is useful for many applications, such as reducing the space for using the physical mouse and in situations where the physical mouse cannot be used. It eliminates the use of devices and improves the human-computer interaction.

1) The proposed model has a higher accuracy than other proposed models for virtual mouse, making it suitable for many applications.

2) The system can be used to control robots and automation systems without the use of devices.

3) AI virtual mouse can be used to play VR/AR games without wireless or wired mouse devices.

4) HCI systems can be used to control robots in robotics.

5) The proposed system can be used to design and architecture virtually for prototyping.

6) The proposed AI virtual mouse can be used to control PC mouse functions without using the physical mouse due to the COVID-19 situation, preventing the spread of the virus.

7) AI virtual system can be used to draw 2D and 3D images using hand gestures.

8) Persons with disabilities can use this system to control mouse functions on a computer.

6. Conclusion

The suggested AI virtual mouse technology has some drawbacks, including decreased right click precision and challenges with clicking and dragging to pick text. Future research will address these issues, and the suggested approach can be improved to virtually manage keyboard and mouse activities. Another potential area of HCI is this. These methods and models have undergone extensive development. It is possible to create a colour detection model that can recognise a certain colour in a coloured image and a mouse movement model that mimics a real mouse. To improve the performance of the models, they can be trained on CNNs. The models may be created in many ways by utilising the most recent packages, such as PyautoGUI, to issue commands that will recognise an input and carry out a task on the system. It can carry out unique functions if a distinct colour is recognised, or if a user input is detected, it will access a specified folder without any effort.

References

[1]. Chang-Yi Kaoa* and Chin-Shyurng Fahna www.elsevier.com/Iocate/procedia D9515011@mail.ntust.edu.tw, No.43, Sec.4, KeelungRd., Taipei, 106, Taiwan, R.O.C
[2]. J. Katona, "A review of human–computer interaction and virtual reality research fields in cognitive InfoCommunications," Applied Sciences, vol. 11, no. 6, p. 2646, 2021.
[3]. L. Thomas, "Virtual mouse using hand gesture," International Research Journal of Engineering and Technology (IRJET, vol. 5, no. 4, 2018.
[4]. D. L. Quam, "Gesture recognition with a Data Glove," IEEE Conference on Aerospace and Electronics, vol. 2, pp. 755–760, 1990.
[5]. K. P. Vinay, "Cursor control using hand gestures," International Journal of Critical Accounting, vol. 0975–8887, 2016.
[6]. J. T. Camillo Lugaresi, "MediaPipe: A Framework for Building Perception Pipelines," 2019
[7]. https://www.tutorialspoint.com› opencv.
[8]. https://pypi.org/project/autopy/
[9]. P. Nandhini, J. Jaya, and J. George, "Computer vision system for food quality evaluation—a review," in Proceedings of the 2013 International Conference on Current Trends in Engineering and Technology (ICCTET), pp. 85–87, Coimbatore, India, July 2013.
[10]. J. Jaya and K. Thanushkodi, "Implementation of certain system for medical image diagnosis," European Journal of Scientific Research, vol. 53, no. 4, pp. 561–567, 2011.
[11]. P. Nandhini and J. Jaya, "Image segmentation for food quality evaluation using computer vision system," International Journal of Engineering Research and Applications, vol. 4, no. 2, pp. 1–3, 2014.
[12]. V. Bazarevsky and G. R. Fan Zhang. On-Device, MediaPipe for Real-Time Hand Tracking.
[13]. K. Pulli, A. Baksheev, K. Kornyakov, and V. Eruhimov, "Realtime computer vision with openCV," Queue, vol. 10, no. 4, pp. 40–56, 2012.
[14]. D.-S. Tran, N.-H. Ho, H.-J. Yang, S.-H. Kim, and G. S. Lee, "Real-time virtual mouse system using RGB-D images and fingertip detection," Multimedia Tools and ApplicationsMultimedia Tools and Applications, vol. 80, no. 7, pp. 10473–10490, 2021.
[15]. A. Haria, A. Subramanian, N. Asokkumar, S. Poddar, and J. S. Nayak, "Hand gesture recognition for human computer interaction," Procedia Computer Science, vol. 115, pp. 367–374, 2017.
[16]. K. H. Shibly, S. Kumar Dey, M. A. Islam, and S. Iftekhar Showrav, "Design and development of hand gesture based virtual mouse," in Proceedings of the 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), pp. 1–5, Dhaka, Bangladesh, May 2019.
[17]. Verma, S. B., & Saravanan, C. (2018, September). Performance analysis of various fusion methods in multimodal biometric. In 2018 International Conference on Computational and Characterization Techniques in Engineering & Sciences (CCTES) (pp. 5–8). IEEE.

[18]. Satya Bhushan Verma, Abhay Kumar Yadav, Detection of Hard Exudates in Retinopathy Images ADCAIJ: Advances in Distributed Computing and Artificial Intelligence Journal Regular Issue, Vol. 8 N. 4 (2019), 41-48 eISSN: 2255-2863 DOI: http://dx.doi.org/10.14201/ADCAIJ2019844148

[19]. Verma, S.B., Yadav, A.K. (2021). Hard Exudates Detection: A Review., Emerging Technologies in Data Mining and Information Security. Advances in Intelligent Systems and Computing, vol 1286. Springer, Singapore. https://doi.org/10.1007/978-981-15-9927-9_12

[20]. Satya Bhushan Verma, Shashi Bhushan Verma, Data Transmission in BPEL (Business Process Execution Language), ADCAIJ: Advances in Distributed Computing and Artificial Intelligence Journal Regular Issue, Vol. 9 N. 3 (2020), 105-117 eISSN: 2255-2863 DOI: https://doi.org/10.14201/ADCAIJ202093105117 105

[21]. Verma, S. et al. 2019. Contactless palmprint verification system using 2-D Gabor filter and principal component analysis. The International Arab Journal of Information Technology.16(1), pp-23–

[22]. Chandran, S., Verma, S.B.: Touchless palmprint verification using shock filter SIFT I-RANSAC and LPD IOSR. J. Comput. Eng. 17(3), 2278–8727 (2015)

[23]. Satya Bhushan Verma, Brijesh Pandey, and Bineet Kumar Gupta, Containerization and its Architectures:A Study, ADCAIJ: Advances in Distributed Computing and Artificial Intelligence Journal, Vol. 11 N. 4 (2022), 395-409, eISSN: 2255-2863, DOI: https://doi.org/10.14201/adcaij.28351

[24].