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# VIRTUAL PALM POINTER MOUSE FOR TOUCHLESS SYSTEMS

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**Abstract:** ´The system's development involves the collection and preprocessing of data, the selection and training of an ML algorithm, and the implementation of object detection for hand or palm recognition. The model predicts movement based on changes in palm position, allowing for seamless mouse pointer control. The system also includes an integration with the operating system to translate these movements into actual mouse pointer actions. This innovative approach presents an intuitive and hands-free method for computer interaction, potentially benefiting users with physical impairments or those seeking more natural and immersive computing experiences. The system utilizes ML algorithms to track and interpret the movements of a user's hand or palm, enabling precise control of a computer mouse pointer. The virtual palm pointer mouse addresses accessibility challenges by offering an intuitive and hands-free interface, abbreviating the reliance on traditional input contrivances. The system has the potential to benefit users with motor disabilities, ergonomic predilections, or those seeking a more natural and fluid interaction with digital interfaces.

**Keywords:** smart browsing, hand gesture recognition, computer vision, image recognition, virtual mouse.

## I. INTRODUCTION

Utilizing machine learning, a virtual palm pointer mouse is an innovative approach that leverages machine learning algorithms to interpret and respond to hand gestures, categorically those made with an open palm, to control a virtual mouse cursor on a computer screen.

This technology aims to provide a more intuitive and natural way of interacting with digital interfaces, eliminating the desideratum for traditional physical input contrivances like a mouse or touchpad. This project aims to involve the concept of Computer Vision, Gesture Apperception, Hand Tracking Virtual Mouse Control, etc. Implementing a virtual palm pointer mouse utilizing machine learning can enhance accessibility and utilizer experience, especially for individuals with mobility challenges or those seeking alternative input methods. As technology advances, we can expect further refinements and applications of such innovative human-computer interaction systems.

The field of human-computer interaction (HCI) has witnessed significant advancements, with a particular focus on developing more intuitive and natural interfaces. One such innovation is the Virtual Palm Pointer Mouse (VPPM), a machine learning-based system that enables users to control a computer cursor using only their hand movements without requiring a physical mouse or touchpad.

The Virtual Palm Pointer Mouse project involves the use of a virtual painter, which is a software tool that simulates the behaviour of a physical paintbrush or drawing tool. This virtual painter allows users to interact with digital interfaces using hand gestures and movements, similar to how one would use a physical paintbrush.

## II. LITERATURE SURVEY

1. ***V. K. Puthukkeril et al.* 1,** An incipient system is developed that takes human gestures into consideration to perform the corresponding operation on the computer contrivance. Hand Gesture Mouse Interface is developed to capture the hand gesture from the utilizer through a web camera.

2. ***Pooja S Kumari Verma et al. 2***, In this project hand gestures to interact with the mouse and keyboard. Eventually, get rid of the electronics. Consequently, use a virtual keyboard and your finger to move the mouse cursor. Using different hand gestures, actions like clicking, dragging, and typing data will be carried out.

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3. ***Shashank Kathar et al. 3,*** This study presents a method for controlling the cursor's position without the need of any electronic equipment. While actions such as clicking and dragging things will be carried out using various hand gestures.

4. ***K. Bharath Reddy et al. 4,*** This proposed system uses the in-built camera or a peripheral web camera for capturing hand movements and finger-tip detection that can perform traditional mouse functions like left-clicking, right-clicking, scrolling and cursor functions. The algorithm is machine learning based. Using deep learning, the algorithm is trained so that hands can be detected using the camera.

5. ***A. Baheti, D. Patwa and S. Gajjar et al.* 5,** The authors presented an Artificial Perspicacity- a predicated virtual mouse that detects or receives hand gestures to control the sundry functions of a personal computer. The virtual mouse Algorithm utilizes a webcam or a built-in camera of the system to capture hand gestures, then utilizes an algorithm to detect the palm boundaries kindred to that of the face detection model of the media pipe face mesh algorithm. After tracing the palm boundaries, it utilizes a regression model and locates the 21-3D hand-knuckle coordinate points inside the apperceived hand/palm boundaries. Once the Hand Landmarks are detected, they are habituated to call Windows Application Programming Interface (API) functions to control the functionalities of the system. The proposed algorithm is tested for volume control and cursor control in a laptop with the Windows operating system and a webcam. The proposed system took only 1 ms to identify the gestures and control the volume and cursor in authentic time.

6. ***Y. Zhao, X. Ren et al.* 6,** In this paper, the authors proposed a portable ring-type wireless mouse scheme predicated on IMU sensors and a multi-level decision algorithm. The utilizer only needs to operate in the air with an astute ring worn on the middle finger of their right hand to realize the interactive function of a mouse. The keenly intellective ring first captures vicissitudes in the finger's posture angle to reflect how the cursor position changes. And it captures the expeditious rotation of the user's palm to the left and right to achieve mouse clicking. In additament, a multi-level decision algorithm is developed to amend the replication speed and apperception precision of the virtual mouse. The experimental results show that the virtual mouse has a target cull precision of over 96%, which proves its practicability in authentic-world applications. This virtual mouse is expected to be utilized as a portable and reliable implement for multi-scenario human-computer interaction applications in the future.

7. **K. H. Shibly, S. Kumar Dey *et al.* 7**, This paper proposes a virtual mouse system predicated on HCI utilizing computer vision and hand gestures. Gestures captured with a built-in camera or webcam and processed with color segmentation & detection technique. The utilizer will be sanctioned to control some of the computer cursor functions with their hands which bear-coloured caps on fingertips. Primarily, a utilizer can perform left clicks, right clicks, and double clicks, scrolling up or down utilizing their hand in different gestures. This system captures frames utilizing a webcam or built-in cam and processes the frames to make them track-able and after that apperceives different gestures made by users and perform the mouse function. So, the proposed mouse system eliminates contrivance dependency in order to utilize a mouse. Ergo it can be proved salutary to develop HCI technology.

8. ***S. Shriram et al.* 8,** In the proposed AI virtual mouse system, this circumscription can be overcome by employing a webcam or a built-in camera for capturing hand gestures and hand tip detection utilizing computer vision. The algorithm utilized in the system makes utilization of the machine learning algorithm. Predicated on hand gestures, the computer can be controlled virtually and perform left-click, right-click, scrolling, and computer cursor functions without utilizing the physical mouse. The algorithm is predicated on deep learning for detecting the hands. Hence, the proposed system will evade COVID-19 spread by eliminating human intervention and dependency on contrivances to control the computer.

9. ***Aabha Waichal et al.* 9,** In this project, the authors have proposed an efficient way of controlling the mouse virtually utilizing the genuine-time camera. We have proposed operations like mouse navigation, clicking, scrolling (up and down), zoom in and out. Their approach is capturing the live aliment, subtracting the background, and passing it to the CNN model. CNN model gives highly precise results. By utilizing background subtraction, they can additionally provide good results in involute backgrounds. This technique can be implemented in sundry systems like gaming, detection of designation language, and communication. This type of system can additionally be implemented with an accentuation on kineticism of ocular perceivers which can be salutary for patients suffering from paralysis.

10. ***R. Annachhatre, M. Tamakuwala et al. 10,*** However, this technology is currently too expensive to be employed on desktop computers. As an alternative to the touch screen, a virtualized human-computer interface gadget like a mouse can be developed using a camera and some computer vision algorithms. A virtual mouse application based on finger tracking has been conceived utilizing a normal webcam in this study.

  

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The goal was to construct a virtual human-computer interface device and an object tracking program to interact with the computer. To achieve this goal, we will be using the openCV2 library along with the Media pipe Palm Detection Model and Hand Landmark Model..

11. ***S. Srivastava, R. Tiwari et al. 11,*** Using a physical mouse is a popular way to interact with a computer but is limited by the reliance on external devices such as batteries and dongles. In this paper, an artificial intelligence based virtual mouse system that enables device-free computer control using computer vision and machine learning technology has been proposed. The system detects hand gestures and hand gestures through a built-in webcam or camera and uses machine learning algorithms to interpret these gestures into computer actions such as clicking left, clicking right, scrolling up-down, and movement of cursor. This algorithm is based on deep learning techniques for hand recognition, eliminating the reliance on human intervention and physical devices. The results proposed system achieves accuracy and speed comparable to physical mice.

12. ***M. Raja., P. Nagaraj et al. 12,*** The Gesture Controlled Virtual Mouse makes it simple to communicate with a computer using voice commands and hand gestures. The computer requires almost little direct physical contact. All input and output processes might potentially be managed digitally by combining voice instructions with both static and dynamic hand gestures. This study employs state-of-the-art Machine Learning (ML) and Computer Vision (CV) algorithms to recognize hand gestures and verbal commands, and it works without the usage of any additional hardware. It takes use of CNN-like models by utilizing Media Pipe, which is based on pybind11. It has two modules: one that operates directly on hands using media pipe. Hand detection, and the other that makes use of gloves of any consistent colour.

13. ***A. Julian, D. Suresh et al. 13,*** The mouse has been a vital tool for human-computer interaction, with wired, wireless, and Bluetooth variations requiring power to connect a dongle to a PC. The proposed work uses the latest technology in computer vision and machine learning to recognize hand movements without needing extra equipment. Compatible with CNN models through media pipe implementation, it enables various actions via various hand movements, all on a single computer. Utilizing a camera as the input device, the system relies on Python and OpenCV. The camera's output is displayed on the system's screen, allowing users to fine-tune their interactions.

14. ***R. Dudhapachare, M. Awatade et al. 14,*** The mouse is a prime example of HCI advancement. Although the modern wireless mouse or Bluetooth mouse still requires peripherals like energy cells and cards to connect to the computer, it is not entirely peripheral- free. The suggested AI virtual mouse system addresses the aforementioned issues by capturing hand motions with an external or digital camera, then improving the system's accuracy using voice assistants and hand point detection through object recognition. The system's foundation consists of machine learning techniques. To operate a computer, navigate, and execute actions like left- and right-clicking, digital hand motion can be used instead of a physical mouse. The program employs machine learning for hand identification and Python modules, for voice assistance.
15. ***K. S, D. M, J. D. Raj C et al. 15,*** A hand gesture-controlled virtual mouse system that utilizes AI algorithms to recognize hand gestures and translate them into mouse movements is proposed in this paper. The proposed system uses a camera to capture images of the user's hand, which are processed by an AI algorithm to recognize the gestures being made. All the input operations can be virtually controlled by using dynamic/static hand gestures along with a voice assistant. In our work we make use of ML and Computer Vision algorithms to recognize hand gestures and voice commands, which works without any additional hardware requirements.

## III. METHODOLOGY

In today's digital age, human-computer interaction is predominantly reliant on traditional input contrivances like mice and touchpads. While these input methods have accommodated us well, they are not ecumenically accessible and can lead to perpetual strain injuries and discomfort for users.

The quandary at hand is the desideratum for a more intuitive, hands-free, and accessible denotes of controlling a computer's mouse pointer. This quandary verbalization seeks to address the challenges associated with the development of a Virtual Palm Pointer Mouse utilizing Machine Learning (ML) techniques.

**Features:**

**Gesture Recognition:** Virtual palm pointer mice often utilize gesture recognition technology to interpret hand movements and gestures as mouse commands. This allows users to control the cursor on the screen by moving their hand in the air.

  

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**Customization:** Depending on the specific device and software, users may be able to customize the sensitivity, gestures, and other settings of the virtual palm pointer mouse to suit their preferences and needs.

**Gesture Customization:** Virtual palm pointer allows gesture customization. Using gesture customization user customize their shortcut by their need. Gesture customization Enhanced Productivity, Enhanced Productivity, User Engagement and Satisfaction, Innovation and Creativity.

**Hold-and-Drag:** Holding your hand in a specific position and then moving it across the screen can simulate dragging and dropping objects. This gesture is useful for rearranging items or files in a graphical user interface.

**Scrolling and Zooming:** Some virtual palm pointer mice support scrolling and zooming functionalities, allowing users to navigate through content on the screen or zoom in and out of documents or images.

**Implementation:**

➔ Creating a virtual palm pointer mouse using machine learning (ML) involves a combination of hardware and software components to enable the tracking and control of the mouse cursor using a user's hand or palm gestures.

➔ The mouse or pointer moves in response to the movements made by the hand being analyzed by the computer's camera, including performing right and left clicks with various gestures. It will function as an electronic mouse and keyboard without the need for cables or other accessories.

➔ The model recommends identifying the human hand and following its motions. The mouse can be used in a number of different ways by making movements like pointing and touching the tips of your fingers, zooming in and out etc.

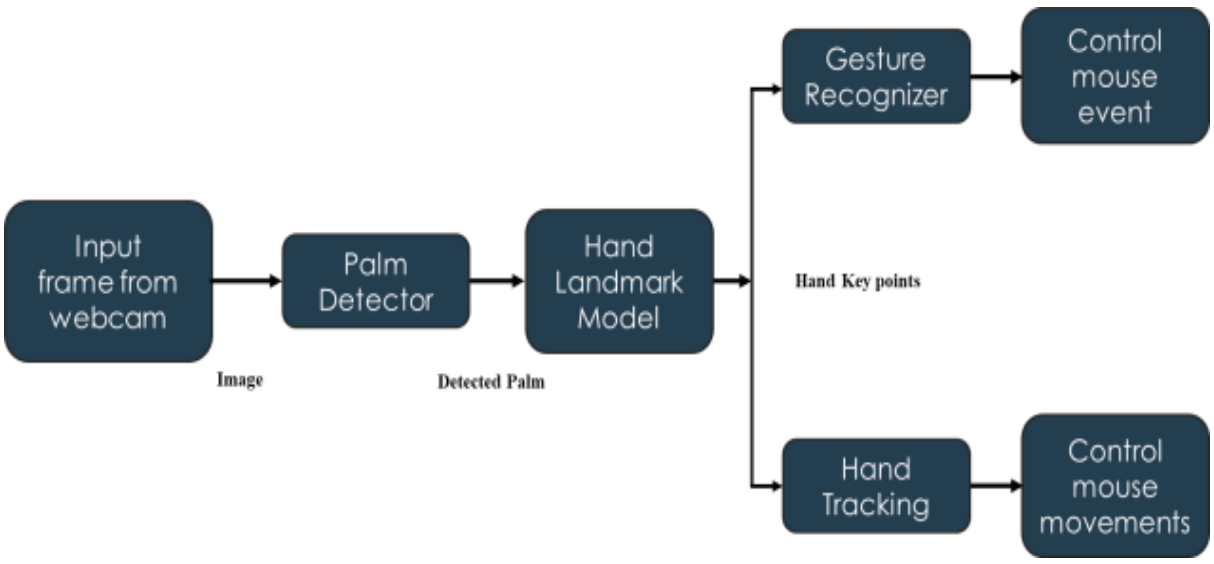


Figure 3.1 Block Diagram

Implementing a virtual palm pointer mouse using machine learning (ML) involves a step-by-step process.

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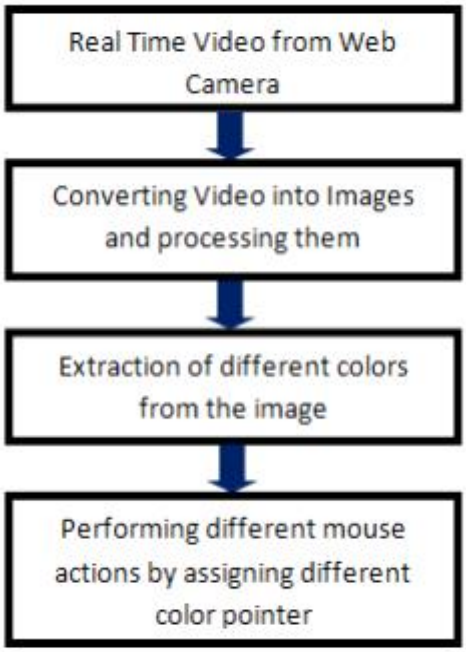


Figure 3.2 Flow Diagram

**1. Hardware Setup:**
Set up a depth-sensing camera (e.g., Intel RealSense, Microsoft Kinect) and connect it to the computer. Ensure that the camera is positioned to capture the hand movements accurately.

**2. Software Setup:**
Install the necessary software and libraries on your computer, such as Python, OpenCV, and machine learning frameworks (e.g., TensorFlow, PyTorch).

**3. Data Collection:**
Collect a dataset of hand and palm movements along with their corresponding cursor movements. This dataset will be used to train the ML model. One can do this by recording video data of your hand movements and manually annotating the cursor positions.

**4. Preprocessing:**
Preprocess the collected data to extract relevant features and format it for training. We may need to convert depth images into suitable formats for input to your ML model.

**5. Machine Learning Model:**
Choose or design an ML model for hand tracking and gesture recognition. We may want to consider Convolutional Neural Networks (CNNs) for image-based hand tracking and recurrent neural networks (RNNs) for gesture recognition.

**6. Training:**
Train your ML model using the pre-processed dataset. Train the model to predict cursor positions based on the captured hand movements and gestures. We'll need to split your dataset into training and validation sets to monitor the model's performance.

**7. Testing:**
Evaluate the trained model's performance on a separate test dataset to ensure it can accurately predict cursor movements based on hand gestures.

**8. Real-time Inference:**
Implement real-time hand tracking and gesture recognition using the trained ML model. The depth data from the camera should be processed in real-time, and the model should predict cursor positions accordingly.

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**9. Cursor Control:**
Implement the logic to control the mouse cursor based on the predictions from the ML model. This may involve emulating mouse events, such as moving the cursor, left-click, right-click, and scrolling.

**10. User Interface:**
Creating a user interface that displays the detected hand or palm and the cursor movement. This interface will provide feedback to the user and allow them to interact with the virtual palm pointer mouse system.

## IV. RESULTS

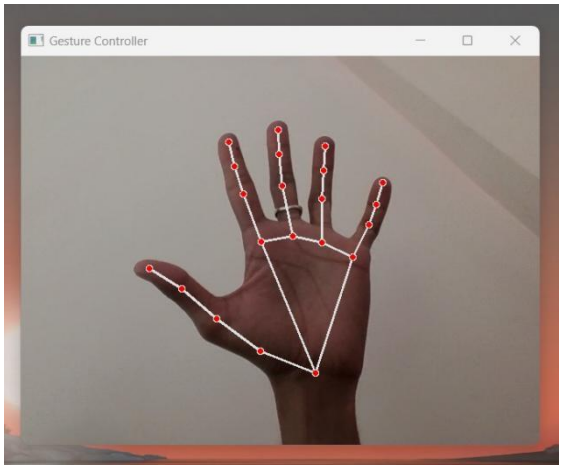


Figure 4.1 Result Image 1

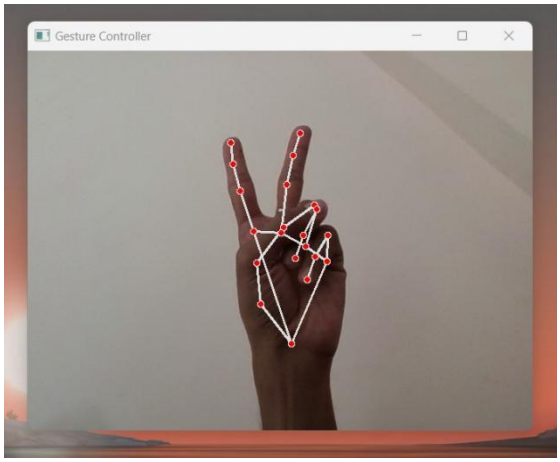


Figure 4.2 Result Image 2

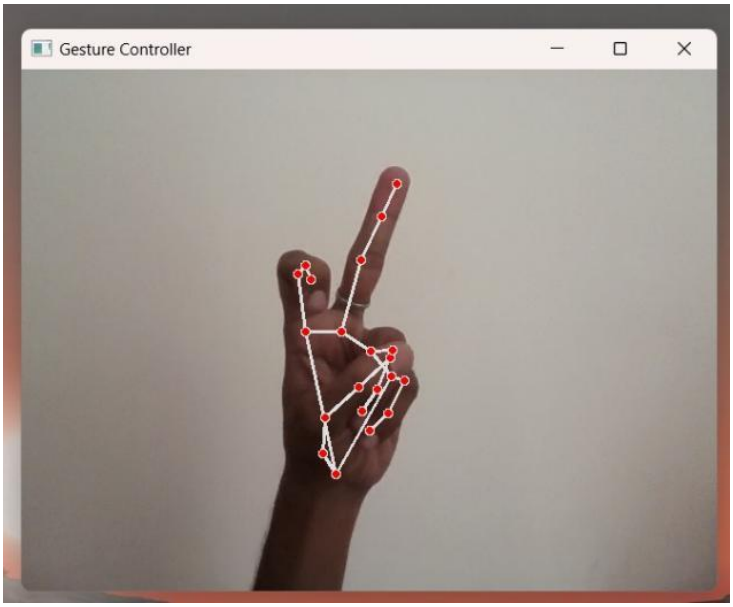


Figure 4.3 Result Image 3

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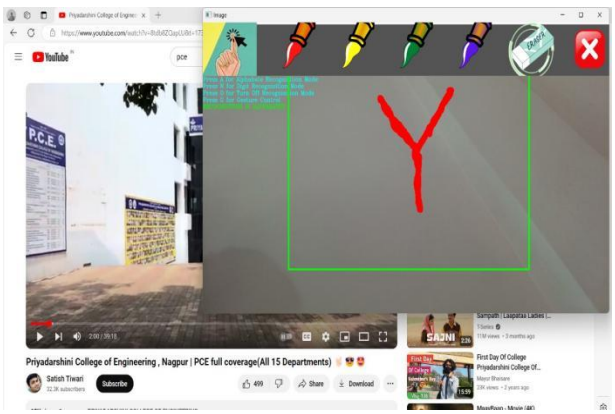

Figure 4.4 Final Result Image 1

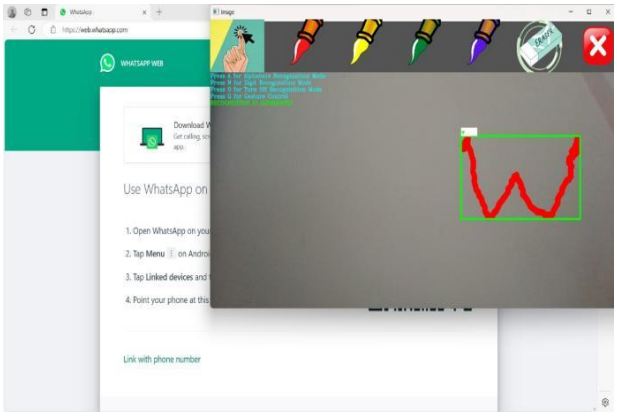

Figure 4.5 Final Result Image 2

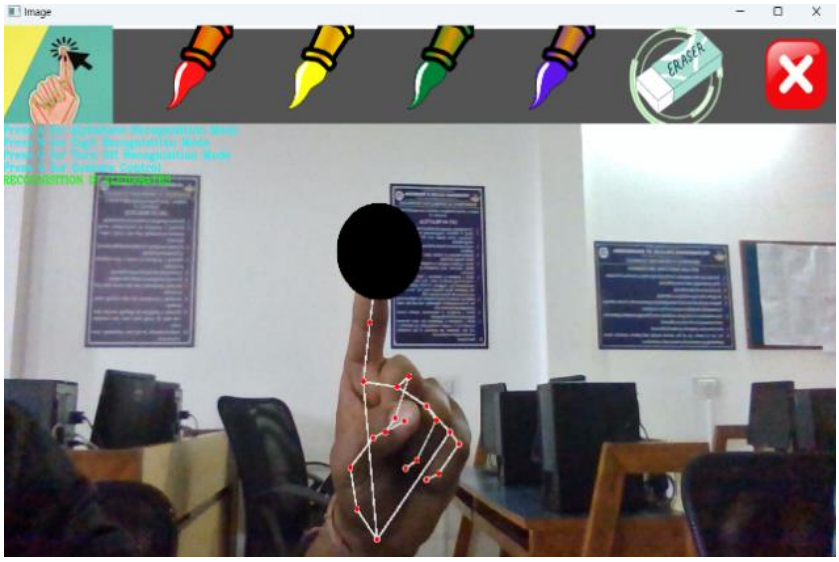


Figure 4.6 Final Result Image 3

Implementing a virtual palm pointer mouse using machine learning can result in several benefits and outcomes, both in terms of user experience and technological advancements.

## V. SYSTEM APPROACH

- Capturing real-time video using Web-Camera.
- Processing the individual image frame.
- Flipping of each image frame.
- Conversion of each frame to a greyscale image.
- Color detection and extraction of the different colours.
- (RGB) from the flipped grayscale image.
- Conversion of the detected image into an RGB to HSV colour format.
- Finding the region of the image and calculating its centroid.
- Tracking the mouse pointer using the coordinates obtained from the centroid.
- Simulating the left click and the right click events of the mouse by assigning different colour pointers.

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- Simulating the left click and the right click events of the mouse by assigning different colour pointers.

## VI. CONCLUSION

The proposed system is utilized to control the mouse cursor and implement its function utilizing an authentic-time camera. We implemented mouse kineticism, cull of the icons and its functions like right, left, double click, and scrolling. This system is predicated on image comparison and kineticism detection technology to do mouse pointer forms of kineticism and cull of icons. From the results, we can expect that if the algorithms can work in all environments, then our system will work more efficiently. This system could be utilizable in presentations and to truncate workspace. In the future, we plan to integrate more features such as enlarging and shrinking windows, closing windows, etc. by utilizing the palm and multiple fingers.

## VII. FUTURE SCOPE

Future systems may incorporate artificial perspicacity to habituate and learn from users' demean or over time. This could result in personalized gesture apperception models that better suit individual users' predilections and habits. Withal, the systems may evolve to fortify multi-modal interaction, amalgamating hand gestures with voice commands or other input methods for a more comprehensive and natural utilizer experience.

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