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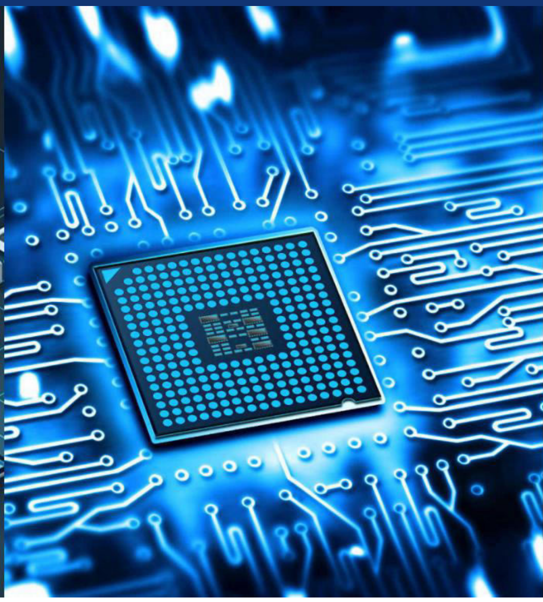


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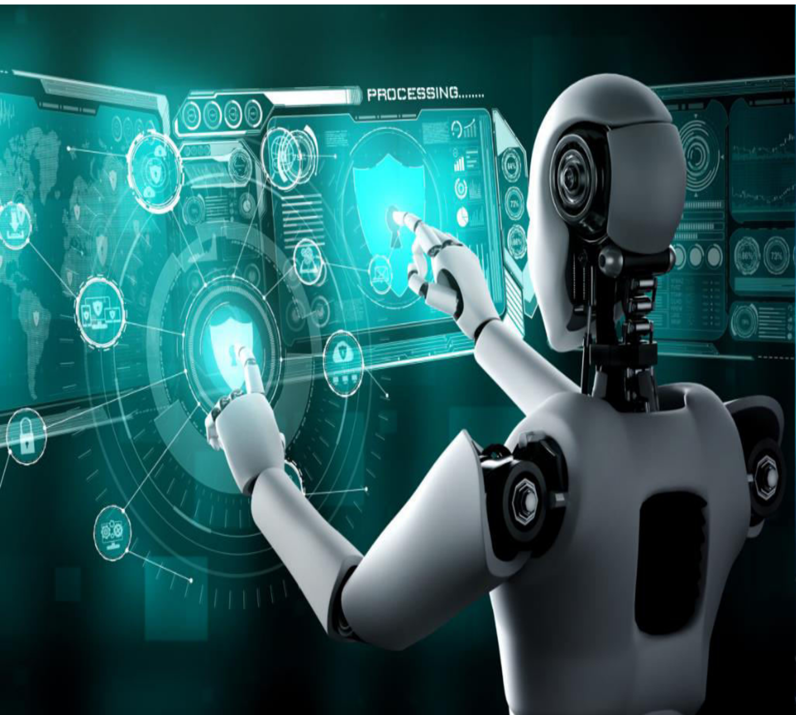

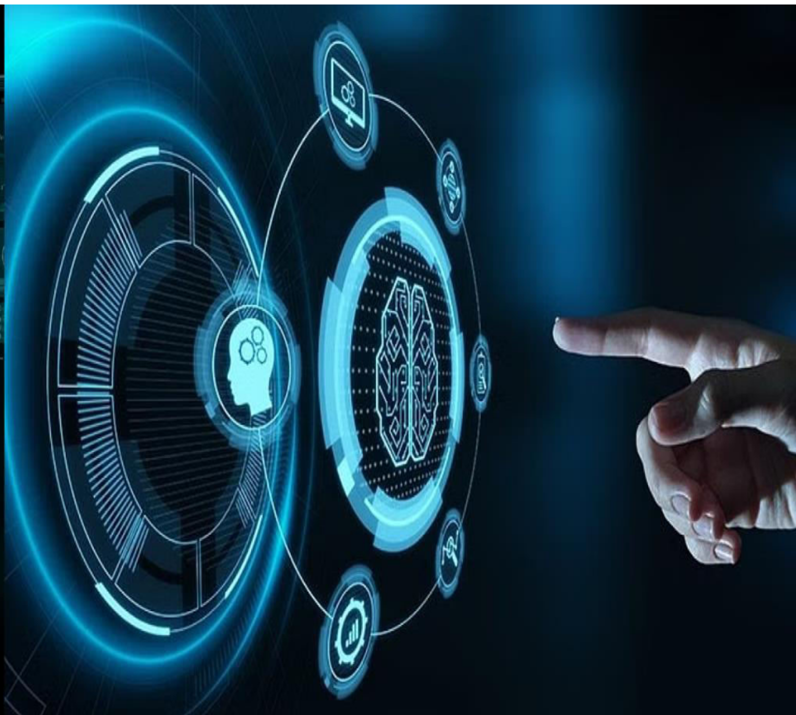

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Virtual Sketchpad using Hand Gesture

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ABSTRACT: In order to allow users to draw on a virtual whiteboard without making physical contact, the "Virtual Sketch Through Hand Gestures" project investigates the combination of computer vision and gesture recognition technologies. The system precisely recognizes and tracks hand movements using OpenCV, Media Pipe, and NumPy in Python, converting them into commands for real-time painting. By providing an easy-to-use, touch-free interface, the initiative seeks to improve online cooperation and artistic expression. However, the accuracy of the camera's hand tip detection determines how effective it is.

KEYWORDS: OpenCV, Media Pipe, Python, Hand Gesture Recognition, Online Collaboration, Color Selection, Eraser Tool, and Virtual Whiteboard

I. INTRODUCTION

More user-friendly and engaging human-computer interaction systems have been created in recent years as a result of developments in computer vision and artificial intelligence. A ground-breaking method that enables people to engage with digital environments naturally and without the use of touch is hand gesture recognition. Virtual sketching, where users may write and draw on a digital whiteboard with just their hand motions, is one exciting use case for this technology.

Conventional digital drawing techniques depend on hardware like a mouse, stylus, or touchscreen, which can limit user experience, accessibility, and flexibility. These restrictions are addressed by the suggested "Virtual Sketch Through Hand Gestures" system, which uses real-time hand tracking to enable freehand drawing. This system records and interprets hand movements using OpenCV, MediaPipe, and NumPy, converting them into accurate strokes on a virtual whiteboard.

This novel strategy has important ramifications for interactive learning, creative expression, and online cooperation. A system that lets users easily convey their thoughts without the need for extra gear can be very helpful for virtual meetings, educational platforms, and artistic applications. Simple movements can be used to switch between colors and tools, which improves the system's usability and makes it a good substitute for conventional input devices.
The design, implementation, and possible uses of the virtual sketching system are all thoroughly examined in this study.

The system architecture, methodology, experimental findings, and upcoming improvements targeted at enhancing gesture detection accuracy and broadening its applicability across other domains are covered in the parts that follow.

OVERVIEW OF THE SYSTEM

The Virtual Sketch Through Hand Gestures technology uses computer vision and AI-based hand tracking to offer a novel approach to touch-free digital drawing. In order to function, the system records live footage from a webcam, recognizes hand gestures in real time, and converts them into commands for sketching on a virtual whiteboard. This method provides a more natural and engaging user experience by doing away with the requirement for conventional input devices like a mouse, stylus, or touchscreen
The following are the main parts of the system:

Camera Input: To record the user's hand movements in real time, the system needs a webcam. Drawing actions and gesture recognition are based on this input.

Hand Detection: The hand-tracking technology from MediaPipe recognizes hand landmarks, such as the locations of the fingertips, and uses these to decipher various movements.
Drawing Interface: The identified hand movements are processed by OpenCV and NumPy, which then produce drawings on a virtual whiteboard. A variety of drawing tools are supported by the system, such as shape selection, erasing, and freehand sketching.
Color and Eraser Selection: The system's creative versatility is increased by allowing users to select between several colors and use pre-programmed hand movements to activate the eraser tool.
Real-Time Processing: As the user draws or erases on the virtual canvas, the system guarantees seamless interaction with low latency and gives them instant feedback.
In creative applications, virtual classrooms, and online collaboration, where users can visually express ideas without physical limitations, this technology is especially helpful. The solution enhances accessibility and enables people to engage with digital information in a natural way by combining gesture detection and artificial intelligence.

EXISTING SYSYTEM

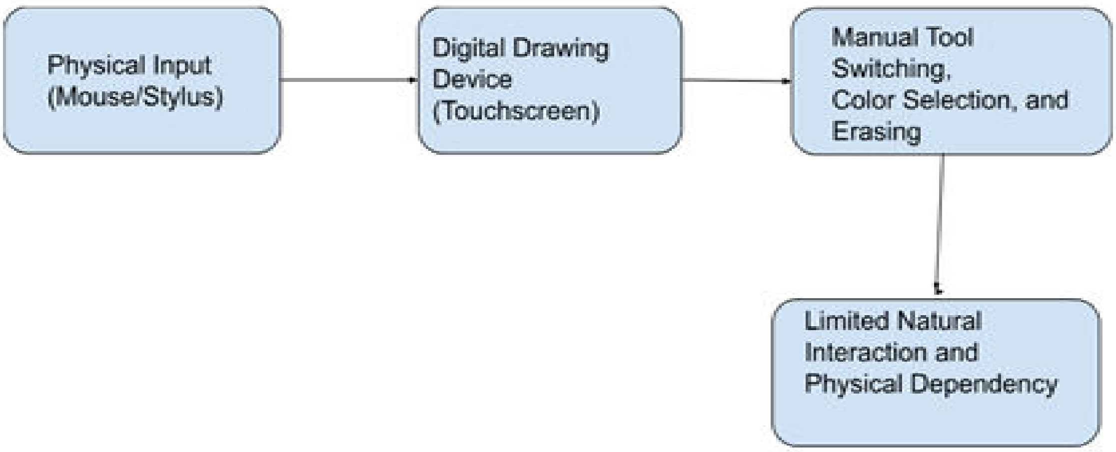

Fig.3.1. Existing System

Conventional digital writing and sketching depend on tangible input tools like a stylus, mouse, or touchscreen. Despite their effectiveness, these techniques have a number of drawbacks:
Limited Natural Interaction: Because users are dependent on external hardware, their ability to be creative freely may be limited.
Physical Dependency: Compared to gesture-based interactions, physical dependence is less natural because it requires direct contact with a device.

Accessibility Challenges: Using traditional input devices may be challenging for people with disabilities or mobility concerns.
The creation of a gesture-based virtual whiteboard that fosters creativity and distant collaboration is the result of these limitations, which emphasize the need for a more organic, touch-free, and interactive method of digital sketching.

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PROPOSED SYSTEM

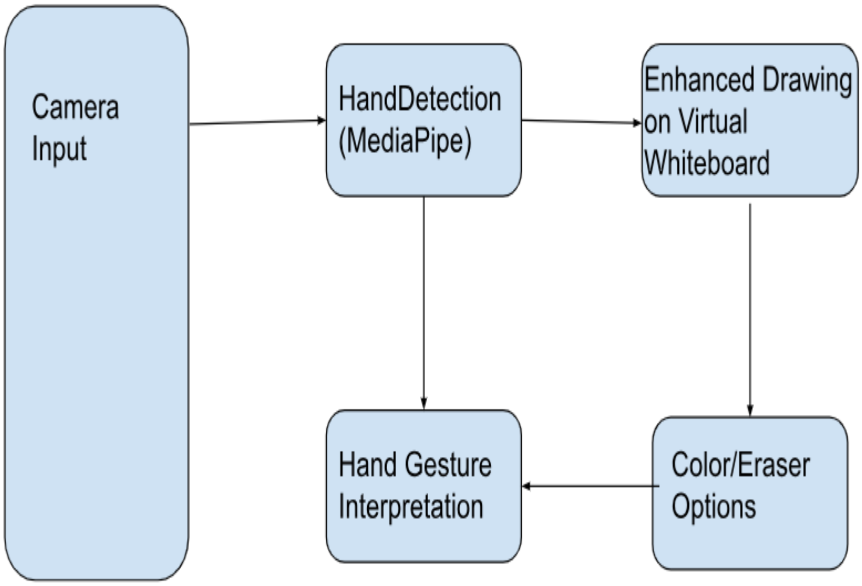

Fig.4.1. Proposed System

By introducing a gesture-based virtual whiteboard, the suggested system does away with the necessity for conventional input devices like a mouse or touchscreen and enables users to write, draw, and express ideas using hand movements. This device uses AI-based hand tracking and computer vision to deliver a seamless and user-friendly experience.
Important attributes:
Hand Gesture Recognition: Tracks and interprets hand movements using MediaPipe.
A digital canvas that allows users to freely write and draw is called a virtual whiteboard.
Color Selection & Eraser: Enables users to utilize gestures to change colors and remove material.
Real-time processing guarantees quick, seamless interaction with low latency.
No Physical Contact Needed: This makes it more accessible and user-friendly by doing away with the requirement for extra hardware.
Boosts Creativity & Collaboration: Perfect for remote learning, online meetings, and creating digital art.

BENEFITS

Cost-effective: Lowers the system's cost by eliminating the requirement for specialized hardware.
No Wear and Tear: Increases system longevity by removing the physical wear and tear that comes with conventional input devices.
Hygienic: Prevents the spread of germs by minimizing physical touch.
Adaptability: Improves device compatibility by effortlessly adjusting to various screen sizes and resolutions.
Interactive Learning: Facilitates interactive learning by offering an entertaining educational tool.
Less Physical Fatigue: Provides a more comfortable and ergonomic means of interaction, which lessens physical strain.
Motions That Can Be Customized: This feature lets users alter hand motions to fit their own tastes.
Remote Control: Provides convenient remote control of digital content using gestures.
Integration with Other Programs: For improved functionality, it may be integrated with other programs.
Creative Cooperation: Promotes creative cooperation by enabling simultaneous interaction between several users.

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II. METHODOLY

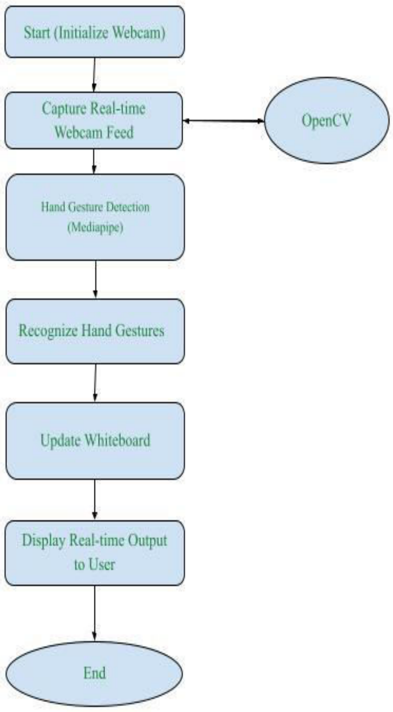

Fig.5.1. Flow Diagram of Methodology

1. Start (Initialize Webcam): Video recording starts after the webcam is initialized. The camera stream is continuouslycaptured by the system.
2. Capture Real-time Webcam Feed: OpenCV is used to process the webcam's video feed frame by frame.
3. Mediapipe's Hand Gesture Detection: Mediapipe tracks the user's hand's important landmarks, including the palm and fingertips. After that, this data is forwarded to the following stage for gesture recognition.
4. Identify Hand Gestures: The system recognizes hand gestures like sketching, erasing, changing color, selecting a tool (pen or eraser), and adjusting pen size based on the locations of hand landmarks. These movements are mapped by the system to particular actions that alter the content displayed on the whiteboard.

5. Update Whiteboard (Drawing, Erase, Color Change, Pen Size, Whiteboard Reset):
• The system updates the whiteboard in accordance with the gesture it detects (for example, fist = draw, open hand = erase, pinch = pen size change, and wave both hands = clear whiteboard).
• Using hand gestures, the user can change the pen's size, change colors, and switch between tools.
6. Show User Real-time Output: • The user is shown the updated content in real-time. The user's actions, such as sketching or erasing, are instantly visible on the whiteboard.
7. End (Loop Continues Until Exit): Until the user chooses to close the application, the system keeps analyzing video frames and identifying motions.

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III. IMPLEMENTATION

System Architecture

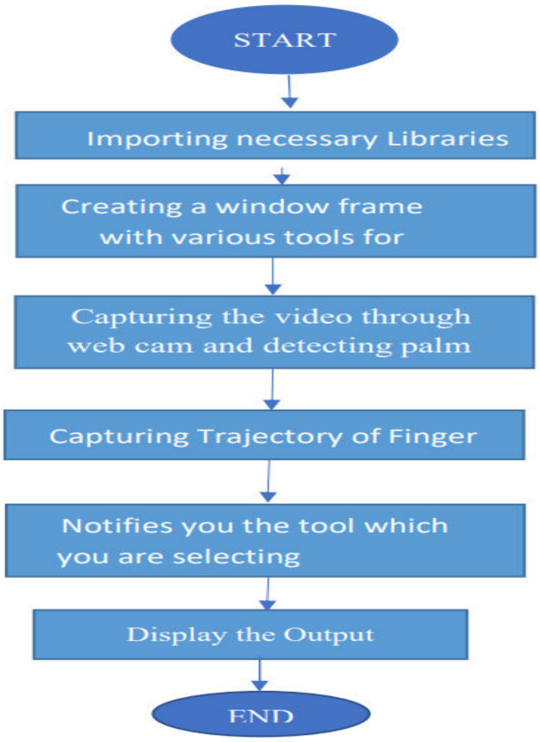

Fig. 6.1. Architecture Diagram

The system's components, such as the webcam for hand movement capture, the Mediapipe and OpenCV libraries for gesture processing, and the whiteboard interface for drawing display, are summarized in the architecture diagram. The architecture demonstrates how the user and system components interact.

The Process of Implementing a hand gesture-based virtual whiteboard system. First, the required libraries—OpenCV, Mediapipe, and NumPy—that are required for image processing and hand tracking are imported. Then, to make the drawing process easier, a window frame is made using a variety of tools, including a whiteboard, an eraser, and color selection.Real-time hand tracking is therefore made possible by the system's ability to detect the palm of the user's hand while recording footage via a webcam. Following the detection of the palm, the software records the finger's trajectory, which is essential for deciphering operations such as writing or erasing on the whiteboard. After determining if the user has selected a color, eraser, or drawing tool, the system notifies the user and displays the output on the virtual whiteboard, allowing the user to see their writing or drawing in real time.

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IV. UML Diagram

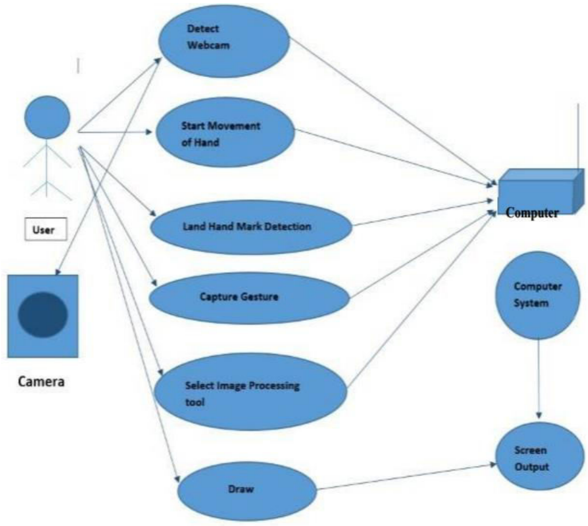

Fig.7.1. Use Case Diagram

The UML diagram shows how various user interactions are mapped to system operations as well as the varied functionalities offered by the system. It covers use cases such pen size modification, shape and color selection, whiteboard clearing, hand tracking, and virtual painting.

V. Hand Recognition

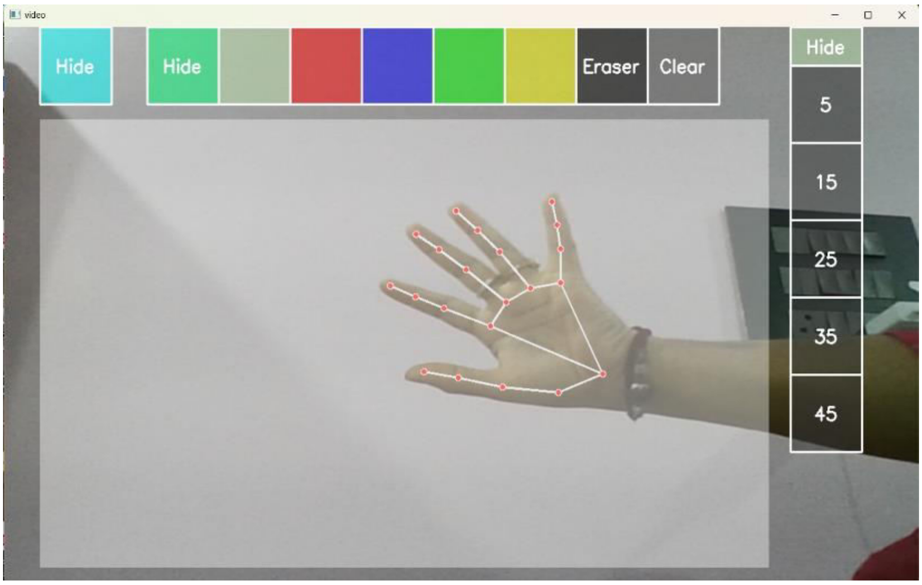

Fig.8.1. Representation of Hand Recognition

A technology that recognizes hand gestures for online sketching. Users can draw on a digital canvas without making actual touch thanks to the system's detection and tracking of hand landmarks using a camera. An intuitive drawing experience is made possible by the interface's color selection, eraser tool, and brush size modification features. The system is appropriate for applications such as interactive learning, digital art production, and virtual whiteboards since it

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uses OpenCV and MediaPipe for real-time hand tracking. This touchless method improves human-computer interaction's inventiveness and accessibility.

Detects Hand Landmarks

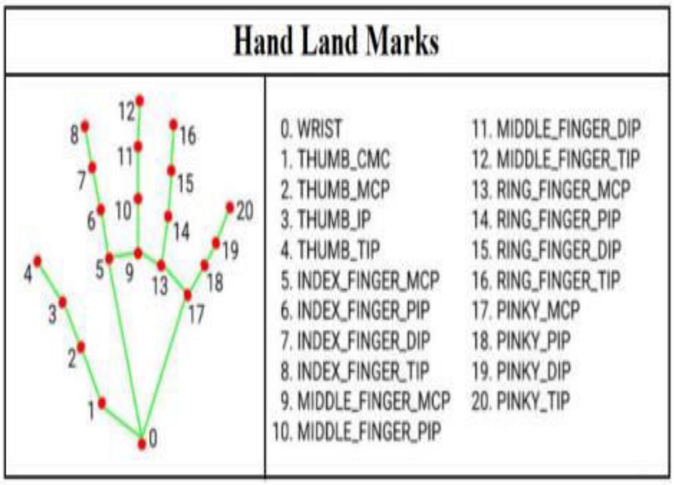

Fig.8.2. Representation of Position of Fingers

A labeled hand landmark mapping method, frequently employed in hand tracking and gesture recognition applications. It allows for accurate motion tracking by identifying 21 critical spots on the hand, including as the finger joints, knuckles, and wrist. The designated points are used as reference locations for sign language recognition, augmented reality, and hand movement analysis in virtual interfaces. Applications such as touchless control, interactive gaming, and virtual drawing make extensive use of such technologies.

VI. RESULT

Fig.9.1. The output of the Application

VII. CONCLUSION

With its emphasis on hand movements for virtual creation, this project effectively illustrates the potential of computer vision and machine learning to develop a natural and intuitive interface for computer interaction. The project uses programs like MediaPipe and OpenCV to precisely record hand gestures and convert them into actions on a virtual whiteboard. A fun and easy experience is offered by the system's recognition of several movements for sketching, erasing, and choosing colors.

VIII. FUTURE SCOPE

Future developments of the Virtual Sketch Through Hand Gestures system could be very important. AI-driven models that increase hand tracking accuracy can improve precision by lowering mistakes brought on by occlusion or changes in lighting. The technology might be used in augmented reality (AR) and virtual reality (VR) settings if it were expanded to provide 3D gesture recognition, which would enable more natural interactions. Features that facilitate multi-user collaboration may allow remote teams to communicate in real time, which would be beneficial for creative creation, brainstorming, and online learning. Furthermore, using configurable gestures and voice commands might result in a more seamless user experience. More investigation into gesture-based control for accessibility applications may benefit people with impairments and increase the inclusivity of human-computer interaction.

REFERENCES

[1] “VIRTUAL SKETCH ON AIR” Saranya.R, Ajit Reddy.V, Tarun Sai Pydi, GokulaKrishnan.K International Journal of Scientific Research in Engineering and Management (IJSREM) Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

[2] Pranavi Srungavarapu, Eswar Pavan Maganti, SrilekkhaSakhamuri, Sai Pavan Kalyan Veerada, Anuradha Chinta, Virtual Sketch using Open CV,ISSN: 2278-3075 (Online), Volume-10 Issue-8, June 2021.

[3] Yash Patil1, Mihir Paun1, Deep Paun1, Karunesh Singh1, Vishal Kisan Borate,First International Conference on Computer Engineering International Journal of Scientific Research in Science and Technology Virtual Painting with Opencv Using Python, Volume 5 Issue 8, November-December-2020.

[4] Suryansh Pratap Singh a, Akshat Mittal b, Manas Gupta c, Soumalya Ghosh d, Anupam Lakhanpale Comparing Various Tracking Algorithms In OpenCV Vol.12 No.6 (2021), 5193-5198.

[5] Bhumika Nand wana, Satyanarayan Tazi, Sheifalee Trivedi Dinesh kumarkhunteta , Santosh kumarvipparthi ,A Survey Paper on Hand Gesture Recognition.

[6] Hemalatha Vadlamudi, Evaluation of Object Tracking System using Open-CV In Python International Journal of Engineering Research& Technology (IJERT) Vol. 9 Issue 09, September-2020.

[7] S. Khan, M. E. Ali, S. Das and M. M. Rahman, "Real Time Hand Gesture Recognition by Skin Color Detection for American Sign Language," 2020 4th International Conference on Electrical Information and Communication Technology (EICT), 2022, pp. 1-6, doi: 10.1109/EICT48899.2019.9068809.

[8] “AIR CANVAS APPLICATION USING OPENCV AND NUMPY IN PYTHON” International Research Journal of Engineering and Technology (IRJET) Volume: 08 Issue: 08 | Aug 2021.

[9] Prajakta Vidhate, Revati Khadse, Saina Rasal, “Virtual paint application by hand gesture recognition system”, International Journal of Technical Research and Applications, 2023, pp. 36-39.

[10] An AI Based Virtual Drawing System Using PythonGayathriG Murali,ShukhairaBeegam,Akhil Raju,A.Amal,TessyAbraham Azhikakathu International Journal of Engineering Research & Technology (IJERT)NCASCD-2023 (VOLUME 11 ISSUE 04)

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