

Interactive Virtual Art With Hand Gestures

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Abstract- *It's been quite difficult to teach students over an online platform and get the lesson interesting amidst the COVID-19 pandemic. Due to this reason, there was a necessity of a dustfree classroom for kids. This article uses MediaPipe and OpenCV to offer an interesting paint application which recognizes hand gestures and traces hand joints. The application makes use of hand gestures to provide users with a user-friendly approach to Human Computer Interaction (HCI). HCI's overall objective is to enhance human-computer interaction.*

Keywords- Hand Gesture Recognition, Human Computer Interaction, Computer Vision, Paint, MediaPipe.

I. INTRODUCTION

The Interactive Virtual Art with Hand Gestures project is a new application that combines advanced computer vision technology with artistic expression, allowing users to paint or draw in the air with hand gestures tracked by a camera. The application does away with the need for conventional input devices like brushes or pens, providing a futuristic and innovative method of digital art design. The system is based on sophisticated libraries such as OpenCV for image processing and MediaPipe for real-time hand tracking to recognize and understand the user's hand gestures. Through the tracking of the hand's major points like fingertips and joints, the program converts the gestures into strokes on a virtual canvas so users can easily engage with the digital interface.

A camera serves as the primary input device, capturing a live video feed that is processed by the application to recognize gestures that control various functionalities, such as drawing, changing colors, clearing the canvas, or erasing specific sections. This real-time interaction ensures a responsive and intuitive user experience, making it engaging for artists, educators, and hobbyists alike.

The project incorporates several modes of operation, including an offline mode where users are able to directly engage with the application or a mode of operation that is online and can potentially integrate with a browser-based interface through frameworks like Flask. The virtual canvas is

dynamic, with customizable stroke widths and colors to enable a deep creative space. Virtual Air Painting also demonstrates the capabilities of assistive technology, where individuals with physical disabilities to be able to express their creativity without needing conventional tools. The evolution of this project solves key challenges, including obtaining precise hand tracking in different lighting conditions and keeping real-time processing to reduce latency. With its focus on accessibility, innovation, and participation, Virtual Air Painting provides a thrilling preview of what the future may hold for interactive digital tools and the ways they could revolutionize creative expression.

II. LITERATURE SURVEY

This section reviews existing systems and technologies that enable gesture-based interaction and virtual painting. It explores various approaches utilizing specialized hardware like Leap Motion and Kinect, as well as more accessible solutions based on OpenCV and MediaPipe. The objective is to identify limitations in current systems and highlight the need for a cost-effective, real-time, webcam-based gesture painting solution.

[1] Development of Virtual Painting Method using OpenCV Library with Finger Gesture (2022)

This study introduces a virtual painter system using OpenCV and finger gestures to enhance online learning interactivity. The system allows educators to draw and present material interactively using hand movements. It was developed using Rapid Application Development (RAD) and evaluated positively across six usability metrics.

[2] Virtual Hand Gesture Painting using OpenCV and MediaPipe (2023)

This project leverages MediaPipe for real-time hand tracking and OpenCV for gesture-based digital painting. It enables users to draw shapes and write text using finger gestures on a virtual canvas. The system aims to provide a more intuitive and interactive alternative to traditional input methods.

[3] Computer Vision-Based Air Canva Virtual Paint (2023)

The system uses Python, OpenCV, and MediaPipe to track hand gestures and create virtual art via webcam input. It

detects fingertip motion to draw in real time, enhancing Human-Computer Interaction (HCI). The focus is on using simple tools to create an engaging art experience.

[4] Hand Gesture Recognition using MediaPipe and OpenCV (2024)

This work explores hand gesture recognition for improved HCI using OpenCV and MediaPipe's pre-trained models. It captures real-time gestures from video streams and translates them into commands. The system demonstrates potential in accessibility, gaming, and interactive applications.

[5] Intelligent Image Processing System Based on Virtual Painting (2023)

This application uses AI, OpenCV, and MediaPipe to enable hand-controlled painting by tracking finger movements. It offers an intuitive interface where gestures translate into brush strokes on the screen. The system highlights the evolution of virtual painting through real-time image processing.

[6] Hand Gesture Controlled Presentation using OpenCV and MediaPipe (2024)

The system allows presenters to control slides using hand gestures instead of traditional devices. OpenCV captures video while MediaPipe tracks finger landmarks for precise gesture recognition. This approach offers greater mobility and interactivity during presentations.

[7] Deep Learning Based Real-Time Recognition of Dynamic Finger Gestures Using a Data Glove

This project uses a sensor-embedded data glove and deep learning to recognize dynamic finger gestures. A gesture spotting algorithm identifies meaningful gestures from continuous motion data. The system operates in real time with high speed and accuracy.

[8] Human Computer Interaction Using Marker Based Hand Gesture Recognition (2016)

This method uses colored markers on fingertips with webcam input and template matching for gesture control. It translates hand gestures into system commands like clicking and zooming. The approach is low-cost and suitable for large or non-touch displays.

[9] A Flexible Finger-mounted Airbrush Model for Immersive Freehand Painting (2017)

Using Leap Motion, this system enables immersive freehand painting through a virtual airbrush that tracks finger gestures. Users can create dynamic brush effects by varying gestures. It provides a natural and interactive digital painting experience.

[10] An Arduino based Gesture Control System for

Human Computer Interface (2018)

This paper proposes a low-cost HCI system using distance sensors and accelerometers to interpret gestures. It supports various functions such as volume control, scrolling, and typing. The system emphasizes flexibility and cost-effectiveness in gesture-based interfaces.

III. METHODOLOGY

The design uses a webcam to capture real-time hand gestures. Using libraries like OpenCV and NumPy, specific gestures are detected for colorful conduct.

- Index & Middle Fingers Together Tool selection(encounter or eraser).
- indicator Cutlet Alone Drawing.
- Thumbs Up Save the artwork.

Encounter and Eraser Selection To elect encounter size and colour, the stoner uses indicator and middle fingers. This activates tool selection mode, offering three encounter sizes(small, medium, large) and colorful colours. Imutils enhances hand discovery across angles for flawless commerce. Real-Time Drawing After opting a encounter, the indicator cutlet is tracked to draw in real-time. Eraser Functionality Switching to eraser mode is done using indicator and middle fingers. The system tracks the indicator cutlet's movement to abolish specific corridor of the delineation.

NumPy ensures accurate updates to the oil. Saving the Artwork druggies save their delineations with a thumbs up gesture. The system captures the image and saves it to the stoner's device for participating or unborn use. stoner Interface A simple web interface erected with Beaker enables easy tool selection, colour adaptation, and smooth gesture recognition. Imutils ensures high-quality videotape feed for accurate discovery. fabrics MediaPipe MediaPipe is a Google open-source frame that was originally released in 2019. MediaPipe has some erected- in computer vision and machine literacy capabilities. A machine learning conclusion channel is enforced using MediaPipe. ML conclusion is the process of running real data points. The MediaPipe frame is used to break AI challenges that substantially include videotape and audio streaming. MediaPipe is multimodal and platform independent. As a result, cross-platform apps are created using the frame. Face discovery, multi-hand shadowing, hair segmentation, object discovery, and shadowing are just a many of the operations that MediaPipe has to offer.

MediaPipe is a frame with a high position of dedication. Low quiescence performance is handed through the MediaPipe frame. It's in charge of coinciding time-series

data. The MediaPipe frame has been used to design and dissect systems using graphs, as well as to develop systems for operation purposes. In the channel configuration, all of the system's way are carried out. The channel that was designed can run on a variety of platforms and can gauge across desktops and mobile bias. Performance evaluation, detector data reclamation, and a collection of factors are all part of the MediaPipe frame. Calculators are the corridor of the system. The MediaPipe frame uses a single- shot sensor model for real- time discovery and recognition of a hand or win. It's first trained for the win discovery model in the hand discovery module since triumphs are easier to train. It designates a hand corner in the hand region, conforming of 21 joint or knuckle coordinates as shown in the Figure 1.

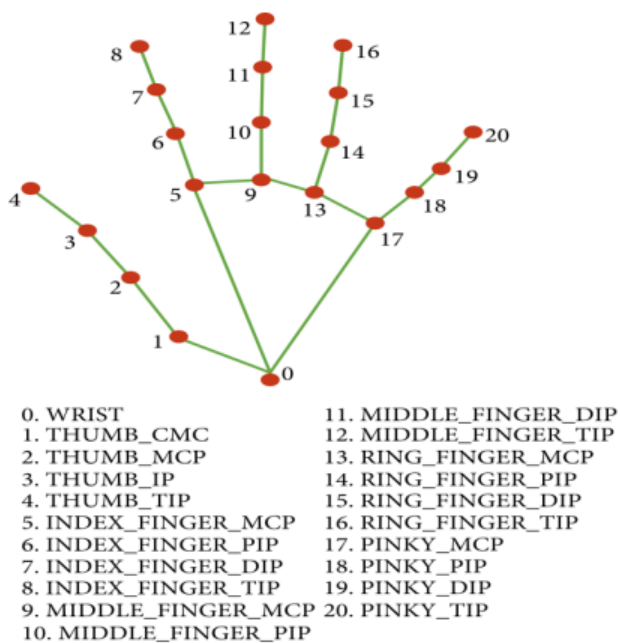
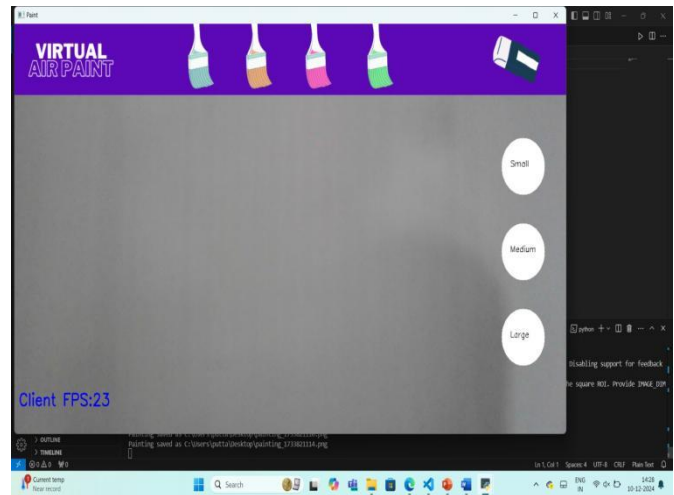


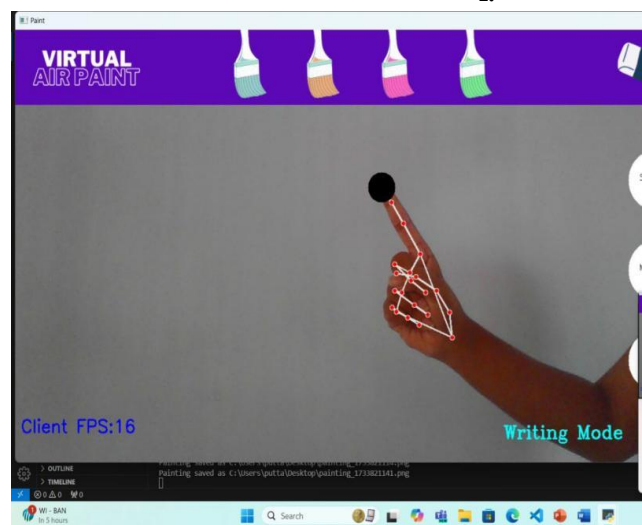
Figure1 :Coordinates or landmarks in the hand

IV. SNAPSHOTS

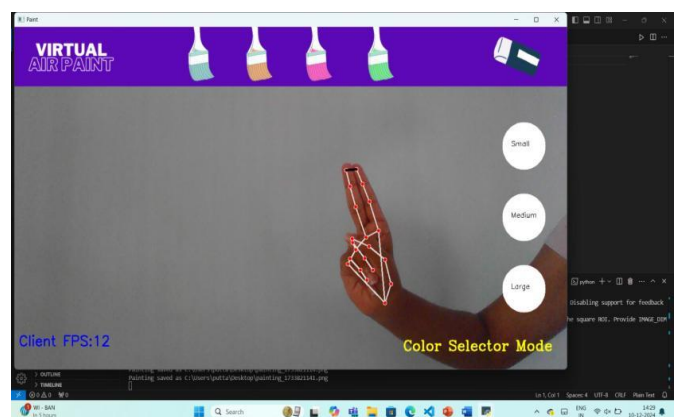


Snapshot1 : Virtual Paint Screen

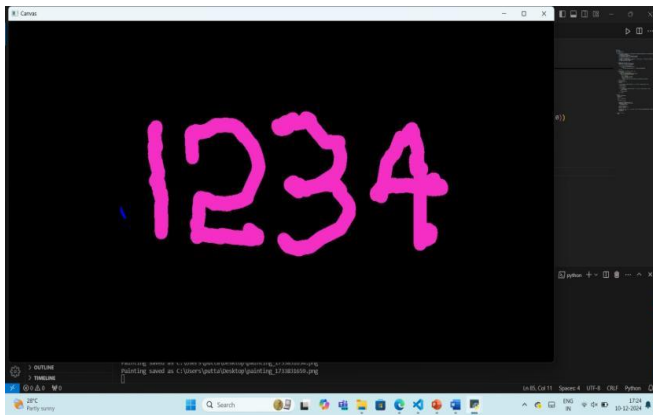
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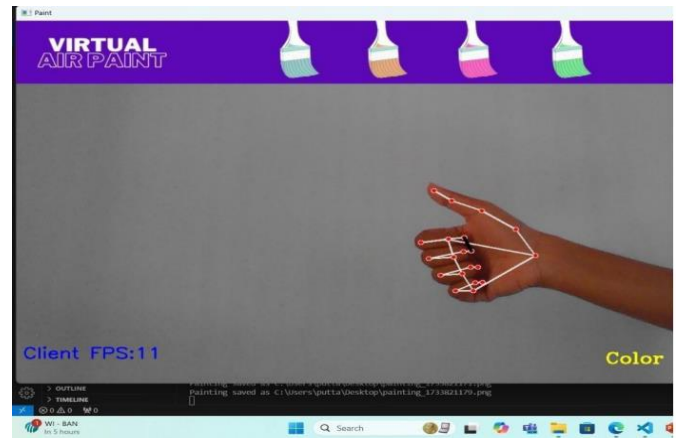
Snapshot 2 : Writing Mode



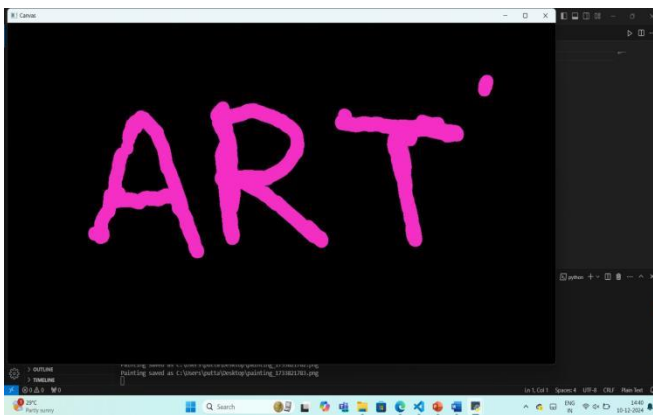
Snapshot 3 : Selection Mode



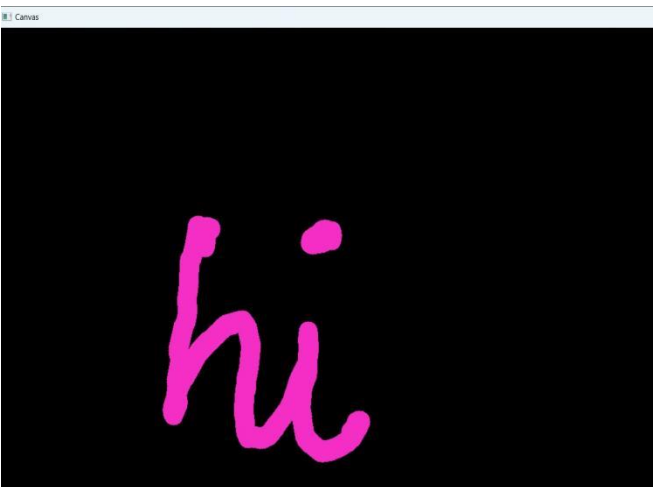
Snapshot 4 : Hand Drawn Digital Art



Snapshot 7 :Hand Drawn Digital Art



Snapshot 5 : Hand Drawn Digital Art



Snapshot 6 : Hand Drawn Digital Art

V. CONCLUSION

The Interactive Virtual Art with Hand Gestures is a state-of-the-art program that utilizes computer vision and gesture recognition to transfigure digital art creation. By combining OpenCV and MediaPipe, it allows druggies to draw, cancel, and save artwork in real-time using simple hand movements, without the use of traditional input bias similar as a mouse or keyboard. This easy-to-use and intuitive system is available to a wide range of people, including people with physical disabilities, rendering it across-platform and accessible device. The design is successful in furnishing dependable hand shadowing, intuitive tool selection, and continued commerce with an artificial oil. druggies are suitable to customize their experience by choosing colours, varying encounter and eraser sizes, and saving their artwork, accommodating different cultural conditions. performing optimally with run-of-the-shop webcams, the system is cost-effective and readily accessible. With unborn possibilities likemulti-gesture support, bettered rigidity to environmental conditions, and comity with new technologies like stoked reality, the Interactive Virtual Art with Hand Gesture is a major step forward in making digital art creation more technologically advanced, accessible, and engaging.

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