VIRTUAL PAINTER USING OPENCV

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***Abstract*—Art is more than just pictures; it is a representation of the user's emotions as well as an abstraction of the real world and a means of communicating a message or a statement to other humans who can comprehend that art. Throughout history, new technologies have been used by artists. from stone carving, cave painting, and clay molding, up to the more recent contributions of digital illustration and 3D painting in virtual reality. In each instance, technology acts as a tool, enabling fresh forms of expression or simply making things a little bit simpler for the artists. This project, Virtual Painter, is just a tool somewhat resembling a paintbrush. This project is created using the OpenCV package and the Python programming language. It uses the OpenCV library to track an object of interest and allows the user to draw by moving the object while using real-time webcam data. This makes drawing simple objects awesome and challenging at the same time.**

I. Introduction

Virtual Painter, using OpenCV and MediaPipe, is an application that tracks the movement of an object. By moving the item (in our project, the human hand) in front of the webcam while it is in the air, the user can draw on the screen using this tracking capability. The user can draw simple things that are both engaging and difficult using this real-time webcam data that is generated by tracking the movement of the object.

OpenCV (Open Source Computer Vision) - is a library of functions for the programming language that is mostly used for computer vision. It is a library used for image processing, to put it simply or in a generic way. It is mostly used for all procedures involving images.

It can be used for:

- Reading and Writing Images.
- Detection of faces and its features.
- Detection of different shapes such as circle, rectangle etc in an image. (example: Detection of coins in images).
- Text recognition in images. (example: Reading Number Plates).
- Can modify the quality of an image or it's color.
- Developing Augmented reality apps.

OpenCV is a library for images. Almost all popular programming languages are supported. Commonly used in Python: To read, write, or modify an image, we can use OpenCv. converting from color to grayscale, binary, HSV, and so on. OPENCV is also open source.

MediaPipe - is a graph-based open source framework developed by Google and used for media processing. It primarily aims to simplify our ability to analyze media by offering machine learning elements and some integrated computer vision.

Its notable applications include:

- Detecting and tracking an object.
- Face detection.
- Multi-hand tracking.
- Segmenting hair.
- AutoFlip - pipeline to crop videos automatically.

II. Literature Survey

A. Human Computer Interaction Using Marker Based Hand Gesture Recognition.

Real-time hand gesture recognition employs a variety of techniques. Jahidul Adnan Sakel, Sayem Mohammad Siam, and Md. Hasanul Kabir has a brand-new approach that makes use of marker identification and tracking techniques. Two colored markers are worn on the tips of the fingers in place of a mouse or touchpad to produce eight hand gestures that are then sent to a desktop or laptop computer equipped with a consumer-grade camera. Additionally, they have employed the "Template Matching" technique to find markers and the Kalman Filter to track them.

B. An economical air writing system converting finger movements to text using web camera

An intangible interface is designed and implemented using vision-based real-time dynamic hand gestures to enable mouse tasks, including moving the mouse cursor and clicking left, right, and center with hand gestures.

C. Skeleton- Based Dynamic Hand Gesture Recognition

Using the geometric contour of the hand, they obtained a useful descriptor from the Intel Real-Sense depth cameras' linked joints in the hand's skeleton. The skeleton-based strategy outperforms the depth-based strategy.

D. Virtual paint application by hand gesture recognition system

They have developed a virtual paint application that follows hand motions and writes on the screen using ball-tracking technology. As a contour, they've utilized a glove with a ping pong ball fastened to it.

III. PROBLEM STATEMENT

Developing an interface between human hand and the system using open cv techniques and python language to pick the colour and draw using hand on the developed drawing area.

IV. OBJECTIVE

- To create a virtual canvas to sketch.
- To detect the human finger as a colour marker.
- To do the morphological operations.
- To create an interface between user and the system.

V. ALGORITHM USED FOR HAND TRACKING

Hand gesture recognition and tracking are handled by the MediaPipe framework, while computer vision is handled by the OpenCV library. The program uses machine learning concepts to track and identify hand movements and hand tips.

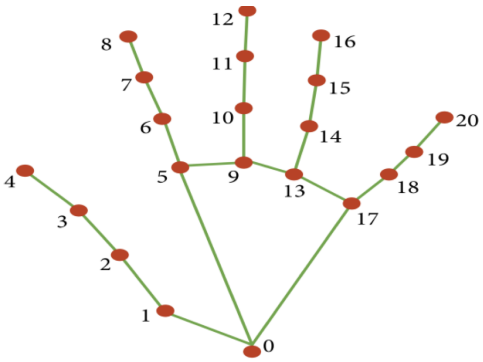
A. MediaPipe

MediaPipe is a Google open-source framework that was first made available in 2019. Machine learning and computer vision features are included in MediaPipe. Using MediaPipe, a machine learning inference pipeline is put into action. The process of running real data points is known as ML inference. The MediaPipe framework is used to solve AI challenges, the majority of which involve streaming audio and video. MediaPipe is cross-platform and multimodal. The framework is used to produce cross-platform applications like hair segmentation, multiple-hand tracking, face detection, and object detection, which are a few of the applications MediaPipe offers. MediaPipe is a framework with a high level of fidelity. The MediaPipe framework offers low latency performance. Time-series data synchronization is its responsibility.

The MediaPipe framework has been used to design and evaluate graph-based systems as well as create systems for usage in applications. The pipeline configuration executes each step of the system. The pipeline can grow across desktop and mobile platforms and run on a range of operating systems. The MediaPipe architecture includes a collection of components, performance evaluation, and sensor data retrieval. The MediaPipe framework is a single-shot detector model for real-time detection. Since palms are easier to train, they are initially trained for the hand identification module's palm detection model. It identifies a landmark for the hand in the hand region, made up of 21 joints or coordinates of the knuckles as shown in the figure1.

B. OpenCV

The computer vision library OpenCV is a must-have for everyone who works with computers. It comprises image processing techniques for object detection. For developing real-time computer vision applications, use the Python package OpenCV. The OpenCV library handles the processing and analysis of images and videos.



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. Coordinates or landmarks in the hand

VI. FLOWCHART

The various constraints in the system are explained in the flowchart of the Virtual Paint Application in Figure 2.

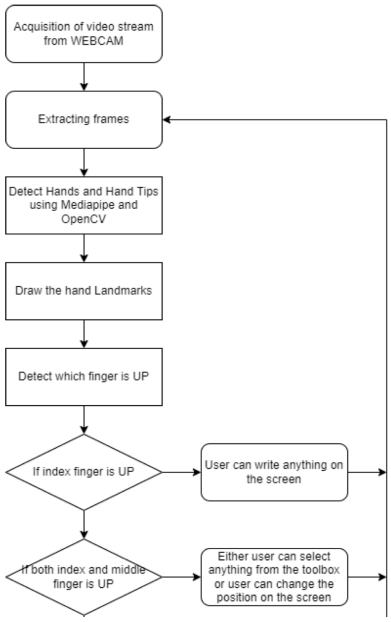


Fig. 2. Flowchart of the virtual Painter

The virtual painting application presented is based on the frames recorded by the PC's web camera. The web camera sends the system the frames that it has received. Each frame is captured using a web camera until the program is complete. The video frames are transformed from BGR to RGB to locate the hands in the video frame. By comparing the tip ID of the corresponding finger discovered via the MediaPipe to the

corresponding coordinates of the up fingers, the system then decides which finger is up and executes the necessary function. If the user raises his or her index finger, anything can be written on the screen. The user can move their position on the screen or use any tool from the application's toolbar if both their index and middle fingers are raised.

VII. Results

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Fig. 3. Hand Detection

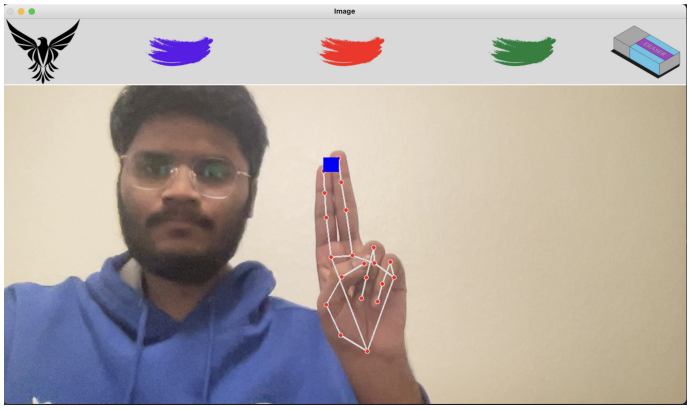

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Fig. 4. For Choosing the color from toolbar

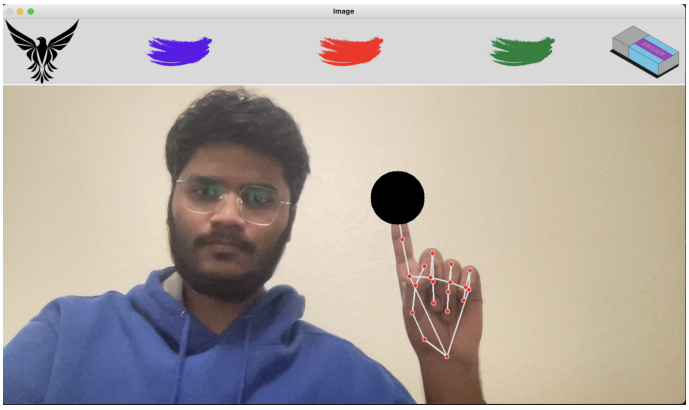

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Fig. 5. To Draw

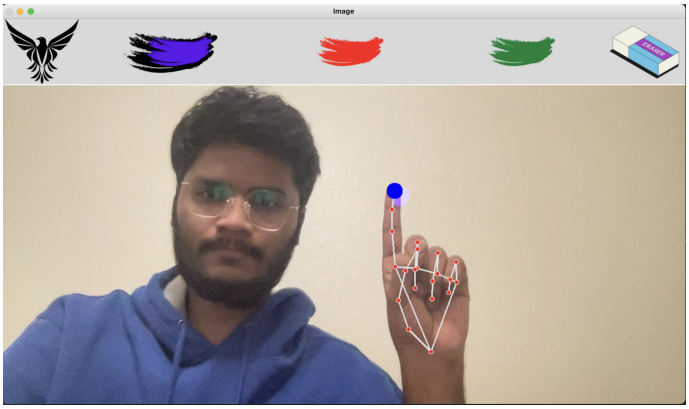

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Fig. 6. Selected Blue Color for Drawing

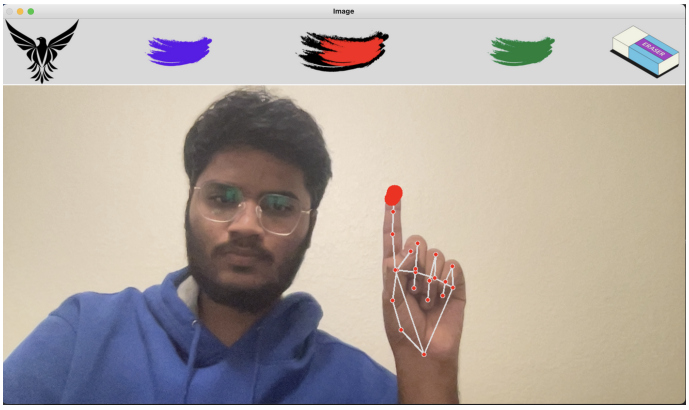

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Fig. 7. Selected Red Color for Drawing

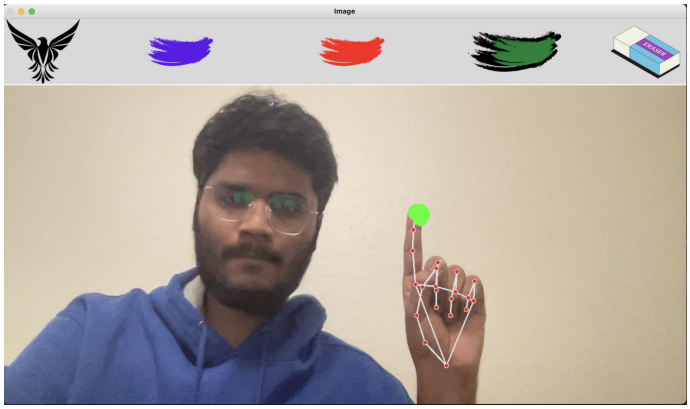

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Fig. 8. Selected Green Color for Drawing

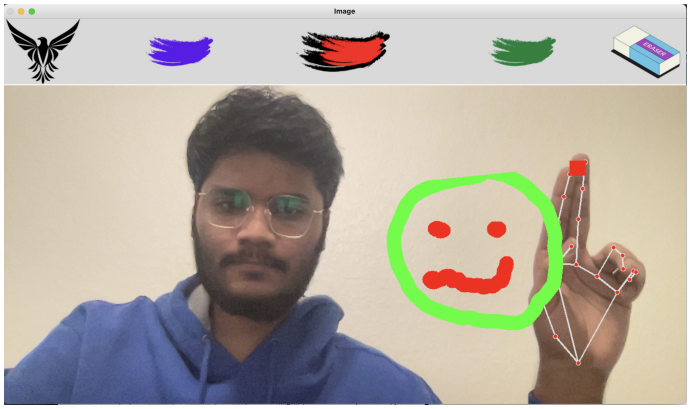

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Fig. 9. Overall Drawing

VIII. Conclusion

This project makes the user have an interactive environment where he can draw whatever he wants by choosing the colors he needs from the toolbar. This application can be used in various sectors and does not require a lot of typing experience. It creates a place where users may draw anything they want with a single finger from the given palette of colors while selecting with two fingers in a very practical and simple way. We can therefore draw the conclusion that Virtual Painter was created utilizing OpenCV and MediaPipe, where a number of libraries and algorithms were built in to make the user interfaces more engaging.

References

[1] Siam, Sayem and Sakel, Jahidul and Kabir "Human Computer Interaction Using Marker Based Hand Gesture Recognition"., 2016

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[3] Q. De Smedt, H. Wannous and J. Vandeborre, "Skeleton- Based Dynamic Hand Gesture Recognition," 2016 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), 2016, pp. 1206-1214, doi: 10.1109/CVPRW.2016.153.

[4] Prajakta Vidhate, Revati Khadse, Saina Rasal, "Virtual paint application by hand gesture recognition system", 2019 International Journal of Technical Research and Applications, 2019, pp. 36-39.