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Gesture-based virtual painter using Mediapipe

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Abstract - *With Air Canvas users can draw on screens through simple hand movements while they do not need to physically touch it. Index finger serves as the main drawing instrument in this system yet users can switch tools without creating accidents by keeping their second finger shut. A fist gesture has been built into the system to instantly delete everything drawn on the canvas. Despite delivering high-precision landmark detection MediaPipe's Hand Tracking module enables better control over smooth and precise drawing performance. User interaction receives improvement through the system's implementation of computer vision methods like color detection and contour extraction and tracking algorithms. Air Canvas enables users to create drawings through touchless gestures that find applications in educational settings as well as design and assistive technology fields.*

Key Words: Air Writing, Motion-to-Text Conversion, Computer Vision, Object Tracking, Human-Machine Interaction.

1.INTRODUCTION

Computer vision along with artificial intelligence research has fostered fresh methods of interacting between humans and computers which can function without physical touching devices. Users can now employ the Air Canvas system to draw on digital screens by performing basic hand motions which eliminates manual screen interaction. The touch-free drawing feature of this system enables useful applications across educational institutions and laboratories that specialize in digital art and assistive technology fields. A combination of OpenCV for real-time processing and hand tracking enables the Air Canvas system which uses MediaPipe's Hand Tracking module to improve recognition efficiency. Index finger operation detects drawings and second finger closure selects tools without producing unwanted marks. Users can easily clear their canvas through the implementation of a fist gesture for an improved user experience. The Air Canvas achieves exact and smooth drawing with its implementation of color detection methods and contour extraction algorithms together with tracking algorithms. A paperless world can be created using this application where there is only need for a device and a hand [1]. Computer vision has proved its capability for developing interactive user interfaces during this project as it sets precedence for new applications in digital accessibility.

2. EXISTING SYSTEM

A. Kinetic sensors

The most commonly used equipment for the studies involving computer vision using hands is kinetic sensors. The hardware is mounted onto the fingertips of our hands like a glove and then the movement is tracked.

B. Simple UI

The air canvas designed by others so far has limited features and gestures, it usually has only a single functionality of writing with an index finger and clearing the board with it, the functions like shapes, erasing or brush size are not really implemented.

C. Using the canvas

It takes a while to get used to the writing in air concept for the user, the canvas has many features and gestures that the user cannot get in the first try, to make the task simple a simple UI is needed.

D. Limited features and gestures

The tools built for computer vision can be very limited as it takes some knowledge to understand the CV techniques, we can use multiple gestures and tools for making the canvas more versatile.

3.PROPOSED SYSTEM

A system design for a "Air Canvas" application using OpenCV needs several key components. This app enables users to utilize camera-captured motions to sketch or paint in midair. Below is a simplified system architecture with a flowchart.

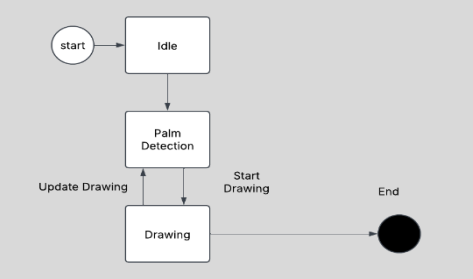

Figure 1. Basic Design of the system

Canvas User Interface: The frontend part of the canvas has functionalities that a user can interact with, the tools contain

line, rectangle, freehand, circle, eraser and a color section with 6 different colors, the gestures are index finger, middle finger and a fist. The three gestures are responsible for tool selection, drawing and clearing the board.

Camera Module: This module records GDG frames in real time by using the computer's camera as an interface and it also provides the video stream for the Image Processing Module. The module absorbs the video from the camera stream and recognizes human gestures by processing and analyzing images in real time.

Hand Tracking module: The Hand Tracking module gets its functionality from MediaPipe which operates as an open-source framework from Google for real-time hand tracking applications in our air canvas system. MediaPipe Hand Tracking provides detection and precise motion tracking of hand fingers to enable users to interact through gestures. Our system depends on this functionality to identify the index finger position because it functions as our initial interface both for creating drawings and choosing colors and providing clearing commands. The efficient structure of MediaPipe along with its lightweight design ensures smooth real-time operational capabilities in applications. This technology enables an easy and touchless drawing process through a conventional camera setup only.

4.ARCHITECTURE

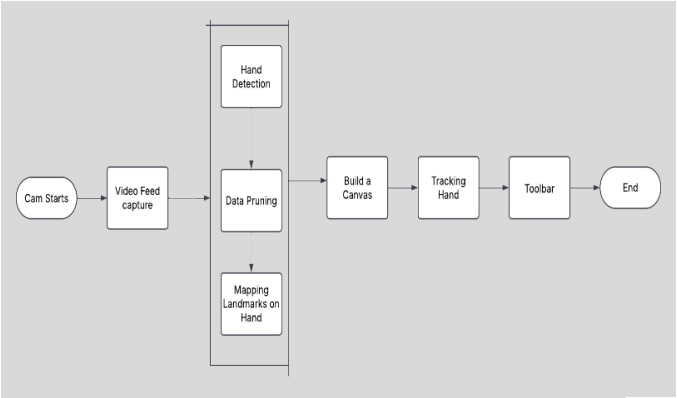

Figure 2. Architecture of the system

An air writing recognition procedure that uses computer vision appears in the flowchart. The algorithm starts with camera power-up and continues with video synchronization. Data pruning and landmark mapping of the hand allow precision improvement at the hand detection phase. A virtual writing surface becomes available as a result of landmark identification in the hand. Hand movement tracking occurs to guarantee accurate gesture detection by the system. Additionally, the system includes a toolbar for user interaction including selection of different colors or canvas clearing features. The system reaches efficiency for air writing functionalities during the conclusion of this process.

5. RESULTS AND DISCUSSIONS

This is the first interface that has the toolbar and fps monitor; we can get it by executing the Python script that uses the OpenCV and Mediapipe modules.

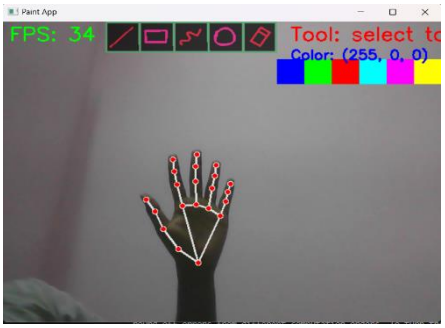

Figure 3. Main Interface of the application

To write and draw, we can choose from five distinct tools and six different colors. Additionally, we have an option for erasing the lines using eraser tool.

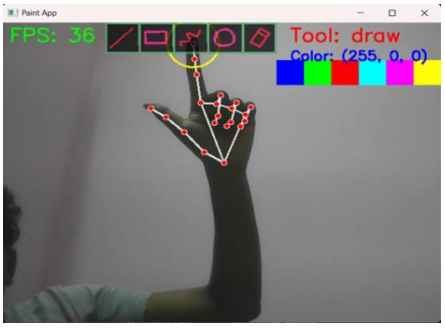

Figure 4. Tool selection using index finger

The most dependable tool for writing and drawing is the draw tool. When choosing a tool, we must close the second finger in order to isolate the tip. We can draw after opening the second finger, and so on. We can use different shapes using line, rectangle and circle tools for adding more versatility to our canvas, the fps monitor is also useful to depict the improvements needed in the hardware the user has currently. The right side of the canvas shows us the current tool selected and also the color.

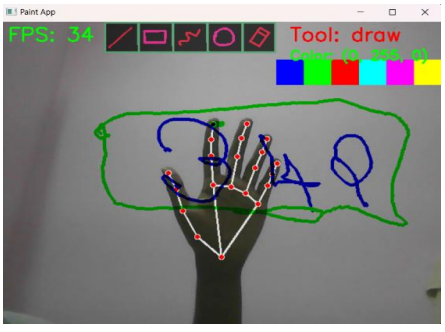

Figure 5. Freehand drawing tool

The paths the index finger takes when drawing are depicted in the figure above.

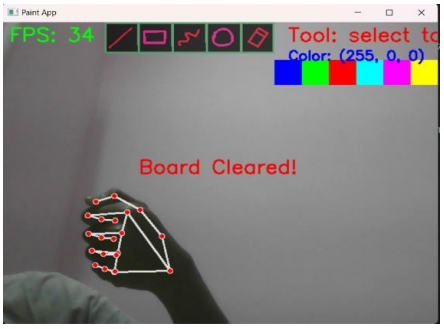

Figure 6. Gesture for clearing the board

We may use the following fist motion to clear the board, after clearing the stuff we have drawn thus far, the message "Board Cleared" appears on the screen.

6.CONCLUSION AND FUTURE ENHANCEMENTS

Air canvas technology systems development will concentrate on enhancing precision and speed alongside user-friendly usability factors. A machine learning model at an advanced research stage should be implemented with the system to decrease errors while improving system adaptability. The implementation of multi-finger gestures would open up opportunities for users to execute digital zoom and rotation commands and select tools within the system. The system gives users additional functions which provide visual information through augmented reality during their writing sessions. Multiple devices connected remotely can collaborate on writing by using cloud-based system synchronization in real-time. Program accessibility alongside user experience will improve because of implementing adjustable toolbars combined with gesture shortcuts in the user interface design. The development of "Air Canvas" with OpenCV software enables effective exploration of computer vision technology potentials through an exciting user experience. Through this application users can perform drawing by using their hand movements. Emphasis for vital subjects exists throughout the development challenges which guide the process.

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