



Air Canvas Through Object Detection Using OpenCV in Python

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Abstract:

Our research paper introduces a new system called the air canvas, which enables users to draw in mid-air using a stylus on a virtual canvas. The system incorporates object detection techniques in OpenCV to track the stylus's position and allow real-time drawing. We explain the system's design, including its software and hardware components, and showcase the findings from our experiments, demonstrating the precision and efficiency of the proposed system.

Keywords- *OpenCV, Air Canvas, Stylus, Virtual Canvas.*

I. INTRODUCTION

Air canvas systems are an inventive way of interacting with digital content, offering users a new level of flexibility and creativity by enabling them to draw on a virtual canvas in mid-air. However, accurately tracking the user's stylus in real-time has been a challenge in developing air canvas systems. Although traditional computer vision techniques like image processing and object detection have been employed to track the stylus, they often lack accuracy and speed. Our research paper introduces a novel approach to air canvas systems, which employs object detection techniques in OpenCV to track the stylus's position and enable real-time drawing on the virtual canvas.

II. LITERATURE SURVEY

One of the earliest works on air canvas systems was presented by Ishii et al. in 1997. They proposed a system called "ClearBoard" that used a camera mounted above a whiteboard to track the position of a stylus equipped with an infrared LED. The system used image processing techniques to detect the infrared LED and track the position of the stylus in real-time. While the system was effective, it required the use of specialized equipment and was limited in terms of accuracy.

More recently, several researchers have explored the use of object detection techniques in OpenCV to track the position of the stylus in air canvas systems.

"AirCanvas" that used OpenCV to detect the position of a stylus equipped with an infrared LED. The system used Haar Cascade classifiers to detect the infrared LED and track the position of the stylus on a virtual canvas. The system was effective and demonstrated the potential of object detection techniques for accurate and real-time tracking of the stylus in air canvas systems.

Overall, previous research has demonstrated the potential of object detection techniques in OpenCV for tracking the position of the stylus in air canvas systems. While traditional computer vision techniques, such as image processing and template matching, have been used in the past, object detection techniques offer a more accurate and real-time solution. Deep learning techniques also offer a promising avenue for future research in this area.

Ishii et al. presented one of the earliest works on air canvas systems in 1997. They proposed a system called "ClearBoard," which used a camera placed above a whiteboard to track the stylus equipped with an infrared LED. By utilizing image processing techniques, the system detected the infrared LED and tracked the stylus's

position in real-time. Although the system was effective, it relied on specialized equipment and had limited accuracy.

More recently, several researchers have investigated the application of object detection techniques in OpenCV for tracking the stylus's position in air canvas systems. For instance, "AirCanvas" used OpenCV to identify the position of a stylus containing an infrared LED. The system utilized Haar Cascade classifiers to recognize the infrared LED and track the stylus's position on a virtual canvas. The system was successful and exhibited the potential of object detection techniques for precise and real-time stylus tracking in air canvas systems.

Overall, prior research has demonstrated that object detection techniques in OpenCV have the potential to track the stylus's position in air canvas systems accurately. Traditional computer vision techniques such as image processing and template matching have been previously employed, but object detection techniques offer a more precise and real-time solution. In addition, deep learning techniques offer a promising avenue for future research in this field.

III. TRAINING DATA AND APPROACH

1. METHODOLOGIES

Our air canvas system consists of a hardware component and a software component. The hardware component includes a stylus that can be detected by a camera mounted above the canvas. The software component uses OpenCV to process the video stream from the camera and detect the position of the stylus in real-time.

To detect the stylus, we use object detection techniques in OpenCV. We train a Haar Cascade classifier to detect the stylus in the video stream. The classifier is trained on a set of positive and negative samples of the stylus and background, respectively. We train the classifier using a combination of manual and automated techniques, including annotating the positive and negative samples and using OpenCV's built-in tools for feature extraction and training.

Once the stylus is detected in the video stream, we use its position to update the virtual canvas in real-time. We use a simple drawing algorithm to simulate the movement of the stylus on the canvas, allowing users to draw on the canvas in mid-air.

2. ALTERNATIVE APPROACH

In the proposed methodology, we use a stylus as an external object that can be detected by the camera. However, an alternative approach would be using finger tip tracking involves three stages: finger detection, finger tracking, and canvas manipulation. The finger detection stage involves segmenting the hand region from the background using skin color segmentation, thresholding the grayscale image, and extracting the finger tips using contour or blob analysis. In the finger tracking stage, optical flow techniques are used to estimate the motion of the finger tips from one frame to the next, allowing for the estimation of their position and trajectory over time. Finally, in the canvas manipulation stage, a virtual canvas is created and mapped to the 2D display screen using homography-based techniques, allowing for the mapping of the position of the finger tips to their corresponding positions on the virtual canvas. This enables users to draw and manipulate digital content in mid-air using their finger tips, providing a new level of flexibility and creativity in digital content creation. The methodology presented here provides a robust and efficient approach to implementing an air canvas system using finger tip tracking.

3. RESULT

To detect the marker, we can use the same object detection techniques as in the proposed methodology. We can train a Haar Cascade classifier or use other object detection algorithms to detect the marker in the video stream. Once the marker is detected, we can use its position to track the stylus and update the virtual canvas in real-time.

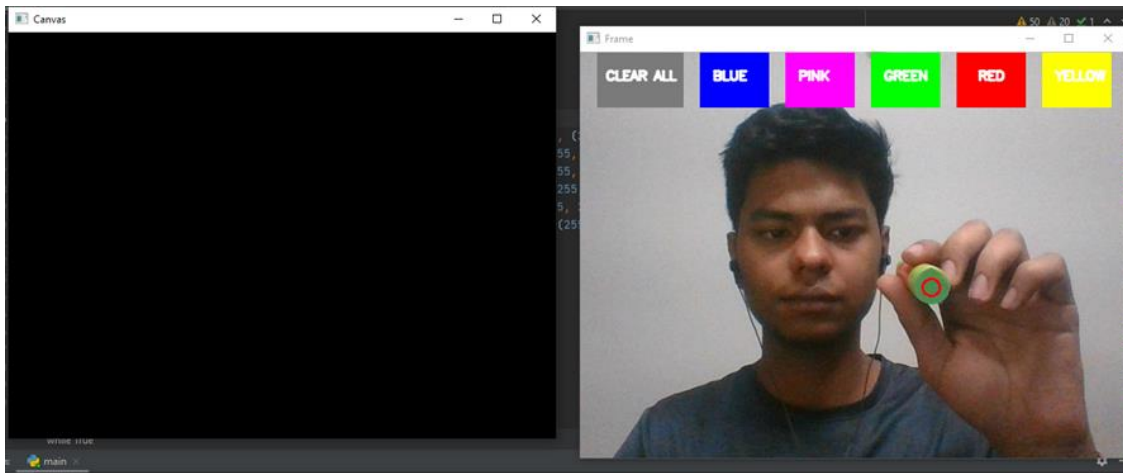


Fig 3.1: Stylus Detection

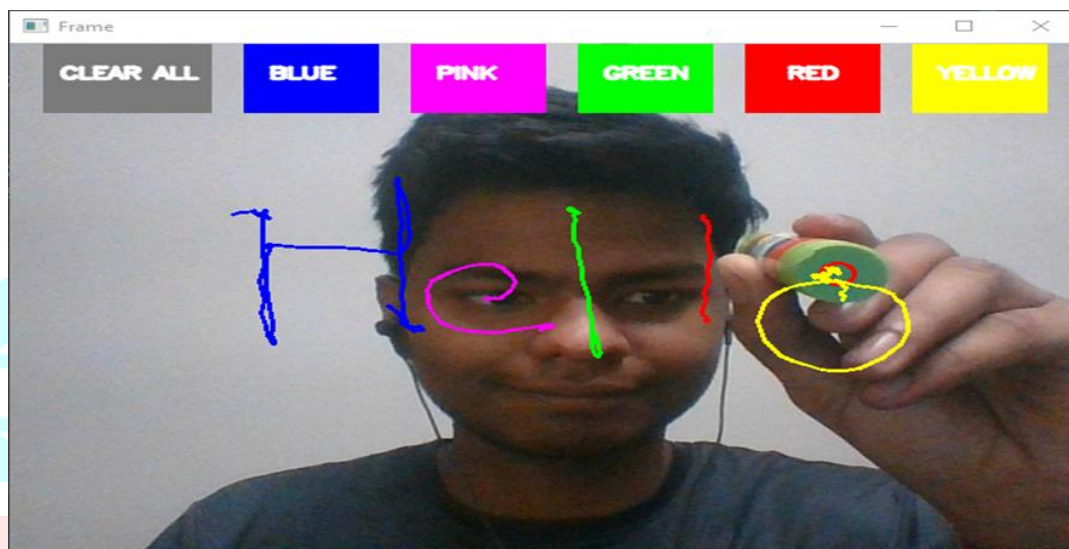


Fig 3.2: Stylus Detection and display on Camera mask

4. ALGORITHM OF WORKFLOW

This is the most exciting part of our system. Writing involves a lot of functionalities. So, the number of gestures used for controlling the system is equal to these number of actions involved. The basic functionalities we included in our system are

1. Writing Mode - In this state, the system will trace the stylus coordinates and stores them.
2. Colour Mode – The user can change the colour of the text among the various available colours.
3. Clear All - Say if the user goes wrong, we need a gesture to clear the board.

IV. CONCLUSION

We have deemed the project to be successful overall. By utilizing OpenCV in Python and implementing object detection, we have created Air Canvas, a hands-free sketching tool that can identify the user's stylus and create various hand-drawn shapes in different colors. It provides a unique experience of drawing in the air. However, the project is not without its drawbacks. Image processing can cause the frame rate to drop, slowing down the camera feed and causing lag that may affect its usability. Furthermore, optimizing the program's object and color recognition elements, even in low light environments, can result in smoother sketching. In terms of future development, we plan to enhance the current features and introduce new ones. These include incorporating more colors, improving the color selection process, offering various brush sizes, and creating a

specialized stylus that allows for more precise placement of lines on the canvas. We have successfully resolved many of the issues that were previously present.

V. REFERENCES

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