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AIR CANVAS WITH OPENCV

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Abstract : This paper presents details of Air Canvas project. In recent years, one of the most fascinating and challenging research areas in the fields of image processing and pattern recognition has been writing in the air. It makes a significant contribution to the development of an automated process and can enhance the interface between a machine and a human in a variety of applications. Numerous studies have concentrated on new methods and techniques that would speed up recognition while reducing processing time. Within the discipline of computer vision, object tracking is regarded as a crucial task. The development of faster computers, the availability of affordable, high-quality video cameras, and the requirements for automated video analysis have made object tracking systems more and more common. In general, there are three main parts in the video analysis process: identifying the object, following its movement from frame to frame, and then analysing the object's behavior. Four major considerations are made for object tracking: choosing an appropriate object representation, choosing tracking features, identifying objects, and tracking them. Object tracking algorithms are a key component of many applications in the real world, including autonomous surveillance, video indexing, and vehicle navigation. This gap is exploited by the project, which focuses on creating a motion-to-text converter that may be used as software for wearable intelligent devices that allow for writing in the air. This endeavor serves as a reporter of infrequent gestures. The finger's route will be traced using computer vision. Messages, emails, and other types of communication can all be sent using the created text. The deaf will be able to communicate effectively thanks to it. By doing away with the need to write, it is an efficient way to cut down on the use of mobile devices and mobiles.

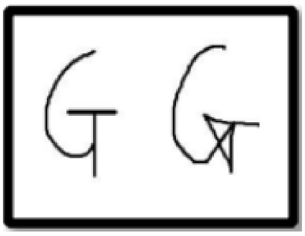
Keywords: Tracking, Opencv, Paint.

Introduction: The "Air Canvas" project is a creative and forward-thinking initiative that uses a powerful tool called OpenCV, which is like a super-smart computer vision system. The main idea behind this project is to change the way people make art by allowing them to draw and paint without actually touching anything – just by moving their hands in the air! OpenCV acts as a sort of digital Observer, closely watching and understanding hand movements in real-time. It then turns these movements into commands for a pretend canvas on the computer screen. Picture it like your hand becoming a magical paintbrush. The big aim of this project is to make drawing not only enjoyable but also accessible to everyone, no matter how skilled they are at art. They've made it super easy with menus where you can pick colors and change brushes. OpenCV's special features make this project unique by blending the real world with digital art in a really cool way. It's like going on a fun and exciting journey into the world of digital creativity, and it doesn't matter if you're a beginner or an experienced artist – there's something for everyone. The main theme of the "Air Canvas" project revolves around leveraging computer vision, specifically using OpenCV, to create an interactive and magical platform for digital art creation. The project's core objective is to redefine how individuals engage with art by enabling them to draw and paint in the air without any physical contact. By tracking hand movements in real-time, OpenCV interprets gestures as commands for a virtual canvas, turning the user's hand into a virtual paintbrush. The overarching theme emphasizes accessibility, making drawing a highly enjoyable and interactive experience for people of all skill levels. The project integrates user-friendly interfaces, such as menus for color selection and brush customization, to enhance accessibility and create a fresh approach to digital art. Overall, the "Air Canvas" project embodies the fusion of technology and artistic expression, offering a unique and enchanting journey into the world of digital creativity.

2. Existing System

2.1. Fingertip detection: The existing system only works with your fingers, and there are no highlighters, paints, or relatives. It is quite difficult to identify and describe an object, such a finger, from an RGB image without a depth sensor.. Collaboration tools. Some people complain that the user interface and system menu are not very friendly. If you connect using a platform other than Webex, you can have audio problems. It is difficult to switch from legacy Webex platforms to this cloud-based version.

2.2. Lack of pen up and pen down motion: The system uses a single RGB camera to write from above. Pen motions up and down cannot be followed since depth sensing is not feasible. Consequently, the whole trajectory of the fingertip is traced, and the resultant image would be ridiculous and unrecognizable to the model. The distinction between a handwritten "G" and an air written one.



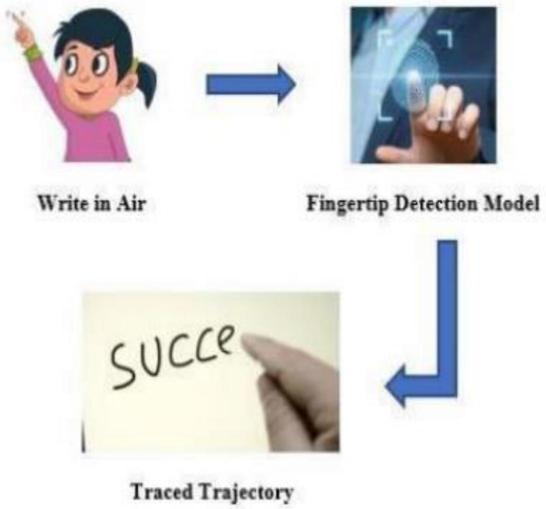
Actual Character vs Trajectory

Controlling the real-time system: using hand gestures presents both coding challenges and considerations for user experience. The implementation demands meticulous coding practices to ensure the accurate interpretation of real-time hand gestures, requiring precise algorithms for gesture recognition and system state transitions. Careful coding is essential to minimize errors and enhance the system's responsiveness. Additionally, the user experience aspect is critical, as users may need to learn and remember a set of specific hand movements to effectively control the system. Striking a balance between a comprehensive set of gestures and user-friendly interactions becomes crucial, necessitating thoughtful design to avoid overwhelming users with a complex control scheme. Iterative testing, user feedback, and continuous refinement are essential to streamline the user's learning curve and ensure a seamless and intuitive experience when transitioning the real-time system through hand gestures.

3. Methodology:

Developing an air canvas means teaching a computer to follow your hand gestures for drawing on a virtual board. It's about quick, natural interactions displayed on a screen. User testing refines and enhances the system for a more engaging experience.

3.1. Fingertip Detection Model:



3.1. Workflow of the system

The Fingertip Detection Model records and understands finger movements, especially during hand gestures. It's software designed for hands-free control of objects. To teach it, we need various examples of finger movements for practice. With learning, it becomes skilled at recognizing and remembering these gestures. This is handy for tasks like operating gadgets without direct touch.

3.2. Video to Images: In this approach, two-second videos of hand motion in different environments, generating 30 images from each video for a total of 2000 images. Manual labeling was used for dataset annotation. The trained model performed well on videos from the same environment but struggled with diverse backgrounds not in the dataset, resulting in a 99% accuracy on the provided data but facing challenges in new scenarios.

3.2. Videos to image

3.3. Taking pictures in distinct Background: To make our system better, we created a new set of pictures. This time, we knew we wanted specific hand movements to control the system, so we gathered four different hand poses. The idea was to teach the computer to recognize all four fingers well. This way, users could control the system by showing a different number of fingers. For example, they could write by showing one finger, turn that writing into electronic text by showing two fingers, add a space with three fingers, delete with five fingers, enter prediction mode with four fingers, and pick predictions with one, two, or three fingers. To stop prediction mode, users could show five fingers. This set of pictures had 1800 images. We used a program to label these pictures with the model we trained before. After fixing mistakes and adding another model, we got a 94% accuracy. Unlike the old model, this one worked well in different backgrounds.

3.3 Taking pictures in background

3.4. Fingertip Recognition Model Training: Once the dataset was ready and labeled, it is divided into train and dev sets (85%-15%). Our dataset was trained using pre-trained Faster RCNN models and Single Shot Detector (SSD) models. SSDs integrate two common object detection modules: one for classifying objects and the other for proposing regions. The performance is accelerated since objects are detected in a single shot. It is commonly used for real-time object detections. Region proposals are computed by Faster RCNN using an output feature map from Fast RCNN. They are evaluated by a Region Proposal Network and Passed to a Region of Interest pooling layer. Finally, two fully connected layers for bounding box regression and classification receive the result. To identify the fingertip in the picture, we adjusted Faster RCNN's final fully linked layer.

3.4. written in the air traced on a black image

4. Results and Discussions:

The culmination of the Air Canvas project aspires to deliver a fully functional hands-free drawing application, redefining the traditional approach to digital art creation. Users are empowered to interact with a virtual canvas using intuitive gestures, eliminating the need for physical drawing tools. The application boasts dynamic features, allowing users to select colors on the fly and customize their digital brush, fostering a personalized and versatile artistic experience. Real-time visualization of the drawing process enhances user engagement, providing immediate feedback as users move their hands in the air. A core strength lies in the system's adaptability to diverse hand movements, achieved through the integration of advanced computer vision and color detection techniques. The success of the project hinges on the accuracy of meticulously implemented algorithms and the system's responsiveness to user gestures. Moreover, the user experience takes center stage, considering factors such as ease of use and accesibility. Continuous refinement through user testing and feedback is deemed crucial, ensuring the optimal performance and satisfaction of users engaged in this innovative hands-free digital art creation platform.

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5. Overview of the process:

The Air Canvas project marks a groundbreaking foray into the realm of digital artistry, presenting an innovative hands-free drawing application that transforms the traditional creative process. With a primary goal of empowering users, the project pioneers a virtual canvas interaction facilitated by intuitive gestures, freeing artists from the constraints of conventional drawing tools. Through a sophisticated sequence of operations, including frame reading, color space conversion, and contour detection, the system offers dynamic color selection, brush customization, and real-time visualization of the artistic journey. The project's success hinges on its ability to seamlessly adapt to diverse hand movements, ach0ieved through the integration of advanced computer vision and color detection te0chniques. This adaptability caters to a spectrum of drawing styles and individual preferences, showcasing the project's commitment to versatility. The emphasis on algorithmic precision and responsiveness underscores a user-centric design approach, with ongoing refinements driven by user testing and feedback. Ultimately, the Air Canvas project aspires to deliver not just a functional hands-free drawing application but a captivating and immersive platform that amplifies the joy and freedom of creative expression.

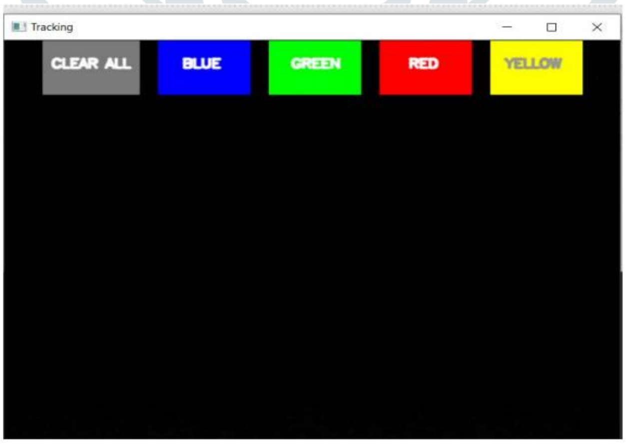
5.1. Color Detectors: In an air canvas project, color detectors recognize different colors, like those on markers or gloves, to track hand movements and gestures. They make it easier for the computer to understand and respond to actions, enhancing the interactive experience.

5.1. color Detectors

5.2. Paint: In an air canvas project, "paint" refers to the digital drawing tool. It allows users to draw and create in the virtual space using hand gestures. This interactive canvas enhances creativity, engagement, and provides real-time feedback for an enjoyable user experience.

5.2. paint

5.3. Tracking: In an air canvas project, tracking is vital for accurately following hand movements in the air. It enables gesture recognition, precise positioning on the virtual canvas, and real-time interaction, providing users with enhanced control and reducing delays for a seamless experience.



5.3. Tracking

6. Conclusion:

The system might put conventional writing techniques to the test. It eliminates the need to always have a cell phone with you in order to take notes, and offers a convenient option to do so when on the road. It will also be very helpful in facilitating communication for those with disabilities. The system is user-friendly enough even for elderly or those with trouble using keyboards. Soon, the system's capability can also be extended to control Internet of Things devices. It is also feasible to make drawing in the air conceivable. The software solution is expected to be highly effective for smart wearables, enabling individuals to engage more effectively with the digital world. Text can come to life using augmented reality. The system has certain drawbacks that may be fixed in the future. First off, writing can be done more quickly by allowing the user to write word by word when utilizing a handwriting recognizer instead of a character recognizer. Secondly, hand motions along with a pause might be utilized in place of using the fingertips to operate the real-time system. Thirdly, occasionally our system detects fingertips in the background and modifies their state. Air-writing systems must solely follow their master's control signals and must not be tricked by their surroundings.

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