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Hand Gesture Controlled Presentation using OpenCV and MediaPipe

Sruthi S[1], Swetha S[2]
[1]*UG – Computer Science and Engineering, R.M.K Engineering College, Kavaraipettai, Tamil Nadu, India*
[2]*UG – Electronics and Instrumentation Engineering, R.M.K Engineering College, Kavaraipettai, Tamil Nadu, India*
Orcid ID: https://orcid.org/0009-0003-2228-3427 , https://orcid.org/0009-0006-2463-2936

ABSTRACT
In today's digital era, presentations play a crucial role in various domains, ranging from education to business. However, traditional manual presentation methods, reliant on input devices such as keyboards or clickers, have inherent limitations in terms of mobility, interactivity, and user experience. To address these limitations, gesture-controlled presentations have emerged as a promising solution, harnessing the power of computer vision techniques to interpret hand gestures and enable natural interaction with presentation content. This paper presents a comprehensive system for hand gesture-controlled presentations using OpenCV and MediaPipe libraries. OpenCV is employed to capture video input from a webcam, while MediaPipe is utilized for hand tracking and landmark extraction. By analyzing finger positions and movements, the system accurately recognizes predefined gestures. Presenters can seamlessly control the slides, hold a pointer, annotate the content, and engage with the audience in a more interactive manner. The responsiveness and real-time performance contribute to an enhanced presentation experience.
Keywords—OpenCV, MediaPipe, Gestures, Presentation

1. Introduction

In today's digital age, presentations have become an integral part of various professional and educational settings. Traditionally, presenters have relied on input devices such as keyboards or clickers to navigate through slides and deliver their content.[3] While these methods have served their purpose, they come with certain limitations that can hinder the overall user experience. One of the primary limitations of traditional input devices is the lack of mobility and interactivity. Presenters often find themselves bound to a specific location, tethered to their computers or clickers, which restricts their freedom to move around and engage with their audience.[6] Additionally, the use of these devices may create a barrier between the presenter and the content, resulting in a less immersive and dynamic presentation experience. To overcome these limitations, gesture-controlled presentations have emerged as an innovative and promising solution.[1][2] By harnessing the power of computer vision and machine learning techniques, it becomes possible to interpret hand gestures and translate them into specific actions within a presentation. This technology allows presenters to interact with their slides using natural hand movements, promoting a more intuitive and engaging presentation style.[7][8] The paper introduces a hand gesture-controlled presentation system that leverages the capabilities of OpenCV and MediaPipe libraries to recognize and interpret a wide range of hand gestures, allowing presenters to perform various actions during their presentations.

2. Existing System

The manual presentation system typically involves using slide decks and input devices such as keyboards or clickers. Presenters navigate through slides by pressing buttons or keys on the input devices. Although widely used, this manual approach has several limitations. Presenters are restricted in their movement, and the use of external tools may lead to distractions or disruptions in

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the flow of the presentation. The lack of intuitive and natural interaction methods can also affect audience engagement. Therefore, there is a need for an alternative approach that offers improved mobility, interactivity, and user experience.

3. Proposed System

The proposed system incorporates computer vision techniques that leverages OpenCV and MediaPipe libraries to detect and track hand movements in real-time. The system focuses on recognizing and interpreting a range of natural hand movements. By analyzing the positions and movements of the fingers, the system recognizes gestures such as swiping left or right to navigate between slides. For example, a swipe gesture to the left can trigger the system to move to the previous slide, while a swipe gesture to the right can move to the next slide. Additionally, the system allows presenters to hold a pointer on the screen. By utilizing the hand tracking information, the system identifies the tip of the index finger and maps its position to the screen coordinates. This enables presenters to use their finger as a virtual pointer, enhancing their ability to highlight specific content on the slides. This ensures a smooth interaction between the presenter and the presentation software, enhancing the overall delivery and audience experience.

4. Block Diagram

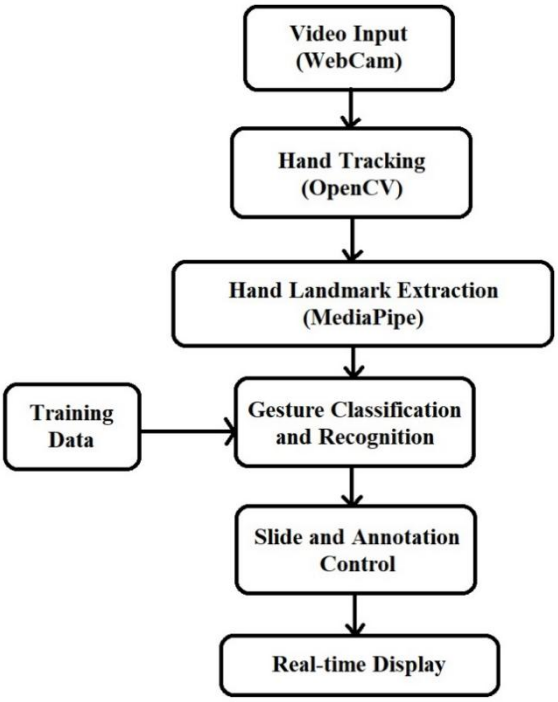

Fig.1 Block diagram

5. Working

The OpenCV and NumPy packages were used to develop the project's code in the Python programming language. The libraries used in this work are initially imported before being used for additional input and output processing. The system captures video input from a webcam, and each frame is processed to detect and track the presenter's hand. The HandTrackingModule, based on the MediaPipe Hands solution, is employed to identify hand landmarks and extract relevant information for gesture recognition. By analyzing the finger positions and movements, the system determines the active gesture and performs the associated action.

The system follows a systematic flow to enable seamless interaction with presentation slides:

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Hand Detection: The system utilizes OpenCV to capture live video input from a webcam. By analyzing the video frames, the system detects and identifies the presenter's hand within the captured images.

Hand Tracking: Once the hand is detected, MediaPipe is employed to track the hand movements and extract hand landmarks. These landmarks represent specific points on the hand, such as fingertips and joints, which will be used for gesture recognition.

Gesture Recognition: By analyzing the positions and movements of the hand landmarks, the system accurately recognizes predefined gestures. Each gesture corresponds to a specific action within the presentation software.

The gestures supported are as follows:

Gesture 1: Thumb Finger - Move to Previous Slide
Gesture 2: Little Finger - Move to Next Slide
Gesture 3: Index Finger and Middle Finger Together - Holding the Pointer
Gesture 4: Index Finger - Drawing on the Slide
Gesture 5: Middle Three Fingers - Erase/Undo the Previous Draw

By analyzing the position and movement of the presenter's hand, the system accurately recognizes these gestures and performs the corresponding actions during the presentation.

A. **Slide Navigation:** The system recognizes the Thumb Finger gesture, allowing presenters to move to the previous slide. Similarly, the Little Finger gesture enables presenters to progress to the next slide, providing seamless slide navigation.

B. **Pointer Control:** Presenters can hold a virtual pointer by bringing the Index Finger and Middle Finger together. This gesture enables them to highlight specific areas of the slide, directing the audience's attention and emphasizing key points. The dynamic pointer control adds an interactive element to the presentation.

C. **Drawing and Annotations:** The system enables presenters to draw on the slide using the Index Finger gesture. By moving their finger across the screen, presenters can create real-time annotations, underline important details, or emphasize specific elements. This feature allows for on-the-fly visual enhancements and effective communication of the content.

D. **Erasing:** To remove or revise previous annotations, presenters can utilize the Middle Three Fingers gesture. This gesture activates the erasing function, allowing presenters to effortlessly erase specific annotations or clear the entire slide, ensuring a clean and polished presentation.

E. **Interaction during Presentation:** The recognized gestures and corresponding actions are then communicated to the presentation software. The system integrates with popular presentation tools, enabling the seamless execution of the desired actions, such as moving between slides, highlighting content, creating annotations, and erasing or undoing annotations.

6. Result

The hand gesture-controlled presentation system, utilizing OpenCV and MediaPipe, has demonstrated accurate gesture recognition. It allows presenters to intuitively control their slides with seamless navigation, dynamic pointer control, real-time annotations, and effortless erasing. The system accurately tracks hand movements in real-time, ensuring a smooth presentation experience and enhancing audience engagement. This implementation opens up new possibilities for interactive and engaging presentations, showcasing the potential of computer vision and gesture recognition technologies in revolutionizing human-computer interaction.

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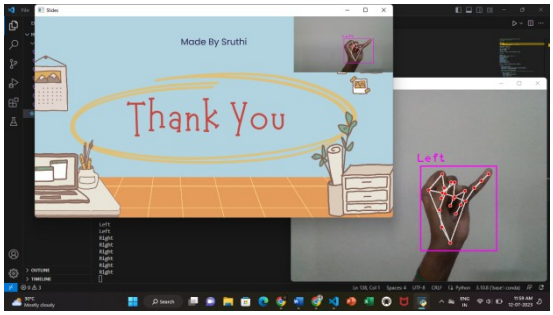

Fig.2.1. Gesture 1: Little Finger - Move to Next Slide

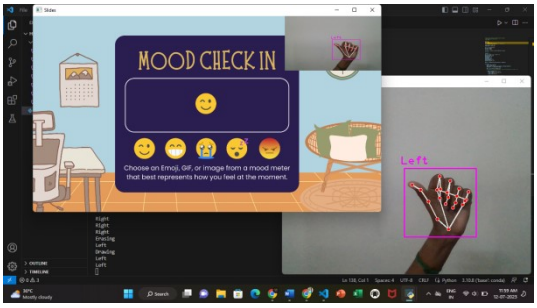

Fig.2.2. Gesture 2: Thumb Finger - Move to Previous Slide

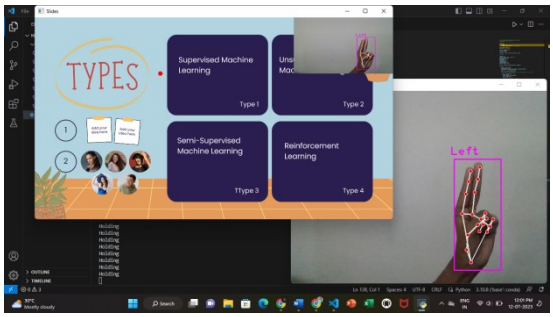

Fig.2.3. Gesture 3: Index Finger and Middle Finger Together - Holding the Pointer

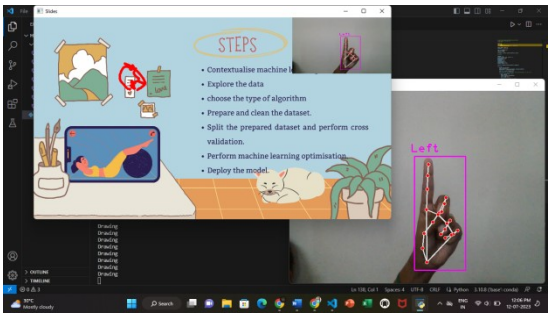

Fig.2.4. Gesture 4: Index Finger - Drawing on the Slide

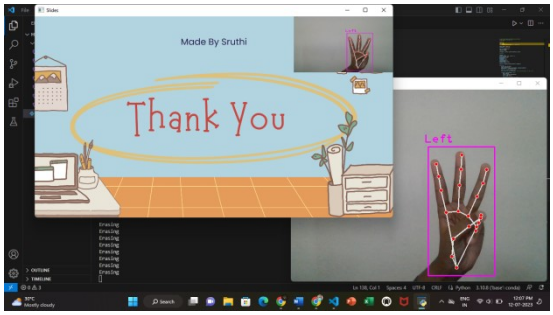

Fig.2.5. Gesture 5: Middle Three Fingers - Erase/Undo the Previous Draw

7. Conclusion

In conclusion, the hand gesture-controlled presentation system presents a compelling advancement in human-computer interaction. The system's precise gesture recognition, seamless functionality, and intuitive control capabilities empower presenters to effortlessly navigate slides, interact with content, and enhance audience engagement. This breakthrough has the potential to revolutionize traditional presentation methods, offering a more immersive and interactive experience for both presenters and viewers. Looking ahead, the success of this hand gesture-controlled system signifies a broader trend in the evolution of human-computer interaction. As technology continues to advance, natural and intuitive interfaces such as gesture recognition have the potential to become ubiquitous across various domains, including gaming, virtual reality, and smart devices. By bridging the gap between users and technology, these interfaces pave the way for a future where technology seamlessly integrates into our daily lives, offering intuitive and immersive experiences that enhance productivity, creativity, and communication.

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8. Future Enhancements

Additional Gestures and Actions: Introducing more predefined gestures and corresponding actions can expand the system's functionality. For example, incorporating gestures for zooming in or out, highlighting specific sections of a slide, or triggering multimedia elements like videos or animations can further enrich the presentation experience.

Multi-User Collaboration: Enabling multiple presenters to collaborate simultaneously using hand gestures would facilitate interactive group presentations. This could involve assigning different roles to presenters or implementing handover gestures to seamlessly transition control between presenters.

Compatibility with Multiple Presentation Platforms: Extending the system's compatibility to work with different presentation software or platforms would broaden its usability and reach. Ensuring compatibility with popular tools such as PowerPoint, Google Slides, or Keynote would enable presenters to utilize the system across various platforms.

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