Gesture-Controlled Document Navigator

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Abstract

In the digital era, traditional methods of document navigation, such as keyboard shortcuts and mouse clicks, are gradually being replaced by more intuitive and interactive solutions. This project, Gesture-Controlled Document Navigator, introduces a novel approach to navigating digital content using hand gestures. By leveraging computer vision techniques and threshold-based gesture recognition, users can seamlessly browse through documents and presentations without physical contact, enhancing accessibility and interactivity.

The system employs OpenCV and cvzone's HandDetector module to capture real-time video input, detect hand landmarks, and interpret specific gestures. Threshold-based gesture control is used to map predefined hand movements to navigation actions, such as moving between slides, drawing annotations, and erasing content. The algorithm identifies finger positions, analyzes their state, and executes corresponding commands with minimal processing delay.

This technology can be applied in education, business presentations, and accessibility solutions, offering a hands-free, interactive experience. The system is efficient, cost-effective, and requires no additional hardware, making it suitable for a wide range of users. Future improvements may include AI-driven gesture recognition for enhanced accuracy and integration with AR/VR environments to further expand its usability.

Keywords: Gesture Recognition Hand Tracking Computer Vision Human-Computer Interaction (HCI) Threshold-Based Control OpenCV MediaPipe Document Navigation Touchless Interface Real-Time Processing Artificial Intelligence Machine Learning Augmented Reality (AR) Integration Presentation Control Accessibility Solutions.

I INTRODUCTION

In the digital era, human-computer interaction is evolving toward more intuitive and contactless control mechanisms. Traditional document navigation methods, such as keyboard shortcuts and mouse clicks, often limit accessibility and efficiency. This project, Gesture-Controlled Document Navigator, introduces a novel approach to navigating digital content using hand gestures.By

leveraging computer vision and gesture recognition, users can seamlessly browse through documents and presentations without physical contact, enhancing user experience and accessibility.This system employs OpenCV and cvzone's HandDetector module to capture real-time video input, detect hand landmarks, and recognize specific gestures. Predefined hand movements trigger various navigation actions, such as moving between slides, drawing annotations, and erasing content. This approach eliminates the need for additional hardware, making it a cost-effective and practical solution for educational, business, and accessibility applications.

II RELATED WORK

Several studies and applications have explored gesture-based interaction for human-computer interfaces. Existing works in gesture recognition using MediaPipe and OpenCV have demonstrated high accuracy in hand tracking and finger detection. However, most prior implementations focus on general interaction rather than document navigation.

Hand Gesture Recognition Using Deep Learning explored CNN-based recognition but required extensive computational power.

Gesture-Controlled Smart Presentations utilized Leap Motion sensors, adding extra hardware costs.

AI-Powered Virtual Mouse Systems replaced traditional input devices but lacked document-specific functionalities.

This project improves upon existing solutions by offering a threshold-based gesture control system that is lightweight, efficient, and does not require external hardware.

III EXISTING SYSTEM

Current document navigation relies on keyboard shortcuts, mouse interactions, and touchscreen gestures, but it is limited by the need for physical contact, restricting accessibility for disabled users and presenters who require hands-free control. The lack of gesture-based navigation prevents intuitive interactions, making real-time annotation and erasing difficult without manual input. Additionally, the absence of voice commands or motion-based controls further reduces accessibility, highlighting the need for more inclusive and hands-free navigation solutions.

IV PROPOSED MODEL

The Gesture-Controlled Document Navigator replaces physical input methods

with hand gesture recognition. This system provides:

Contactless Navigation – Users navigate slides with predefined hand gestures.

Efficient Real-Time Processing – OpenCV and MediaPipe ensure low-latency tracking.

Secure & Privacy-Focused – No documents are stored; processing is in real-time memory.

Customizable Gestures – Predefined gestures enhance ease of use and intuitiveness.

Gesture Mapping:

Thumbs Up → Previous Slide

Little Finger Up→ Next Slide

Index Finger Up → Mouse Pointer

Index + Middle Finger → Enable Drawing

Index + Middle + Ring Finger → Erase Annotations

Index + Middle + Ring + Little Finger → Close Document

V SYSTEM ARCHITECTURE

The system consists of five primary components:

A. Input Module (Hand Gesture Detection)

Captures real-time video feed.

Detects hand landmarks using cvzone & MediaPipe.

B. Gesture Recognition & Processing

Analyzes hand position and movements.

Uses threshold-based classification for gesture recognition.

C. Document Processing Module

Converts PDF/PPT into images using pdf2image & python-pptx.

Stores images temporarily for real-time interaction.

D. Navigation & Interaction Module

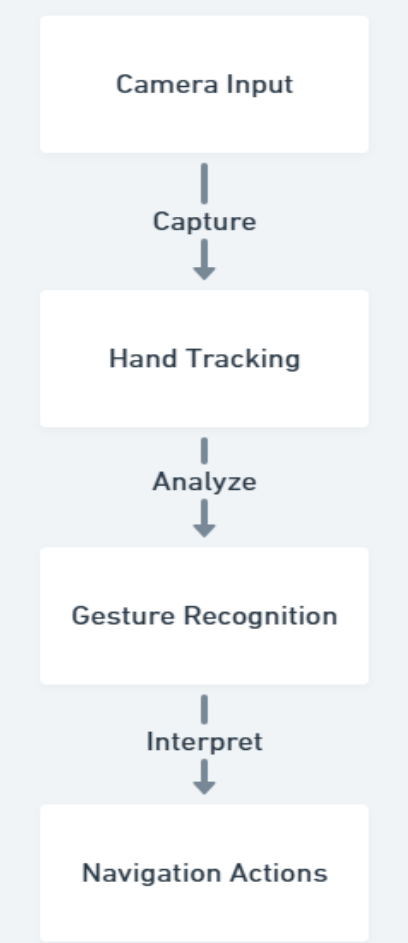
Maps detected gestures to slide transitions, pointer movement, drawing, erasing, and closing actions.

Ensures real-time responsiveness for seamless control.

E. Secure Processing & Temporary Storage

All document data is stored temporarily in RAM.

No data is saved permanently, ensuring user privacy.



VI MODULES

1 User Document Processing Module Converts PDF/PPT into images.

Loads images into memory for interaction.

2 Real-Time Hand Gesture Detection Module Uses OpenCV & MediaPipe for hand tracking.

Identifies predefined gestures and their states.

3 Gesture-Based Navigation Module Maps gestures to document control actions.

Ensures smooth transitions & real-time feedback.

4 Secure Processing & Temporary Storage Module No documents are stored permanently.

Data is cleared after the session ends.

5 User Interface & Display Module Displays real-time pointer feedback.

Provides interactive drawing & erasing features.

VII CONCLUSION

The Gesture-Controlled Document Navigator revolutionizes document interaction by replacing traditional input methods with gesture-based control. It provides an efficient, cost-effective, and hands-free solution for navigating presentations and PDFs.By leveraging computer vision and threshold-based recognition, this system ensures real-time, secure, and accessible document interaction. Future enhancements may include AI-based gesture classification and AR/VR integration for an even more immersive experience.

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