

# Gesture-Based Touchless Control System Using Computer Vision

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**Abstract-** Gesture-based interaction is quickly becoming a viable replacement for touchscreens, particularly where hygiene or accessibility is a concern. This study details a touchless control system that uses computer vision to read hand gestures in real-time. By merging image processing with a deep-learning tracking model, our approach can identify specific poses and motion-based gestures. The process is broken down into capture, preprocessing, feature extraction, classification, and execution. We designed the system to handle various lighting environments and backgrounds to ensure it works reliably in everyday scenarios. Performance tests show high accuracy and low latency, allowing for smooth interaction without the need for wearables or physical touch. This makes the system useful for applications ranging from healthcare and public kiosks to smart homes. The findings demonstrate that computer vision is an effective tool for building safer, user-friendly touchless interfaces.

**Keywords:** Human Activity Recognition (HAR), Adaptive AI Framework, Machine Learning, Healthcare Monitoring, Context-Aware Systems, Real-Time Activity Recognition, Intelligent Healthcare.

## I. INTRODUCTION

With the rapid growth of digital systems, touch-based interfaces such as screens, buttons, and switches have become a part of everyday life. Frequent physical contact with these interfaces, however, can result in hygienic problems, particularly in settings like public spaces, hospitals, and shared facilities. Additionally, older users or those with physical restrictions might not always find touch-based systems convenient. The need for more accessible and touchless interaction techniques has grown as a result of these issues. Gesture-based interaction offers a practical solution by enabling users to control devices with hand gestures without making physical contact. Accurate detection and recognition of hand gestures using common cameras is now feasible thanks to recent developments in computer vision and machine learning. Vision-based methods reduce the need for additional hardware while providing a more comfortable and natural user experience than wearable or sensor-based systems. This work presents a computer vision and deep learning-based touchless control system.

The system captures images, preprocesses them, extracts features, classifies gestures, and executes

commands in an organized manner. It is appropriate for real-world use because it is built to function dependably in a variety of lighting and background conditions. According to the experimental evaluation, the suggested system achieves low response times and high recognition accuracy, allowing for seamless, real-time interaction. Numerous industries, including public kiosks, smart home automation, and healthcare monitoring, can use this system. All things considered, the study shows that computer vision-based gesture recognition is a useful and approachable method for creating secure and effective touchless control interfaces.

## II. CURRENT APPROACHES

Most existing systems depend on touch-based interfaces such as touchscreens, buttons, and keyboards for user interaction. These techniques are straightforward and popular, but they necessitate physical contact, which raises hygienic issues in settings like public spaces and hospitals. Wear and maintenance problems are also brought on by continuous use. For gesture recognition, some sophisticated systems make use of wearable technology or external sensors. These solutions lessen direct contact, but they can be uncomfortable

for users and frequently raise costs. Furthermore, wearable-based systems aren't always appropriate for daily or prolonged use. As a result, there is currently no completely touchless, cozy, and widely available interaction method.

### **III. SYSTEM ARCHITECTURE AND FRAMEWORK**

The proposed system enables touchless interaction using computer vision and deep learning techniques. Its modular architecture ensures accuracy and real-time performance by having each component carry out a distinct function in the gesture recognition process. The system begins with image acquisition, in which a camera records hand movements in real-time video frames. In order to minimize noise and manage changes in lighting and background conditions, these frames undergo preprocessing. Next, important hand landmarks and motion characteristics needed for gesture recognition are identified by a deep learning-based hand tracking and feature extraction module. The gesture classification module then analyzes the extracted features to identify predetermined gestures. The execution module recognizes a gesture, translates it into the appropriate command, and carries out the necessary action without making physical contact. For real-world objectives, this architecture offers dependable performance, low latency, and seamless interaction.

### **III. IMPLEMENTATION METHODOLOGY**

The implementation of the proposed touchless control system is carried out in a step-by-step manner to ensure accurate gesture recognition and real-time performance. The approach prioritizes ease of use, dependability, and flexibility in response to actual circumstances. First, a standard camera is used by the system to record live video input. To extract valuable visual information, every video frame is processed separately. To enhance image quality and preserve consistency in a variety of lighting situations, preprocessing techniques like noise reduction, resizing, and illumination adjustment are used. Following preprocessing, the hand region and important landmarks are identified using a deep

learning-based hand tracking model. The position and motion of the fingers and palm are represented by these landmarks. The system recognizes predefined gestures by analyzing hand poses and motion patterns based on these features. A gesture is mapped to a particular control command once it has been accurately identified. Then, without any physical contact, the corresponding action is carried out in real time. This procedure is constantly updated by the system to guarantee dependable, responsive, and seamless operation. The system can operate efficiently in a variety of settings and application scenarios thanks to this implementation strategy.

### **IV RESULTS AND PERFORMANCE EVALUATION**

The performance of the proposed touchless gesture control system was evaluated through real-time testing under different lighting and background conditions. Accurate gesture recognition, response time, and system stability were the main evaluation criteria. For the predetermined gestures, the system produced accurate and dependable gesture recognition. It produced seamless interaction with little delay by reacting swiftly to user inputs. Additionally, the system demonstrated effective handling of environmental variations by maintaining consistent performance when used continuously. Overall, the findings show that the suggested system is effective, reliable, and useful for real-world applications where touchless interaction is crucial, like public kiosks, healthcare settings, and smart home systems.

### **V. CONCLUSION**

The suggested gesture-based touchless control system uses deep learning and computer vision to efficiently identify hand gestures in real time. It is appropriate for applications like healthcare, public kiosks, and smart homes since it offers precise, quick, and contact-free interaction without the need for wearable technology

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