**Title:** Real-Time Hand Tracking and Distance Measurement Using MediaPipe and OpenCV

**Abstract:**

This paper presents a real-time hand tracking system that utilizes MediaPipe and OpenCV to detect and track the human hand, focusing on the index finger tip. The primary objective is to measure the Euclidean distance between the fingertip and the center of the video frame, providing users with immediate visual feedback. This system uses MediaPipe's advanced hand landmark detection capabilities to achieve high accuracy with minimal computational overhead, making it suitable for various applications such as human-computer interaction (HCI), virtual reality (VR), and gesture recognition systems. The experimental results demonstrate the robustness and efficiency of the proposed method in real-time environments.

**Introduction:**

Hand gesture recognition and tracking have become pivotal in developing intuitive and natural interfaces for human-computer interaction (HCI). Recent advancements in computer vision and machine learning have led to more efficient and accurate hand tracking systems. Among these, Google's MediaPipe framework has emerged as a leading solution for real-time, cross-platform applications due to its lightweight architecture and robust performance.

In this research, we leverage the capabilities of MediaPipe and OpenCV to develop a system capable of real-time hand tracking with a specific focus on measuring the distance between the index fingertip and the center of the video frame. The system employs MediaPipe's hand landmark model, which detects 21 landmarks per hand, ensuring precise localization of hand keypoints. This research aims to provide a low-cost, real-time solution for gesture-based controls in interactive applications, including augmented reality (AR), virtual reality (VR), and touchless user interfaces.

The structure of this paper is as follows: Section 2 reviews related works and technologies, Section 3 details the methodology and system architecture, Section 4 presents experimental results and performance analysis, and Section 5 concludes with potential future enhancements.

**References:**

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*Note: Additional sections such as methodology, experimental results, and conclusion can be developed based on project requirements.*