**HAR Using Pose Estimation**



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# Abstract

In the realm of computer vision and human-computer interaction, the ability to understand and interpret human poses is a crucial aspect. This project aims to create an efficient and real-time pose detection and analysis system using OpenCV and the MediaPipe library. The system captures live video feed from a webcam, employs a custom PoseModule, and utilizes the capabilities of MediaPipe to perform accurate pose estimation. The analysis includes the identification of specific body positions such as sitting, standing, and movement through angle calculations.

# Introduction

Understanding human body language and movements has become increasingly important in various applications, ranging from fitness tracking to human-computer interaction. This project addresses the need for a robust system that can interpret and analyze live human poses. Leveraging OpenCV and MediaPipe, the goal is to provide real-time insights into a user's body position and detect dynamic movements.

# Methodology

## Pose Detection Module

The pose detection module is a critical component of the system, responsible for accurately identifying and localizing key landmarks on the human body. In this project, a custom PoseModule is developed, leveraging the capabilities of the MediaPipe library. The module is initialized with parameters such as mode, upBody, smooth, detectionCon, and trackCon. These parameters control the behavior of the pose estimation model, allowing flexibility in the system's configuration.

The PoseModule utilizes the MediaPipe Pose model with specific configurations:

* static\_image\_mode: This parameter is set to the project's mode, controlling whether the model operates in static image mode or video mode.
* model\_complexity: The complexity of the pose estimation model is set to 1, balancing accuracy and computational efficiency.
* smooth\_landmarks: This parameter influences the smoothness of the detected landmarks, enhancing the stability of pose estimations.
* min\_detection\_confidence: The confidence threshold for detecting landmarks is set to detectionCon, filtering out less confident predictions.
* min\_tracking\_confidence: The confidence threshold for tracking landmarks across frames is set to trackCon, ensuring continuity in landmark identification.

## Pose Analysis

The pose analysis phase involves interpreting the detected landmarks to extract meaningful information about the user's body position. This is achieved by calculating angles between specific joints. The system focuses on key body parts, such as elbows, shoulders, and knees, to determine the angles formed by these joints. These angles are indicative of the user's pose, whether they are sitting, standing, or engaging in specific movements.

The findAngle method in the PoseModule calculates the angles between three specified landmarks, providing a numerical representation of the body's orientation. These angles are then used to draw lines and circles on the video feed, visually representing the calculated angles and aiding in the interpretation of the user's pose.

## Thresholding and Movement Detection

To enhance the accuracy of pose analysis, a thresholding mechanism is introduced. This mechanism compares the difference in joint positions between consecutive frames. If the average difference surpasses a predefined threshold, the system interprets this as significant movement. The thresholding ensures that only substantial changes in pose are considered, reducing the likelihood of false positives and enhancing the system's robustness.

The check\_pose function in the main script utilizes this thresholding mechanism to categorize the user's action as sitting, standing, or moving. By comparing the average differences in joint positions against a predefined threshold, the system can effectively identify dynamic movements.

This combination of pose analysis and movement detection provides a comprehensive understanding of the user's actions, making the system versatile and suitable for various applications.

# Results

Extensive testing in real-time scenarios demonstrates the effectiveness of the developed system. The pose detection and analysis consistently provide accurate insights into the user's body position. The graphical user interface enhances the user experience by overlaying relevant information directly on the video feed. The system successfully identifies sitting, standing, and dynamic movement states with precision.

# Conclusion

In conclusion, this project presents a comprehensive solution for real-time pose detection and analysis. The integration of OpenCV and MediaPipe, along with a custom PoseModule, enables accurate pose estimation and angle-based pose analysis. The system's ability to detect movements enhances its versatility, making it suitable for applications such as health monitoring and interactive interfaces. Future developments may focus on refining movement detection algorithms and exploring additional use cases for this robust pose analysis system.