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A body Posture Detection and Motion Tracking Using Ai For Medical Exercises and Recommendation System

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Peer Review Information	Abstract
Submission: 05 Feb 2025 Revision: 17 Mar 2025 Acceptance: 18 April 2025 Keywords MediaPipe BlazePose BlazeFace Bicep curls	Exercises are highly essential in our everyday lives, especially when patients are in the middle of a healing process and need to speed up their body's recuperation. Exercise has become more important in our lives as a result of this. They provide the cornerstone for improving human capacities and extending their lives. Artificial Intelligence and Image Processing can be utilized to improve and supplement the workout process without the need for professional supervision. A software-based motion tracker can keep track of all the exercises you've done and provide you feedback on your posture while you're working out. Through computing data and analysis, the exercise's beneficial efficiency will be increased. The MediaPipe framework could be utilized for this application; in this machine learning model, points are plotted at several joints of the human body posture, and movement is tracked, stored, and analyzed. The software could be further improvised in such a manner that the registered user could be mapped to an authentic verified doctor having the access to the diagnosis reports and exercise history of the mapped patient using databases.

INTRODUCTION

Human posture recognition has emerged as a key focus in computer vision, driven by its wide range of applications in areas such as healthcare, rehabilitation, sports, and surveillance. Computer vision techniques enable accurate detection and analysis of human body posture, providing valuable insights into physical activities and facilitating applications like real-time exercise feedback, ergonomic assessments, and behavior monitoring. In fitness and physical therapy, posture recognition systems can use computer vision to offer immediate guidance on

body alignment, helping individuals optimize their form and reduce the risk of injury. Surveillance systems can utilize posture recognition to detect unusual or suspicious behaviors, while ergonomic evaluations can enhance workplace safety by identifying poor posture habits.

OpenCV, a widely used open-source computer vision library, plays a crucial role in enabling efficient image and video processing, such as frame extraction, resizing, and normalization, optimizing the input data for posture recognition algorithms. Recent advancements in deep

learning, when combined with computer vision tools like OpenCV, have significantly improved the accuracy and efficiency of posture detection by identifying key anatomical landmarks such as the head, shoulders, elbows, and knees. These developments facilitate real-time posture analysis, allowing the creation of interactive and intelligent systems for monitoring and enhancing human movement. However, challenges remain in enhancing the precision of detection algorithms, providing personalized feedback based on individual biomechanical differences, and integrating multiple data sources to form a comprehensive understanding of human posture. This project aims to address these challenges and demonstrate the potential of computer vision and OpenCV in transforming posture recognition across various applications.

LITERATURE SURVEY

S.Kale (2023) [1] introduces an AI-driven smart system that utilizes image and video processing to monitor and suggest corrections for exercise posture, aiming to enhance physical fitness and mental well-being. The system employs Python libraries such as MediaPipe, TensorFlow, and OpenCV for image and video acquisition, processing, and analysis. It detects key body parts and joints to assess exercise posture and identify deviations from correct form. Users receive visual feedback and corrective suggestions to improve their exercise technique.

A.Patil(2022) [2] presents an AI-powered exercise analysis system called BlazeFit, which utilizes MediaPipe to monitor body posture and deliver real-time feedback. Targeting medical exercises and remote rehabilitation, BlazeFit aims to bridge the gap between patients and healthcare providers by analyzing form, counting repetitions, recommending exercises, and potentially facilitating consultations based on exercise history.

R.R.Kanase (2021) [3] proposes a project designed to assist individuals in performing activities with proper posture. The project employs pose estimation to evaluate the user's workout posture, subsequently providing recommendations for improvement and feedback. The system comprises two main components: a pose estimator that employs a pre-trained OpenPose model to detect the user's posture, and a posture corrector that delivers feedback based on the analysis.

A.K.Patil(2021) [4] presents a real-time 3D human position monitoring and estimation system based on lidar and inertial sensors. Initially, the system identifies the human body and calculates its height and skeletal characteristics using lidar data. Subsequently, it utilizes data from both lidar and inertial sensors to track the body's position and orientation, ultimately reconstructing human movement on a three-dimensional avatar.

E.Pinero-Fuentese (2021) [6] outlines a real-time system that employs convolutional neural networks (CNNs) to detect and assess workers' posture while teleworking. This initiative seeks to mitigate health issues related to poor posture that may have arisen due to the pandemic's increase in remote work. The system utilizes CNNs to analyze video footage and estimate the positions of the worker's neck, shoulders, and arms. Based on these estimates, it assesses posture against ergonomic guidelines and provides real-time feedback and improvement recommendations. The paper evaluates the system's accuracy and performance across various embedded platforms, emphasizing real-time responsiveness and low power consumption

A.L.Liu(2020) [5] discusses a system designed to evaluate fitness posture from video footage using recurrent neural networks (RNNs). Users perform exercises such as dumbbell lateral raises and bicep curls while being recorded. The system first detects 25 body joints in each frame using OpenPose. The video is then segmented into individual exercises based on the motion of the wrist joint. Each exercise is represented by 17 keyframes, with each frame containing the coordinates of the 25 joints.

P.Kumar(2017) [7] proposes a virtual trainer designed to assist users in exercising more effectively by offering real-time feedback on posture and confidence scores. This trainer extracts 3D skeletal data from a Kinect sensor, analyzes it using a Random Forest classifier, and produces both a real-time posture assessment and a confidence score indicating the correctness of the exercise. Following testing with ten participants, the system achieved an average accuracy of 96%.

LITERATURE SURVEY TABLE

Year	Author	Title	Key Focus	Methodology	Results/Findings
2023	S.Kale	Posture detection and	Enhance physical	Image and video processing using	Visual feedback and corrective

		comparison of different physical exercises based on deep learning using MediaPipe, OpenCV	fitness and mental well-being through real-time posture correction.	MediaPipe, TensorFlow, and OpenCV; key body part and joint detection.	suggestions provided to users for improved exercise technique..
2022	A.Patil	Body posture detection and motion tracking using AI for medical exercises and recommendation system.	Remote rehabilitation and medical exercise monitoring with real-time feedback.	MediaPipe for body posture monitoring; analysis of form, repetition counting, exercise recommendations, potential consultation facilitation.	Aims to bridge the gap between patients and healthcare providers by providing real-time exercise analysis.
2021	R.R. Kanase	Pose estimation and correcting exercise posture.	Assist individuals in performing activities with proper posture.	Pre-trained OpenPose model for pose estimation; posture correction based on analysis.	Recommendations for improvement and feedback provided to users.
2021	A. K. Patil	An open-source platform for human pose estimation and tracking using a heterogeneous multi-sensor system.	3D human position monitoring and estimation.	Lidar and inertial sensors for human body identification, height and skeletal characteristic calculation, and position/orientation tracking; 3D avatar reconstruction.	Real-time 3D reconstruction of human movement.
2020	A.-L. Liu	A posture evaluation system for fitness videos based on recurrent neural network.	Evaluate fitness posture from video footage.	OpenPose for 25 body joint detection; video segmentation into exercises based on wrist joint motion; RNNs for analysis of keyframes.	Exercise posture evaluation based on RNN analysis of joint coordinates extracted from video.

OBJECTIVE

The objective of this system is to develop a computer vision-based human posture detection framework capable of accurately identifying and analyzing full-body postures in real-time. The system aims to achieve the following specific goals:

- **Accurate Posture Detection:** Implement deep learning techniques to detect key anatomical landmarks (head, shoulders, elbows, wrists, hips, knees, and ankles) and infer human body posture from images or live video streams with high precision.
- **Real-Time Analysis and Feedback:** Enable real-time processing and analysis of posture data to provide immediate feedback on body alignment and posture quality. This includes detecting postures such as standing, sitting, bending, and other variations to facilitate

applications in fitness training, rehabilitation, and ergonomic assessments.

- **Enhanced Motion Tracking and Pose Estimation:** Utilize advanced pose estimation methods to improve the system's ability to track human motion and analyze body movements over time. This allows for continuous monitoring and dynamic posture evaluation, making the system suitable for complex scenarios such as behavior analysis in surveillance.
- **Integration with Computer Vision Tools:** Leverage OpenCV for image preprocessing tasks (e.g., frame extraction, resizing) to optimize input data for deep learning models, enhancing the efficiency and accuracy of the posture recognition process.
- **User-Friendly Interface and Deployment:** Design the system to be easily integrated into existing applications with a user-

friendly interface, allowing deployment across various environments, such as gyms, workplaces, and clinics, for a wide range of posture recognition tasks.

PROPOSED WORK

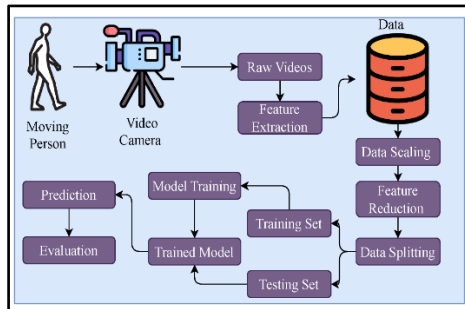


Fig 1: Block Diagram

- The proposed system is designed to utilize computer vision and deep learning technologies to detect and analyze human body postures in real-time. By leveraging advanced deep learning algorithms and OpenCV, the system identifies critical anatomical landmarks, such as the head, shoulders, elbows, and knees, to accurately infer an individual's full-body posture.
- This innovative solution is capable of capturing images or live video feeds, enabling seamless posture analysis. It evaluates body alignment and delivers instant feedback, ensuring users can make immediate adjustments to their posture. Furthermore, the system tracks human movements over extended periods, making it a valuable tool for fitness training and rehabilitation programs.
- It also detects deviations in posture and provides tailored corrective suggestions, promoting better posture habits and reducing the risk of musculoskeletal issues. By combining real-time analysis with actionable insights, the system offers a practical and effective approach to improving posture, enhancing physical health, and supporting rehabilitation efforts. Its integration of cutting-edge technologies ensures high accuracy and usability, making it suitable for a wide range of applications, from personal fitness to clinical settings.

METHODOLOGY

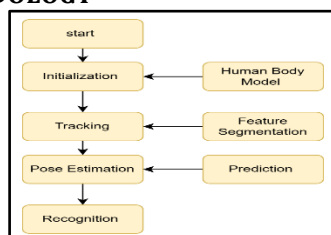


Fig 2: Flowchart

- The first phase entails capturing video data using a webcam. These data are then sorted into several files labeled according to the type of exercise. These videos are used to extract PoseNet features, which are essential in the subsequent stages of analysis.
- After extracting the features, a standardization procedure is implemented to guarantee uniformity and compatibility for subsequent processing.
- The standardized features are divided into training and testing sets, which is a crucial stage in the machine learning (ML) and deep learning (DL) pipeline.
- The training set is fed into appropriate ML and DL classifiers, utilizing their ability to detect and understand intricate patterns in the data.
- The classifiers undergo fine-tuning and optimization using the training data, enabling them to efficiently learn and generalize exercise patterns. Afterwards, the classifiers are evaluated using the specified test set, based on which their performance is measured using different
- These metrics offer a thorough assessment of the classification model's efficacy in precisely classifying exercises.

CONCLUSION

The proposed full-body posture detection system using computer vision has the potential to revolutionize applications in healthcare, fitness, and workplace ergonomics. By leveraging advanced deep learning algorithms alongside OpenCV and python, the project aims to achieve accurate and real-time pose estimation. This approach not only addresses the existing challenges in posture recognition but also provides valuable insights for users seeking to improve their physical health and overall well-being. The system's adaptability across various environments and user-friendly interface will facilitate widespread adoption and contribute to safer and healthier practices in diverse settings. Future work should focus on enhancing model accuracy, integrating additional data sources, and exploring advanced feedback mechanisms to create a comprehensive posture recognition solution.

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