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AI-Driven Workout Guide

Sakshi Shinde[1], Rajas Shah[2], Nupur Dhage[3], Yash Thakare[4], Amruta Patil[5]

Undergraduate Research Paper, Department of Computer Engineering, Smt. Kashibai Navale College of Engineering, Pune, India[1,2,3,4]

Department of Computer Engineering, SKNCOE, Savitribai Phule Pune University, Pune 411041, India[5]

Abstract: In the past years, thousands of fitness enthusiasts are seeking solutions to having an effective and personalized workout. Presently, most of the users experience a bad posture during some exercises that results in pain or reduced outcome. To overcome this challenge, the "AI-Based Workout Guide" is a technology-driven solution which uses computer vision and AI to give real-time posture correction along with rep counting.

The project uses AI and machine learning algorithms to assess the motion of users' bodies while executing a workout. Captured through a camera or smartphone, the system will compare this posture against predefined models for the best techniques to do the exercises. If there is an incorrect posture, it will always give instant feedback as to what adjustments are needed. Another system feature is that the number of repetitions is automatically counted, so there's no manual counting involved and even more concentration on the proper form by the user.

The model has been trained on the dataset of various exercise postures, including squats, push-ups, and lunges. Computer vision libraries OpenPose or Mediapipe are used to detect key landmarks, such as joint angles and alignment. In real time, the system evaluates these landmarks in order to provide an accurate posture assessment and count of the rep. In the end, this would help the users improve their workout efficiency, reduce the chances of injury, and achieve fitness goals in a better manner.

It's an accessible, scalable AI-based workout guide, from which follows that it can easily be adapted into any mobile or web application. Its applicability extends to novices and more experienced fitness enthusiasts. This project shows how technology may transform personal training in fitness: a combination of advanced AI techniques with a practical solution for the application of fitness.

Keywords: AI, Computer Vision, Workout Guide, Pose Estimation, MediaPipe, OpenCV, Exercise Form Correction.

I. INTRODUCTION

There is a growing awareness of fitness these days, and more people are doing workouts, either at home or in the gym. Indeed, this trend fosters physical well-being and health, but with this trend comes a challenge: ensuring that proper posture is observed during exercises. Incorrect posture develops especially if one does such strength-based or repetitious movements as squats, push-ups, or lunges, leading to injuries and strains and poor workouts. Moreover, rep counting regularly shifts the focus from form to maintaining the necessary pace. It reduces the chances of moving forward and increases the risk of errors. For all these reasons, technology is fundamental in personal fitness to overcome the problems stated above with artificial intelligence (AI) emerging as a powerful tool to assist users in real-time.

This will result in an intelligent workout guide that not only recognizes workout posture but also corrects it and counts the repetitions made. The AI system would utilize computer vision, where it tracks the movement of the body of the user and analyses it instantly for different exercises. With pre-trained models of perfect posture, the system would find out whether the user is actually exercising or not. It will alert the user immediately about improper posture and thus give them the opportunity to correct it. In addition, it tracks repetitions without burdening the user so that he does not have to count repetitions himself but can focus on proper posture and optimize workout effectiveness.

The significance of good posture while working out cannot be overstated. Poor form does more than simply make a workout less effective: a bad posture in stress or strength exercises may lead to severe physical trauma. Some small mistake, such as bending the back in squats or neglecting overall alignment in a pushup, for an ordinary person, goes unnoticed. This is where AI technology comes in. AI examines the postures in real time using advanced machine learning algorithms and computer vision techniques and data from multiple sources, which can even catch small deviations in the ideal form and prompt the user to make the necessary adjustments. The core technology behind such a system is OpenPose or Mediapipe, popular libraries for human body landmark detection, such as joints, angles, and the like.

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II. PROBLEM STATEMENT

Many people can easily sustain injury or lose the effectiveness of their workout if they do not maintain proper posture. Moreover, manually tracking repetitions during exercise would divert a user's concentration to form. The absence of immediate feedback while working out, with workouts often performed at home or without supervision, creates a demand for an intelligent solution that would be capable of correcting posture and counting repetitions automatically. This proposed project would develop an AI-based fitness guide for which a computer vision-based live detection and correction of exercise posture with accurate rep counting was used, thus making the workout better and lowering the injury risk.

III. LITERATURE REVIEW

A literature survey is as follows:

In "Deep Learning: Methods and Applications," Deng and Yu (2016) present some of the developmental efforts and effectiveness of deep learning algorithms toward various applications such as pose detection and human movement tracking. Their work serves as the basis of the foundational methods applied in AI models for detecting the patterns of posture and movement in humans. This paper constructs the basis of creating systems that would track human poses in real-time on the discussion posed, that of neural networks, which would prove to have tremendous applicability to AI-driven workout guides where precise pose estimation forms a critical component.

Islam et al. (2020) in their paper, "Correction and Estimation of Workout Postures with Pose Estimation using AI," show how AI-based pose estimation techniques can actually detect incorrect workout postures. In this paper, the analysis has gone into how deep learning algorithms can be applied to analyze human movements and input real-time feedback into users when exercising. This work contributes to the establishment of intelligence.

Park et al. introduced "Virtual Gym Tracker: AI Pose Estimation" in 2021. The paper describes a system that uses advanced deep-learning techniques to track users' movements in a workout environment. The system provides immediate analyses and feedback to the users hence enhancing the effectiveness of their workout through an immediate change in the form of users. This research is helpful for AI-based fitness systems as it exemplifies how immediate feedback enhances user engagement in physical activities and their performance.

Another paper added to this field is the Ranganathan et al. paper from 2021. The study discusses how AI can be used to track the posture of exercise and count the repetitions in real time. It uses pose estimation techniques for popularly done exercises in gyms such as squats and lunges. In turn, it provides a solution that increases the accuracy of execution and makes sure the users maintain the correct form. In conclusion, the paper allows its readers to understand how AI can be interfaced with fitness regimes and the possibility of such integration to augment the user experience while exercising in real time.

Li et al. (2022) in "Robust Intelligent Posture Estimation for an AI Gym Trainer" identifies a system of posture estimation based on AI techniques, like Mediapipe and OpenCV, that would be applied to provide real-time feedback when working out in the gym. This paper is highly relevant because of the capability to track and correct form in real-time in the context of AI-based fitness guides. This further reveals that smart posture estimation can make personal fitness more accessible while doing away with the need for constant supervision from human trainers.

IV. TECHNOLOGIES USED

We have used many libraries in our implementation like OpenCV and MediaPipe that use machine learning combined with a lot of arithmetic operations and algorithms. We are using CPU capacity for posture estimation in order to get the precise positions and angles. Knowing these angles, we can recognize special activities like the number of bicep curls and so on. We can calculate the angle between any three points using just one line of code.

[1] OpenCV

OpenCV is an open-source computer vision library aimed mainly at real-time applications. Originally developed by Intel, the program currently receives support from Willow Garage and Itseez. The library is cross-platform and is distributed under the BSD license, which makes it open-source and hence widely available.

[2] Python

This language is general-purpose, high-level, simple, and readable. Python also contains dynamic type checking plus automatic garbage collection, with support for multiple programming paradigms, including procedural object-oriented and functional programming styles. Despite not being at the top of the list for web development, it is ideal for machine learning applications, data analysis, and GUI development. Its libraries and frameworks are used to a great extent in data

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science work. Those include the analysis of big datasets, visualization of data, and prototyping. Among other industries, it has become more popular with data scientists than the recent trend for web development.

[3] Artificial Intelligence

Artificial intelligence is the field of computer science that constructs systems that can mimic human-based judgment, understanding, and intelligent behaviour to solve complex tasks carried out by humans. It includes voice recognition, decision-making, and translation. Essentially, an AI system fundamentally aims at emulating human behaviour and decision-making patterns.

[4] MediaPipe

MediaPip**e s**implifies the building of live applications, like 3D human posture estimation, by enabling efficient neural network inference directly on the device. Its posture estimation tool works with 33 key points on the body that it is able to identify and predict according to a dataset. Using the BlazePose tool, which is powered by machine learning, MediaPipe detects poses in real-time from a camera feed or RGB video. This method uses a two-step pipeline of machine learning to improve its accuracy. In the former, it first detects the region of interest in the video; then the latter detects key points within the region of interest. The tracker runs only when the model is at the onset of the process or fails to detect key points.

V. SYSTEM ARCHITECTURE

One of its main strengths is providing real-time feedback to the users. It allows them to correct their posture and then always maintain proper form during their workout, which is critical for avoiding injuries as well as maximizing the effectiveness of any exercise. To avoid such deviations in posture, the system establishes threshold values and can subsequently detect such deviations immediately, providing instant alerts to the user in real time. This also ensures that they receive instant feedback so that while the users exercise, they can correct their form and increase their performance. The proposed system is carefully engineered to provide real-time support for exercisers in various exercises. It features a pose recognition model combined with geometric analysis of posture to detect and correct it, ensuring the proper performance of the exercises. The system processes information coming from a live webcam feed or a video data set, providing subjects with real-time feedback, including progress tracking and repetition counting. Below is a flowchart that represents the architecture of our system:

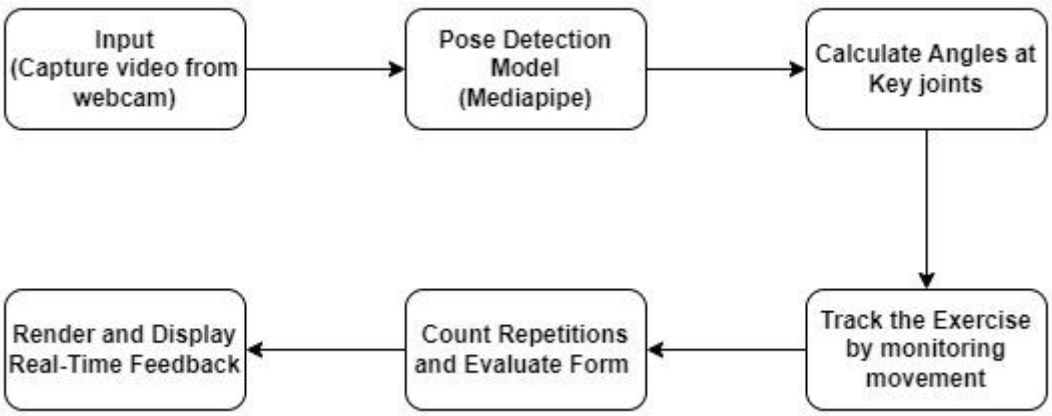

Fig 1. System Architecture

Input and Output:

Input: Real-time video feed

Output: Repetition Counter, Posture Feedback

Flow of Data :

Captures video from webcam.

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Process each frame to detect the human pose using Mediapipe.

Calculate angles at specific joints.

Track the exercise by monitoring arm movement and back posture.

Count Repetitions and access forms based on angles.

Render and Display Results such as count, form evaluation, and pose landmarks on the screen.

Exit when the user chooses to do so.

VI. CONCLUSION

In this project, we have come up with an AI-based gym workout guide that not only supports the fitness journeys of the users through personalized training experiences but also has the capability to offer real-time posture correction and automated repetition counting using advanced computer vision methodologies. Since the guide is also a friendly and easily accessible workout option for a wide cross-section of fitness enthusiasts, it is an enabler toward healthier lifestyle choices. In a nutshell, this venture demonstrates the adaptability of artificial intelligence technology in revolutionizing personal fitness training and providing core benefits to users.

VII. FUTURE SCOPE

Enhanced AI Algorithms: It shall improve the accuracy of posture detection and rep counting by including more advanced machine learning algorithms and through an expanded exercise dataset.
User Community Features: Social features allow users to connect, share how they're doing, and participate in challenges in order to build a healthy fitness community.
Incorporating wearable technology: Augment functionality through the integration of fitness trackers and smartwatches, thereby facilitating thorough health monitoring and tailored feedback.
Mobile App Development: Create a dedicated mobile application for better accessibility and user engagement, allowing users to access workouts and feedback on the go.
Advanced Analytics: Incorporate data analytics functionalities that provide users with insights regarding their performance trends, thereby facilitating the more effective establishment and attainment of fitness objectives.
Multilingual Support: Implement multilingual functionalities to accommodate a wider audience, thereby promoting inclusivity and enhancing user engagement across various regions.

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