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Revamping the Workout Routine : An Overview of PoseNet Thunder-Driven Fitness Apps Incorporating Computer Vision and Machine Learning

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ABSTRACT

In today's modern lifestyle, characterised by a sedentary routine, the prevalence of chronic diseases among individuals has increased significantly. Juggling a 9-5 job, family responsibilities, and social commitments leaves little time for commuting to a gym regularly. As a result, more people are opting to exercise at home, leveraging the convenience of having fitness resources available through their handheld devices. This shift towards home workouts is facilitated by the remarkable advancements in technology.

Using Different innovative approaches leverage the power of deep learning algorithms to analyse exercise routines and classify different types of workouts. Through computer vision, the system can process visual information from workout videos, enabling the recognition and understanding of various body movements, postures, and exercise techniques. This provides users with valuable insights and feedback on their performance, ensuring that they are executing exercises correctly and effectively.

The integration of deep learning, computer vision, and image processing technologies offers immense potential in the field of exercise analysis and classification. Consistently performing an exercise improperly may result in significant long-term injury. We propose a method to assess the user's body posture during a workout and compare it to a professional's reference work out to assist address this problem and provide visual feedback while conducting a workout. To detect faults and deliver remedial action to the user, we model the human body as a collection of limbs and assess angles between limb pairs. Our system builds on the latest advancements using deep learning for human body pose estimation.

Keywords: Django, Flask, Posenet thunder, fitness, Android Studio, Yoga, Workout

I. INTRODUCTION

To solve the issues, this research study provides a complete strategy that blends PoseNet Thunder, an enhanced posture estimate model, with machine learning techniques, OpenCV, and image processing algorithms. We hope to build an intelligent exercise

categorization system capable of reliably detecting and assessing various workouts undertaken by individuals by utilising the capabilities of these technologies.

Pose Net Thunder derives important body joint locations from 2D video frames using deep neural networks, enabling real-time and robust pose estimation. This rich data is then fed into our workout categorization models, which are developed using machine learning methods. The models are intended to analyse position data and determine the precise exercise being performed, while taking into consideration variances in execution, body types, and other aspects. Furthermore, combining OpenCV and image processing techniques improves the accuracy and reliability of our method. We may enhance the posture data and increase the overall performance of the exercise classification models by using picture pre-processing, noise reduction, and feature extraction approaches. This research has huge potential advantages.

A computer-based automatic exercise categorization system based on Pose Net Thunder and machine learning have the potential to provide a wide range of applications, including personalised training assistance, performance monitoring, and virtual coaching. A complete examination of workout execution can also help fitness enthusiasts, athletes, and healthcare professionals discover areas for development and reduce the risk of injury. We will present the approach utilised to construct the exercise categorization system in this research study, including the data gathering procedure, pre-processing techniques, model training, and assessment.

We will provide experimental findings to illustrate the efficacy and precision of our technology in comparison to existing approaches. Finally, we will examine the implications of using this approach to improve exercise experiences and overall health results, as well as potential future possibilities. This study aims to solve a problem by combining Pose Net Thunder, machine learning, OpenCV, and image processing to bridge the gap between technology and fitness, paving the way for a new era of intelligent exercise classification and guidance systems.

II. Methods

1. Data Collection and Annotation:

a. Collect a large dataset of workout videos or motion data, capturing various exercises performed by individuals.

b. Annotate the dataset by manually labelling the exercises or movements present in each video or data sample.

2. Pose Estimation:

a. Use pose estimation models (e.g., OpenPose, PoseNet) to estimate the joint positions and pose of individuals from the captured video frames or motion data.

b. Extract the relevant body joint coordinates from the pose estimation output.

3. Exercise Classification Model Training:

a. Preprocess the annotated dataset, converting the pose estimation data into a suitable format for training.

b. Split the dataset into training sets and testing sets.

c. Train a machine learning model (e.g., CNN, RNN) using the training set to classify different workout exercises or movements.

d. Optimise the model's hyperparameters and evaluate its performance on the testing set.

4. Real-time Workout Analysis:

a. Capture video or motion data using cameras or sensors in real-time.

b. Apply image and video processing techniques (e.g., frame extraction, object tracking) to the captured data.

c. Utilise the pose estimation models to estimate the joint positions and pose from the processed data.

d. Feed the extracted pose data into the trained exercise classification model for real-time inference.

e. Classify and recognize the current exercise or movement being performed by the user.

5. User Interface and Feedback Generation:

a. Develop a user interface that displays the analysed workout data in real-time.

b. Visualise the user's pose, exercise correctness, and other relevant information on the user interface.

c. Generate real-time feedback, such as visual cues, audio prompts, or textual instructions, to help the user correct their form and improve their exercise technique.

6. Backend and Database Integration:

a. Develop a backend server using technologies like Node.js, Django, or Flask.

b. Implement APIs and endpoints for communication between the user interface, machine learning models, and database.

c. Store user data, workout information, and other relevant data in a database (e.g., MySQL, MongoDB).

7. Deployment and Scaling:

a. Deploy the application, including the user interface, backend server, and machine learning models, to a suitable hosting environment or cloud service (e.g., AWS, Azure, Google Cloud Platform).

b. Scale the system to handle concurrent users and store large amounts of data using cloud computing resources and storage options.

Working model :

An organised workflow is followed by the suggested workout analysis and feedback system. The trainer begins by recording an exercise session, which is subsequently uploaded to a cloud server. The technology retrieves accurate body component coordinates from the trainer's footage using a Deep Learning Convolutional Neural Network (CNN) model. This augmented video, together with the retrieved metadata, is then sent to the user's device.

The user then conducts their own workout and records it using a mobile or TV device. Body component extraction is performed on the server for every kth frame of the user's video. The user's gadget uses optical flow tracking to compute body component locations in the interim frames.

Dynamic Time Warping (DTW) is used to build frame pair mappings for comparison in order to precisely synchronise the user and trainer films. These key-frame mappings allow for the assessment of errors. Affine transformations are also used to align and project the trainer's body parts onto the relevant frames of the user's video, offering visible feedback.

The system analyses the angles between limb pairs in the matching frames during error computation. A visual feedback is produced whenever the deviation of any participating limb pair, labelled as "limb pair ij" consisting of "limb i" and "limb j," exceeds a predetermined threshold angle. This real-time feedback assists the user in correcting their form and guaranteeing proper workout completion.

This systematic technique offers effective analysis of the user's workout, accurate mistake detection, and rapid visual feedback by utilising Deep Learning, optical flow tracking, and DTW. Through this thorough procedure, the system improves the user's training experience, encourages proper form, and reduces the chance of injury, allowing users to effectively achieve their fitness objectives.

III.Result

With the help of this paper, we designed a comprehensive system designed to monitor user workouts without the need for a personal trainer. The system's capability to detect subtle errors in limb positions during exercises is particularly valuable, as such errors can have significant implications. One potential application of this system is in patient monitoring, where physicians can obtain progress reports on their patients' workout performances.

IV.Conclusion

The presented system represents a significant step forward in monitoring user workouts independently, offering potential benefits in various fields, including patient monitoring in healthcare. By addressing the identified limitations and pursuing future

enhancements, the system can be further refined to provide even more accurate and efficient workout monitoring capabilities.

Additionally, it's worth noting that the current system operates effectively in two dimensions of motion. However, expanding the system to encompass three dimensions is feasible by incorporating an extra camera for top-view perspective or incorporating depth perception mechanisms. This extension would provide a more comprehensive understanding of the user's movements during workouts.

V. Future work

1-In the future, we plan to offer customised exercise plans for aged and disabled individuals, tailored to their specific needs and physical abilities.
2-We aim to increase community engagement by introducing weekly fitness challenges that users can participate in and share their progress with others.
3-Our premium version of the app will offer a personalised coaching feature, allowing users to directly connect with a fitness coach for more individualised guidance and support.
4-For those looking to achieve their dream body, we will provide personalised exercise plans that are specifically designed to help them reach their goals.
5-To provide users with a diverse range of workout options, we plan to incorporate different types of exercises such as Pilates, Zumba, and cardio workouts into our app.
6-Our app will include a pedometer feature that will calculate steps taken and calories burnt, providing users with a more comprehensive understanding of their physical activity levels.
7-We plan to integrate AR and VR technology into our app to offer users a more immersive workout experience.
8-For users seeking more guidance and motivation, we will offer live workout sessions led by renowned fitness trainers.

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