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Personalized Gym Trainer Using Mediapipe

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Abstract: With the growing demand in personalised fitness experiences, this paper takes a fresh look at home workouts by creating a Personalised Gym Trainer with the Mediapipe library. This sophisticated device combines pose detection technology with voice assistance to provide users with real-time feedback and personalised instruction while exercising. The system identifies various exercises accurately and leverages torso point detection for greater precision by leveraging the capabilities of the Mediapipe library and OpenCV for camera tasks. Individual Python modules for certain workouts such as pull-ups and bench press are written to support a flexible and scalable solution. Python, Git, GitHub, and Jenkins are among the tools and technologies used in the process. Furthermore, the Findpose library is used to calculate angles between torso locations, resulting in Providing a quantitative assessment of proper posture. The suggested Personalised Gym Trainer is a promising leap in home fitness solutions, integrating cutting-edge pose detection with voice assistance for an interactive and personalised workout experience.
Keywords: Personalized Gym Trainer, Mediapipe library, Pose Detection, Voice Assistance, OpenCV

I. INTRODUCTION

Technology has ushered in a new era of fitness solutions, in which personalised instruction and interactive feedback are critical for efficient home exercises. Traditional exercise apps frequently fall short of offering real-time, personalised help. To fill this void, our initiative provides a cutting-edge Personalised Gym Trainer, a system meant to transform home training habits. This clever trainer is built around the Mediapipe library, a powerful pose detection tool that is supplemented by OpenCV for camera functions. Accuracy of Pose Detection: To ensure accurate pose detection, our method goes beyond traditional approaches by using torso point detection. This not only improves the system's precision, but it also provides the groundwork for a more comprehensive knowledge of user movements. Recognising the vast range of exercises, our system features a modular structure. Individual exercises, such as pull-ups and bench press, are represented by distinct Python modules, enhancing code organisation, scalability, and ease of maintenance.

Technological Framework: The creation of the Personalised Gym Trainer necessitates the use of a variety of tools and technologies. Python is the core programming language, and Git and GitHub make version control and collaborative development possible. Jenkins is used for continuous integration, ensuring a smooth
development workflow.

Angle Measurement for Correct Posture: We introduce angle measurement using the Findpose library to evaluate the accuracy of a user's posture. The device can objectively detect whether the user has taken the correct stance during each exercise by calculating the angles between torso spots on the body.

II. LITERATURE REVIEW

There are various applications on the market that instruct users on how to execute exercises. But We employ computer vision to instruct the user not only through which exercise to execute, but also through proper posture and counting repetitions. This application functions as a workout assistant, providing real-time posture monitoring and food advice. The application may be used not just by individuals at home, but it can also be utilized in gyms as smart trainers, minimizing the need for human interaction.

[1] Their goal was to give a bottom-up strategy for the activity of estimating the user's stance and real-time segmentation of the user utilizing photographs from the multiparton solution and by creating an effective single-shot approach.

So, the idea they proposed used a CNN, or convolutional neural network, by training it to detect and classify key points and provide accurate results by studying relative displacements and thus clustering or identifying groups of different key points and studying pose instances.

The model obtained a COCO [6] accuracy of the points of 0.665 and 0.687 using multiple level inference and single-scale inference. Part-based modelling is used. Training is dependent on the key point level structure.

[2] In a research paper Their goal was to develop BlazePose, a lightweight convolutional neural network optimised for mobile use. Human posture prediction network architecture. During inference on a Pixel 2 phone, the network generates 33 body key points (as illustrated in Fig 1) for a single user and runs at over 30 frames per second. As a result, it's suitable for real-time applications like fitness tracking and sign language recognition. A unique body posture monitoring technology and a lightweight body position prediction neural network are two of our most significant achievements. To determine the points, both algorithms employ heatmaps and regression.

They developed a stable technique for estimating posture using Blazepose, which employs CNN and a dataset of up to 25K pictures displaying unique body endpoints to improve accuracy.

With BlazeFace and BlazePalm, the provided algorithm with 33 keypoint topology is efficient. The authors of this study have designed a strategy for predominantly upper body critical locations. A solution demonstrating lower-body analysis of stance will also be incorporated.

The researchers suggested an efficient solution to the multi-person challenge while recognizing poses when there are numerous persons in the Realtime frame in their research paper

[3] The model is trained in this technique such that it recognizes the user's points and then segregates depending on the affinity of distinct points in the frame. This is known as the bottom-up strategy, and it is incredibly efficient in terms of accuracy and performance, regardless of the number of individuals in the frame. They used a deep neural network to get the precise location of the points in the research paper

[4]. In this method, they demonstrated DNN-based estimators. This allowed for more precision in predicting stance. The overall using this method boosts efficiency.

[5] Human Activity Recognition is one of the most researched topics in the field of computer vision. It is a powerful tool mainly used to aid medical systems, smart homes, surveillance, and many more areas. In this paper, an RGB camera was used to record gym activities such as push-up, squat, plank, forward lunge, and sit-up. Features were extracted from the recorded videos and were fed into classification algorithms such as Support Vector Machines, Decision Tree classifier, K-Nearest Neighbor classifier, and Random Forest classifier. The developed models were evaluated using metrics such as accuracy, balanced accuracy, precision score, recall score, and F1 score. The Random Forest Classifier outperformed all the other attempted methods with an accuracy of 98.98%. A repetition counter was developed, which splits workouts based on local minima analysis, and correctness of the workout was calculated for each skeletal point using dynamic time warping. An interactive android application was built for the user to gain insights on the performed workouts.

III. METHODOLOGY

The existing gap in personalized guidance during home workouts, coupled with the availability of advanced pose detection libraries, forms the basis for this project. Traditional fitness applications often lack real-time feedback and tailored guidance. This project aims to address these limitations by integrating pose detection technology, specifically leveraging the capabilities of the Mediapipe library, to provide users with personalized and accurate guidance during their workout routines. The core methodology involves the utilization of the Mediapipe library for accurate pose detection. This library offers a robust solution for tracking key body points, enabling the identification of various exercises. By leveraging the capabilities of Mediapipe, the personalized gym trainer can precisely detect the user's body movements and positions in real-time.

To capture and process the live feed from the user's webcam, OpenCV is employed. OpenCV provides essential functionalities for video capture and image processing, enabling the system to obtain frames and subsequently apply pose detection algorithms from the Mediapipe library.

In addition to standard body points, the system focuses on detecting torso points, a critical element in many exercises. This inclusion enhances the accuracy of pose detection, ensuring a more comprehensive understanding of the user's body positioning.

To streamline the development and maintenance of the system, distinct Python modules (files) are created for each specific exercise. This modular approach allows for a scalable and organized codebase, facilitating the addition of new exercises in the future. The project utilizes a range of tools and technologies, including Python for coding the application, Git for version control, and GitHub for collaborative development and code management. Continuous integration tools, such as Jenkins, aid in automating testing processes. For a nuanced evaluation of correct posture, the findpose library is employed to measure angles between torso points on the body. This method allows the system to quantitatively assess the alignment of key body parts, determining whether the user has adopted the correct pose during exercises.

To ensure the effectiveness and user-friendliness of the personalized gym trainer, user studies are conducted to gather feedback on the system's usability and satisfaction levels.

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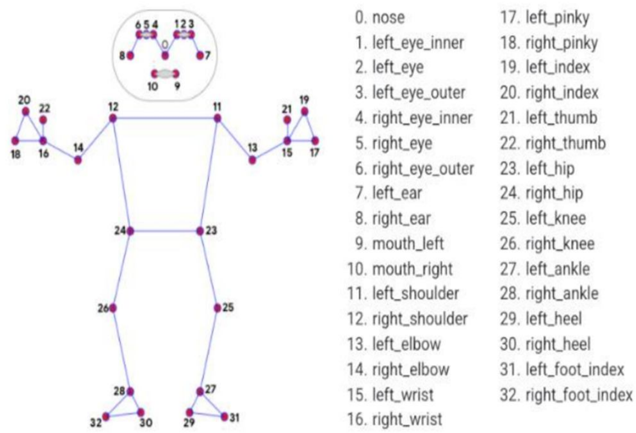
Iterative testing and refinement processes are implemented based on the collected feedback. Additionally, the system is designed with modularity in mind, enabling easy integration of new exercises and adaptability to evolving fitness trends. The emphasis on torso points detection and angle measurement contributes to the system's accuracy in recognizing and guiding users through various exercises.



IV. FLOWCHART

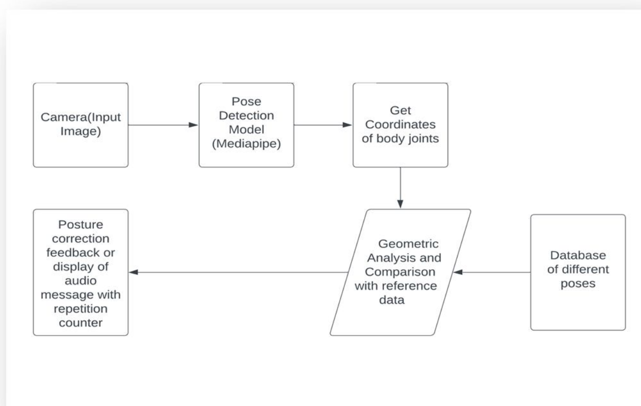


Fig 01: Flow char

1) *Camera (Input Pose):* The project starts with capturing an image of the person's body using a camera. This image is the input to the system.
2) *Image Detection:* The next step is to use image detection to identify the body joints in the image. This is likely done using MediaPipe.
3) *Get Coordinates of body Joints:* Once the body joints are detected, the system extracts their coordinates from the image. This information is used to determine the person's posture.
4) *Geometric Analysis and Comparison with Reference Data:* The system then performs a geometric analysis of the body joint coordinates. This analysis likely involves comparing the angles and distances between the joints to a set of reference data that represents correct posture.
5) *Data of Different Poses:* The system likely relies on a data of different poses in order to compare the person's posture to the reference data.
6) *Posture Correction Feedback or Display of Audio Message with Repetition Counter:* Based on the results of the geometric analysis, the system provides feedback to the person on their posture. This feedback is in the form of an audio message. The feedback may also include a repetition counter to track how many times the person has performed the exercise or movement.

V. RESULTS AND DISCUSSIONS

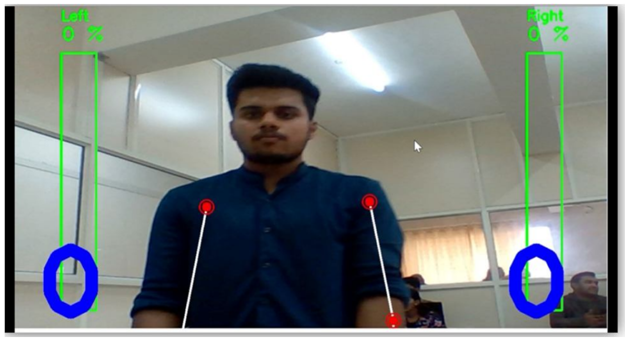


Fig 02: Demonstration Pose

In the above image, demonstration of pose is started. In this we can see the left angle and right angle of hand. Initially it is set as Zero.

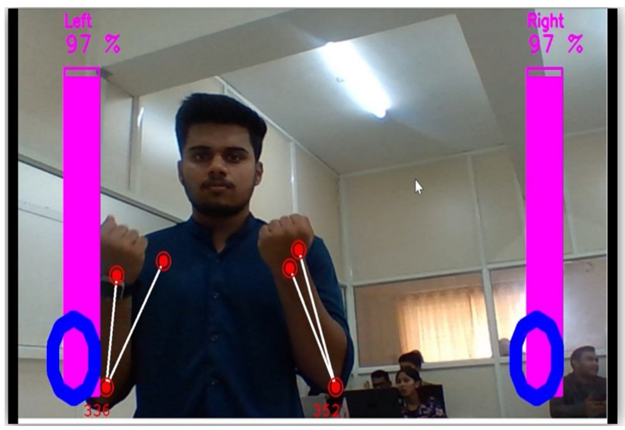


Fig 03: Counting Rep

In the figure 3 there is a counting of the rep is presented .In the right & left section, They will demonstrate the percentage of your hand angle.

Fig 04: Rep Counted

In above fig 04, correct pose is detected, so the count of rep changed to 1, where we can see both hands are in 100% correct position.

Fig 05: Full pose not detected, Rep not count

For fig 05, there is no correct pose so rep not counted. here the angle between torso point of hands is not in ideal state. So, the model will guide to do the correct posture of your hand by using voice commands.

VI. CONCLUSION

Nowadays, our lives are increasingly busier, and we rarely find time in our schedules to be healthy, fit, and exercise on a daily basis. This has resulted in a slew of diseases and health problems. Many challenges can be solved by implementing Artificial Intelligence in the field of fitness. Health-related apps and technology make our life easier and our fitness path more enjoyable.

Individuals can include this programmed into their own workouts, making them more efficient and error-free. We learned how to use the OpenCV library and package, as well as how machine learning may benefit humans, during this process.

This project has a lot of potential for growth. The project can be expanded to include more exercises. A user interface can be built to make it easier to go through the activities. The AI trainer's collected data can be retained and processed for future sessions. A daily step tracker can also be included. The trainer will provide a workout schedule and intensity level based on your body type and weight. For simplicity of use, this application can be expanded into a full Android/iOS application.

Future work may include the movement of the camera vertically and horizontally to capture another wide variety of exercises or it may include the use of multiple cameras to capture the body pose from various angles in order to feed the template of other exercises also Multiple failure identification considering the whole body.

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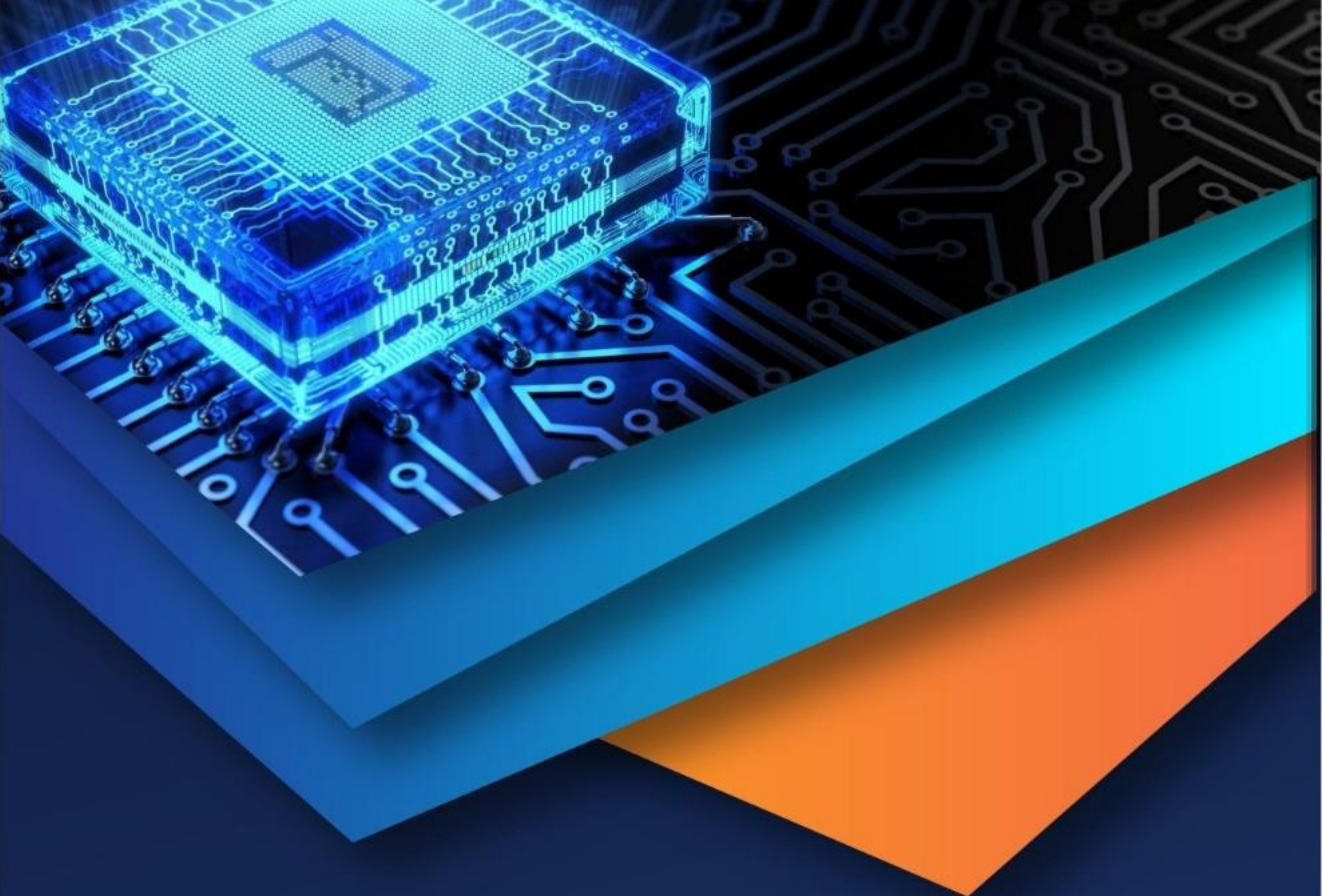

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