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A Novel Personal Fitness Trainer and Tracker powered by Artificial Intelligence enabled by MEDIAPIPE and OpenCV

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Abstract*:* Human pose estimation has gained a lot of attention in recent years, and it has become an essential tool in various fields. In order to produce a representation of the human body, such as a body skeleton, from input data, the purpose of human pose estimation is to estimate the locations of human body joints. Additionally, evaluation during workouts and physical therapy is essential to figuring out the best and most appropriate ways to carry out physical activities. This study suggests evaluating bicep curl exercises by measuring the elbow flexion angle and locating critical areas at the shoulder, elbow, and hand using human pose estimation approaches to address this issue. The goal is to assess if the user has obtained the proper amplitude of the exercise by comparing their performance to the standard angle. We compared our method using the COCO dataset and our own dataset and discovered that the MediaPipe method produced the best results for evaluating bicep curl workouts.

Keywords: *Fitness, AI personal trainer, exercise, cost-effective tracking, motion detection.*

1. Introduction

Advances in technology have had a profound impact on almost every aspect of our lives, including the fitness industry. In the past, people would have to join a gym or fitness centre and hire a personal trainer if they wanted to achieve their fitness goals. However, not everyone could afford the cost of a personal trainer, and even for those who could, it wasn't always convenient to fit in gym sessions around their busy schedules. This is where AI personal trainers come in. They offer an affordable and convenient way for people to get fit and healthy, without the need for expensive gym memberships or personal trainers. An AI personal trainer is a virtual trainer powered by artificial intelligence that can provide users with tailored workout plans, nutritional advice, and progress tracking. With just a few clicks, users can access a wealth of information and guidance to help them achieve their fitness goals. AI personal trainers are not a new concept, but they have become increasingly popular in recent years. This is thanks in part to the rise of digital fitness programs and the growing availability of digital coaching services. AI personal trainers can be accessed from anywhere at any time, making them ideal for people with busy schedules or those who prefer to work out at home. An AI personal trainer works by using artificial intelligence to analyze data about a user's fitness level, goals, and lifestyle. This data is then used to create a customized workout plan that is tailored to the user's specific needs. The AI personal trainer will also provide nutritional advice and track the user's progress, adjusting the workout plan as needed to ensure maximum results.

The main objectives of our work are as follows:

Cost-effectiveness: Hiring a personal trainer can be expensive, especially if you need regular sessions to achieve your fitness goals. An AI personal trainer is a more cost-effective solution that can provide you with tailored workout plans and nutritional advice at a fraction of the cost.

Convenience: With an AI personal trainer, you can work out from anywhere at any time, without the need for a gym membership or personal trainer. This is particularly beneficial for people with busy schedules or those who prefer to work out at home.

Customization: An AI personal trainer creates a customized workout plan based on your fitness level, goals, and lifestyle. This means that you get a workout plan that is tailored to your specific needs, rather than a generic plan that may not be effective for you.

Progress tracking: An AI personal trainer tracks your progress over time, providing you with valuable feedback and adjustments to your workout plan. This helps you to stay motivated and on track towards achieving your fitness goals.

24/7 support: An AI personal trainer is always available to provide you with guidance and support, no matter what time of day or night it is.

The potential benefits of AI personal trainers extend

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beyond just individuals looking to improve their fitness. Fitness centers and gyms can also benefit from incorporating AI personal trainers into their offerings, as it allows them to provide more personalized training and attract a wider range of clients. Additionally, employers and insurance companies are beginning to offer digital wellness programs that include AI personal trainers as a way to improve the health and well-being of their employees and members.

Moreover, the use of AI personal trainers can lead to a better understanding of fitness and exercise science. By collecting and analyzing data from users, AI personal trainers can help researchers identify trends and patterns in how people exercise, eat, and live, which can lead to new insights and advancements in the field of health and fitness.

However, there are also potential challenges associated with the use of AI personal trainers. For example, some individuals may prefer the accountability and motivation that comes with working with a human personal trainer. Additionally, there is a risk that some people may rely too heavily on the technology and not develop the knowledge and skills necessary to maintain their fitness on their own.

Overall, the rise of AI personal trainers has had a profound impact on the fitness industry, providing users with an affordable, convenient, and personalized way to achieve their fitness goals. As technology continues to advance, it is likely that the use of AI personal trainers will become even more widespread, leading to new opportunities and challenges for the industry and individuals alike.

The paper consists of as follows. The section 2 is describing the literature survey part. The proposed work has been described in section 3. The result and discussion of our work is tabled in section 4. The conclusion is present in section 5.

2. Related Works

In 2020, H. Zhou et.al. [1] proposed that the popularity of the fitness concept had led to an increase in demand for fitness trainer systems. However, the then-existing trainer systems lacked the ability to provide feedback on users' motions. Based on human pose estimation, this research proposed an intelligent fitness trainer system. The device offered suggestions for motion correction in addition to demonstrating fitness training programs. The system used an optical camera to obtain users' motion data, applied human pose estimation to analyze the data, and finally provided advice on correcting the motion. The study detailed the human position estimation technique used and provided the system's design on hardware and software. The field trial findings showed that the method had a good impact on fitness training.

In 2021, Samhitha et.al. [2] proposed that in today's society, the significance of exercise extended beyond physical transformations, as it profoundly influenced our mental well-being, attitude, and mood. The pursuit of fitness had become a popular trend, with everyone aspiring to be fit, beautiful, and healthy. However, the COVID-19 pandemic had limited people's ability to hire personal trainers or access gym facilities. While wearable fitness devices offered an alternative, they were not financially accessible to everyone. To address this issue, this paper proposed an innovative solution: an AI Trainer model that could be utilized by individuals of all ages and health conditions. The model leveraged the power of Human Pose Estimation, a widely adopted technique that accurately determined the position and orientation of the human body. By generating key points on the body, a virtual skeleton in a 2D dimension was constructed. The AI Trainer took live video input from a person's webcam and identified and captured essential landmarks or key points on the human body. It provided tailored instructions, specifying the number of repetitions and duration for each exercise, while offering real-time feedback on any mistakes made. This paper presented a comprehensive methodology for implementing pose estimation on a CPU, enabling the accurate identification of key points. Additionally, the proposed approach utilized OpenCV, a versatile computer vision library, to implement the human pose estimation technique. Through this AI Trainer model, individuals could engage in personalized fitness training, enhancing their overall well-being and promoting a healthier lifestyle.

In 2021, L. Yang et.al. [3] proposed that exercise was a popular activity that had many benefits, but it was important to perform exercises correctly to avoid injury and get the most out of the activity. To assist individuals in exercising safely and productively, they developed software that analyzed the user's workout posture using video acquired by a camera. The software made use of OpenPose as the basic pose estimation network, and two methods were proposed to improve its effectiveness. Based on professional movement specifications, the software determined two correct forms of common movements: squats and push-ups. The software recognized the user's body position, acquired the coordinate information of key locations, assessed the exercise posture, and made suitable suggestions based on the definition of optimal exercise form. The aim of this software was to help people exercise properly and safely, and achieve the best results from their exercise routine.

In 2022, Palani et.al. [4] proposed this. Extensive research in the disciplines of biomechanics, rehabilitation, motion tracking, and augmented reality had been undertaken to examine human upper limb movements. Evaluating joint angles to measure flexibility and range of motion was a common technique for analyzing human motion.

Previously, inertial measurement units (IMUs) comprised gyroscopes, accelerometers, and other sensors. These systems, however, had drawbacks such as sensor drift and mistakes caused by gravity and external interferences. Other options, such as magnetic, ultrasonic, and marker-based visual sensors, provided precision but were expensive, limiting their usage to clinical settings. To overcome these issues, this research presented a combination of low-cost vision-based sensors and IMUs to enable real-time joint angle estimation. The proposed apparatus provided a reliable, portable option for tracking joint angles during rehabilitation tasks. Two IMUs were installed on the upper and lower arms, respectively, and a marker-less vision-based sensor using the mediapipe architecture detected landmark critical locations. The obtained root mean square error (RMSE) for IMU-based estimation was 6.30 degrees, whereas it was 7.70 degrees for vision-based estimation. The proposed methodology obtained a reduced RMSE of 6.18 degrees by fusing the sensor outputs and established a close correlation with the ground truth readings. The approach's efficacy was assessed using simple rehabilitative activities performed by healthy subjects. This low-cost and portable solution had held promise for facilitating real-time joint angle tracking in rehabilitation settings.

In 2022, Kaur et.al. [5] proposed that early and accurate identification of frailty in the elderly was crucial to prevent falls and muscle movement loss, enabling timely intervention and prolonged muscular activity. However, the Covid-19 pandemic had imposed significant restrictions on the aging population, confining them to their homes and adversely affecting their physical health. The prolonged lockdowns, travel restrictions, and reduced social support had disproportionately impacted the elderly, who were more vulnerable to these consequences. This research aimed to develop a technique that could assist older individuals in assessing their level of frailty using the Geriatric Agility Detection with Early and Accurate 30-second chair-stand test. Geriatric agility, defined as the ability to move quickly and freely, played a vital role in reducing falls among older people. By implementing this technique, healthcare professionals could accurately evaluate the agility and frailty levels of the elderly population, facilitating early interventions and targeted care to mitigate the risk of falls and muscle movement decline. The proposed approach provided a valuable tool to support the physical well-being and independence of older individuals, particularly in the context of the challenges posed by the Covid-19 pandemic.

In 2022, Irfan et.al. [6] proposed that sport and exercise were integral parts of everyday life, catering to individuals of all age groups. However, many people struggled to find time for exercise due to busy schedules and limited access to gyms, particularly during the global pandemic. Virtual movement tracking offered a solution to this problem by enabling individuals to track their movements remotely. Human Pose Estimation technology played a crucial role in monitoring and analyzing a person's movements in real-time. This study focuses on data collecting related to optimal detection distance, calculating the number of fitness repetitions using Human Pose Estimation, and analyzing data received through the use of Human Pose Estimation during fitness activities. The study revealed that three meters was the ideal distance for webcam-based Human Pose Estimation to detect fitness repetitions. The webcams tracked and forecasted a person's motions, allowing for precise monitoring. The application estimated fitness repetitions based on elbow angle, connecting important spots on the human body with utility lines to build the body's skeleton. The detection methodology relied on the elbow angle, considering a stage up as one rep when the angle was greater than 300 degrees (e.g., lifting dumbbells), and a stage down as one rep when the angle formed greater than 170 degrees. The research highlighted the accuracy and effectiveness of using MediaPipe for detection and tracking, providing a reliable tool for virtual movement tracking and fitness repetition calculation. This approach enabled individuals to engage in effective exercise routines from the comfort of their homes while monitoring their performance accurately.

In 2022, Anuj Patil et.al. [7] proposed that exercising was crucial for maintaining a healthy lifestyle, especially for people who were recovering from an illness or injury. However, not everyone had access to professional guidance or supervision during their workouts. To address this issue, artificial intelligence and image processing techniques could be used to enhance and support the workout process.By using a software-based motion tracker, users could receive feedback on their posture during exercises. This feedback could be based on data and analysis, which could help improve the effectiveness of the exercises. The MediaPipe framework was a machine learning model that could track body movements by plotting points on various joints of the human body. This detailed analysis of body tracking could be used to develop an application that kept track of an individual's medical exercises. The application could be further enhanced by mapping the registered user to an authentic and verified doctor who had access to the patient's diagnosis reports and exercise history through databases. This would provide personalized support and guidance for the user's exercise routine. Overall, using AI and image processing could significantly improve the workout process for individuals who lacked access to professional supervision.

In 2023, Kale et.al. [8] proposed that artificial Intelligence (AI) had rapidly shaped the future of technology, enabled swift processing and offered powerful libraries in Python. The paper aimed to explore the functioning of AI-enabled

healthcare systems and the profound impact they had on human life, providing comfort, cost-effectiveness, and environmental sustainability. AI-based intelligent systems had found extensive applications in various domains such as agriculture, waste management, home security, and healthcare. In the context of exercise prediction, image and video processing had played a pivotal role in promoting a healthier lifestyle. Recent advancements in machine learning and artificial intelligence had witnessed significant progress in neural networks, particularly deep neural networks comprising multiple layers. Various deep learning models had emerged to solve diverse tasks effectively. It was well-established that mental health was closely intertwined with physical fitness. Practitioners often recommended daily exercise as a means to aid in recovering from depression. However, performing exercises correctly was crucial, as improper posture could render the activity ineffective or even lead to discomfort. While having a coach present during exercise sessions was ideal for monitoring and adjusting an individual's posture, not everyone had access to a personal trainer. In such cases, an AI-driven application could play a crucial role in detecting exercise positions and providing accurate guidance to assist individuals in improving their form. This system would be particularly valuable for individuals who lacked access to a trainer. By leveraging the capabilities of AI, we could revolutionize the way people approached physical fitness, fostering a healthier and happier society.

In 2023, Saleem et.al. [9] proposed that the correlation between posture and physical/emotional wellness was well-established. Various approaches had been explored for detecting human postures, including posture analysis in the medical industry to determine a patient's resting position. The paper proposed an image processing-based technique that utilized OpenCV and the Mediapipe Python library for human posture estimation, with a specific focus on analysing standing and sitting postures. While fitness activities offered remarkable health benefits, improper execution could render them ineffective or even detrimental, often due to incorrect posture. To address this issue, the suggested application leveraged pose estimation to identify the user's workout posture and provide tailored advice on correcting their form. The mediapipe pose estimation module in Python detected the major joints of the human body and calculated the angles between these joints, enabling the system to track repetitions accurately. By utilizing computer vision technology, the application analyzed images or videos of the user to precisely locate the body's major joints, highlighting important regions such as the elbow or shoulder. Additionally, the application offered an interactive boxing game built using pygame, catering to users of all age groups and providing an engaging workout experience. Users could track their work out details, including calories burned, daily goals, and personalized workout plans through the application. Overall, this application offered a comprehensive solution for monitoring posture during workouts, providing corrective guidance, and incorporating interactive elements to promote physical well-being for individuals of all ages.

In 2023, W. Supanich et.al. [10] proposed that exercising is important for maintaining good health, but doing exercises with incorrect posture can lead to pain and injury, especially for the elderly. Hiring a personal trainer, on the other hand, might be costly and out of reach for many people. To solve this issue, the researchers devised a posture classifier system that recognized different exercise postures using machine learning. Instead of a personal trainer, the technology automated the assessment of exercise posture. Body skeleton sequences were extracted from video footage captured by a fitness specialist using a simple web camera using the MediaPipe pose estimation framework. To recognize each posture class in each form of exercise, different machine learning models were assessed based on precision, recall, and accuracy metrics. The system achieved an average accuracy score of 100% on test data of three types of exercises, demonstrating its potential as an affordable and accessible solution for monitoring and correcting body postures during exercise.

In 2023, Raju, Krishnanunni et.al. [11] published a paper focused on developing a deep learning model for tracking and classifying different exercises performed by humans. A posture estimation framework and the Spatial-temporal Graph Convolution Network were used in the investigation. In this work, MediaPipe BlazePose was utilized instead of OpenPose to extract the moving individual's skeleton information, yielding 33 critical spots of the body. After identifying the human, the model monitored the subject, retrieved characteristics, and performed classification while monitoring the time it took to complete each exercise. The top-1% and top-5% accuracy criteria were used to implement and evaluate the ST-GCN model. Four variations of the ST-GCN model were developed and assessed, with the best model produced by combining a spatial partitioning method with learnable edge importance weighting for ST-GCN. This model obtained 41.75% top-1 accuracy and 89.32% top-5 accuracy. This solution eliminated the need for another person or sensors attached to the body to keep track of the workout, making it easier and more accessible for individuals to monitor their exercise routine.

In 2023, Nguyen et.al. [12] proposed that human pose estimation was a technology that used deep learning algorithms to locate and identify human body parts from images or videos. It had become popular in recent years and had been applied in various fields such as human-computer interaction, motion analysis, and virtual reality. Despite the significant progress in the development of deep

learning-based algorithms for human pose estimation, challenges such as insufficient training data, depth ambiguities, and occlusion still existed. One of the challenges in using human pose estimation technology for physical workouts and treatment was evaluation. Proper evaluation helped in determining the right way to perform physical exercises. This study proposed using human pose estimation to analyze bicep curls exercises by measuring the angle of elbow flexion and identifying key points such as the shoulder, elbow, and hand. By comparing the angle measured with the standard angle, the proposed method could determine if the user was performing the exercise correctly or not. The study tested two open-source solutions, OpenPose and MediaPipe, to compare their performance on the COCO dataset and their own dataset. The results indicated that MediaPipe provided better results for evaluating bicep curls exercises. In the future, the proposed method using MediaPipe would be used to develop a mobile application to support users in their training.

3. Proposed Work

We have developed a user-friendly Graphical User Interface (GUI) using Tkinter. The interface allows users to input their name and current date. It also includes a button that, when clicked, navigates to the next page, displaying a new GUI.

On the second page, users are presented with options to choose the exercise they wish to perform. Additionally, they can set a daily goal for themselves, specifying the number of biceps curls they aim to complete on that particular day.

Overall, our GUI design streamlines the user experience, making it easy for individuals to provide their information and make exercise selections with just a few clicks.

We have also developed a comprehensive database system that seamlessly integrates with our GUI (Graphical User Interface). This database efficiently stores all the data provided by the user through the interface, ensuring that no information is lost.

Every piece of data entered by the user, including their name, current date, exercise choices, and daily goals, is securely stored in the database. This feature enables users to effortlessly access and retrieve their data history at any time in the future.

By implementing this database functionality, we empower users to review and analyse their exercise progress, track their goals, and make informed decisions based on their historical data. Our system prioritizes data integrity and accessibility, enhancing the overall user experience and facilitating a seamless record-keeping process.

In our application, we have utilized the powerful Mediapipe library (a cross-platform framework for mobile and web-based applications) for pose detection and analysis. Mediapipe is a framework developed by Google that provides pre-built models and tools for various computer vision tasks.

With Mediapipe, our application can detect and recognize different poses of the user in real-time. It processes the webcam feed and analyses the human body's configuration and movement. By identifying key body locations and landmarks, such as joints and other anatomical points, Mediapipe helps to understand the user's posture.

Once Mediapipe detects these landmarks, our application can draw them on the screen. This visual representation helps in visualizing and verifying the accuracy of landmark detection. It allows users to see how their body is being detected and understand which specific points are being tracked.

The landmarks provided by Mediapipe play a crucial role in analysing posture. By tracking the position and movement of these landmarks over time, our application can evaluate the user's posture and identify any deviations or incorrect alignments. This information can be used to provide feedback and guidance to the user for posture correction and improvement.

Basically, in simple words using Mediapipe our application gains access to a robust framework for pose detection. It detects and recognizes different poses of the user, identifies key body locations and landmarks, and enables the analysis of posture in real-time. This functionality is vital for providing accurate feedback, guidance, and monitoring during various activities, such as fitness exercises or physical therapy. After extracting the coordinates of the landmarks from Mediapipe, our application proceeds to calculate the angles between specific joints using trigonometry.

For example, in the case of bicep curls, our application focuses on the angle formed by the elbow joint. By measuring the change in the angle of the elbow joint as the user performs bicep curls, our application can track the repetitions. The angle calculation typically involves three key points: the shoulder joint, the elbow joint, and the wrist joint. By utilizing trigonometric principles, such as the arctangent function, our application can determine the angle formed at the elbow joint based on the coordinates of these three points.

As the user performs a bicep curl, the angle at the elbow joint will change. Our application monitors this angle in real-time, comparing it to predefined thresholds or ranges that signify a completed repetition. When the angle reaches or crosses these thresholds, our application increments the count of bicep curls.

To provide visual feedback, our application displays the current count of bicep curls on the screen. This could be done using OpenCV (Open-Source Computer Vision Library), which allows for rendering text and overlays on the webcam feed. By updating the count in real-time, users can visually track their progress and see the number of biceps curls they have completed.

Therefore, by calculating the angles between joints using trigonometry, our application can track the user's bicep curls. It continuously monitors the angle at the elbow joint, increments the count when a repetition is completed, and displays the count on the screen using OpenCV. This provides users with real-time feedback and helps them keep track of their workout progress.

Furthermore, in our application, we have incorporated the pyttsx3 library for text-to-speech conversion, and enabled our application to audibly communicate the number of reps the user has completed in real-time.

After each bicep curl repetition is detected, and the count is updated, our application utilizes pyttsx3 to convert the updated count into spoken words. The library takes the count as input and generates an audio output, which is then played through the speakers or headphones connected to the user's device.

This text-to-speech functionality allows users to receive immediate audio feedback on the number of reps they have completed. They don't need to constantly look at the screen to track their progress, as the application "speaks out" the count, providing a more hands-free and interactive experience.

Additionally, our application uses OpenCV for rendering the results on the screen. OpenCV is a powerful computer vision library that enables various visual tasks, including the manipulation and overlaying of images or video feeds.

In our case, OpenCV is utilized to display the webcam feed, along with overlays that include the number of bicep curls and the angle of the elbow joint. This visual representation allows users to have a real-time visual reference of their workout performance.

By combining the webcam feed, the count of bicep curls, and the angle information, OpenCV generates a composite image that is continuously updated and displayed on the screen. Users can observe their movements and see the count and angle information overlaid on the live video feed.

In short, we can say that our application integrates the pyttsx3 library to convert the count of bicep curls into spoken words, providing real-time audio feedback to the user. Additionally, OpenCV is used to render the webcam feed along with overlays of the count and angle, allowing users to track their progress visually. This combination of audio and visual feedback enhances the user experience and provides comprehensive information during their workout sessions.

We used two different approaches for evaluating bicep curls: OpenPose and MediaPipe. We trained the models on the COCO dataset.

a. Human Pose Estimation

Human pose estimation is a challenging problem in computer vision, and it has been extensively studied in recent years. The goal of human pose estimation is to estimate the positions of human body joints and create a human body representation from input data such as images and videos. Human pose estimation can be used for various applications, including human-computer interaction, augmented reality, and motion analysis.

Traditional approaches to human pose estimation relied on handcrafted features and models. However, with the emergence of deep learning, researchers have developed neural network-based methods that have achieved excellent performance in human pose estimation. Deep learning-based methods learn features and models from data and can handle complex and non-linear relationships between input and output.

One of the popular neural network-based methods for human pose estimation is OpenPose. OpenPose uses a deep convolutional neural network (CNN) to estimate human joint locations in 2D space. OpenPose also estimates the depth of the joints using multi-scale features and part affinity fields (PAFs), which encode the degree of association between body parts. OpenPose has achieved state-of-the-art performance on various datasets, including the COCO dataset.

Another neural network-based method for human pose estimation is MediaPipe. MediaPipe is an open-source cross-platform framework that provides a customizable pipeline for building various perceptual computing applications, including human pose estimation. MediaPipe uses a similar approach to OpenPose, but it also incorporates temporal information to improve the estimation accuracy. MediaPipe has shown promising results in various applications, including hand tracking and body tracking.

b. Bicep Curls Evaluation Using Human Pose Estimation

Evaluation during workouts and physical treatment is crucial to determine the most appropriate and correct ways to perform physical exercises. One of the popular exercises for strengthening biceps is bicep curls. Bicep curls involve lifting weights using the biceps and forearm muscles, and the correct performance of this exercise requires proper elbow flexion and extension.

To evaluate the performance of bicep curls, this study proposes to use human pose estimation techniques to measure the elbow flexion angle and identify key points at the shoulder, elbow, and hand. The goal is to compare the user's performance with the standard angle to determine if the user has reached the correct amplitude of the exercise or not.

The workflow diagram shown in Fig. 1 illustrates the sequential steps involved in the research project. The diagram begins with the data collection from the user using a Graphical User Interface (GUI). Here the users are able to input their name and current date and navigate to a second page, where they choose the exercise and set a daily goal. The GUI integrates with a comprehensive database system to securely store user data for future access and analysis. Alternatively, the user may choose to view their workout history that has been stored in the database.

Next, it analyses posture and movements by leveraging the Mediapipe library. Landmarks and body locations are identified, enabling accurate feedback and guidance for posture correction.

Further, our application calculates angles between joints to track exercises like bicep curls using trigonometry. Real-time feedback is provided through visual overlays using OpenCV, and the count of completed reps is also communicated audibly via the pyttsx3 library.

Flow Chart of our Proposed Work

Fig 1. Work flow diagram of our AI fitness trainer

4. Results And Discussion

Fig 2. GUI for user input for name and date

In the Fig 2., when the user runs the program this Graphical User Interface(GUI) appears on his/her screen, the interface is designed in such a way that it consist of two fields such as the user's name and current date, after the user fills all his/her information he/she has to click on the next button in-order to provide what kind of exercise he/she wants to perform for the day and the user can also set goals that is the he/she can set a certain number of bicep curls that he/she wants to complete on that particular day. And this data will be recorded in the database so that the user can also check for their exercise history anytime later.

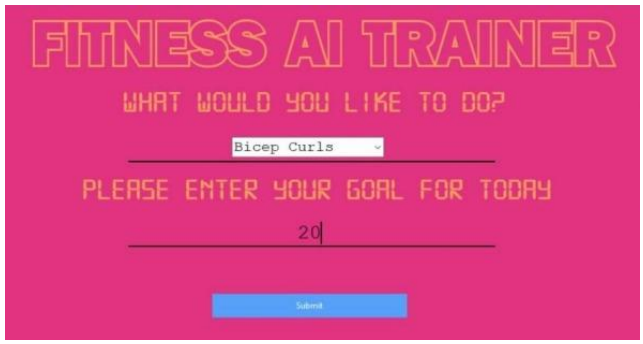

Fig 3. GUI for user input for choice of exercise and goal

The Fig 3. appears after taking data from the user such as his/her name and current date, this GUI asks for the type of exercise the user want to perform and also provides an option where the user can set a certain goal that is the user can set the number of times he wants to perform a certain exercise and after filling all the required data the user have to press on submit button, now all the data that the user provides will be recorded in the database and hence the

user can proceed further to complete his everyday workout.

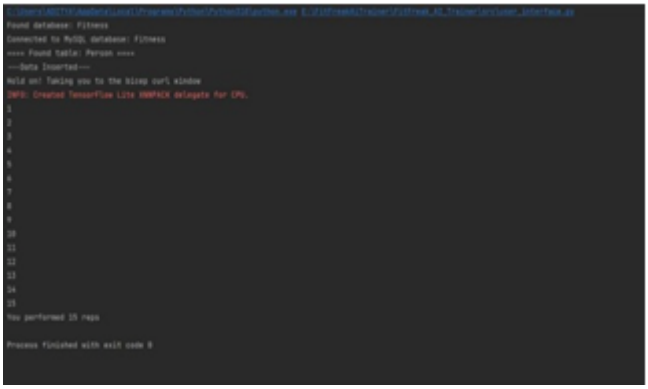

Fig 4. In the above figure the terminal window shows the number of biceps curls the user does in real time.

In the Fig 4., the terminal window shows the number of biceps curls the user does in real time.

	Name	Goal	Performed	Date	Exercise
1	Diya	20	20	2023-05-08	Bicep Curls
2	Aditya	30	30	2023-05-08	Bicep Curls
3	Sreeja	15	10	2023-05-08	Bicep Curls
4	Anirudha	30	22	2023-05-10	Bicep Curls
5	Sayandeep	15	15	2023-05-16	Bicep Curls
6	Sayandeep	30	26	2023-05-16	Bicep Curls
7	Sayandeep	30	30	2023-05-16	Bicep Curls
8	Sayandeep	30	15	2023-05-16	Bicep Curls
9	Sreeja	10	5	2023-05-17	Bicep Curls

Fig 5. Records of different users

The Fig 5. shows the recorded data from the different users, this data gets recorded into the database when the Graphical User Interface (GUI) appears on the user's screen and the user provides his/her information which gets saved into the database. The database displays name of the users, their everyday goal, date and the type of exercise they have performed on the very day.

Fig 6. User history

The Fig 6. displays the user history which includes the details of the exercises performed by the user which consists of their name, goal, date, type of exercise and number of reps he/she has successfully performed.

Final Output at the User's end:

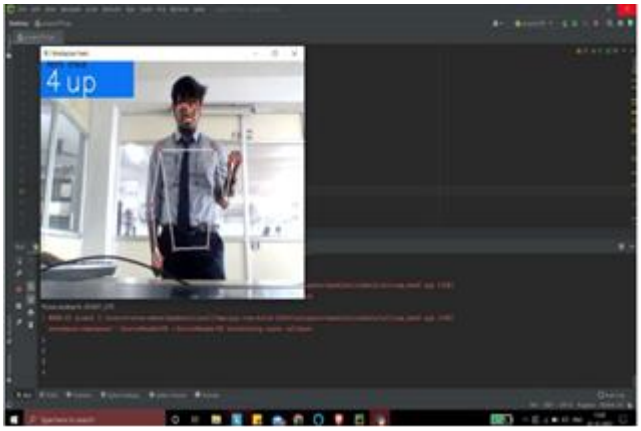

Fig 7. Counting Bicep curls

The Fig 7. displays how the bicep curl counting takes place. Our application uses Mediapipe to detect and track various poses of the user based on their webcam feed. It identifies specific points on the body and analyzes their positions to assess posture. By measuring the angles between joints using trigonometry, we can determine the user's movements, for counting Bicep Curls. And hence displays the number of Bicep Curls performed by the user on the screen and with that it also displays the angle between the joints.

5. Comparative Study

After examining previous research papers, we found that existing fitness trainer systems based on human pose estimation techniques lacked important features related to user input and customization. These systems primarily focused on capturing users' motion data using optical cameras and analyzing it using human pose estimation algorithms.

However, we identified a significant gap in these systems, particularly in terms of user interaction and personalization. Users were unable to provide their own input, such as their name or preferences for specific exercises, leading to a lack of customization and individualization in their fitness training experience. Additionally, there was no provision for recording and storing user data for future reference.

To overcome these limitations, we developed an innovative solution that incorporates a user interface within the fitness trainer system. The user interface allows individuals to input their personal information, including their name, and choose the specific exercises they wish to perform on a given day. Furthermore, users have the flexibility to set goals, specifying the desired number of repetitions or duration for each exercise.

A crucial enhancement we implemented is the integration of a database. This database serves as a repository for storing all user input, including their name, selected exercises, and set goals. For example, if a user engages in

bicep curls, our system includes a curl counter that keeps track of the number of curls performed during the training session. This valuable data is then saved in the database.

The advantage of having a database is that it enables users to access and retrieve their exercise history and performance data whenever they want. By reviewing their progress over time, users can gain valuable insights into their fitness journey. This empowers them to make informed decisions and adjustments to their workout routines based on their past performance.

By implementing this user interface and integrating a database, our system significantly enhances the functionality and effectiveness of fitness trainer systems. Users can now personalize their fitness training experience by providing input and preferences, track their progress over time, and make data-driven decisions to optimize their workouts accordingly. This advancement addresses the limitations identified in previous research, where user interaction and exercise history were not adequately addressed.

Overall, our proposed system offers a user-friendly interface, customization options, and a comprehensive database for tracking and analyzing user performance. This comprehensive approach promotes a more personalized and efficient fitness training experience, ultimately benefiting individuals in achieving their fitness goals.

6. Conclusion

Artificial intelligence (AI) has become a pervasive force, impacting various sectors across society and shaping the future. It continues to drive the development of ground breaking technologies such as big data analytics, robotics, and the internet of things (IoT). In line with this trend, our proposed work leverages modern technologies to address a significant problem in today's society.

Our proposed work offers a solution that allows individuals to exercise conveniently from the comfort of their own homes, eliminating the need to visit a gym or hire a personal trainer. By combining the power of Python programming language, AI algorithms, OpenCV, and Mediapipe, we have created a sophisticated system.

Through the implementation of AI, our system provides real-time guidance and feedback to users during their exercise routines. By utilizing computer vision techniques, it can accurately track and analyze users' movements, ensuring that exercises are performed correctly and safely. This intelligent feedback mechanism helps users improve their form, avoid injuries, and optimize their workouts.

The integration of Python, AI, OpenCV, and Mediapipe allows our system to deliver an immersive and interactive exercise experience. Users can access a wide range of exercises and workout routines, personalized to their fitness goals and preferences. The combination of these modern technologies empowers individuals to take charge of their fitness journey with convenience and effectiveness.

By providing an accessible and intelligent home exercise solution, our proposed work aligns with the concept that modern problems necessitate modern solutions. We aim to revolutionize the way people approach fitness, making it more accessible, engaging, and tailored to individual needs.

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