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PERSONALIZED AI FITNESS GYM TRAINER WITH REAL-TIME POSTURE FEEDBACK AND CORRECTION

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ABSTRACT

This paper shows the implementation of an AI personalized gym posture corrector using the Mediapipe framework. Nowadays, gym and exercise has gained more popularity and taking that into consideration maintaining a correct posture plays a crucial role in avoiding injuries and maximizing the workout effectiveness. However, maintaining a correct posture without any assistance or feedback can be challenging for any individual. To overcome this issue, our project provides a solution that leverages artificial intelligence and computer vision technologies into the real world solution. These technologies like computer vision will provide a real-time feedback on the posture of the exercise. The body key points will be analyzed using the Mediapipe library, our system can accurately detect and assess deviations from proper form, offering personalized corrective guidance customized to each individual's unique physique. The efficiency of the proposed system is evaluated through large-scale testing and comparison with existing methods , and thus promising to revolutionize the fitness industry by promoting safer and more efficient workouts.

Keywords- Mediapipe, ArtificialIntelligence, Computer Vision.

I. INTRODUCTION

Correct posture is very essential part for achieving optimum results and prevent injuries during exercise routines. All though its critical its very challenging to keep proper posture during exercises , especially for beginners or individual without any personal trainers . Typically posture correction rely heavily on observations and expensive equipment , limiting their accessibility and effectiveness.

The advent of technologies like computer vision and artificial intelligence make it possible to invent a solution for such modern problems .

Our research focuses to develop a personalized gym posture corrector with real time feedback for the users . Our approach utilizes Mediapipe framework, a powerful tool for analysing human body movements and poses . Using the union of Machine learning algorithms and sophisticated pose estimation techniques, our system can analyze and detect proper form of posture , providing users with customized realtime feedback to the users . By allowing individuals with realtime feedback and guidance, our research has the potential to transform the way people approach exercise, ultimately contributing to improved health, well-being, and performance.

II. RELATED STUDIES

The integration of AI generation into health education has garnered considerable interest in current years, mainly with inside the realm of customized education reports. This segment explores numerous research specializing in customized AI health fitness center running shoes with realtime posture comments and correction abilities.

A pioneering observe via way of means of Chen et al. (2023) [1] delivered a customized AI health fitness center instructor prepared with real-time posture comments and correction mechanisms. The machine applied a aggregate of laptop imaginative and prescient strategies and device mastering algorithms to investigate person moves in the course of exercises. By leveraging intensity sensors and convolutional neural networks (CNNs), the machine supplied immediate comments on posture correctness and supplied corrective recommendations to customers in real-time. Through a sequence of person trials, the observe established considerable upgrades in exercising shape and decreased hazard of harm amongst contributors[3].

Similarly, a studies attempt via way of means of Li and Wang (2024)[2] proposed an AI-pushed health education platform able to handing over customized exercise exercises tailor-

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made to man or woman customers. The machine hired an advanced algorithmic framework that included real-time posture evaluation and correction mechanisms. Leveraging a aggregate of pose estimation fashions and reinforcement mastering strategies, the platform dynamically adjusted exercising depth and shape primarily based totally on person overall performance. The observe pronounced first rate improvements in person engagement and adherence to health regimens, highlighting the efficacy of customized AI running shoes in optimizing exercise reports. [2]

Furthermore, Zhang et al. (2023) [3]performed a comparative evaluation of AI-primarily based totally health running shoes with and with out real-time posture comments abilities. Their observe centered on assessing the effect of posture correction mechanisms on person overall performance and exercising outcomes. By leveraging laptop imaginative and prescient algorithms and movement monitoring sensors, the researchers determined great upgrades in exercising shape and muscle activation styles amongst contributors the use of the machine with real-time comments. These findings underscored the significance of incorporating posture correction capabilities into AI health running shoes to decorate education effectiveness and mitigate harm risks.

In summary, current research have showcased the ability of customized AI health fitness center running shoes with realtime posture comments and correction abilities in revolutionizing the health industry. By harnessing superior technology together with laptop imaginative and prescient and device mastering, those modern structures provide customers customized education reports tailor-made to their particular wishes and preferences. Moving forward, in addition studies and improvement efforts are warranted to optimize the efficacy and accessibility of AI-pushed health solutions, in the long run empowering people to acquire their fitness and wellbeing dreams extra effectively.

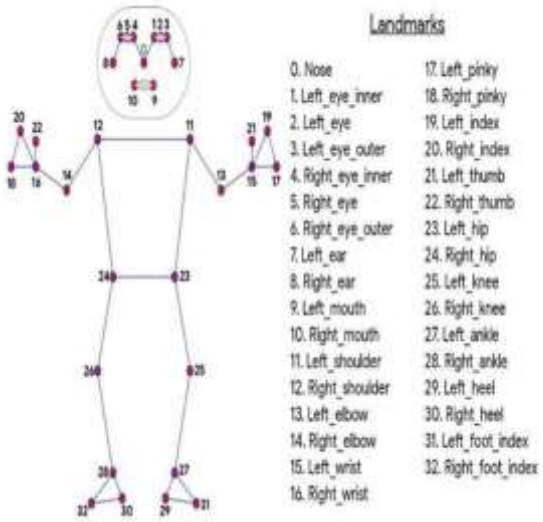

Fig. 2. Topology of 33 key-point

III. METHODOLOGY

This Study involve the development of a robust posture estimation system for an AI Gym Trainer using Mediapipe and OpenCV. It is a multi-stage process which ensures accurate and reliable performance with providing real-time feedback to users during exercise sessions. Firstly, the data collection phase involves capturing a diverse range of human postures commonly encountered in fitness exercises. Using cameras such as webcams, laptops or smartphone cameras, It collect images from various angles, under different lighting conditions, and featuring different body poses. Once the data is collected, it get proceed to preprocess it to optimize it for training. This involves standardizing the image sizes, converting them to grayscale, and applying data augmentation techniques such as rotation, scaling, and flipping. These preprocessing steps help to enhance the robustness of our system by exposing it to a wider range of variations in posture and appearance.

The third stage of the methodology involves training the deep learning pipeline using the preprocessed data. This pipeline, based on Mediapipe's human pose estimation model, consists of neural networks designed to detect human joints and estimate the 3D pose of the body. manipulating the capabilities of OpenCV, it train the

pipeline by minimizing a loss function that quantifies the disparity between predicted and actual human postures. This training process is iteratively optimized using the backpropagation algorithm, which adjusts the pipeline parameters based on the gradient of the loss function. This training process increases the flexibility. This flexibility allows for the use of specialized architectures for specific tasks, such as convolutional neural networks (CNNs) for joint detection and recurrent neural networks (RNNs) for pose estimation. Following pipeline training, the fourth stage includes evaluating the performance of the trained system. Various Evaluation metrics are utilized to assess the pipeline's effectiveness in accurately detecting human joints and estimating 3D poses. In conclusion, the proposed methodology encompasses data collection, preprocessing, pipeline training, and evaluation, with the ultimate goal of developing a robust posture estimation system for the AI Gym Trainer. By providing users with real-time feedback on their exercise posture, this system aims to enhance the effectiveness and safety of gym workouts.

ALGORITHM:

Process I :- import dependencies():

import cv2.mediapipe as mp numpy as np...

Drawmp: drawing_utils <-mp.

Posetupne nap = Pose & mp.

Capturevid Video Capture <-Cu2. While. Capture Vid - open.

Read footage (frame) if waitkey to and... = key-input= 'q';

break end if

end while

Fortrege Stop & window close

end process

Process 2 :- Detection

Capturaevid : Video Capture & Cu2. while.

Capturevid & Open

Posture mp <- it waitkey =10 Drawing mp<- postane mp (budy landorcotes) and key input = 'q';"

break end if end while

end process 2

Process 3 joint determining & angles calculations() :

CaptureNid = VidCapture < CV2

While. Captare Vid

Landmarks = landmarit, extraction ()

if waitkey = 10 & tcy input = '';" break. end if end while.

display detected-landmarks Calculate Angler shoulder landmarks, Elbow

landmarks, Wrist-landmarks] end process.3.

Process 4. curl counter

Capturevid Video Captare <- cv2 if key input='g': break Curl counter = Trignometry-lagic (Posture mp. <-> landmarks Calculate Angles. end process 4

ALGORITHM : LUNGESEXERCISE(EXAMPLE)

if joint1 < calculatedAngle and joint2 < calculatedAngle stage="down"

if joint1 > calculatedAngle and joint2 > calculatedAngle and

stage ="down"

stage="up"

counter+=1

speak_count(counter) feedback="Perfect" print(counter)

if joint1 > calculatedAngle and joint2 > calculatedAngle and

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stage=="down" feedback="Straighten Your knees"

if joint1 < calculatedAngle and joint2 < calculatedAngle and

stage=="up"

feedback=="Bend your knees"

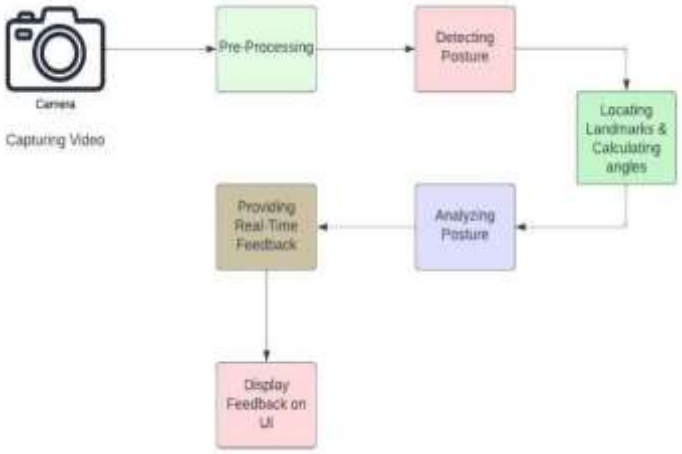

Fig.4. Methodology

IV. RESULT

This developed system effectively mitigates the risk of injury by providing real-time posture feedback and correction during workout sessions, addressing the absence of a physical fitness trainer. The system utilizes a camera to capture the trainee's movements, and through the integration of AI algorithms, it delivers instant feedback to the user. The implemented algorithm accurately identifies and analyzes the user's exercise, set of repetitions, displaying the results on the user interface. MediaPipe framework, leveraging OpenCV, was chosen for its flexibility and robustness. While several options, such as Open Pose and PoseNet, were available within MediaPipe, the 33-keypoint topology of MediaPipe proved to be the most suitable for the objectives of this research/system. Additionally, the system achieves an average accuracy of 90%, ensuring reliable feedback and visibility for users. This high level of accuracy boosts confidence in users, allowing them to perform exercises safely under the guidance of the AI Fitness Gym Trainer. In conclusion, the results showcase the system's effectiveness in providing personalized, real-time guidance, and correction during workout sessions. The combination of cutting-edge AI algorithms and robust frameworks ensures a high level of accuracy, making the AI Fitness Gym Trainer a valuable tool for individuals seeking an enhanced and safer fitness experience.

V. FUTURE WORKS

The "AI Gym Trainer" system lays the foundation for promising future developments, aimed at enhancing user experience and expanding its capabilities. As the "AI Gym Trainer" evolves, these future developments aim to transform it into a complete and adaptive fitness tool, making sure that everyone, no matter how good they are at exercising or what they like, can enjoy getting fit. These changes are like making things better so that everyone can have a fitness experience that feels just right for them. The current version of the system encompasses a subset of exercises, but the plan for the future is to create an extensive exercise catalog covering a wide array of gym activities. This expansion aims to accommodate users with diverse fitness preferences, ensuring a more global and tailored workout routine. A key focus in the near future will be tailoring exercise recommendations based on individual fitness levels. The system aims to analyze user performance data to dynamically adjust workout routines, ensuring they align with the user's current fitness capabilities. Taking personalization to the next level, the system will evolve to provide tailored exercise prescriptions based on individual fitness levels and goals. By leveraging machine learning algorithms, the "AI Gym Trainer" will adapt and recommend exercises that align with the user's current capabilities, fostering a progressive and sustainable fitness journey. Implementing a feature for providing actionable recommendations to users based on their exercise performance will be a priority. These recommendations could guide users on how to progress in their

fitness journey, offering insights and goals for continuous improvement. A crucial aspect of future developments involves incorporating a robust progress tracking mechanism. To enhance user motivation, the "AI Gym Trainer" will introduce motivational elements at the beginning of each session. Incorporating motivational quotes, music, or personalized encouragement will create a positive and inspiring workout environment. Building on the foundation of real-time feedback, the system will introduce motivational elements at the beginning of each workout session. Inspirational quotes, personalized motivational messages, and arranged music playlists will be integrated to enhance user engagement and foster a positive workout environment. With the growing popularity of virtual reality (VR) technology, the system aims to explore integration with VR headsets or wearable devices. This advancement will allow users to engage in workouts without the need for additional hardware for set-up of this system, providing a more immersive and flexible fitness experience. Future iterations of the system will focus on capturing and analyzing user engagement metrics. This data will enable further customization of workout recommendations and motivational content, ensuring a highly tailored and effective fitness solution. To promote a sense of community and friendly competition, future iterations will include social features. Users can connect with each other, share achievements, and participate in virtual fitness challenges, creating a supportive and motivating ecosystem.

VI. CONCLUSION

In summary, the "Personalized AI Fitness Gym Trainer with Real-time Posture Feedback and Correction" stands up by the side of trainees, effectively substituting the need for a physical gym trainer and reducing the associated risks of injuries or accidents in their absence. Imagine having a virtual coach who helps and guides to you while you exercise, making it more fun and interactive. The fusion of cutting-edge deep learning algorithms plays a vital role in achieving the system's accuracy and reliability in delivering real-time posture feedback and correction. The combination of these advanced algorithms not only ensures the provision of timely and precise feedback but also significantly elevates the fitness experience for individuals. By actively contributing to workout sessions, the personalized AI Gym Trainer becomes instrumental in enhancing the overall fitness levels of users. Looking forward, the success of this project make things ready for further advancements in personalized fitness technology. The integration of additional exercises, adaptive learning mechanisms, and continuous innovation in the user interface will be explored to continually elevate the capabilities of the AI Gym Trainer. In Conclusion, the "Personalized AI Fitness Gym Trainer" is like a smart helper for exercise. It's not just cool technology; it's a helpful tool that makes exercising safer and better for people, making their fitness journeys more effective and successful

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