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PERSONAL AI TRAINER

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ABSTRACT

Inactivity is one of the main causes of obesity which has affected many people worldwide. Studies show that fitness is an important goal for a healthy lifestyle and is been used as a measurement for health-related quality of life. A fitness trainer can motivate and teach users to do exercise daily and stay fit and healthy. However, to use a fitness trainer might involve a huge cost and sometimes is not suitable for a certain setting. Exercises are very beneficial for personal health but they can also be ineffective and truly dangerous if performed in an incorrect method by the user. There are lot of mistakes made during a workout when user workout alone without supervision like wrong form which could result fatal for user as they can pull a hamstring or even fall due to it. In our project, we introduce AI Trainer,

an application that detects the user's exercise pose and provides personalized, detailed recommendations on how the user can improve their form. Pose Trainer uses the state of the art in pose estimation module known as "BlazePose" tool from "MediaPipe" to detect a user's pose, then evaluates the pose of an exercise to provide useful feedback. We record a dataset of over 1000 keypoints coordinate of parts of body in correct and incorrect form, based on personal training guidelines, we build a machine learning algorithm for evaluation. AI Trainer works on six common exercises and supports any Windows or Linux computer with a GPU and a webcam. Personal AI Trainer combines the power of AI and virtual reality that provides personal fitness training. This AI Trainer detects the movement and posture of the Trainee using object recognition through camera and gives a virtual counter(how many reps) and a motion/range bar that displays if the activity or the exercise that is done is done correctly and if it is done in full range motion or not.

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1.INTRODUCTION

The main motivation behind this project is to make exercise easier and fun for people and make it more effective for them so that they can exercise more effectively in their own homes. These days virtual assistant plays a crucial role in our day-to-day life activities and has become an inseparable part of our lives. AI is one such emerging field that we aim to explore through this project of AI-based workout trainer. In our project, we introduce AI Fitness Trainer, a desktop application that detects the users exercise pose, counts the specified exercise repetitions and provides recommendations on how the user can improve their form. We use BlazePose tool from MediaPipe for pose detection module when user do their work out, and afterwards analyses the form of the pose from the dataset and real-time video and counts the repetitions of the particular exercise. We started this project during pandemic and when all the gyms were shut down and we were in lockdown.

At that time, we understood how important is fitness and how such situations can let us to work out in our homes. Sometimes people cannot afford gym membership and are sometimes shy to work out in gym and use weights. On the other hand, sometimes people can afford gym and trainers but because of tight schedule and inconsistency they are not able to remove time for their body and fitness. Thus, we aim to build an AI-based trainer that would help everyone to exercise more efficiently in their own homes in their own comfort. The project focuses on creating an AI to help you exercise, by determining the quality and quantity of repetitions which is done by using pose estimation. This project is intended to make exercise more easy and more fun. We are going to see an overview of this project, the algorithms used, its advantages, disadvantages, its efficiency as compared to other existing technologies, applications and possible future work.

2.LITERATURE SURVEY

“AI-powered Fitness Training. A survey of the Literature” is a paper that presents an outline of the current studies on the application of artificial intelligence in fitness training. The authors conduct a comprehensive search of the literature and analyze the existing studies to provide an overview of the field. The authors found that AI-powered fitness training has the potential to provide personalized training programs, improve the accuracy of physical activity recognition, and provide real-time feedback and motivation to users. The authors also highlight the challenges

of using AI in fitness training, such as privacy and data security concerns, and the need for additional research to evaluate the effectiveness of AI-powered fitness training. In conclusion, the authors suggest that AI-powered fitness training has the potential to revolutionize the field of fitness and wellness by providing personalized and effective training programs. Never the less, they underscore the necessity for further research to comprehensively grasp the potential advantages and drawbacks of this technology.

Overall, this literature review provides a valuable overview of the field of AI-powered fitness training and highlights the need for further research in this area. The paper "Artificial Intelligence-based personal Fitness Trainer" by dr.S.M.Patil et al. provides review of the existing research on the use of artificial intelligence in personal fitness training. The authors conducted a comprehensive search of the literature and analyzed existing studies to provide an overview of the field. The authors found that AI-based personal fitness trainers have the potential to provide personalized training program, real-time feedback and motivation to users, and improve the accuracy of physical activity recognition. The authors also discuss the challenges of using AI in fitness training, such as data privacy and secuty concerns, and the need for additional research to evaluate the effectiveness of AI-based personal fitness training.

The authors also highlight the current trends in AI-based personal fitness training, including the use of wearable device and mobile applications, and the integration of machine learning and deep learning algorithms. They also provide an overview of the existing systems and applications for AI-based personal fitness training. The authors suggest that AI-based personal fitness training has the potential to revolutionize the field of fitness and wellness by providing personalized and effective training programs. However, it is also emphasized that more research is required to gain a complete understanding of the technology's potential advantages and limitations. Overall, this literature review provides a valuable overview of the field of AI-based personal fitness training and points to the need for further research in this area. The authors provide a comprehensive analysis of the existing studies and highlight the current trends in the field, making it a valuable resource for those interested in AI-based personal fitness training.

The paper "AI Fitness coach at Home using Image Recognition" by Ji et al. focuses on the use of image recognition in AI-powered fitness coaching. The authors describe a system that uses image recognition to provide users with personalized exercise guidance and feedback in the

comfort of their own homes. The authors found that image recognition can improve the accuracy of physical activity recognition and provide real-time feedback and motivation to users. They also discuss the challenges of using image recognition in fitness coaching, such as the need for large training data sets and the limitations of the technology in recognizing more complex movements. The authors present a prototype system that uses image recognition to provide personalized exercise guidance and feedback to users in real-time. The system includes a camera that captures images of the user's movements, which are the analyzed using machine learning algorithms to provide accurate and personalized feedback.

The authors also provide an evaluation of the system, which shows that is can accurately recognize a range of exercises with a high degree of accuracy. In conclusion, the authors suggest that AI-powered fitness coaching using image recognition has the potential to revolutionize the field of fitness and wellness by providing personalized and effective training programs .Overall, this paper provides a valuable contribution to the field of AI-powered fitness training by exploring the use of image recognition in this context. The authors present a prototype system that demonstrates the feasibility of using image recognition for personalized fitness coaching and provide an evaluation of its performance, making it s valuable resource for those interested in this area.

3. SYSTEM DESIGN

3.1 SYSTEM ARCHITECTURE

As shown in Figure 2.1 the proposed system consists of three main parts which gives us and running AI fitness trainer which help user have an efficient and effective workout. On frontend application displays the six exercises, namely "Squats", "Bicep Curls", "Push Ups", "Pull Ups", "Shoulder Press", From above mentioned exercises user can choose which exercise they want to do. After they chose the exercise, they land on to the exercise page where user can see steps to do the said exercise and even have video link present if they want to watch before doing the exercise. When user is ready to start, they need to press start button feed of their webcam will be shown on the screen. Next part is processing the real time video coming from webcam from the device user is using and to render it in a way so each frame is sent to the program for further

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analysis of the accuracy of the exercise. System uses a very accurate pose detection module form MediaPipe known as blazepose.

The MediaPipe pose estimation tool uses a 33 keypoints approach wherein it detects the key points and accordingly uses and sends the data further for processing. It tracks users' movement from the real-time camera frame by using the blazepose tool that has a Machine Learning approach in pose detection. OpenCV is used to display the 33 keypoints exoskeleton on the with colorful lines and it also shows the rep count of the same exercise. After coordinates of desired keypoints are procured then they are sent to ML module that is trained for the said exercise and finds the accuracy of whether the user is doing it correctly or not if the accuracy is less than 0.9 then the users form is incorrect which further use feedback function to give user constructive feedback so user can correct their form and increase the accuracy above or equal to 0.9 so that it can increase the rep count by 1. When user is finish with the workout, they can press stop button and if want to go to homage they can press back button.

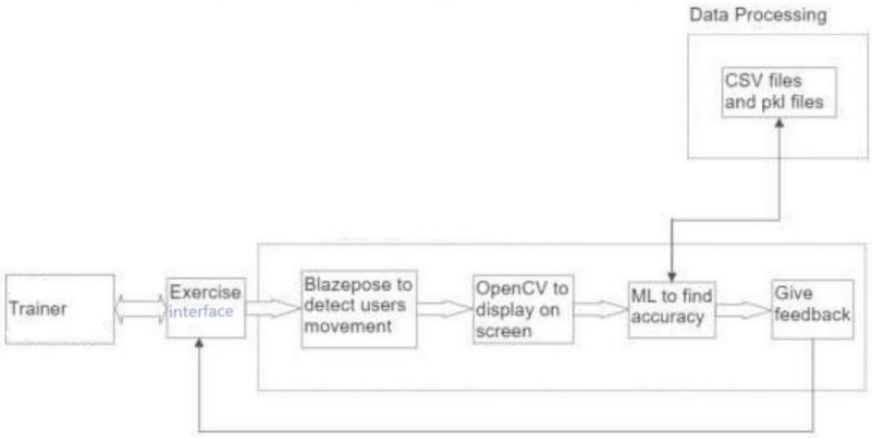

FIG:1 System Architecture

Last part of the system is where all data is stored like csv files which contain over 1000 of landmark point coordinates which have been extracted from the video of the exercise and are manually cleaned to be stored. This data is used by the ML algorithm Random Forest Classifier to create an ML module of that exercise which is deployed when the system needs to check the accuracy of users form and these modules are stored as ". pkl" file extension.

3.2 ACTIVITY DIAGRAM

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Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

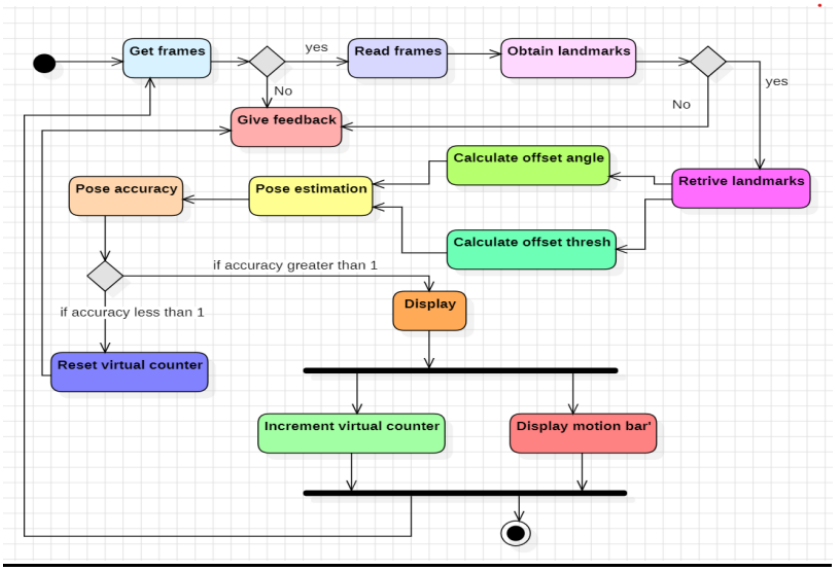

FIG:2 Activity Diagram

4.OUTPUT SCREENS

The output screen for ‘pushups’ can be seen as follows:

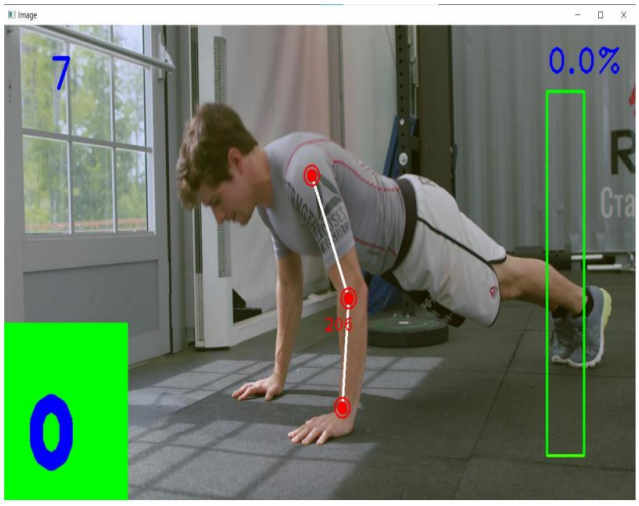

FIG:3 Output Screen-1.1

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In the above output screen(FIG:9) , you can initially that as the arm is streatched the count is at 0 and also the motion bar percentage is 0.0% which indicate the motion range of the trainee.

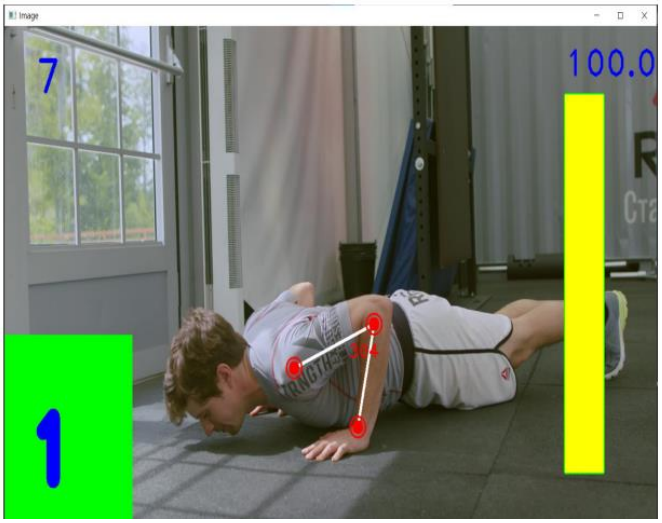

FIG:4 Output Screen-1.2

In the above output screen(FIG:10),you can see as the motion range of the exercise is full the count is incremented by one i.e the count 1, and the motion range is also upto 100%. After completion of 10 reps its gives a feedback through speech that “you have completed 10 reps” and also after completion of 15 reps its gives a feedback saying “you have completed one set”. 32 The output screens for ‘Bicep curls’ can be seen as follows:

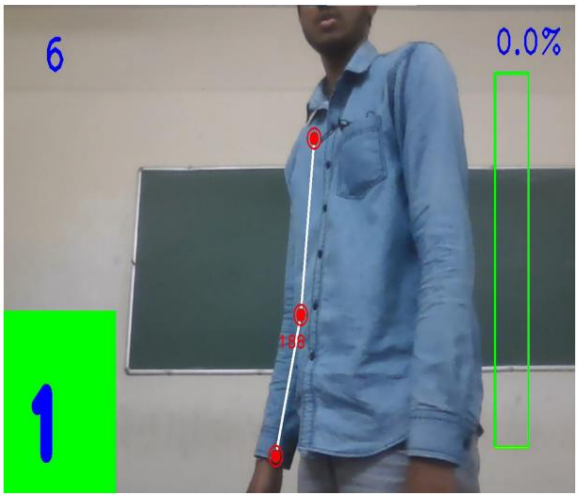

FIG:5 Output Screen-2.1

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In the above output screen(FIG:11) , initially the count of the exercise is at 1, and the motion bar is at 0.0% which tells the motion range of the exercise .

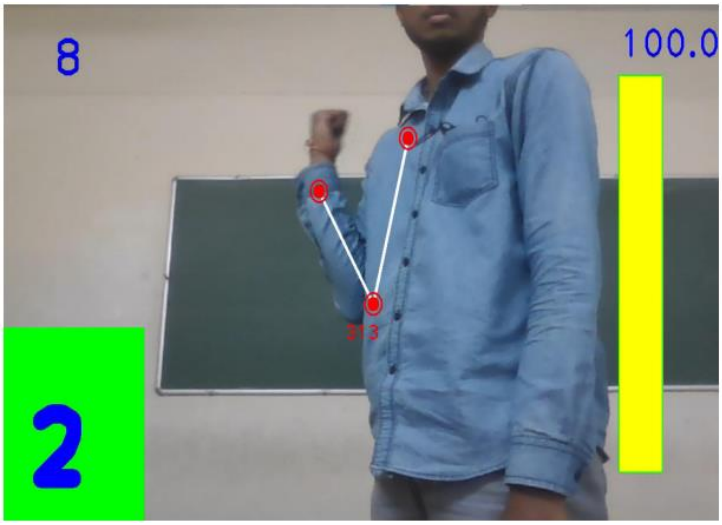

FIG:6 Output Screen-2.2

In the above output screen(FIG:12),you can see as the arm is pulled up the count is increased by 1 i.e the count is now 2 , and also the motion bar is at 100% which tell that the motion range of the exercise is correct done. After completion of 10 reps its gives a feedback through speech that "you have completed 10 reps" and also after completion of 15 reps its gives a feedback saying "you have completed one set".

5. CONCLUSION

These days our life is becoming busier and that we hardly find time in our schedules to be healthy and fit and exercise daily. This ends up with many health issues. Our main motive is to spread the importance of good health and fitness among common people and help them to achieve it. Implementation of Artificial Intelligence and Machine Learning in the field of fitness can solve many problems. The fitness applications and devices are making our lives easier and eases our fitness journey. Individuals can use this application to do their own workouts at home, hence making them more efficient are less error-prone. During this process, we learnt how to use the many python libraries and package and how the application of machine learning can be beneficial to humans. In this report, we introduce AI Fitness Trainer, an end-to-end computer vision application that uses pose estimation, and machine learning to provide personalized

feedback on fitness exercise form. We use the output of pose estimation to evaluate real-time webcam feed of user doing exercise through human pose keypoints. We work with six different exercises to provide personalized feedback on specific exercise improvements, as well as machine learning algorithms to automatically determine posture correctness using only labeled input videos. The application monitors the user in real-time keeping track of the quality repetitions of a particular exercise, thus keeping his form intact and correct throughout their workout. This will educate amateurs about different exercise routines and their correct postures to prevent injuries.

6.FUTURE ENHANCEMENT

Enhancing an AI trainer for personal exercise involves incorporating advanced features and technologies to provide a more personalized, effective, and engaging fitness experience. Here are some future enhancements for an AI trainer for personal exercise:

1. Emotion Recognition: Integrate emotion recognition technology to understand users' emotional states during workouts. The AI can then adapt the training program based on the user's mood, providing motivation or suggesting modifications as needed.

2. Adaptive Learning Algorithms: Develop advanced machine learning algorithms that adapt the training program based on the user's progress, preferences, and goals. The AI should continuously learn from user feedback and adjust workout plans to maximize effectiveness.

3. Social Integration: Integrate social features that allow users to connect with friends, share achievements, and participate in virtual group workouts. Social support can enhance motivation and create a sense of community.

4. Integration with Smart Home Devices: Connect the AI trainer with smart home devices such as smart mirrors, connected fitness equipment, or IoT devices for a seamless and integrated workout experience.

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