

# Real Time Fitness Tracking and Analysis using BlazePose Pose Estimation

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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*

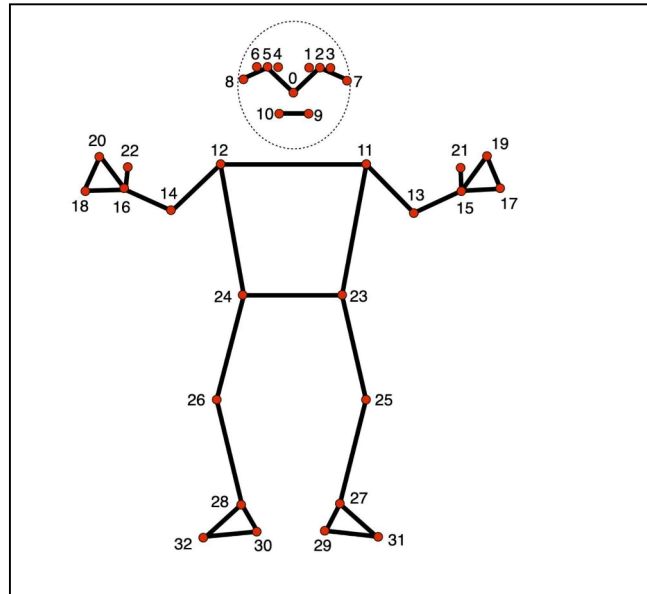
**Keywords:** AI Fitness Trainer, Machine Learning, Pose detection, BlazePose, Health, Workout

## I. INTRODUCTION

The situation which we have faced in recent times of infection and confinement causes people to stay at home for long periods of time, but this cannot be an excuse for poor quality products because it is a good idea to use the extra time we have gained to protect our own health. The main purpose behind this project is to make exercise easier, more fun and more efficient for people so that they can exercise more in their own homes. Nowadays, virtual assistants play an important role in our daily lives and have become an integral part of our lives. Artificial Intelligence is an emerging field that we aim to explore through artificial intelligence-based education. In our project, we introduced AI Fitness Trainer, a desktop application that detects the user's fitness level, calculates the number of repeated exercises and provides a data document showing the user how to improve his application.

As the user exercises, we use MediaPipe's BlazePose tool for face detection, then analyze body shape from configuration data and live video footage and count the number of repetitions of a particular exercise. We started this project during the epidemic period, when all gyms were closed and we were also closed. Then we understand the importance of exercise and how this allows us to exercise at home. Sometimes people can't afford a gym membership, and sometimes they're embarrassed to exercise and use weights at the gym. On the other hand, sometimes people can afford gyms and trainers, but cannot find time for their bodies and exercises due to tight and inconsistent schedules. That's why our goal is to create an AI trainer that will help everyone work efficiently from the comfort of their home.

The project aims to develop artificial intelligence to help you exercise by using physical predictions to determine the quality and quantity of repetitions. The program is designed to make exercise easier and more fun. We will see the details of the project, the algorithm used, its advantages, disadvantages, performance compared to other existing techniques, its usage and future work. Use the enter key to start a new paragraph. The appropriate spacing and indent are automatically applied.



### A. Proposed System

#### Proposed System:

There are many fitness apps on the market that allow users to track their exercise and provide users with workouts that will help them achieve their fitness goals. These apps have many features that only provide users with information but do not provide a place for users to exercise without going to the gym or personal trainer. The apps do not explain how users are exercising and whether they are doing it correctly.

We created our Artificial Intelligence Fitness Coach project to resolve the above complaints of all existing systems. The project can be described as an artificial intelligence that can control our body during exercise, provide important information about our exercise form and calculate the duration, so that the user can devote all his attention and energy to moderate exercise rather than exercise. movement. Our working hours.

This system overcomes the main disadvantage of not always being able to exercise at home without guidance. This system gives us the opportunity to exercise anytime, anywhere and guides us to do it in the best way possible.

The computer system does not use any vision to work on our body. The system uses "BlazePose", "MediaPipe"'s best body detection technology, to detect the user's body position during performance. OpenCV is used to record the exoskeleton of the user's body and display the code of the iteration on the screen. The system uses different videos and images of a particular exercise to generate 1000 key field data and save it as a csv file. This data is used to train the ML model of the training feature using a machine learning classification algorithm called random forest classifier

*System overview:* 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", "Jumping Jacks", "Shoulder Press", "Static Lunges", "Bridge". 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 analysis of the accuracy of the exercise. System uses a very accurate pose detection module from 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 user's form is incorrect, which further uses a feedback function to give the user constructive feedback so the 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 the user is finished with the workout, they can press the stop button and if they want to go home, they can press the back button. The 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 the user's form and these modules are stored as ".pkl" file extension.

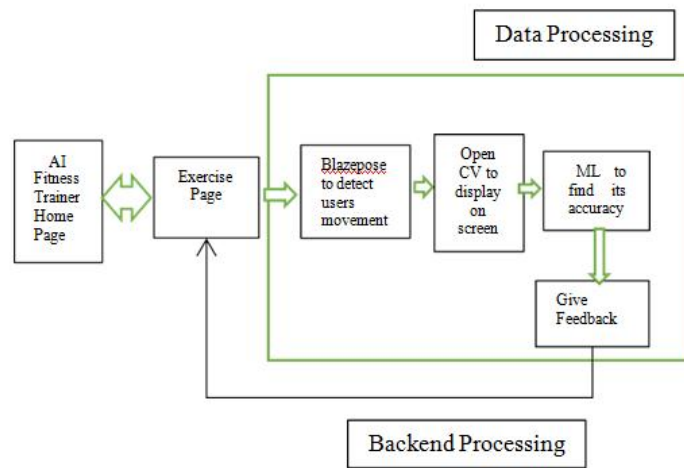


Fig. System Architecture.

## II. IMPLEMENTATION

So that the user can easily access our AI fitness trainer program module and not have to worry about typing commands running this program will end up with an ugly pop-up window in which the program starts, so we have created an attractive and engaging user interface.

The application uses Python's most commonly used standard library Streamlit for creating a user interface for a desktop application. When Python is combined with Streamlit, it provides a quick and easy way to create a GUI for a desktop application. Streamlit provides a powerful object-oriented interface to run our desktop application.

The application uses the OpenCV Python library to capture the content of the user's webcam in real time. Then one shot from that real-time scrolling is used to detect human pose using "BlazePose" by "MediaPipe". MediaPipe Position Estimator uses a 33 keypoint approach where it detects keypoints and uses them accordingly to study the data set to estimate the position. It tracks the pose from the camera shot in real-time using the BlazePose tool, which has a machine learning approach to the pose detection. The current standard for detecting the position of the human body is the COCO topology, which consists of 17 landmarks across the globe torso, arms, legs, and face. However, with BlazePose, we present a new topology of 33 key points of the human body, which is a superset of COCO, BlazeFace, and BlazePalm topologies. This allows the system to determine the semantics of the body from the pose.

The prepared dataset is then used by the MediaPipe BlazePose tool to capture the pose and then saved using the label in the model file using Python's pickle library. The application uses a real-time web camera to capture key points of their position and feed them to the ML model. It provides a system estimate based on the label assigned to it when training the model. If the model gives an accuracy rate between 0.9 to 0.92 or higher, it is counted as up or down based on the label. To calculate repetitions, the system takes into account the cycle from position up to lower position. The system also uses a critical model that was trained using the same classification algorithm mentioned above to check the user's form during training and if its accuracy is less than 0.9, give the user constructive feedback to improve them.

We now describe the AI Fitness Trainer application from a technical perspective as a pipeline system, consisting of multiple system stages (see Figure 3.2). Pose training starts from the user real-time feed from the webcam of an exercise, and ends with the Pose Trainer application providing specific voice feedback on the exercise that the user has chosen. However, there are no requirements on camera type, but distance from camera and the user needs to be at least where users whole body is visible. Application provides user with six different exercises by collecting. Application basically first detects the landmark positions on the body in the video with the help of BlazePose tool of MediaPipe. Then it passes the points to the ML model to find the accuracy of users form and to calculate the number of repetitions of the exercise and display the count and give critique on the user's form.

Whenever you open the application, you have to first select the exercise which you have to perform for your workout from six exercise displayed on the screen. You can select only one exercise at a time, once you have selected the exercise then you will land on the selected exercise page. After that when you are ready after placing the system having webcam you have to click on the start button below. After clicking the start button, the application will open the camera to capture your whole body. Once the webcam feed can be seen on screen with exoskeleton on it you can go ahead and start your workout. During your workout the app will also count your reps and display on screen and will also give you voice critique feedback. After you have done with that exercise you can stop the clicking on the stop button, the application will close the real-time feed of your webcam and also stop the reps counter so you can check how many reps you have done. Each page of exercise has detailed instruction with visual representation of how to do that exercise. Also, there is a back button that will take you on the first page so you can again select the desired exercise you want to do

### III. CONCLUSION

These days our life is becoming busier and we hardly find time in our schedule to be healthy and fit and exercise daily. This ends up with many health problems. Our main motive is to spread the importance of good health and fitness among people ordinary people and help them achieve it. Implementation of artificial intelligence and machine learning in the field fitness can solve many problems. Fitness apps and devices make our lives easier and our fitness journey easier. Individuals can use this app to perform their own exercises at home, making them more efficient and less error-prone. During this process, we learned how to use many python libraries and packages and how to apply machine learning can be beneficial to a person. In this report, we present AI Fitness Trainer, a comprehensive computer vision application that uses position estimation and machine learning that provides personalized feedback on fitness exercise form. We use the output from the position estimation for evaluation Real-time web cam of a user exercising through human pose key points. We work with six different exercises personalized feedback on specific exercise improvements as well as machine learning algorithms that are automatically determined posture correctness using only labeled input videos. The application monitors users in real time and monitors quality repetition of a specific exercise, keeping your form intact and correct throughout the exercise. This will educate amateurs on different exercise routines and their proper posture to avoid injury

We also tested the performance of our random forest classifier algorithm using a confusion matrix to find the accuracy and memorizing each exercise. Furthermore, we also discuss the accuracy of the same classifier and how it affects the accuracy exercises.

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