AI PERSONAL GYM TRAINER

Abstract

Human activity recognition has emerged as an active research area in recent years. With the advancement in mobile and wearable devices, various sensors are ubiquitous and widely available gathering data a broad spectrum of peoples' daily life activities. Research studies thoroughly assessed lifestyle activities and are increasingly concentrated on a variety of sport exercises. The enhanced performance of modern Artificial Intelligence algorithms has opened up limitless possibilities in the development of smart systems and devices. One of the most complex tasks for interactive devices is the analysis of human motion. The main objective of this research/project was to illustrate the potential of artificial intelligence (AI) techniques in sports on the example of weight training and exercising. Our research was focused on the implementation of pattern recognition methods for the evaluation of exercises performed by people with or without equipment.

Over the last 1 to 2 years everyone has been confined to their homes without much physical activity. Hence, a personalized fitness trainer has the potential to replace a human trainer whenever possible. It can help various individuals to carry out routine exercises from the comfort of their homes without physically going to a gymnasium and performing the same. This gives a lot of flexibility and people can practice at a time of their choice, rather than a fixed time given by the trainer.

Index

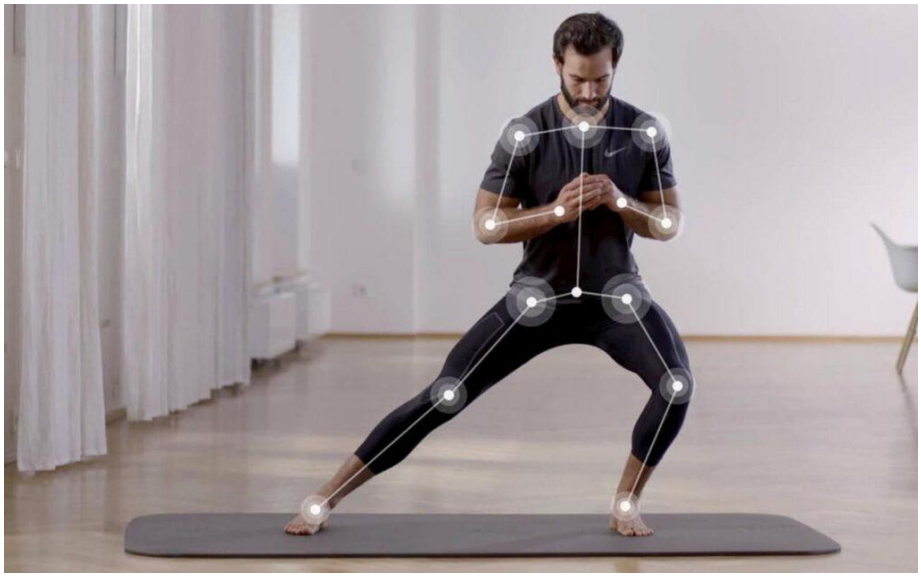
I. INTRODUCTION

Insufficient physical activity is recognized as one of the leading risk factors for death worldwide and can lead to a variety of health issues, including cardiovascular diseases, diabetes, cancer, and mental health conditions.

Over the last 1 to 2 years everyone has been confined to their homes due to the COVID pandemic. The gym is one public place which everyone uses on a regular basis as personal fitness is an important necessity in everyone's life. However, due to public places being shut, it has led to disruption in daily routine and exercise patterns for everyone. Hence, many people have struggled with various health-related problems such as obesity, irregular sleep patterns, eye strain, mental stress, decreased immunity, and hence, are at a higher risk of getting infected with various health problems. Gyms generally have a variety of equipment and personal trainers are always there who can tell you what to do. The lack of these in one's home can often be the culprit that stops them from working out.

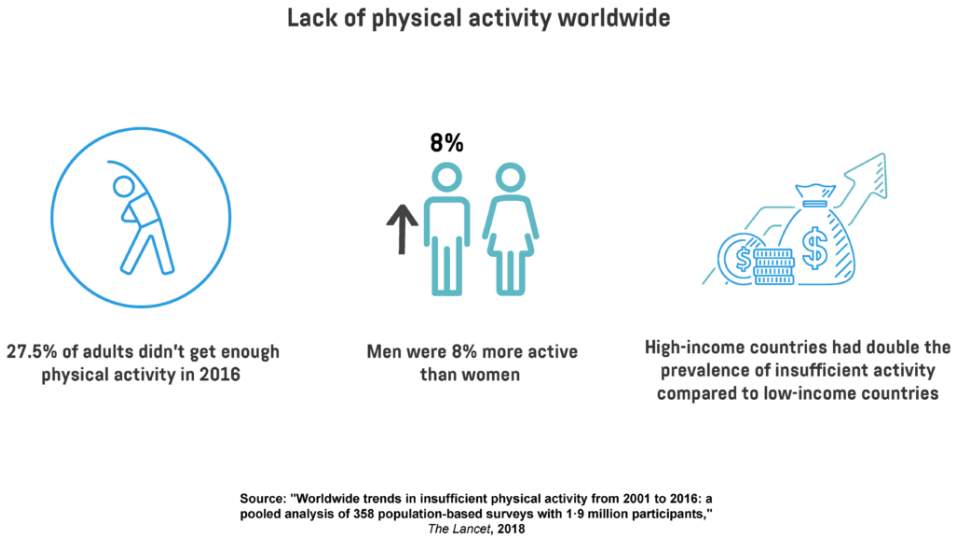
Many people watch YouTube videos, have wearable tech and train with personal gym trainers. But all of them have their disadvantages. While watching YouTube videos, no feedback is given and we have to manually keep count of the exercises. This distracts the person performing the exercise as a lot of things need to be tracked and there is no mechanism for the same.

This is the problem our project aims to solve. We have developed a personal Gym Trainer using Artificial Intelligence. This gym trainer works on a real-time basis and keeps track of the exercises performed, repetitions in each exercise and the number of sets performed as well. However, it will also work if one uploads an already recorded video, but in order to make things easier we have decided to keep the monitoring in real time. Using our tool, users will be able to perform their daily exercises with ease from the comfort of their home without bothering too much about other things such as reps, sets, etc. We have added as many exercises as possible and have covered most of the upper body exercises in our research. Exercises such as left bicep curls, right bicep curls, right wrist rotation, left wrist rotation, etc. are some of the exercise patterns we have added into our project.



II. LITERATURE SURVEY

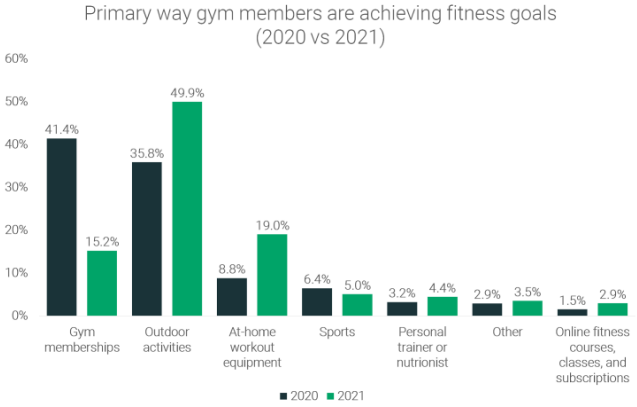
Insufficient physical activity is recognized as one of the leading risk factors for death worldwide and can lead to a variety of health issues, including cardiovascular diseases, diabetes, cancer, and mental health conditions. According to a recent Lancet Global Health report, in 2016, approximately 27.5 per cent, or more than a quarter of all adults worldwide, didn't get enough physical activity.



In recent years, people have been increasingly turning to technology to help them solve this problem, with a number of wellness, fitness, and nutrition apps and gadgets appearing on the market.

Many new fitness apps, gadgets, and wearables are being launched in the market and creating all the buzz. A recent report from Research n Reports revealed that the global worth of fitness technology was $17.9 billion in 20119 and it is expected to grow to $62.1 billion by the year 2025. You may be unaware, but Artificial Intelligence (AI) is assimilating deeper into our lifestyles.

The fitness industry is going through a major transformation as IoT and AI are bringing innovations in fitness product offerings. Reports and Data research firm predicted that by the year 2027, the annual revenues of the fitness app market will be $14.64 billion, with around 100.2 million active fitness users by 2024.



The primary way gym members plan to stay fit in 2021 is now outdoor activities like running, hiking, walking, cycling, etc. Having increased from 35.82% in at the beginning of 2020 to 49.92% in 2021 (a 39.4% increase).

What are gym members favoring:

- 1.4x more gym members are opting for home fitness options like at-home workout equipment (18.99%) and **online fitness courses**, classes, and subscriptions (2.93%) than gym memberships in 2021.

At least, according to a recent survey of 2,000 Americans.

72% of us are finding it easier to maintain our fitness routines now, when we can't go to the gym, than pre-Coronavirus. Almost half are using fitness apps for the first time, and 56% of people actually don't plan to buy back into their gym memberships after the current health crisis. And a staggering 80% of men are exercising more now without access to their gyms than before Covid-19, according to data from Freeletics, an AI-based fitness app with 47 million users in over 160 countries.

III. METHODOLOGY

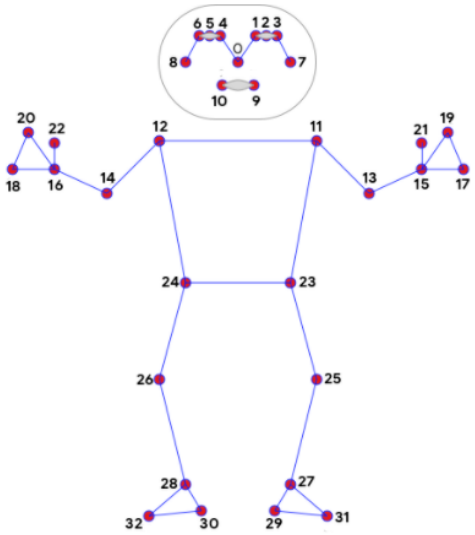
The assessment of human poses is sophisticated technology based on computer vision. It's like face recognition for the whole body. Human pose estimation systems detect and evaluate the posture of the human body using three analytical methods:

Skeleton modeling: This employs key points to depict the human body's skeletal system.

Contours modeling: This employs the body's raw breadth and extremities to display a person's figure's rectangular border boxes.

Modeling Volume: This analytical approach employs 3D body scans to capture the body using geometric meshes and forms.

Shown below is the points which have been given to us by the mediapipe library:



0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

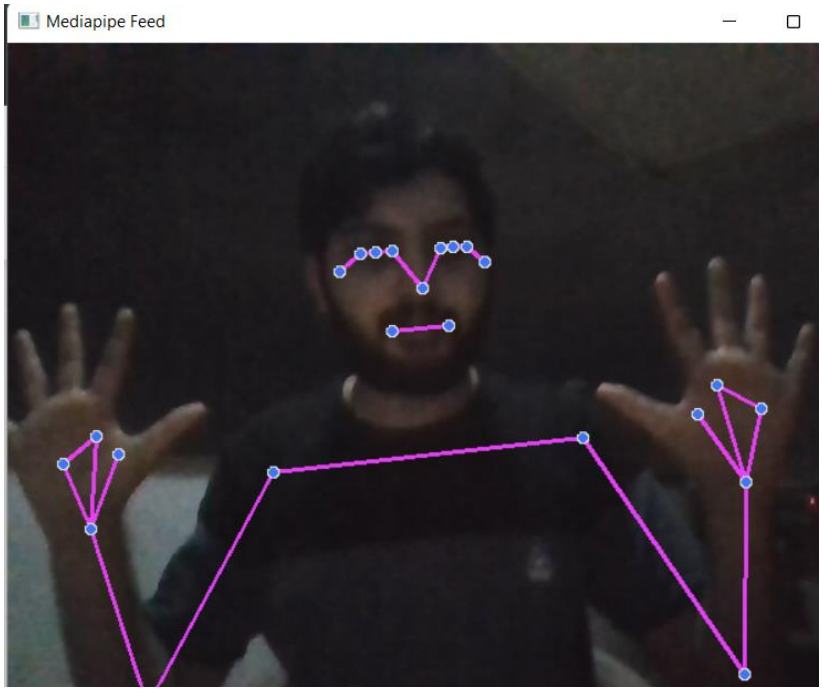
In our project, we have made use of OpenCV for capturing real-time feed. After capturing the real time feed, we made use of the mediapipe library to help in pose detection. Following this, we wrote a function to calculate the points in the upper half of the body again using mediapipe. Once the points were calculated, we took 3 random points(in this case – left shoulder, left wrist and left elbow were taken) and wrote a function to calculate the angle between these calculated points.
Once this was done a custom function was written for the left bicep curl exercise, the methodology for all exercises remains the same, which has been explained below:

First all points are estimated and between the calculated points we find out the angle, if the angle is greater than a fixed number, we increment the rep count(up) and vice versa for rep count(down).

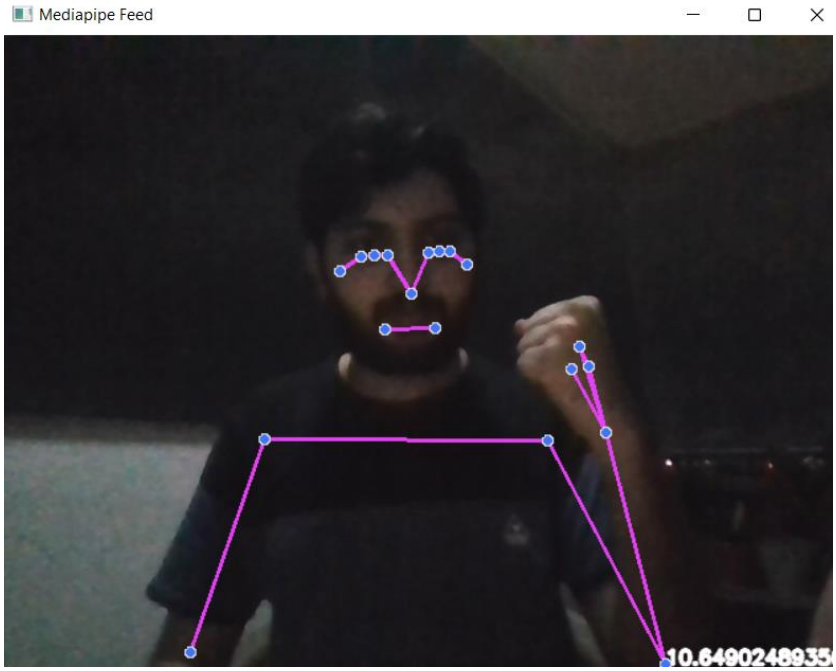
IV. EXPERIMENTATIONS AND RESULTS

No dataset was used by us in this project. However, we used the mediapipe library which provided us with pre trained models enabling us to calculate and estimate poses with ease.

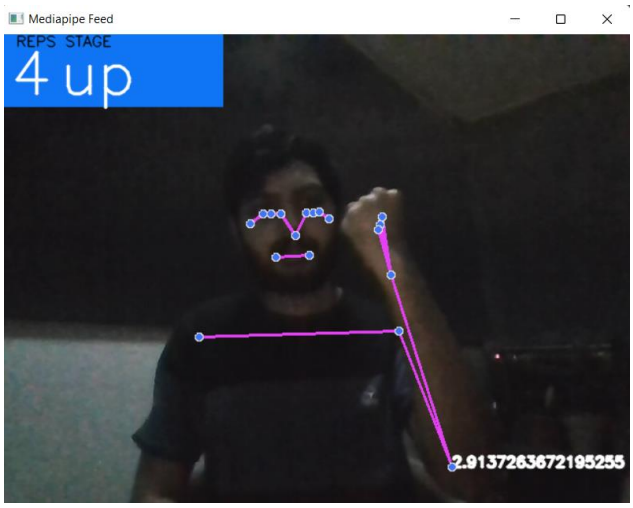
Calculation of points using mediapipe



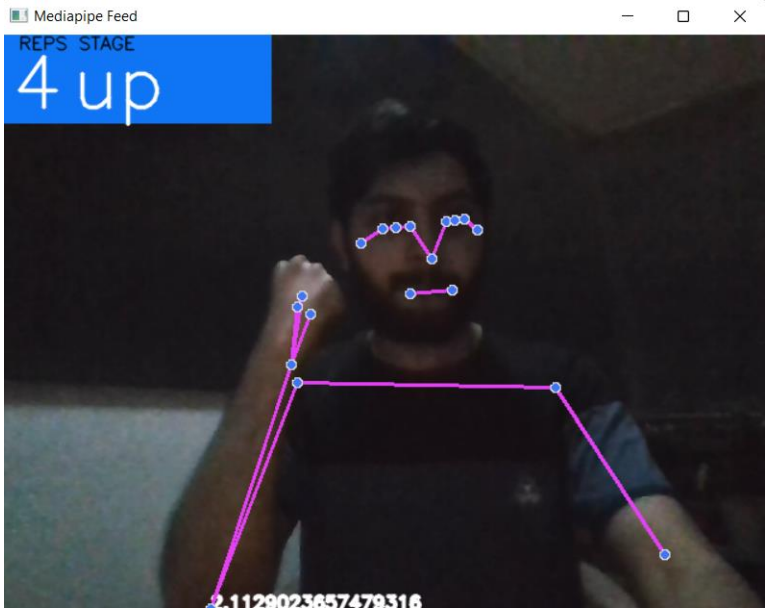
Calculation of angle between 3 random points



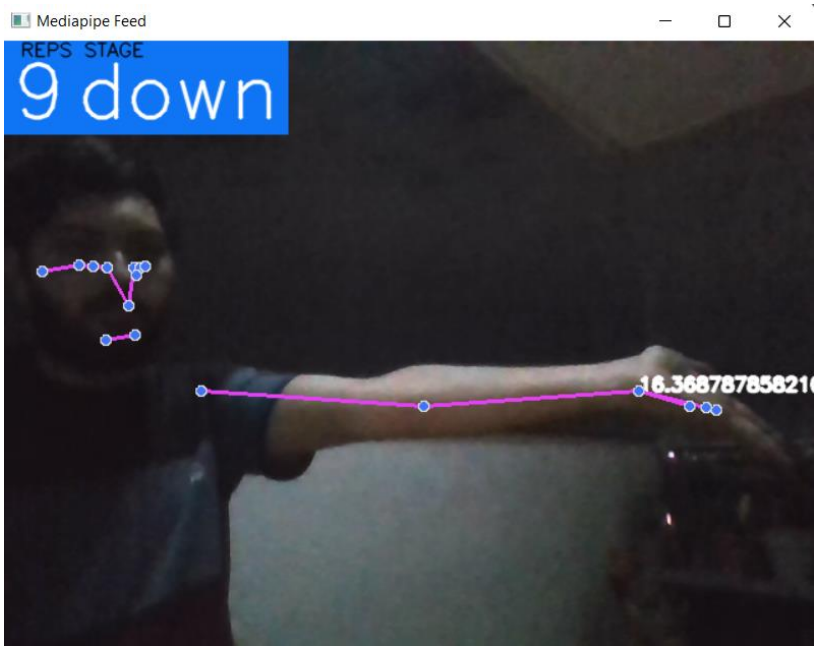
Left bicep curl



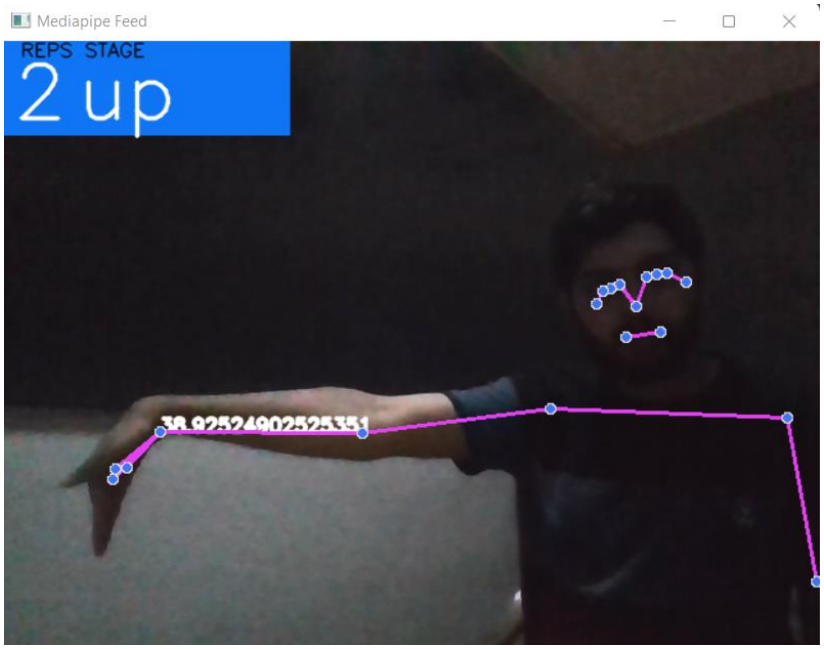
Right bicep curl



Left wrist rotation



Right wrist rotation



V. CONCLUSIONS

To sum it up, this is a very innovative idea which is here to stay and this tool will be used by many people in the future as times are uncertain and as people continue to practice the work from home routine. However, there are some additions to be made to this project/research. The future prospect is to add in more mechanism to detect other exercises for the lower body parts and later deploy this as a model to Heroku or AWS. Hence, users will be able to register on a website and keep track of their daily exercises and the model once properly trained can also recommend exercises.

VI. REFERENCES

HTTPS://WWW.ANALYTICSSTEPS.COM/BLOGS/HOW-AI-REVOLUTIONIZING-FITNESS-INDUSTRY

HTTPS://BLOG.RICHARDVANHOOIJDONK.COM/EN/THE-FUTURE-OF-FITNESS-AI-BASED-PERSONAL-TRAINING/

HTTPS://HACKERNOON.COM/HOW-AI-IS-IMPROVING-THE-FITNESS-INDUSTRY-L72N347O?SOURCE=RSS

HTTPS://WWW.FORBES.COM/SITES/JOHNKOETSIER/2020/08/04/AI-DRIVEN-FITNESS-MAKING-GYMS-OBSOLETE/?SH=3A2F27232A8F

HTTPS://INDIAAI.GOV.IN/ARTICLE/YOUR-PERSONAL-GYM-TRAINER-WILL-SOON-BE-AN-AI

HTTPS://WIKIPEDIA.COM