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AI Personal Trainer using OpenCV and Python

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ABSTRACT

Everyone benefits from exercise and physical activity. Staying active can benefit you in a variety of ways, regardless of your health or physical abilities. In reality, research shows that “taking it easy” is dangerous. When older adults lose their ability to perform activities on their own, inactivity is often to fault rather than ageing. Lack of physical activity can also contribute to additional doctor visits, hospitalizations, and medication use for a range of conditions. This idea of a personal AI fitness trainer allows more people to get involved in the fitness field using this AI trainer makes sure everyone can perform exercises in correct way, minimizing the risk of injuries.

Keywords: Computer Vision, MediaPipe, OpenCV, Python.

INTRODUCTION

Lifting weights is a great way to develop muscles, protect bones, burn calories, and stay fit. Maybe you don’t know where to start or how to perform the exercises. You may be tempted to just copy the exercises your others are doing, but they may be doing things the wrong way. This is where your personal AI trainer comes in handy. With your personal AI trainer, you have immediate access to a world of knowledge to help you develop a weight-training routine that’s safe and effective.Weight training and healthy diet is one of the best ways to get into shape and lead a healthy lifestyle. With each passing day people are getting conscious about their health. Many people today have a busy and hectic life and they cannot manage to go to the gym and take the guidance of any professional and during this pandemic many people started doing in home workouts and this they a have a big chance of getting injured. In this project, we will develop a personal AI fitness trainer which will help the user to do exercises in a correct form and posture.

TECHNOLOGY USED

- **OpenCV -** OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection. In this tutorial, we explain how you can use OpenCV in your applications.

- **Computer Vision** - Computer Vision can be defined as a discipline that explains how to reconstruct, interrupt, and understand a 3D scene from its 2D images, in terms of the properties of the structure present in the scene. It deals with modelling and replicating human vision using computer software and hardware.

- **Python** - Python was chosen as the programming language for this project. For a variety of reasons, this was an obvious choice.

  Python as a programming language has a sizable user base. A trip to the stack overflow can simply solve any potential issues. Python is one of the most popular languages on the site, making it simple to get an immediate response to any query.

  Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

- **MediaPipe -** MediaPipe is a framework mainly used for building multimodal audio, video, or any time series data. With the help of the MediaPipe framework, an impressive ML pipeline can be built for instance of inference models like TensorFlow, TFLite, and also for media processing functions.

- **NumPy -** NumPy is a Python programming language library, adding support for multiple, multi-layered and mathematical editing, as well as a large collection of high-level mathematical functions running on these arrays. NumPy's ancestor, Numeric, was originally created byJim Hugunin with donations from several other developers. In 2005, Travis Oliphant made NumPy by adding the features of competing Numarray to Numeric, with multiple modifications. NumPy is open source software and has many sponsors

METHODOLOGY

We are going to recognize the pose of the model using *pose estimation* running on CPU to find the correct points and using these points we will get the desired angles, and then based on these angles we can find many gestures including number of workouts such as bicep curls.

We want to find the angle using minimum three points to create two lines to tell us how much angle we are at and based on that we can do some calculations for the gestures. Below are the detailed steps discussed for how the model works.

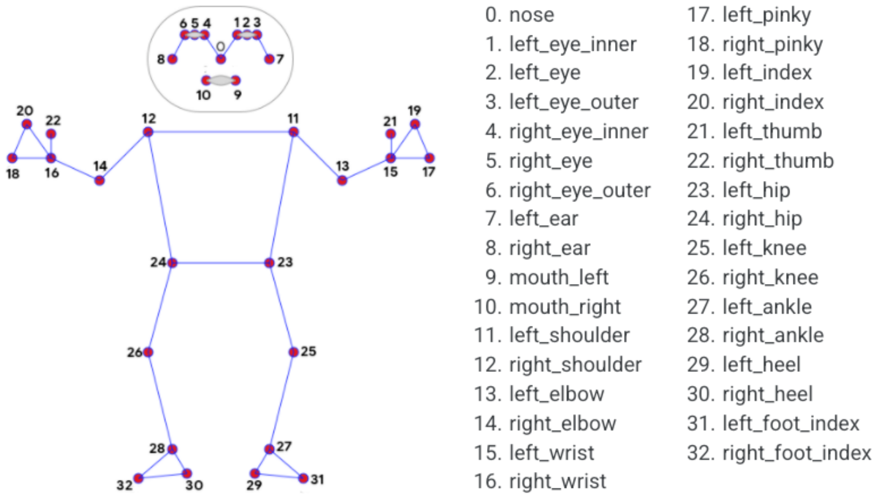
1. Install and setup

First up, we'll install and import our dependencies that we need which are *MediaPipe* and *OpenCV*. These two will help us gather data about the various joints in our body such as our wrists, shoulders, etc. for making our calculation with angles possible to count our repetitions with heavier weights. Secondly we would want *NumPy* which would help us with our trigonometry to calculate the angles.

2. Make Detections

To make our detections possible, firstly we need to recolor our image because OpenCV renders the RGB image to BGR color format but for MediaPipe to work, we need to convert our BGR image back to RGB. Print the detections of our model. Lastly change the color format back to BGR format as OpenCV runs on BGR format, and then we can start rendering our detections.

3. Determining Joints



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

Figure 1

There are 33 landmarks in total, starting from index 0. These represent the different joints within the pose. For instance, if we want to calculate the angle for our Right hand's bicep curl, we would require the joints of *shoulder*, *elbow and wrist* which are 12, 14 and 16 respectively as referred in Figure 1.

4. **Calculating Angles**

   First we get the coordinates of the threejoints which we require to get the angle calculated. Then we can calculate the slopes of the joints using *NumPy*. Angles are calculated in radians which then can be converted into degrees.

RESULTS

Our program has successfully run and has calculated the angle of our model.

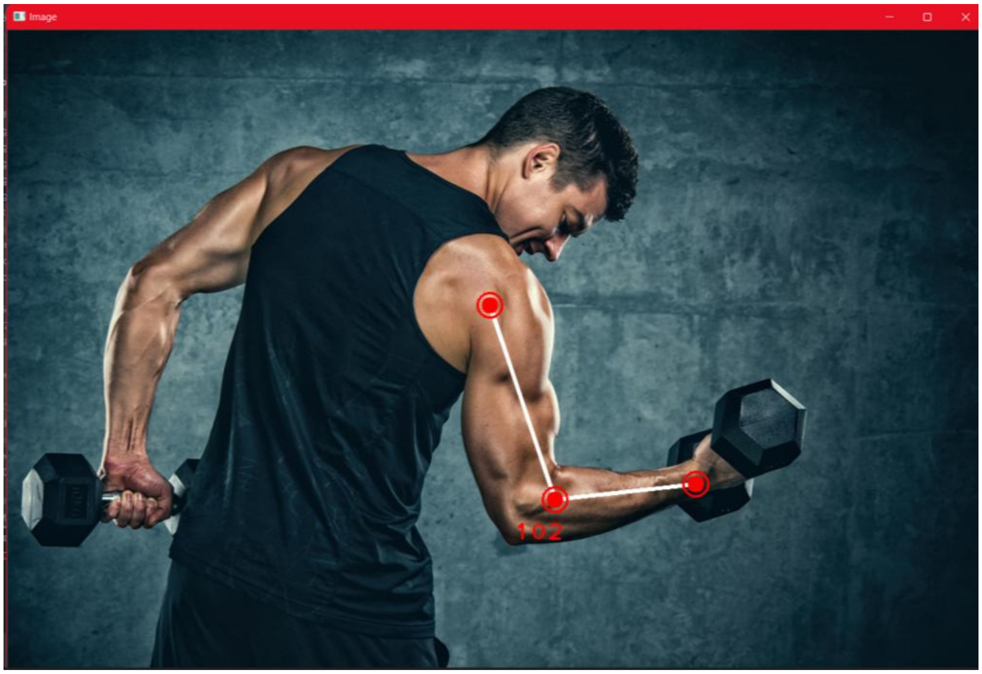


Figure 2

Our program has been able to detect the joints accurately and calculated the angle as per the instruction of the joints given by the user.

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