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Workout Analysis Using Mediapipe BlazePose and Machine Learning

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Abstract: If we search online for workout applications, we get many results with multiple functionalities. These applications provide many workout programs which help us to perform it on our own. But somewhere those programs cannot improve user's posture and accuracy. Those applications aim to provide workouts only, but sometimes following these workouts in the wrong way may lead to short-term or permanent injuries. To avoid such a problem, we proposed a system for workout analysis using the pose classification technique. The objective is to develop an application that can assist people in performing various exercises without getting injured. An application with the pre-trained workout set with the help of pose estimation technique. We proposed to use the Blaze-pose pose estimation module developed by MediaPipe. This neural network provides 33 body-points which are more than enough to capture the movements of the user. The pose estimation model is generally used to classify the different movements. We are using such technology with some advancement to provide accuracy of user's workout which will provide state of art results. The application will not just provide workouts to users but also it will monitor the real-time movements of users and also provide accuracy to users.

Index Terms - **Mediapipe, Machine learning, CNN, Blaze pose, Pose estimation.**

I. INTRODUCTION

Nowadays, it is observed that a healthy lifestyle is one of the most crucial things in day-to-day life. Everyone wants to be fit and healthy but it is also seen that very few of them follow the routine strictly. From our observation's we notice that many of the people are willing to do exercises but sometimes they don't have enough knowledge about the workouts and their forms, variations, etc. There are hundreds of different workout videos on the internet that include short workout videos for a variety of exercises. The purpose of these programs is to assist users in performing those exercises on their own. Despite having these features, they lack the ability to monitor user's workout. It is often observed that even regular gym users struggle to perform all steps correctly when working out. Continuously performing an exercise incorrectly may eventually lead to severe long-term injuries. It is suggested that all adults, even those with chronic medical conditions, should engage in at least 30 minutes to 60 minutes daily of moderate-intensity exercise if they are able.

New data are emerging that exercise may reduce the risk of acute respiratory distress syndrome, a major cause of death in patients with Coronavirus disease 2020 (COVID-19). Just as COVID-19 changed the way health care is, it has also upended the way consumers approach physical activity. Although gyms and workout classes are crowded areas with lots of surface areas, they can transmit infections. To avoid these issues, gyms and fitness centers throughout the country were closed during this period to ensure safety.

To overcome such a problem, we are trying to create an application to encourage users to take a more active interest in their health. For this application, we propose to use the blaze pose machine learning model provided by mediapipe, which can run the application on very few processing-powered devices. Due to the rapid development of deep convolutional neural networks, human pose estimation has significant performance improvement, this helps to accurately analyze the exercise the user is performing. Human pose estimation localizes body key points to accurately recognize the postures of individuals given in images or video. This step is a crucial prerequisite for the workout analysis. We describe a method of detecting a user's body posture during a workout, and comparing their body posture to a professional reference workout, for aiding in resolving this problem. Based on the latest advancement in deep learning for human body pose estimation, we represent the human body as a collection of limbs and calculate angles between them to detect errors and provide accuracy to the user. Other features like repetition counting, real time body movement recognition can do with the help of blazpose model.

II. LITERATURE SURVEY

Human pose estimation refers to the process of inferring poses in an images/ video and these estimations are performed in 2D and 3D. We identified various techniques from past years which are used for human pose recognition. We studied various researches from the year 2017 it was noticeable that this field of machine learning grasping more and more attention from many researcher communities. Many of the researchers proposed the new system collaborated with past technologies which give the state of art results. Nowadays, deep convolutional neural networks provide dominant solutions. There are two mainstream methods: Regression the position of key-points and estimating key-point heat maps followed by choosing the locations with the highest heat values as the key-points.

The paper presented by Ching-Hang Chen in the year 2017 used 2D pose estimation, followed by 3D exemplar matching it uses Big-data sets of 3D mocap data to regress 3D pose from 2D measurements. [1]

Juliet Martinez et al in the year 2017 had used a 2d-to-3d human pose estimation and coupled with a state-of-the-art 2d detector [2]

Qingtian Yu, Haopeng Wang, Fedwa Lamartine, and Abdulmotaleb El Saddik have proposed a system comprising a deep-learning multitask model of exercise recognition and repetition counting. Multitask system can estimate human pose, identify physical activities and count repeated motions with 95.69% accuracy in exercise recognition on the Rep-Penn dataset. The multitask model also performed well in repetitive counting with 0.004 Mean Average Error (MAE) and 0.997 Off-By-One (OBO) accuracy on the Rep-Penn dataset. [3]

A paper by Choi in the year 2021 proposed a mobile-friendly model, Mobile Human Pose, for real-time 3D human pose estimation from a single RGB image. It consists of the modified MobileNetV2 backbone, a parametric activation function, and the skip concatenation inspired by U-Net. This model is seven times smaller than the ResNet-50 based model. In addition, their extra small model reduces inference time by 12.2ms on Galaxy S20 CPU, which is suitable for real-time 3D human pose estimation in mobile applications. [4]

Xie et al in the year of 2019 have proposed a human pose estimation algorithm called Open Pose But its efficiency is very low. To overcome this, deep learning methods are based on Tensor Flow to recognize human body postures. [5]

III. PROPOSED SYSTEM

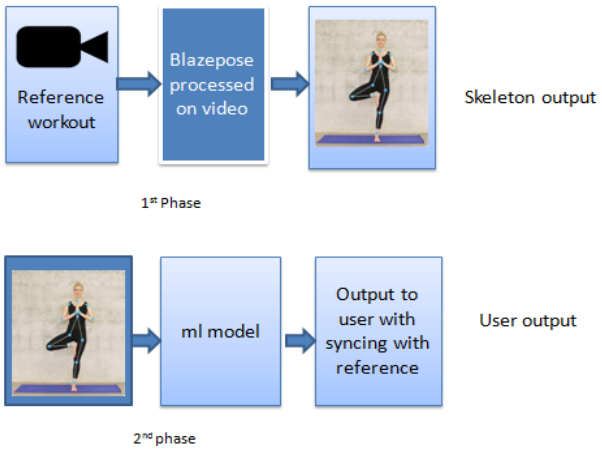

Figure 1 system architecture

Human Pose Estimation

Pose estimation is a machine learning task that estimates the pose of a person from an image or a video by estimating the spatial locations of specific body parts (key points). Pose estimation is a computer vision technique to track the movements of a person or an object. This is usually performed by finding the location of key points for the given objects. Based on these key points we can compare various movements and postures and draw insights.

Pose Estimation with Deep Learning

With the rapid development of deep learning solutions in recent years, deep learning has been shown to outperform classical computer vision methods in various tasks, including image segmentation or object detection. Therefore, deep learning techniques brought significant advances and performance gains in pose estimation tasks. There are lots of deep learning estimation approaches available e.g. openpose[7], movenet, deeppose, posnet, bodynet[6], etc. In our scenario we are using a Blazepose because it is the latest model developed by Google and this runs smoothly on lightweight devices such as the browser or mobile device. Hence, BlazePose can be used to estimate **either** a **single pose** or **multiple poses**.

What is Blaze pose

Blaze pose is a real-time pose detection technique that can detect human beings poses in Image or Video. It works in single-mode (single human pose detection). In simple words, the blaze pose is a deep learning model that allows you to estimate human pose by detecting body parts such as elbows, hips, wrists, knees, ankles, and forms a skeleton structure of your pose by joining these points. It is a lightweight model which uses depth wise separable convolution to deepen the network and reduce parameters, computation cost, and increased accuracy. Blaze pose gives us a total of 33 key points which we can use, right from the nose to left foot index.

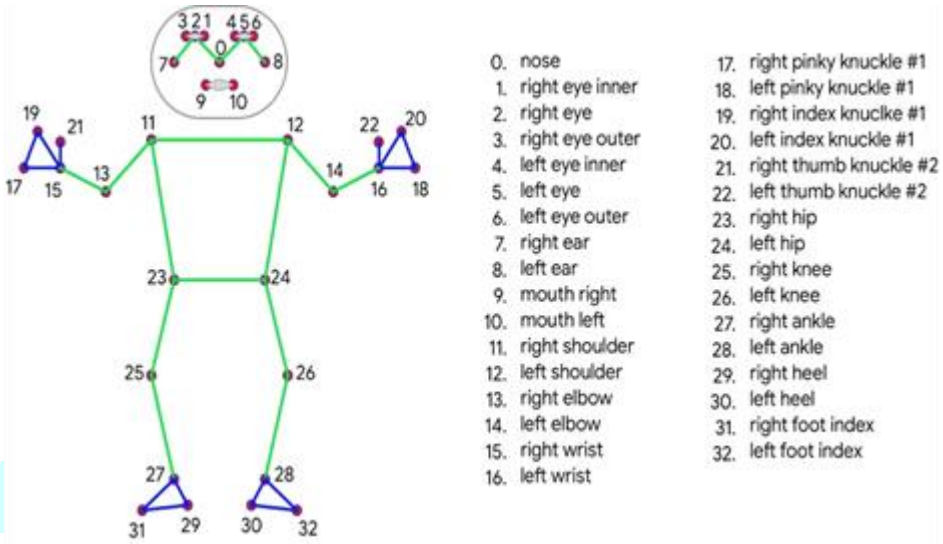

Figure 2 blaze pose

Working of Blaze pose

Blaze pose has two machine learning models: detector and Estimator. The detector is used to cut the human part from given input image. An estimator takes the images provided by the detector as an input and provides output.

Single-person Pose Estimation

The single-pose estimation algorithm is the simpler and faster of the two. It's ideal use case is for when there is **only one** person centered in an input image or video. The disadvantage is that if there are multiple persons in an image, key points from both persons will likely be estimated as being part of the same single pose — meaning, for example, that person 1's left arm and person 2's right knee might be conflated by the algorithm as belonging to the same pose. If there is any likelihood that the input images will contain multiple persons, the multi-pose estimation algorithm should be used instead.

A) Human body modeling

In human pose estimation, the location of human body parts is used to build a human body representation (such as a body skeleton pose) from visual input data. Therefore, human body modeling is an important aspect of human pose estimation. It is used to represent features and key points extracted from visual input data. Typically, a model-based approach is used to describe and infer human body poses and render 2D or 3D poses. In our case we use an N-joints rigid kinematic model where a human body is represented as an entity with joints and limbs, containing body kinematic structure and body shape information.

- **Kinematic Model**, also called skeleton-based model, is used for 2D pose estimation as well as 3D pose estimation. This flexible and intuitive human body model includes a set of joint positions and limb orientations to represent the human body structure. Therefore, skeleton pose estimation models are used to capture the relations between different body parts. However, kinematic models are limited in representing texture or shape information as shown in above figure 2

2D Vs 3D pose estimation

Pose estimation can be done either in 2D or in 3D. 2D pose estimation predicts the key points from the image through pixel values. Whereas 3D poses estimation refers to predicting the three-dimensional spatial arrangement of the key points as its output. In our scenario, the angles between limbs are determined by 3D pose estimation to give the user accurate results because of this we are using 3D pose estimation rather than 2D.

Media Pipe

Media pipe is an open-source cross-platform framework for building multimodal machine learning pipelines. It can be used to implement cutting-edge models like human face detection, multi-hand tracking, hair segmentation, object detection and tracking, and so on.

IV. CONCLUSION

There are several applications for pose detection in real-life. Here, we delve into one such application to learn more about pose detection. A Smartphone or tablet with a high-resolution camera has the same capabilities as a laptop or desktop. Since mobile phones and tablets have these capabilities, pose estimation has been pushed to new heights. We present an application for monitoring workouts without any involvement of a personal trainer. The application offers features like pose estimation, real-time workout analysis, and injury prevention and is getting the best results. The system is limited for workout purposes with single-person compatibility at a time.

REFERENCES

(1) Ching-Hang Chen and Dev Ramanan 3D Pose Estimation = 2D Pose Estimation + Matching In CVPR,2017

(2) Martinez, Juliet, et al. "A simple yet effective baseline for 3d human pose estimation." Proceedings of the IEEE International Conference on Computer Vision. 2017.

(3) Qingtian Yu, Haopeng Wang, Fedwa Laamarti and Abdulmotaleb El Saddik, A. Deep Learning-Enabled Multi Task System for Exercise Recognition and Counting. Multimodal Technol. Interact. 2021, 5, 55. https://doi.org/10.3390/mti5090055

(4) Choi, Sangbum, Seokeon Choi, and Changick Kim. "MobileHumanPose: Toward Real-Time 3D Human Pose Estimation in Mobile Devices." Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2021. (Choi, 2021)

(5) Xie, Ling, and Xiao Guo. "Object Detection and Analysis of Human Body Postures Based on TensorFlow." 2019 IEEE International Conference on Smart Internet of Things (SmartIoT). IEEE, 2019. (Xie, 2019)

(6) G¨ul, Varol1, Duygu Ceylan2 Bryan Russell2 Jimei Yang BodyNet: Volumetric Inference of 3D Human Body Shapes.

(7) Zhe cao, Gines Hidalgo, Tomas simon, Shih-En Wei, Yaser Sheikh. OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields. Cs.CV, 2018.

(8) Amit Nagarkoti, Revant Teotia, Amith K. Mahale and Pankaj K. Das. Real time Indoor Workout Analysis Using Machine Learning Computer Vision [2019].

(9) Bastian Wandt and Bodo Rosenhahn Leibniz Universit¨at Hannover Hannover, Germany RepNet: Weakly Supervised Training of an Adversarial Reprojection Network for 3D Human Pose Estimation, CVPR, 2019.