

MediaPipe Based Fitness Workout Pose Estimation Approach towards Physical Exercise Detection and Calorie Burnt Estimation on Tracking key Body Landmark Movements

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Abstract

Nowadays, lifestyle changes and mental stress on the peoples make them obese with extra fat deposited in the body and it leads to various health complication. In order to burn extra fat deposited in the body, gym workout become important which burn extra and unwanted calories through different type of workouts. Especially advancement of technologies helps to track the fitness of the health in real time. Technologies uses devices such as sensor like accelerometers and altimeter to gather movement of the body and it is processed using machine learning and deep learning model to determine the calories burnt. However these model are highly expensive and time consuming and it requires receiver and transmit unit which increase the device size. Further to handle these challenges, device free method has been employed to process the human movement gathered through camera in real time or through recorded video. Tracking fully body postures of the workout in real time process the human body movement through MediaPipe which is considered as pose estimation approach. MediaPipe perform machine learning task like pose estimation which is able to extract the human movement like arm gestures, leg lifts, squats and jumps on relative difference between body parts as feature points. Feature points were processed to identify the movement of the body landmarks related to the specified exercise and to detect motion pattern corresponds to specific exercise. Based on detected human body movement, time series data is generated. These data is processed further to determine the calories burnt and to track the progress to provide instant feedback to enhance workout performance and its routines. Experimental analysis of the proposed model proves that pose detection based fully body workout represents immense potential in generating interest in the fitness enthusiasts. Further it helps to perform exercise with proper form on correcting the movement patterns to eliminate the risk of injuries. Furthermore, particular model provides increased accuracy and efficiency compared to other existing models.

Keyword: Pose Detection, MediaPipe, Device Free methods, Calories Estimations, Motion Patterns

1. Introduction

Peoples were exposed to different types of lifestyles and mental stress due to their surrounding makes them obese with extra fat deposited in the body and it leads to various health complication. In order to burn extra fat deposited in the body, gym workout become important which burn extra and unwanted calories through different type of workouts. Especially advancement of technologies helps to track the fitness of the health in real time through software applications. Those applications uses devices such as sensor like accelerometers and altimeter to gather movement of the body and it is processed using machine learning and deep learning model to determine the calories burnt with increased accuracy and efficiency. In Particular, Pose estimation plays an important role in the world of interactive applications such as security applications, game application and fitness applications. Recent advancements in this field have greatly improved the fitness experience. Meanwhile the cost associated with motion capture technology tends to be expensive.

Nowadays, significant advancement has been made in fitness application through device free method on using various pose of the bodybuilders for tracking to enhance the workout performance without any external devices to recognize it. However those application were focused using openpose and microsoft Kinect. It uses machine learning architecture towards pose detection to the specific poses even those advancement could not able to give complete solutions to multiple locations. In order to provide complete solutions to multiple workout at any

different location to body builders, , entire body poses has to be gathered for the performance tracking and to provide instant feedback to enhance the workout routine to burn extra fats and calories.

In this paper, MediaPipe which is considered as deep learning model is utilized for full body pose detection in real time to gym workouts. Media is pose estimation approach designed towards real time tracking of the gym workouts on utilizing their body posture and body landmarks of specific exercises..MediaPipe perform pose estimation on extracting the body movement of exercise on arm gestures, leg lifts , squats and jumps with relative difference between body parts indicated as feature points. Feature points were processed to identify the movement of the body landmarks related to the specified exercise and to detect motion pattern corresponds to specific exercise. Based on detected human body movement, time series data is generated. These data is processed further to determine the calories burnt and to track the progress to provide instant feedback to enhance workout performance and its routines. Further it helps to perform exercise with proper form on correcting the movement patterns to eliminate the risk of injuries.

Experimental analysis of the proposed model proves that pose detection based fully body workout represents immense potential in generating interest in the fitness enthusiasts. Furthermore, particular model provides increased accuracy and efficiency compared to other existing models. Rest of the paper is organized as follows, section 2 provides related work while section 3 presents the proposed model. Section 4 provides experimental and performance analysis. Finally section 5 concludes the article.

2. Related works

In this section, device based methods and device free method employed for pose detection on human movement towards fitness tracking and calories burnt estimation has been illustrated below

2.1. Microsoft Kinect

Microsoft Kinect is device free method uses camera for video acquisition and those video employed for human movement recognition using position estimation capabilities which extract the Keypoints of human movements as postures and those feature classified into different workout patterns to determine fitness training quality.

2.2. OpenPose

OpenPose is device free method used for human movement recognition using position estimation capabilities which extract the Keypoints of human movements by estimating and connecting the main joints of the person in the video using straight line in real time and those feature points extracted considered as Keypoints. Finally Keypoints is classified into different workout patterns to determine the fitness training quality.

3. Proposed model

In this section, MediaPipe is employed as device free method for human movement recognition to fitness training quality tracking.

3.1. Webcam

Web camera is placed to observe the workout position of the body builder and to captures the body builders poses from their entire body. Each poses has been indicated with landmarks to present the movement and its associated fitness quality. Figure 1 represents the Keypoints of the full body of the body builder .

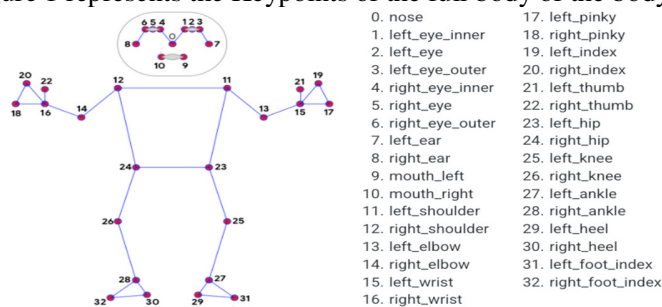


Figure 1: Keypoints of the full body of the body builder

3.2. MediaPipe based Pose Detection

In this part, real time tracking poses is processed using MediaPipe pose estimation model. It extract the human body movement like arm gestures, leg lifts , squats and jumps on relative difference between body parts as feature points. Feature points were processed to identify the movement of the body landmarks related to the specified exercise and to detect changes in workout pattern corresponds to specific exercise. Based on detected human body movement, time series data is generated.

3.3. Time series analysis

Time series analysis is carried out on the time series data to determine the calories burnt during the exercise or workout and to track the progress to provide instant feedback to enhance workout performance and its routines in any convenient locations along solutions to performs workout in proper form to reduce the risk of injuries.

Algorithm: Pose Estimation

Input : Live Streaming Video

Output: Workout Performance on basis of Calorie burnt and Changes in workout pattern which leads to injuries

MediaPipe()

Extract ()

It extract the human movement like arm gestures, leg lifts , squats and jumps

Feature points= landmarks points { arm gestures, leg lifts , squats and jumps }

Compute()

Difference in Motion patterns to specified exercise()

Provides the relative difference between body parts

Gather (feature point)

Time Series Data

Time Series Analysis (Time series Data)

Calories burnt ()

Total Calories burnt to specified future points

Recommendation ()

Correct the Exercise forms.

4. Experimental Analysis

Experimental analysis of the proposed model(openCV and MediaPipe) is carried out against existing device free methods such as Kinect and Openpose in the python enviroment. Model is evaluated using accuracy and IoU measure. Figure 2 represents the accuracy evaluation of the device free methods on pose estimation among the various human movement of the full body.

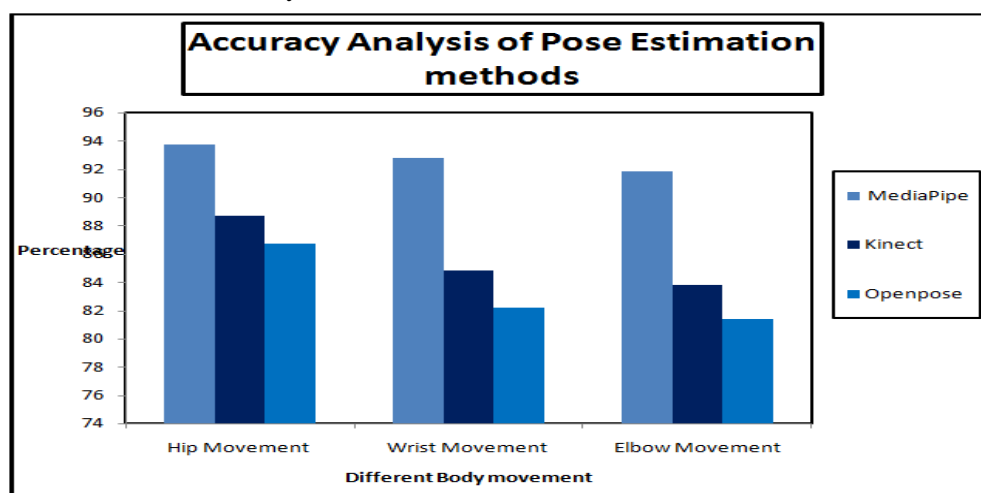


Figure 2: Accuracy Analysis of pose estimation methods

Table 1 represents the accuracy evaluation and IoU of the device free methods on pose estimation among the various human movement of the full body. Human Movement estimation efficiency is calculated on basis of IoU. IoU is measure of overlap among the keypoints of the pose. Finally model produces better results on all movement of the body for controlling proper form of workout in the multiple environments.

Table 1: Performance Analysis

Methods	Human Body Movements	Accuracy	IoU
MediaPipe	Hip Movement	93.7	0.07
	Wrist Movement	92.8	0.07
	Elbow movement	91.8	0.07
Kinect	Hip Movement	88.7	0.05
	Wrist Movement	84.8	0.05
	Elbow movement	83.8	0.05
Openpose	Hip Movement	86.7	0.03
	Wrist Movement	82.1	0.03
	Elbow movement	81.4	0.03

Conclusion

In this article , device free methods towards full body human movement estimation using MediaPipe has been used for pose detection towards tracking of the gym workout to determine the calorie burnt and suggest the proper form of the exercising. MediaPipe based pose detection approach is machine learning model which provides better performance comparison compared to existing model. Especially proposed model provides increased accuracy to various full body movements as compared with existing models.

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