DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Weight Training Pose Estimation

A project submitted

in partial fulfillment of the requirements for the degree of

Bachelor of Technology in Computer Science and Engineering

by

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CERTIFICATE

This is to certify that the report entitled "Weight Training Pose Estimation" submitted by "Sanjay Kumar Singh (2019001156), Watan Raj Thakur (2019000475), Akansha Raghuvanshi (2019558675)" to Sharda University, towards the fulfillment of requirements of the degree of "Bachelor of Technology" is record of bonafide final year Project work carried out by them in the "Department of Computer Science & Engineering, Sharda School of Engineering and Technology, Sharda University".

The results/findings contained in this Project have not been submitted in part or full to any other University/Institute forward of any other Degree/Diploma.

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ABSTRACT

The concept of correct posture and ‘form’ has always been integral to weight training, especially when dealing with relatively heavier weights. The concept of pose estimation for humans has been a widely explored avenue by researchers, but applying the same for calibration of muscle flexions is something not explored enough. This study touches upon the subject and explores a variety of approaches and methodologies proposed in recent years based on existing pose datasets comprising of basic body parameters and workout information. The proposed methods range from application of Greedy Bipartite matching algorithms to *OpenPose* and *DensePose* etc. with varying degrees of recorded accuracies and throughputs. This study is an attempt to condense the processes and methods employed for human pose estimation and specific examples pertaining to weight training.

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

Chapter 1. INTRODUCTION

1.1. Problem Statement

Human health is the complete state of physical, social and mental well-being and not merely the absence of any disease, illness or infirmity. In current situation, human health has been on a steep decline. Number of people with some ailment or the other is increasing rapidly. Most of this is attributed to lack of any physical exercise or a regime for the same.

Some who actually do take up the initiative to exercise regularly and primarily weight train most often than not find themselves new and unaware of the intricacies like correct posture and ‘form’ for an exercise and end up hurting themselves in the process. In the process of this study, several such approaches were reviewed which would assist the subject in assessing appropriate pose and form. There are several algorithms, which have been proposed recently for pose estimations.

Regular exercise and weight training can have significant health benefits, but it is important to perform exercises with correct posture and form to avoid injury. Many individuals who are new to weight training may be unaware of these intricacies, leading to improper form and increased risk of injury. To address this issue, several approaches have been reviewed in this study to help individuals assess appropriate posture and form. One such approach is the use of algorithms for pose estimation. These algorithms utilize camera/image acquisition devices to track body movements and provide real-time feedback on posture and form during exercises. This can be a helpful tool for individuals who are new to weight training or those who want to ensure that they are performing exercises correctly.

Other approaches include virtual training programs that provide individuals with guided workouts and real-time feedback on form and technique. These programs can be accessed online and are often led by qualified professionals, providing individuals with expert guidance regardless of their location or financial situation.

By using these approaches, individuals can learn correct posture and form for exercises, reducing their risk of injury and maximizing the effectiveness of their workouts. Additionally, these approaches promote self-confidence and motivation during workouts, leading to a better overall fitness experience. The use of algorithms for pose estimation and virtual training programs can be helpful tools for individuals who want to improve their posture and form during exercises. By providing real-time feedback and expert guidance, these approaches can reduce the risk of injury and maximize the effectiveness of workouts. These tools promote self-confidence and motivation, making fitness more accessible and enjoyable for individuals from all backgrounds. Several of these tools including YOLO-Pose and Google MediaPipe Pose have been proposed in recent years, and they have been proven to have surprisingly reliable performance in human body pose predictions. While many gyms and fitness facilities do have a variety of equipment and experienced trainers to assist with correct posture and form during workouts, the availability of these resources may be limited during times of lockdown or quarantine. For example, during the COVID-19 pandemic, many individuals have been unable to access gyms or fitness facilities due to closure or limited capacity.

In these situations, it may be challenging to set up a workout regime at home without proper guidance on correct posture and form. Virtual training programs and algorithms for pose estimation can provide a solution to this problem by offering real-time feedback and guidance on form and technique from the comfort of one's own home. These programs and algorithms can be accessed from anywhere with an internet connection and can provide individuals with the guidance and support they need to perform exercises correctly and safely.

Furthermore, these tools can be particularly helpful for individuals who are just starting out with fitness or who may not have access to experienced trainers or expensive equipment. By providing affordable and accessible guidance, virtual training programs and algorithms for pose estimation can help individuals achieve their fitness goals without breaking the bank. In summary, while gyms and fitness facilities may offer equipment and experienced trainers to assist with correct posture and form during workouts, virtual training programs and algorithms for pose estimation can provide a viable alternative during times of limited access or for individuals who may not have access to these resources. These tools offer real-time guidance and support, making fitness more accessible and achievable for individuals from all backgrounds. Most gyms and similar facilities have a wide variety of equipment and experienced trainers for guidance regarding the correct posture and form. Unavailability of these equipment and trainers especially while setting up a workout regime at home during COVID-19 or similar housebound scenarios.

1.2. Project Objectives

Many people are suffering from various types of severe injuries because they are unable to complete the exercise correctly. They can learn how to perform from a variety of online videos, but these videos cannot act as a real-time guide during a workout. This method may be useful to them as a real-time guide during workouts at home or in the gym, wherever they perform.

Correctly performing exercises is essential to avoid severe injuries, but many people struggle to do so without proper guidance. Although online videos can be a helpful resource for learning how to perform exercises, they cannot provide real-time feedback during a workout. As a result, many individuals continue to struggle with improper form, increasing their risk of injury.

The new method of providing real-time guidance during workouts can be incredibly beneficial to individuals who struggle with proper form. By using camera/image acquisition devices and online resources, individuals can receive immediate feedback on their form and technique, ensuring that they are performing exercises correctly and reducing their risk of injury. This technique can be used anywhere, whether individuals are working out at home or in the gym.

The real-time guidance provided by this technique can help individuals feel more confident and motivated during their workouts. Knowing that they are performing exercises correctly can help them achieve better results and avoid injuries, leading to an overall improved fitness experience. Additionally, this technique can be a cost-effective alternative to personal trainers or gym memberships, making fitness more accessible to individuals from all backgrounds.

The new method of providing real-time guidance during workouts can be a game-changer for individuals who struggle with proper form. By leveraging technology and online resources, individuals can receive immediate feedback on their form and technique, reducing their risk of injury and improving their overall fitness experience. This technique is a cost-effective alternative to personal trainers or gym memberships, making fitness more accessible to individuals from all backgrounds.

1.3. Motivations

Proper guidance is essential for individuals to perform exercises accurately and effectively. Many people struggle to complete exercises correctly, leading to poor results and even injury. To address this issue, various virtual systems have been developed to monitor individuals in real-time while exercising. However, some of these systems still lack certain features that are crucial for a successful workout.

To provide individuals with the guidance they need, a new technique has been developed. This technique is designed to help individuals exercise properly and at the right weight. By using camera/image acquisition devices and online resources, individuals can access virtual training programs and guidance from qualified professionals. This allows individuals to receive real-time feedback on their form, technique, and weight selection, ensuring that they are performing exercises accurately and effectively.

The new technique fills a gap in the fitness industry by providing individuals with access to expert guidance regardless of their location or financial situation. It eliminates the need for expensive gym memberships or personal trainers, making fitness more accessible to individuals from all backgrounds. Additionally, the technique promotes proper form and technique, reducing the risk of injury and maximizing the effectiveness of the workout.

The new technique for providing individuals with guidance during exercise is an innovative and effective solution to a long-standing problem in the fitness industry. By leveraging technology and the expertise of qualified professionals, individuals can exercise properly and at the right weight, regardless of their location or financial situation. The technique promotes proper form and technique, reducing the risk of injury and helping individuals achieve their fitness goals.

1.4 Hardware & Software Specifications

- Hardware:
  - Laptop with built-in camera or external camera
  - PC with camera

- Software:
  - Python with Libraries (MediaPipe)

1.5 Other Non-Functional Requirements

- There should be good free space for better computer vision.
- Should maintain appropriate distance to be captured in the camera frame.
- Camera lens should keep as much clean as possible for clear vision

Chapter 2. LITRATURE SURVEY

2.1. Existing Work/Related Works

A wide variety of approaches, essentially for pose estimation, have been proposed. One aspect that came out of the survey was that there have been almost no specific approaches suggested for weight training poses. Primarily all of them have been proposed for successful pose estimation and have been adapted into estimating appropriate pose and form for different weight training exercises.

G. Taware et al., [5] in 2021 have developed an application in which the training dataset has 60,000 images with Some images showing the same posture have different key points and there are 25,000 frames in which the user performs the exercise. The system will attempt to estimate the poses and keep track of the repetition count for a limited number of exercises. However, using computer vision for posture estimation during exercise can be challenging. It has only been developed as a cross-web applications that cannot be used as a mobile application. The application could not however the system is able to detect and record multiple people in a single frame in real-time.

H. Xiong et al., [7], in 2020 worked on a sturdier vision based workout analysis, and the test results showed how effective their suggested 3D posture assessment was compared to previous ones. Would help in distinguishing between incorrect and correct motions but would not suggest anything for the timings of these motions. This lack of a timely feedback system was why they couldn’t integrate the proposed model with video tutorials

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S. Yadav et al., [8], in 2019 suggested a model using deep learning techniques to distinguish different Yoga poses with the highest level of accuracy. The dataset included 6 yoga poses performed by 15 different people. For the purpose of identifying yoga positions in real-time video data, a hybrid deep learning model made up of LSTM and CNN was used.

Yiwan Gu et al [9] used Deep Learning Models in 2019 for Human Pose Estimation and work on interactive computer vision systems for home-based physical therapy, but they were unable to give users a side-view option or create an algorithm that could provide more particular comments about the patient's progress.

S. Chen and R. yang et al [10] has developed a tool that adjusts users' posture by generating the appropriate exercise form. For pose estimation, they employed OpenPose and deep neural networks, and for comparing user performance, they used machine learning and heuristic-based models. The developed application only functions online and is supported by GPU-based Windows and Linux systems.

Z. Cao et al [11] in 2021 has performed pose estimate for both single-person and multiple-person poses. They use a mixture of local observations of the bodily parts and their spatial relationships to draw conclusions about a single person. They have applied a top-down approach strategy for numerous persons in order to first identify persons, then gauge the posture of each individual person individually. It can only be used for the user-provided photographs; it cannot be used for videos.

Q. Dang et al [12] did a deep study in 2019 on techniques for estimating human posture. The estimate of single person is divided into two categories. Heatmap-based technique and regression-based approach, respectively and Top-down and bottom-up approaches are the two categories used to categories multi-person pose estimation. Today, there are many uses for human posture estimation systems, and their accuracy can still be increased for usage in real practical applications. The algorithms' pace is still too slow for real-time applications and forecasting in several industries.

F. Sajjid et al [13] in 2017 examined many methods for recognizing human poses to determine which one is the best by calculating each method's accuracy and obtaining better results, so that it could be used for human pose recognition to get better and more accurate results.

Alexander Toshev et al [14] in 2014 Pose estimation has been formulated as a joint regression issue, and it has been effectively cast in DNN contexts. Using a 7-layered generic convolutional DNN as an input and the complete image as output, the location of each body joint is regressed. The use of this mixture has two benefits. First, because each joint regressor uses the complete images as a signal, the DNN is able to capture the full context of everybody jointing comparison to methods based on graphical models, the methodology is far easier to develop because there is no need to explicitly define feature representations and detectors for parts, as well as a model topology and interactions between joints. Instead, they demonstrated how to learn a general convolutional DNN for this issue. It slowed that generic convolutional DNN can be understood for this problem

Naimat ullah Khan et al [15] in 2018 began their research with the conventional graphical format, then discussed how Deep Neural Networks dramatically improved human position estimation before moving on to the most recent and well-known method, the stacked hourglass. Modern approaches rely on training, evaluating, and comparing on a few common datasets using various Deep learning module architectures. They presented a thorough analysis of some of the most popular deep learning techniques, starting from the first usable models for estimating human posture, to provide a succinct analytical framework.

Mr. Rutvik Sonawane et al [16] in 2022 created an artificial intelligence-based fitness trainer software that will assist users in leading healthier and fitter lives. With the aid of Open CV Library, they employed image processing in their application to compute height and video processing to identify exercises performed by a user. A user will receive their workouts based on their height and weight and BMI. Additionally, they have subdivided. Underweight, normal weight, overweight, obese, and extremely obese are the five classifications for BMI.

Riza Alp Guler et al [17] in 2018 had given contribution can be summarized in 3 points. 1) By assembling study provides a comprehensive mapping between the SMPL model and individuals in the COCO dataset, they presented the first hand compiled ground truth dataset for the job. This is achieved using a cutting-edge annotation pipeline that makes use of 3D surface data while annotation. 2) The researchers trained CNN-based algorithms to estimate body surface coordinates for any image pixel, resulting in dense correspondence for real-world images, using the dataset generated from this process. They tested both region-based systems using Mask RCNN and fully-convolutional architectures using Deep lab, concluding that the latter was superior. They also thought of cascading variations of their strategy, which would result in more advancements over existing designs. 3) They investigated several strategies for utilizing the ground truth data we created. A selection of image pixels from each training sample are used to define the supervision signal. They trained a network of teachers that can in paint supervisory signal in remaining picture domain using these sparse correspondences. In comparison with spare points or other datasets, using this in painted signal yields greater performance.

Ke Sun et al [19] in 2019 has focus on the problem of human pose estimation, with a particular emphasis on finding reliable high-resolution representations. The authors are interested in this area of research as it is crucial for various applications such as action recognition, human computer interaction, and animation. By discovering trustworthy high-resolution representations, they aim to improve the accuracy and robustness of human pose estimation algorithms Current techniques in human pose estimation often involve a high-to-low resolution network, which converts low-resolution representations into high-resolution ones. They suggest a network that preserves high resolution instead. Depictions during the entire process. They first began with a high-resolution subnetwork. The authors propose a method to improve human pose estimation by adding high-to-low resolution subnetworks incrementally. They create extra stages by connecting parallel multi-solution subnetworks, which repeatedly combine different scales of information. By continuously receiving data from other concurrent representations, the high-to-low resolution representation becomes richer and more precise in both time and space. The authors show that their approach outperforms existing methods on two benchmark datasets for key-point detection (COCO Key point Detection and MPII Human Pose) and demonstrate its superior performance in pose tracking using the Pose Track dataset.

M. Patel et al. [20] in 2021, For the purpose of estimating a single person's or multi-person, they compared and summarized a number of deep learning models. Depending on the use, applications of this technology include recognizing actions, creating animations, analyzing sports, and enhancing reality in various domains. Pose estimation can output the results in either 2D or 3D coordinates. Joint angles in 2D are taken into consideration when estimating a 3D position. Several obstacles, including weak articulations, occlusions, clothes, and tiny, almost discernible joints, Human pose estimation has advanced remarkably, CNN models based on deep learning.

K Pushpendra et al [21] in 2018 has presented a review of recommender systems (RSs), which are used to help users find the items they are looking for on e-commerce websites. One of the techniques used in RSs is collaborative filtering. The authors of the paper evaluated the various methods and algorithms used in the recommender system, including the metrics used to measure performance and the challenges of recommendation systems, such as cold-start, data sparsity, scalability, and privacy. They found that although collaborative filtering provides good recommendations, it still faces problems with scalability and sparsity. The study suggests that the quality and performance of collaborative filtering-based recommendation systems could be improved by using fuzzy clustering and optimization techniques.

K. Dinesh et al [22] in 2017 has referred to a feature selection and dimensionality reduction method for face recognition. The DCT (Discrete Cosine Transform) and PCA (Principal Component Analysis) combination, followed by the Bat algorithm, is used to extract the most relevant features for face recognition in uncontrolled environments. The use of the Bat algorithm as a meta-heuristic optimization technique is beneficial in achieving better performance compared to other optimization techniques like GA (Genetic Algorithm), PSO (Particle Swarm Optimization), and CS (Cultural Algorithm). The proposed method is robust to the presence of noise, making it a suitable choice for face recognition applications in real-world scenarios.

S Saquib et al [23] in 2019 has proposed a comprehensive method for evaluating recommendation systems has been proposed, incorporating implicit user feedback, a mechanism for verifying the authenticity of the feedback, and a mathematical model to categorize products based on their preferred criteria.. The rank aggregation algorithm is employed to generate a conclusive ranking that is then compared to the initial ranking for evaluation. By comparing the proposed method with existing systems, it has been determined that the approach outperforms other methods based on several parameters. The proposed evaluation scheme is expected to provide users with a reliable means of assessing recommender systems, thereby facilitating ease and dependability in online shopping.

Z Soumaya et al [24] in 2022 has worked aim is to detect an individual's emotional state by analyzing their facial expressions and upper body gestures. This is achieved through the use of multi-modal classification involving both facial images and upper body gestures, which are analyzed by multi-task convolutional neural networks (MTCNNs). The two branches are integrated and linked to one another, and two fully connected layers are included to extract emotional data. The study demonstrated that the method attained a significant accuracy rate of 99.75%. Furthermore, the analysis of both body gestures and facial expressions proved to be more effective in detecting emotions than relying on either modality alone. The proposed model could also be utilized to extract additional characteristics, such as age and gender.

Chen Sun et al [25] in 2017 has made progress in unraveling the connection between 'big data' and visual deep learning. The researchers used the JFT-300M dataset, containing over 375 million noisy labels for 300 million images.

Table I. Papers Analysed As A Part Of Review

S. No.	Author/Year	Methodology	Results	Remarks
1.	W. Ouyang et al., 2019	DTW (Dynamic Time Warping), Convolutional Neural Network (CNN) model that was trained on the Common Objects in Context (COCO) dataset [11] for human pose estimation	The Conference on Computer Vision and Pattern Recognition organized by the Institute of Electrical and Electronics Engineers (IEEE).	A multi-source deep model is used that combines three information sources non-linearly: appearance, deformations, and appearance mixture type.
2.	G. Dsouza et al., 2020	One should focus on acquiring the model weights, which may be done online because to the availability of various example data sets for the general public. Model weights must be loaded into the network. The system must be able to read the user-uploaded video input. As a group of frames that we utilized as network input. The machine will then analyses crucial data and make predictions. Using the primary points, a stick figure or skeletal framework will be created. Calculations might be made to determine the angles between the various body components and the stick figure-like skeletal system. Using the angles that were established by obeying certain directions, a result can be attained.	Project execution is a fairly simplistic. The accuracy of the angels between them, using top-notch cameras and advanced graphics, joints and limbs may be made to look clear.	To improve quality of this paper project the camera should be of high mega pixels for good resolutions.
3.	A. Nagarkoti et al., 2019	The workout videos used had a frame rate of 25 frames per second and the user's activity was recorded using a laptop and an external webcam with a resolution of 1280 x 720.	Was able to detect errors in limp positions. Needed more fine-tuned data set for better result.	

4.	M. Kocabas et al., 2018	They evaluated the method on four different datasets (MPII Human pose dataset), (Human3.6M), (Penn Action), (NTU RGB+d)	85.5% accurate on the NTU for 3d action recognition. 97.4% accurate on the Penn action recognition. 53.2% accurate on the Human3.6M action recognition. 63.9% accurate on the MPII action recognition	Out of all these datasets used in this project, the algorithm performed well in Penn Action Recognition with well accuracy
5.	G. Taware et al., 2021	The training data set consists of 60000 photographs, 25000 frames in which the user really completes the activity, and a few images of the same stance with different critical points.	Estimating poses through computer vision for a range of exercises and postures can be challenging, the poses and count repetitions for a select few exercises. It is not compatible to operate on a mobile Android or iOS application; rather, it is created as a cross-web application. In the real-time system, the program is unable to catch many people in the frame.	This project is able to detect and recognize the pose of group of people but unable to do so in realtime.
6.	H. Pardeshi et al., 2022	Greedy bipartite matching algorithm. and multi stage CNN for three significant stages	Works with 86.534% accuracy	Using the greedy bipartite matching algorithm

7.	H. Xiong et al., 2020	It operated using reliable workout analysis based on robust vision.	It recognizes improper movements and does not take timing into account. Consequently, don't give the user timely feedback.	Improper poses with irrespective to time constrains was found.
8.	S.K. Yadav et al., 2019	Recognize various yoga poses using deep learning algorithm and data sets of 6 yoga asana is used. Yoga pose detection in real-time videos using CNN and LSTM.	It can be used on a compact and convenient device for self-training and real-time predictions.	Able to detect and find the position for yoga.
9.	Y. Gu et al., 2019	Utilized deep leaning for human posture estimation and an interactive computer vision-based system at home to complete physical therapy.	They were unable to create a way of algorithm which, provides more specific evaluation of the patient's progress or offer users the option of viewing the side of the object.	It was unable to provide the complete viewing the user.
10.	Chen & Yang, 2018	Deep neural networks and OpenPose were utilized to estimate poses, while machine learning and heuristic-based models were employed to calculate performance results through comparisons.	The Pose Trainer is a computer application that offers tailored feedback on exercise form using pose estimation, visual geometry, and machine learning. It assesses exercise movies by using pose estimation to look at significant times in human pose. The software then evaluates posture accuracy and offers tailored guidance on exercise	It only functions on web-based Windows and Linux computers that use GPU technology. The project less utilized for the user as it is based on the web.

			improvement using machine learning and geometric heuristics. It produces training videos for all four activities it uses.	
11.	Z. Cao et al., 2019	It performed pose estimation for both single individuals and groups of people. They do inference on a single person based on a variety of local observations of various body parts. Multi-person employed a top-down approach to first identify persons and then separately assess each person's stance.	OpenPose, the first real-time system for body, foot, hand, and face keypoint recognition, has been open-sourced and is currently being extensively used in human analysis study. Additionally, OpenPose is now a part of OpenCV.	This only executes on images; it cannot be applied to videos. Able to predict the pose on the image constraint but not on videos.
12.	Q. Dang et al., 2019	The two types of single-person pose estimation are regression-based approach and heatmap-based approach. Top-down approach and bottom-up approach	Human pose estimation can still be improved and For real-time prediction, algorithms still perform too slowly.	The study seeks to make it easier for readers to comprehend each step in the estimation pipelines.
13.	F. Sajjad et al., 2017	Here many various methods for the human pose recognition, When compared to identifying which, one works better and performs correct in recognitions	they examined the literature on learning-based human posture recognition. They described the pose identification sensors, the feature extraction and categorization procedures, and a catalog of datasets that are freely accessible. Additionally, they contrasted	Different datasets are used for different parts of body, some algorithms used in real time videos whereas some are used for images and some for videos

			and talked about the output of various classifications.	
14.	Toshev & Szegedy, 2014	Used Deep Neural Networks (DNN) and formed a DNN-based regression problem towards body joints.	were able to capture context (where some of the body parts were barely visible) in a holistic manner	Were able to produce outcomes that were state-of-the-art or better on a number of difficult academic datasets.
15.	Khan & Wan, 2018	They have discussed about first pictorial Structures, Global Analysis of Structures, and Greater Visual Simulator for Pictorial Structures, depose, Image-dependent pair-wise relations in DNN, Combining a localized perspective with a holistic one, Hourglass stacked, Multi-Context Focus, Network with Multi-Scale Structure Awareness	Explains how these methods are still being used	There are still some contemporary models that use the pictorial structure, but for the most part, DNNs are used to estimate human location.
16.	M.R. Sonawane et al., 2022	They applied image processing in their application to compute height and video processing with the aid of the Open CV Library to identify exercises performed by a user. Users will receive exercise recommendations based on their height and weight and BMI. Additionally, they separated BMI into five groups: underweight, normal, overweight, obese, and extremely obese.	They employed image processing in their application to compute height and video processing with the aid of the Open CV Library to identify exercises performed by a user. Users will receive exercise recommendations based on their height and weight and BMI. Additionally, they separated BMI into five categories: underweight,	a very simple application which used Open CV library for video processing And divided body Mass Index (BMI) into categories.

			normal weight, overweight, obese, and extremely obese.	
17.	RA Güler et al., 2018	They introduced the Dense Pose-COCO dataset, a large collection of image-surface correspondences with ground truth, and developed specialized architectures to achieve fast and precise mapping between images and body surfaces in real-time.	They developed unique architectures for recovering highly-accurate dense correspondences between images and the body surface in numerous frames per second and introduced DensePose-COCO, a sizable collection of ground-truth image-surface correspondences.	The system was able to produce highly accurate mapping between images and body surfaces in multiple frames per second.
18.	D. Tome et al., 2017	For the purpose of improving both tasks have created an all-encompassing formulation that takes the approach addresses the issue of estimating 3D human posture from a single raw RGB image by considering both 2D joint estimation and 3D pose reconstruction. Simultaneously. They used a combined strategy that combines probabilistic understanding of human's 3D position along with CNN architecture's multi-stage via application of understanding of conceivable 3D landmark locations to focus finding for more suitable 2D places. The entire procedure is trained from beginning to end, is incredibly effective, and produces cutting-edge results on Human 3.6M that surpass earlier methods for both 2D and 3D mistakes.	While a GPU-based realtime technique for Convolutional Pose Machines has been announced, the upgrading for each step in CPU-based Python code when utilising three models runs at about 1,000 frames per second. A logical future step is the integration of these systems to offer a trustworthy real-time 3D posture estimator, as well as the integration of this work with a more straightforward	Hence while using the 3 models, The CPU-based Python code upgrades each level at a rate of roughly 1,000 frames per second,

			2D technique for real-time pose estimate on lower power devices.	
19.	K. Sun et al., 2019	They began with a high-resolution subnetwork in the first stage and gradually added subnetworks of decreasing resolution and connected multiresolution subnetworks.	The method was effective in two ways: (i) it kept high resolution throughout the process without needing high resolution recovery; and (ii) it frequently combined multi-resolution representations to create trustworthy high-resolution representations.	As a result, the predict key-point heat map is potentially more accurate and spatially more precise.
20.	Patel & Kalani et al., 2021	In this paper, they have used CNN and comparison and summary of various deep learning models for the estimation of posture for single individuals and groups of people.	They have shed light on the fundamental principles and fundamental workings of CNN in this article, which also reviews deep learning methods for estimating human stance.	Deep Convolutional Neural Networks have proven effective in learning various computer vision tasks.
21.	C. Sun et al., 2017	This study makes progress in unraveling the connection between 'big data' and visual deep learning. The researchers used the JFT-300M dataset, containing over 375 million noisy labels for 300 million images.	In the absence of noise, their suggested method not only produces superior results with fewer features, but it also does so in the presence of noise.	For all the given datasets, the proposed approach outperforms existing algorithms in terms of recognition rate with fewer features.

2.2 Proposed System

The system is formed with 3 different modules and yet to update for finalizations:

I. Weight recommendation

As the users having different body strength with different body factor, therefore, they needed to pick appropriate weight for performing exercise (i.e. Bicep curl), which will ultimately come up with good results

II. Appropriate Angle Finding

Varying in weight for performing exercise with respect to user also need to find appropriate angle range for good results and healthy exercise.

When performing exercises, it is essential to consider the user's weight as a crucial factor. A person's weight affects their center of gravity, balance, and stability. Therefore, exercises that may be suitable for a person with a particular weight may not be as effective or safe for someone with a different weight. For instance, a lightweight person may find it easier to perform a push-up due to less body weight to lift, while a heavier person may struggle due to the extra weight they have to lift. It is crucial to vary the weight for different exercises to ensure that the user is comfortable and safe when performing them. Varying the weight can also help to increase or decrease the intensity of the exercise, depending on the user's fitness goals and ability.

In addition to considering weight, finding the appropriate angle range for exercise is also important. The angle range refers to the range of motion that a joint goes through during an exercise. Choosing the appropriate angle range can help to prevent injuries and promote healthy exercise. If the angle range is too narrow, the user may not be engaging the muscles effectively, while if the angle range is too wide, it may put unnecessary stress on the joints, leading to injuries. Therefore, it is essential to find the appropriate angle range for each exercise to achieve the desired results and ensure the user's safety. This can be done by consulting a fitness professional or doing thorough research on the correct angle range for each exercise. Overall, considering weight and angle range are crucial when performing exercises to achieve good results and promote healthy exercise.

III. Executing process to count the repetitions

Ensuring that the user meets the appropriate angle with the recommended weight during exercise is essential for achieving optimal results and avoiding injuries. When the user is positioned correctly, it allows them to engage the targeted muscles effectively, leading to more significant gains in strength and endurance. Similarly, using the recommended weight helps to prevent overloading the muscles or joints, which can lead to injuries such as sprains, strains, or even fractures. With the correct weight and angle, each repetition of the exercise can be completed efficiently, which contributes to the overall effectiveness of the workout.

Moreover, keeping track of the number of exercise repetitions is crucial for monitoring progress and setting achievable fitness goals. Counting the number of repetitions completed during each exercise session can help to track the user's progress over time and identify areas for improvement. It also helps the user to maintain a consistent workout routine, ensuring that they are getting the most out of each session. A counter is a useful tool for keeping track of exercise repetitions, allowing the user to focus on the exercise and form rather than keeping a mental count. In conclusion, using the appropriate angle with the recommended weight and counting exercise repetitions is essential for achieving optimal results and maintaining a safe and effective workout routine.

Fig 1. Weight Recommendation

In above figure 1, basic body info includes different body factors like Body Weight, BMI, Physical Strength, etc. and on the basis of these variable, an appropriate weight will be recommended to the user.

$$\boldsymbol{S} \propto \boldsymbol{W}$$

Here, *Strength(*$\boldsymbol{S}$*)* is directly proportional to the *Weight (*$\boldsymbol{W}$*)*

To equate the proportional let's, assume a constant $\boldsymbol{h}$,

The final equation is

$$\boldsymbol{S} = \boldsymbol{h}.\boldsymbol{W}$$

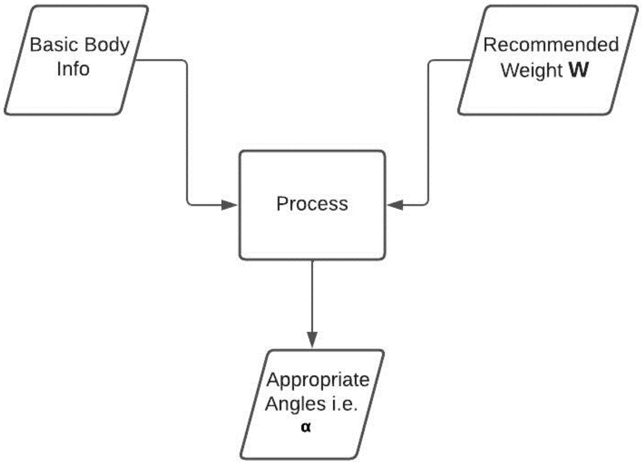

Fig 2. Finding Appropriate Angles

Here in above figure 2, with respect to user's body factors variables and recommender body weight, the system will calculate an appropriate angle range for performing the bicep curls.

$$\boldsymbol{S \propto A}$$

Here, *Strength(**S**)* is directly proportional to *Angle (**A**)* between arm and forearm

To equate the proportional let's assume a constant **K,**

The final equation is

$$\boldsymbol{S = K.A}$$

And the relation between Weight (W) and Angle (A) is inversely proportional i.e. "More Weight Less Angle and Vice Versa"

$$\boxed{\boldsymbol{W \propto 1/A}}$$

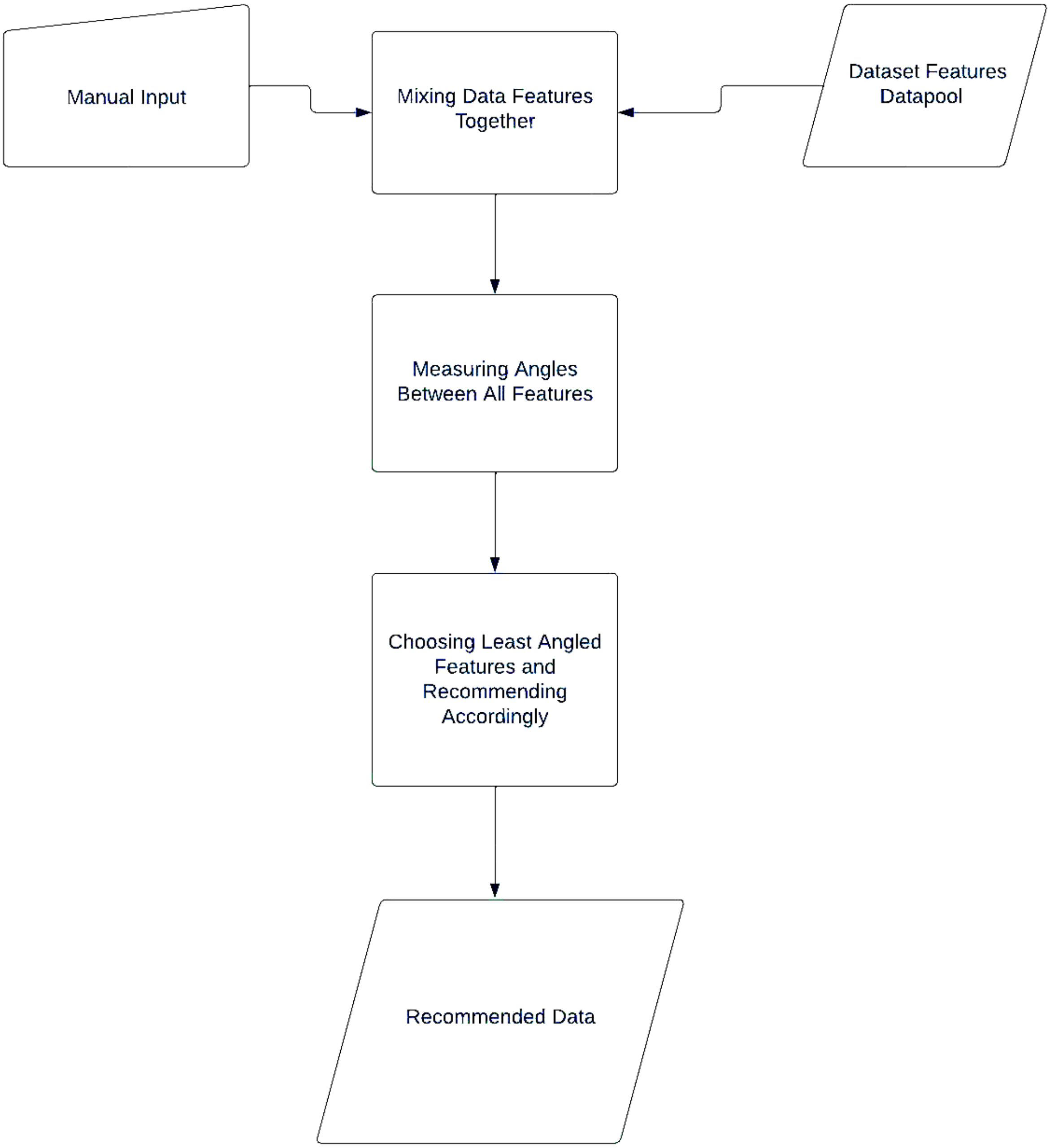

Fig 3. Recommendation System

- Dataset:

A dataset containing 150 data points that includes workout routine in a week, number of sets of biceps workout performed, body weight, dumbbell weight, contraction angle of arm, relaxation angle of arm, place of workout (home, outdoor, or gym), and level of workout (beginner, intermediate, or advanced), could be used for a wide range of research purposes related to fitness and exercise science.

One possible use of this dataset could be to identify common patterns and trends in workout routines among different groups of individuals, such as those who work out at home versus those who go to the gym. Researchers could also use the data to explore the relationship between various workout variables and outcomes such as muscle growth, strength gains, and overall fitness levels. Additionally, this dataset could be used to investigate the impact of different workout settings, such as home or gym, on workout performance and outcomes. By analyzing the data, researchers could identify factors that contribute to successful workouts, such as the optimal number of sets and contraction angles for biceps exercises.

Finally, the dataset could be used to develop targeted workout plans for individuals based on their workout level and goals. By analyzing the data and identifying correlations between different variables, researchers could develop personalized workout plans that are tailored to individual needs and preferences. Overall, a dataset containing 150 data points that includes information on workout routine, body weight, dumbbell weight, contraction angle, relaxation angle, place of workout, and workout level could be a valuable resource for researchers in the field of fitness and exercise science.

- Personal data:
  It is important to clarify that collecting personal data during program executions can potentially raise privacy concerns. Therefore, it is essential to ensure that proper measures are taken to protect the user's personal data. Regarding the data collected, the system collects information related to the user's workout routine, such as the type of exercises, number of sets, bodyweight, and workout level. However, it does not collect information on dumbbell weights or angles of contractions and relaxations.

  It is also worth noting that the data collected can be used to identify trends or patterns in the user's workout performance and provide personalized recommendations to improve their workout regimen. However, the data must be analyzed and interpreted correctly to avoid drawing incorrect conclusions or making inappropriate recommendations.

- Data pool
  The concept of combining datasets with personal data in a centralized location is commonly known as a data pool. Data pooling allows for the aggregation and analysis of a large amount of data from multiple sources, providing insights that might not have been possible if the data were analyzed in isolation.

  By combining personal data with datasets, data pooling can offer a more personalized approach to analyzing data. For example, in the context of fitness and exercise, combining a user's personal workout data with a larger dataset of workout data can provide insights on how the user's workout routine compares to others in the same demographic or skill level. This can be used to suggest modifications or improvements to the user's workout routine.

- Cosine Similarity and Choosing closest sets of information:
  After pooling the data, one common approach to analyzing the data is to measure the cosine angle between each feature. The cosine similarity is a measure of the similarity between two non-zero vectors of an inner product space that measures the cosine of the angle between them. In this case, each data point in the data pool can be represented as a vector

with each feature as a component. By measuring the cosine angle between each feature, it is possible to determine the similarity between different data points in the pool. This can be useful for clustering similar data points together or for identifying outliers in the data. Once the cosine angles have been measured, a similarity index can be calculated for each data point in the pool. This similarity index indicates how similar the features of the data point are to the features of other data points in the pool. This can be useful for identifying patterns and trends in the data, as well as for making predictions or recommendations based on the data.

- Recommended Data:
  It is important to note that the recommendation process is not just based on the closest features, but also considers other factors such as the user's fitness level, workout goals, and any existing injuries or health conditions. The system uses machine learning algorithms to analyze the data and make personalized recommendations for each user.

  Once the recommended data is generated, it is displayed to the user in a user-friendly interface, along with instructions on how to perform the recommended exercise correctly and safely. The system also tracks the user's progress over time and makes adjustments to the recommendations as needed based on the user's feedback and performance. This way, the user can gradually improve their fitness level and achieve their workout goals in a safe and effective manner.

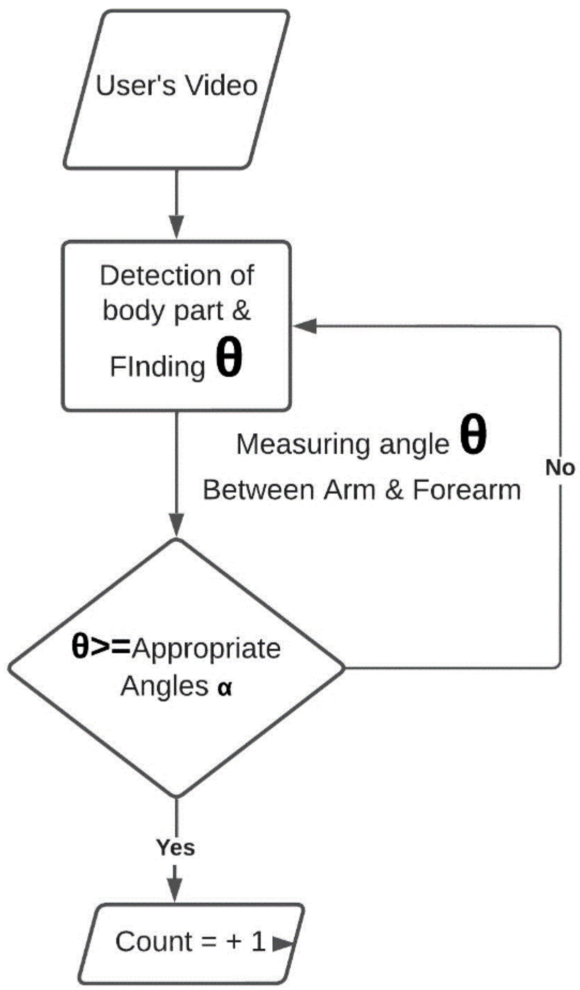

Fig 4. Counting Repetitions of Process

In above figure 3, with all the parameters and recommendations, if the exercise performance matches those values, the system count as one complete performance cycle and each time of repetition, the counter will add the value by 1 to previous value.

2.3 Feasibility Study

- Operational feasibility:

  The use of camera/image acquisition devices has become increasingly popular in various fields, including fitness and exercise. With the advancements in technology, it is now possible to perform and operate exercises using any camera or image acquisition device from anywhere. This has made it easier for people to maintain a consistent exercise routine, regardless of their location or access to fitness equipment. With the use of camera/image acquisition devices, users can follow workout routines or instructions from their personal trainers, fitness apps, or online resources. This technology has made it possible for users to receive personalized coaching and guidance, even when they are not in the same physical location as their trainer.

  The convenience of using camera/image acquisition devices for exercise has numerous benefits. Firstly, it provides flexibility in terms of time and location. Users can perform exercises at their convenience, whether at home, in the office, or while traveling. Secondly, it eliminates the need for expensive gym equipment, making it more affordable for users. Additionally, the use of camera/image acquisition devices promotes proper form and technique during exercise, which reduces the risk of injury. Finally, it provides an opportunity for users to receive feedback on their performance, allowing them to make necessary adjustments and improve their technique. In conclusion, the use of camera/image acquisition devices has revolutionized the fitness industry, making it more accessible, affordable, and convenient for users to maintain a healthy lifestyle.

- Economic Feasibility:

  Providing a free workout guide for people who cannot afford to pay high fees for trainers or gyms can be a significant benefit of using technology in fitness. With the help of camera/image acquisition devices and online resources, users can access a range of workout routines, exercises, and training programs without incurring any costs. This allows individuals from all walks of life to access high-quality fitness resources and improve their health and wellbeing.

  One of the key benefits of providing a free workout guide is that it promotes inclusivity and accessibility in fitness. It enables individuals who may not have access to traditional gym facilities or personal trainers to take advantage of virtual training programs and fitness communities. Additionally, it eliminates the financial barrier to entry for many people, allowing them to pursue their fitness goals without incurring high costs.

  Another advantage of a free workout guide is that it can help to promote healthy habits and prevent lifestyle-related diseases. By providing users with access to workout routines and exercises, they can maintain a regular exercise routine and improve their overall health and wellbeing. This, in turn, can reduce the risk of chronic diseases such as diabetes, heart disease, and obesity, which are often linked to a sedentary lifestyle.

- Scheduling feasibility:

    The ability to calibrate workout postures based on the user's time schedule, regardless of their location, is a significant advantage of using technology in fitness. With the help of camera/image acquisition devices, users can maintain their exercise routine, even when they are unable to visit the gym or attend a fitness class. By providing real-time feedback, these devices can help users to adjust their posture and technique, ensuring that they are performing exercises safely and effectively.

    One of the key benefits of using camera/image acquisition devices is that they allow users to exercise at their convenience. This means that users can create a personalized workout plan that fits into their busy schedules, whether they are at home or on-the-go. The technology provides an opportunity for users to access virtual workout classes and connect with trainers from anywhere, eliminating the need to commute to a gym or fitness studio. Additionally, by providing instant feedback on posture and technique, the devices can help users to optimize their workouts and achieve their fitness goals more efficiently.

    In conclusion, the use of camera/image acquisition devices in fitness provides a convenient and effective way for users to maintain their exercise routine, regardless of their location or schedule. By allowing users to access personalized coaching and feedback, the technology can help users to improve their posture and technique, reduce the risk of injury, and achieve their fitness goals.

Chapter 3. SYSTEM DESIGN & ANALYSIS

3.1 System Features

- **Functionality**
  - Curl counter:

    A curl counter is a tool that counts the number of repetitions a person completes during a workout. It is commonly used during weight training exercises such as bicep curls or triceps extensions. The counter is designed to be placed near the exercise equipment and can be easily operated by the user. The counter typically displays the number of repetitions completed in real-time, allowing the user to keep track of their progress and maintain their desired workout intensity. In addition, some curl counters can also display other information such as the recommended weight and appropriate angle range for optimal results and healthy exercise. Curl counters are especially useful for people who are new to weight training or who may not have access to a personal trainer or gym. By tracking their progress and ensuring they are completing the correct number of repetitions, users can improve their form and achieve their fitness goals more effectively.

- **Functions Defined**
  - Angle measure:

    The angle measure between the arm and wrist at the elbow is a crucial factor in determining the effectiveness and safety of an exercise routine. By measuring this angle, one can ensure that they are performing the exercise correctly and using the appropriate weight for their level of fitness. This angle can be measured using a device such as a goniometer, which is a tool used to measure the range of motion of a joint. In the context of a curl counter, the angle measure between the arm and wrist at the elbow is used to determine whether the user is performing a bicep curl correctly. If the angle is too large or too small, it may indicate that the user is using too much weight or not using the correct form. The curl counter can display the angle measure in real-time, allowing the user to adjust their form and weight as necessary. This feature can be particularly helpful for beginners who are learning how to perform exercises correctly and safely.

  - Appropriate Weight Recommendation

    The appropriate weight recommendation is an important aspect of the system. It is based on the datasets collected from college students, friends going to the gym, and trainers. The weight recommendation is determined based on the individual's body weight and workout routine. The dataset includes information on the number of sets of biceps workout performed, the place of workout (home, outdoor, or gym), and the level of workout (beginner, intermediate, or advanced). Based on this information, the system recommends the appropriate weight for the user to lift. The weight recommendation is crucial in preventing injuries and ensuring that the user is not overexerting themselves. It is important to note that the recommended weight is not a one-size-fits-all approach and may vary depending on the individual's fitness level and workout routine.

In addition to recommending the appropriate weight, the system also monitors the user's form during the exercise. This is done through the use of the curl counter and angle measure between the arm and wrist at the elbow. By monitoring the user's form, the system can ensure that they are performing the exercise correctly and reducing the risk of injury.

- Appropriate Angle Recommendations
  the recommendation of the appropriate angle of contraction and relaxation of the arm during a bicep curl exercise based on the datasets collected. The angle of contraction refers to the angle between the upper arm and the forearm when the hand is lifted towards the shoulder, while the angle of relaxation refers to the angle between the upper arm and the forearm when the hand is lowered back down.

  The dataset collected from college students, gym-goers, and trainers would contain information on the angles at which they perform their bicep curl exercise. Based on this data, the system can recommend the appropriate angles of contraction and relaxation of the arm for a particular individual. This is important because performing the exercise at an inappropriate angle can lead to incorrect posture and form and may even cause injury. Therefore, the system can provide personalized recommendations to ensure that the individual performs the exercise safely and effectively.

3.2 Methodology

For Recommendation system:

- Cosine similarity
  A popular statistic in data analysis, machine learning, and information retrieval is cosine similarity. It is a metric for how similar two vectors are to one another in a multidimensional space. To assess how similar two vectors are, the cosine of the angle between them is computed and compared. Cosine similarity has a value between -1 and 1, with 1 denoting perfect similarity and -1 denoting complete dissimilarity. Because it may be used to find similarities between objects or documents, cosine similarity is a helpful statistic in data analysis. It can be used, for instance, to compare the resemblance between two song lyrics or movie scripts based on their content.
  Cosine similarity is a tool used in machine learning for classification and clustering tasks. It can be used to classify objects into multiple categories or to group objects together that are like one another. Because it can be used to calculate how similar two documents or web pages are, cosine similarity is a potent tool in information retrieval. This aids in the retrieval of pertinent results for a particular query by search engines. It is also used in recommendation systems to suggest products to users based on how those products compare to others they have already used. Cosine similarity is a flexible and practical metric for determining similarity in a variety of applications.

With the rapid development in the field of deep learning for various tasks including image segmentation or object detection, there are numbers of different techniques, which has brought significant advances and performance gains in pose estimation tasks:

- OpenPose: it’s most popular bottom-up approaches for multi-person human pose estimation.
- DeepPose: Human pose estimator that leverages the use of deep neural networks.
- BlazePose: it’s much faster technique to predict two additional virtual keypoints, which firmly detect human body center, rotation and scale as a circle.

In this project, BlazePose is going to be used to track the limbs and joints as it is light and executing with good accuracy. It is inspired from BlazeFace model, which is light and used in MediaPipe Face Detection.

It consists of two machine learning models:

- A Detector- cut out the human region from the image,
- An Estimator- takes a 256*256 resolution image and detect person as in image and outputs the keypoints

3.3 Accuracy

The accuracy of a measurement or calculation can be influenced by various factors such as the precision of the measuring instruments, the calibration of the equipment, the technique used to perform the measurement, and the skill level of the operator. In order to ensure accuracy, it is important to follow proper procedures, use appropriate measuring tools, and minimize sources of error. The accuracy of a measurement is typically expressed in terms of the percentage error or deviation from the true value, with a lower percentage indicating a higher degree of accuracy.

In the project MediaPipe is used to find detect body parts and joints for measuring angle between arm and wrist, the body detection accuracy of it is 93.52% which was initially 71.76%. as per Article published in Scientific Research

Additionally, the accuracy of "Recommendation System" is not determinable at this moment as it just recommends the angles and weight on the basis of using input features and dataset it has. However, the recommendation system will be more precise whenever the dataset gets enlarged.

Chapter 4. RESULTS AND OUTPUT

4.1 Proposed Model Outputs

4.1.1 Recommendation systems

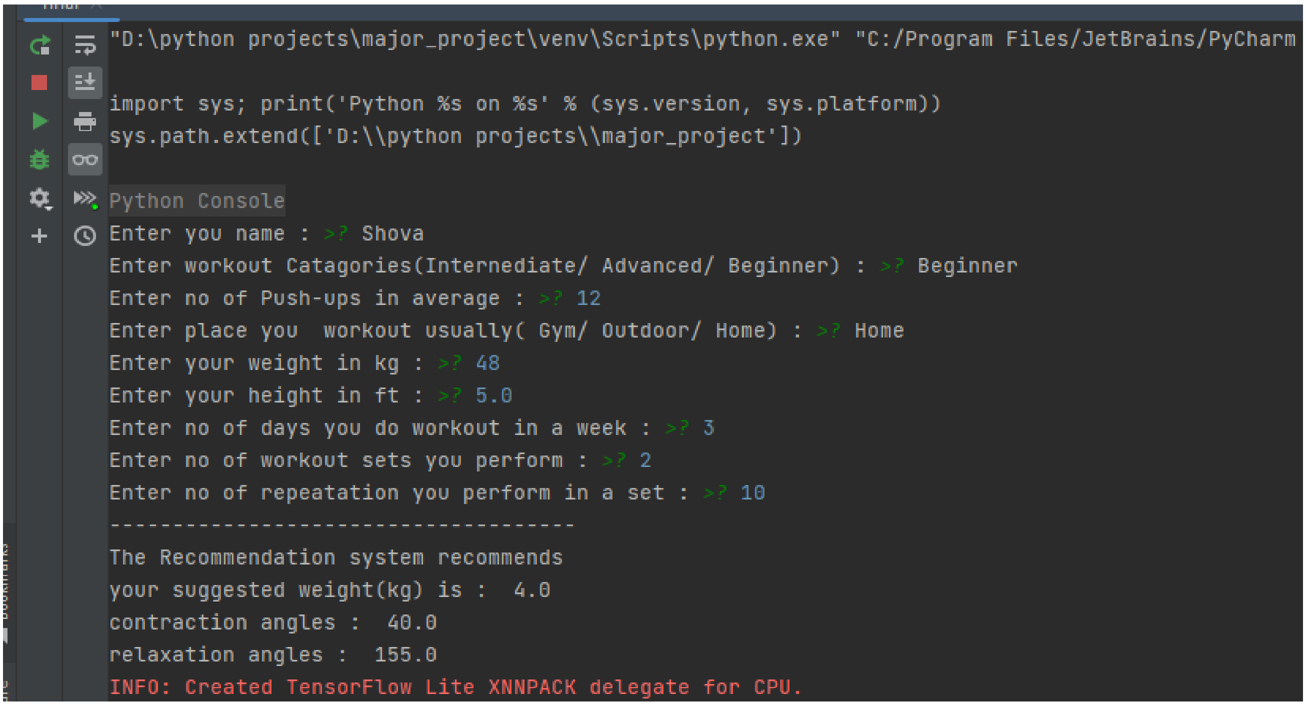

Fig.5: recommendation Data on the basis on user input

The recommendation data provided by the system is based on the user's input, which is compared with the dataset provided during the system's training. The system is trained using a large dataset to identify patterns and make accurate recommendations. When a user inputs their workout routine, sets, body weight, and level of workout, the system compares this input to the dataset it has been trained on. The system then uses algorithms to identify the most similar workout routines in the dataset and recommends the appropriate weight, angle of contraction and relaxation, and other related details to the user.

By comparing the user's input with the dataset, the system can provide accurate and personalized recommendations to the user. This improves the user's workout experience by reducing the risk of injury and ensuring that they are using the correct weight and form for their level of fitness.

4.1.2 Angle measuring and Repetition counters.

Fig 6. Results of Current Model with Test Provided Data

The figure provided contains four distinct images, each demonstrating a different angle between the arm and forearm while performing a bicep curl exercise. In addition to the images, a counter is visible in the bottom left corner of the figure, which displays the number of repetitions completed during the exercise. The counter also indicates the current stage of the exercise, prompting the user to either raise or lower their hand to complete the bicep curl. The variation in angles between the arm and forearm in the images highlights the importance of proper form and technique during the bicep curl exercise. By adjusting the angle of the arm and forearm, users can effectively target different areas of the bicep muscle group. The use of images in the figure provides a visual aid for users, enabling them to see the correct form and adjust their technique accordingly. The inclusion of the counter in the figure provides a useful tool for users to track their progress during the exercise. By monitoring the number of repetitions completed, users can set and achieve their fitness goals. Additionally, the prompt to raise or lower the hand during the exercise helps to ensure proper form and technique, reducing the risk of injury and maximizing the effectiveness of the workout.

In conclude, the figure provided demonstrates the proper form and technique for performing a bicep curl exercise, with variations in angle between the arm and forearm. The use of a counter and prompts to raise or lower the hand during the exercise provides a useful tool for users to track their progress and ensure proper form, making the workout more effective and safer.

Chapter 5. CONCLUSION AND FUTURE SCOPES

5.1 Conclusion

The aspect of the system which combines fitness and technology to successfully bring an advancement in exercise tracking and acting as personal trainer to the users without actually requiring the help of actual trainer in person. It brings flexibility to the user to perform the exercise safely and appropriately irrespective of place at any time anywhere throughout the day during availability of free time. It recommends the appropriate weight with appropriate angles, which leads to better outcome results of users.

With a variety of techniques being used to precisely monitor and analyze weightlifting movements, the field of weight training pose estimation is one that is expanding. While there are still some issues to be resolved, creating accurate and trustworthy systems has the potential to enhance coaching and training methods as well as athlete performance. The researchers have developed a system blends fitness and technology to deliver a breakthrough in tracking and personal training. Users can now exercise without a physical trainer thanks to a novel system that combines fitness and technology. This AI trainer makes weight suggestions and suggests suitable angles for exercises to be performed correctly whenever and wherever it is needed. This eliminates the need for a personal trainer during exercise and promotes excellent physique.

5.2 Future works

Numbers of potential opportunities of future works for technologies-based trainer and guide. Real-time feedbacks can be provided during workouts, helping users to correct their form and maximize the results. Performance analysis also helps to analyze the user’s performance during workouts and provide detailed reports on their progress, which can help to identify the areas where the user needs to improve and adjust their work accordingly. Nutritional guidance can provide nutritional guidance, helping users create meal plans that support their fitness goals. The AI system can also analyze a user’s health data and dietary preferences to design a personalized meal plan. Personalized workouts recommendations as the system get all the personal data for of the user’s workout, diets, it can generate personalized workouts to a specific fitness goals and abilities. The system efficiency gets upgraded and also the experiences level for workout gets optimized.

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Program Code:

```
import cv2
import mediapipe as mp
import numpy as np
import csv
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity
from sklearn.feature_extraction.text import CountVectorizer

mp_drawing = mp.solutions.drawing_utils
mp_pose = mp.solutions.pose

#taking personal data
with open ('C:/Users/sanja/OneDrive/Desktop/major 
project/weight6.csv','a+',newline='') as file:
    myfile = csv.writer(file)
    stdName = input("Enter you name : ")
    WCatagory = input("Enter workout Catagories(Internediate/ Advanced/ 
Beginner) : ")
    pushUp = int(input("Enter no of Push-ups in average : "))
    wPlace = input("Enter place you  workout usually( Gym/ Outdoor/ Home) : 
")
    bWeight= int(input("Enter your weight in kg : "))
    Height =  float(input("Enter your height in ft : "))
    times = int(input("Enter no of days you do workout in a week : "))
    wBicepsset = int(input("Enter no of workout sets you perform : "))
    wRepetitioninset = int(input("Enter no of repeatation you perform in a 
set : "))

myfile.writerow([stdName,WCatagory,pushUp,wPlace,bWeight,Height,times,wBice
psset,wRepetitioninset])

#data reading
df = pd.read_csv('C:/Users/sanja/OneDrive/Desktop/major 
project/weight6.csv')
dfs = df.astype(str)

#preprocessing and fitting
dfs['Tags'] =  dfs['Workout Categories']+" " +dfs['Avg']+" " 
+dfs['Place']+" " +dfs['bWeight']+" " +dfs['Hgt']+" " +dfs['Sets']+" " 
+dfs['Rpt']+" " +dfs['Times']
dfn = dfs[['Name','Tags','dWeight','cAng', 'rAng']]

#vectorizations
cv = CountVectorizer(max_features = 1000, stop_words= 'english')
vectors = cv.fit_transform(dfn['Tags']).toarray()

#cosine similarity
similarity = cosine_similarity(vectors)


# Recomendation System
def recommend(naam):
    name_index = dfn[dfn['Name']== naam].index[0]    #fetching indexs of 
name
    distances = similarity[name_index]# finding distances
    #for sorting
    # #enumerate include the index part
    # #key helps me to sort on respective column
    weight = sorted(list(enumerate(distances)),reverse = True,key = lambda
```

```
x:x[1])[1:2]
    global mini
    global maxi
    #to select first data and then printing the recommendations
    ind_wt = weight[0][0]

    print("--------------------------------------")
    print("The Recommendation system recommends")

    print('your suggested weight(kg) is : ', dfn.iloc[ind_wt].dWeight)
    cang = dfn.iloc[ind_wt].cAng
    rang = dfn.iloc[ind_wt].rAng


    print('contraction angles : ',cang)
    print('relaxation angles : ',rang)
    cng = float(cang)
    rng = float(rang)
    mini = int(cng)
    maxi = int(rng)


#system call
recommend(stdName)

# Angle
def calculate_angle(a, b, c):
    a = np.array(a)  # First
    b = np.array(b)  # Mid
    c = np.array(c)  # End

    radians = np.arctan2(c[1] - b[1], c[0] - b[0]) - np.arctan2(a[1] -
b[1], a[0] - b[0])
    angle = np.abs(radians * 180.0 / np.pi)

    if angle > 180.0:
        angle = 360 - angle

    return angle


cap = cv2.VideoCapture(0)

# Curl counter variables
counter = 0
stage = None

## Setup mediapipe instance
# for determination being level of accuracy in detection & tracking and
providing good efficiency used 0.5
# stored all these in a single variable called pose to act as one
with mp_pose.Pose(min_detection_confidence=0.5,
min_tracking_confidence=0.5) as pose:
    while cap.isOpened():
        ret, frame = cap.read()

        # Recolor image to RGB
        image = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
        image.flags.writeable = False

        # Make detection
```

```
        results = pose.process(image)

        # Recolor back to BGR
        image.flags.writeable = True
        image = cv2.cvtColor(image, cv2.COLOR_RGB2BGR)

        # Extract landmarks
        try:
            landmarks = results.pose_landmarks.landmark

            # Get coordinates
            shoulder =
[landmarks[mp_pose.PoseLandmark.LEFT_SHOULDER.value].x,

landmarks[mp_pose.PoseLandmark.LEFT_SHOULDER.value].y]
            elbow = [landmarks[mp_pose.PoseLandmark.LEFT_ELBOW.value].x,
                     landmarks[mp_pose.PoseLandmark.LEFT_ELBOW.value].y]
            wrist = [landmarks[mp_pose.PoseLandmark.LEFT_WRIST.value].x,
                     landmarks[mp_pose.PoseLandmark.LEFT_WRIST.value].y]

            # Calculate angle
            angle = calculate_angle(shoulder, elbow, wrist)

            # Visualize angle
            cv2.putText(image, str(angle),
                        tuple(np.multiply(elbow, [640, 480]).astype(int)),
                        cv2.FONT_HERSHEY_SIMPLEX, 0.5, (255, 255, 255), 2,
cv2.LINE_AA
                        )
            cv2.putText(image, str(angle),
                        tuple(np.multiply(elbow, [640, 480]).astype(int)),
                        cv2.FONT_HERSHEY_SIMPLEX, 0.5, (255, 255, 255), 2,
cv2.LINE_AA
                        )

            # Curl counter logic & angle
            if angle > maxi:
                stage = "down"
            if angle < mini and stage == 'down':
                stage = "up"
                counter += 1
                print(counter)

        except:
            pass

        # Render curl counter
        # Setup status box
        cv2.rectangle(image, (0, 0), (250, 73), (245, 117, 16), -1)  # data
of rectangular box

        # Rep data & positions
        cv2.putText(image, 'REPS', (15, 12),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 0), 1,
cv2.LINE_AA)
        cv2.putText(image, str(counter),
                    (10, 60),
                    cv2.FONT_HERSHEY_SIMPLEX, 2, (255, 255, 255), 2,
cv2.LINE_AA)

        # Stage data & positions to show
```

```
        cv2.putText(image, 'STAGE', (95, 12),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 0), 1,
cv2.LINE_AA)
        cv2.putText(image, stage, (95, 60),
                    cv2.FONT_HERSHEY_SIMPLEX, 2, (255, 255, 255), 2,
cv2.LINE_AA)

        # Render detections
        mp_drawing.draw_landmarks(image, results.pose_landmarks,
mp_pose.POSE_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(245, 117,
66), thickness=2, circle_radius=3),
                                  # for nodes
                                  mp_drawing.DrawingSpec(color=(245, 66,
230), thickness=2, circle_radius=2)
                                  # for edges
                                  )

        cv2.imshow('Mediapipe Feed of User Video', image)

        if cv2.waitKey(10) & 0xFF == ord('q'):
            break

    cap.release()
    cv2.destroyAllWindows()

# mp_drawing.DrawingSpec?? //foqr drawing whole body


len(landmarks)


landmarks[mp_pose.PoseLandmark.LEFT_SHOULDER.value].visibility
landmarks[mp_pose.PoseLandmark.LEFT_ELBOW.value]

landmarks[mp_pose.PoseLandmark.LEFT_WRIST.value]

shoulder = [landmarks[mp_pose.PoseLandmark.LEFT_SHOULDER.value].x,
            landmarks[mp_pose.PoseLandmark.LEFT_SHOULDER.value].y]
elbow = [landmarks[mp_pose.PoseLandmark.LEFT_ELBOW.value].x,
landmarks[mp_pose.PoseLandmark.LEFT_ELBOW.value].y]
wrist = [landmarks[mp_pose.PoseLandmark.LEFT_WRIST.value].x,
landmarks[mp_pose.PoseLandmark.LEFT_WRIST.value].y]

shoulder, elbow, wrist
calculate_angle(shoulder, elbow, wrist)
tuple(np.multiply(elbow, [640, 480]).astype(int))
```

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