

FabReps

Capstone Project Report

MID SEMESTER EVALUATION

Submitted by:

(101903282) Devansh Thakur

(101903263) Jashanjot Singh

(102083017) Armaan Sandhu

(101903068) Yashkaran Bhandari

BE Fourth Year- COE

CPG No. : 216

Under the Mentorship of

Dr. Jhilik Bhattacharya

Associate Professor



Computer Science and Engineering Department
Thapar Institute of Engineering and Technology, Patiala
July 2022

TABLE OF CONTENTS

ABSTRACT.....	i
DECLARATION.....	ii
ACKNOWLEDGEMENT.....	iii

ABSTRACT

Nowadays, because of busy schedules, people have no time to go to the gym, and even if they manage to find a gym nearby, having a gym trainer besides all the time to correct postures while doing exercise is impossible unless people do not opt for a personal trainer. Even if they assist a personal trainer for them they would have to adjust their time accordingly and both of these methods are quite costly and not everyone can afford it, also during this global pandemic, people are stuck at home and have no access to go to the gym or can't even take a risk of getting in contact with a personal trainer. Performing exercises let it be exercise or doing exercise proper body posture is important, if not performed properly it can lead to crucial problems such as poor joint alignment, increased shear forces on the spine, compression of discs and joints, less space for nerves to course through the body due to compression, reduced blood flow, etc. to prevent such injuries and pains, and to track gym exercises repetitions we came up with a system called Fitness Freaks. Fitness Freaks is an AI Fitness tracker. It tracks the user's body movements using human pose estimation. This in turn keeps track of repetitions of gym exercises and detection of wrong body posture while doing exercise.

If we search online for workout applications, we get many results with multiple functionality. These applications provide many workout programs which help us to perform it on our own. But somewhere those programs cannot improve the 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 workout -pose pose estimation module developed by Media Pipe. 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 the 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.

DECLARATION

We hereby declare that the design principles and working prototype model of the project entitled FabReps is an authentic record of our own work carried out in the Computer Science and Engineering Department, TIET, Patiala, under the guidance of Dr. Jhilik Bhattacharya and during 7th semester (2022).

Date: 25 August, 2022

ACKNOWLEDGEMENT

We would like to express our thanks to our mentor, Dr. Jhilik Bhattacharya. She has been of great help in our venture, and an indispensable resource of technical knowledge. She is truly an amazing mentor to have.

We are also thankful to Dr. Shalini Batra, Head, Computer Science and Engineering Department, entire faculty and staff of Computer Science and Engineering Department, and also our friends who devoted their valuable time and helped us in all possible ways towards successful completion of this project. We thank all those who have contributed either directly or indirectly towards this project.

Lastly, we would also like to thank our families for their unyielding love and encouragement.

They always wanted the best for us and we admire their determination and sacrifice.

INTRODUCTION

1.1 Project Overview

Human pose estimation is a challenging problem in the discipline of computer vision. It deals with localization of human joints in an image or video to form a skeletal representation. To automatically detect a person's pose in an image is a difficult task as it depends on a number of aspects such as scale and resolution of the image, illumination variation, background clutter, clothing variations, surroundings, and interaction of humans with the surroundings. An application of pose estimation which has attracted many researchers in this field is exercise and fitness. One form of exercise with intricate postures is exercise which is an age-old exercise that started in India but is now famous worldwide because of its many spiritual, physical and mental benefits. The problem with exercise however is that, just like any other exercise, it is of utmost importance to practice it correctly as any incorrect posture during an exercise session can be unproductive and possibly detrimental. This leads to the necessity of having an instructor to supervise the session and correct the individual's posture. Since not all users have access or resources to an instructor, an artificial intelligence-based application might be used to identify exercise poses and provide personalized feedback to help individuals improve their form. In recent years, human pose estimation has benefited greatly from deep learning and huge gains in performance have been achieved. Deep learning approaches provide a more straightforward way of mapping the structure instead of having to deal with the dependencies between structures manually. used deep learning to identify 5 exercise poses: pull up, swiss ball hamstring curl, push up, cycling and walking. However, using this method for exercise poses is a relatively newer application.

Development in the field of fitness and well-being of health has grown exponentially in the last decade which includes fit-bands, Calorie counter, diet planner, run tracker, etc. Supporting the advancement in this field, we focused on the problem of getting assistance while doing exercises and focusing on the prevention of injuries. A system to track count of user performed exercises and detect errors in an exercise pose, with the use of computer vision in which we use OpenCV python library, Openpose which uses baseline CNN network, and COCO dataset. We define rules for different exercise poses, exercises and accordingly, we get the results for the count of repetitions of the user performing exercises and error for the exercise poses if there is any, feedback is given to users based on the results observed. For this, the user needs to run the system on their mobile, no fitness band or other extra weight is to be carried with the user while performing it. After analysing the user's exercise, feedback about the exercise is given to the user using a voice assistant. It helps the user to keep track of repetitions and focus more on correcting the body posture while doing exercises.

1.2 Need Analysis

In order to prevent this some form of physical exercise is needed. The application of pose estimation for exercise is challenging as it involves complex configuration of postures. Furthermore, some state-of-the-art methods fail to perform well when the asana involves horizontal body posture or when both the legs overlap each other. Hence, the need to develop a robust model which can help popularize self-instructed exercise systems arises. The constant need for the attention of personal trainers in gyms and exercise classes while performing the exercise is drawn out by AI Fitness Tracker. A system like these can replace personal trainers for correcting body posture and the need for their constant attention while performing exercises or exercise poses. the need to detect individual people. It consists of three branch CNN architecture which predicts joint location, limb direction and orientation with part affinity field keeping the initial features. This method has improved accuracy of regression because it combines and enhances the output of three branches. For this application a simpler approach is used which includes the analysis of the angles of distances between joint key points to provide feedback to the user without a full physical simulation. t, the users need to record a video performing a particular exercise with a certain point of view (front side, back side, etc. which allows the exercise to be seen properly. There are no restrictions on the distance from the camera or the type of camera, the only thing that the user needs to take care of is that their posture is visible properly. For example, if you are performing a workout and you need to evaluate your form, but do not have access or resources for an instructor to evaluate your form, it would be great to have an Artificial Intelligent agent provide real time feedback through your laptop or phone. use Part Affinity Fields to estimate poses of multiple people in a scene in real time without the need to identify individual persons first. We note the need to generalize our application to account for users with different body length measurements, distance from the camera, as well as other relative factors.

Motivation

The motivation for this project comes from the large successes achieved by multiple computer vision machine learning models. In particular, pose estimation has provided a variety of options with its key point challenge results. Although we do not train any models for pose estimation in our project, we use the key points provided to analyze the pose of the individual performing the workout and provide simple feedback such as how many repetitions the individual has completed. We have implemented an alternative approach to provide similar feedback. Rather than analyzing the workout with key points and angles, we train multiple models on individuals performing a given workout. Then we apply those models on either real-time or pre-recorded videos and give rep counts back to the user. some of the models which motivated our work, along with tools which would help us achieve faster results. Our goal is to be able to cover the following steps end to end:

- Gather datasets
- Augment data
- Organize and label data
- Train a few neural networks
- Integrate with OpenCV 5
- Compare results from our silhouette-based approach to pose estimation approach

1.3 Research Gap

After identifying the problem statement and gaps in the research paper, we proposed a solution to build a technical personal trainer to perform and track users' workouts 24/7. Fitness Tracker: The fitness tracker will help users maintain their posture while exercising in the gym and exercise positions. Exercises in the gym: The system counts the repetitions of the exercises performed so that the user does not have to record the exercises. exercise position: The system informs about the accuracy of the performed exercise positions and detects an error in the user's posture. We were assisted by 12 professional trainers and exercise instructors who could help us build a robust system. We asked them to identify all the factors to consider when performing 2 simple exercises, one a gym exercise and the other an exercise pose. For the gym workout, we built a system for bicep curls, while for the pose workout, we built a system for Warrior Pose. Based on the instructions we have created 10 rules for the fighter pose as the total number of factors involved to perform this pose was 10 and similarly for bicep curls only 2 rules, based on these 2 rules the user's reps will be counted. If the user does not comply with these rules, the repetitions will not be counted.

1.4 Problem Definition and Scope

To overcome such a problem, we are trying to create an application that encourages users to take a more active interest in their health. For this application, we propose to use the exercise pose machine learning model provided by mediapipe, which can run the application on a very small number of CPU devices. Due to the rapid development of deep convolutional neural networks, the estimation of human posture has a significant improvement in performance, which helps to accurately analyze the exercise performed by the user. Human Pose Estimation locates key body points to accurately recognize the positions of individuals shown in images or video. This step is a crucial prerequisite for training analysis. We describe a method of detecting a user's posture during training and comparing their posture to professional reference training to help solve this problem.

Based on the latest advances in deep learning for human body pose estimation, we represent the human body as a set of limbs and calculate the angles between them to detect errors and provide accuracy to the user. Other features like rep counting, real-time body motion recognition can be done using the blaze pose model.

1.5 Approved Objectives

- The goal is to develop an application that can detect live exercise movements and build a system that can help correct faulty postures and bad forms performed by people.
- To create an easy-to-understand user-interface for users which will allow them to properly understand and use the app to its full potential.
- To build a system that uses technologies like machine learning and artificial intelligence to classify and correct the performance of exercise with a pre-trained exercise 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 sufficient to capture the user's movements. A pose estimation model is generally used to classify various motions. We use this technology with some progress to ensure the accuracy of the users workouts which will provide state-of-the-art results.
- The application will not only provide users with exercise but also track users movements in real time and also provide users with accuracy.

1.6 Methodology

Pose estimation is a machine learning challenge that estimates a person's pose from an image or video by way of estimating the spatial positions of certain physique parts (key points). Pose estimation is a computer vision method for monitoring the actions of an individual or object. This is typically achieved by discovering the area of the key factors for the given objects. Based on these key factors we can evaluate distinctive actions and postures and generate ideas.

Deep Learning Pose Estimation:

With the speedy improvement of deep studying options in recent years, deep learning has been proven to outperform classical computer vision strategies in a range of tasks which includes image segmentation or characteristic detection. Therefore, deep learning methods introduced massive advances and overall performance features to pose estimation tasks. Many deep learning estimation processes are available: open pose, action network, deposition, pos network, body network, etc. In our scenario, we use a workout due to the fact it is the trendy model Developed by way of Google and works seamlessly on light-weight units such as browsers or cellular devices. Therefore, the workout can be used to estimate a single pose or more than one pose. workout Pose is a real-time pose detection approach that can notice poses of human beings in images or videos. Works in single mode(unique human pose detection). In easy terms, workout Pose is a deep learning model that lets you estimate human pose by means of detecting physique parts such as elbows, hips, wrists, knees and ankles and by connecting these factors to structure a skeletal shape of your pose. It is a light-weight model that makes use of depth-separable convolution to deepen the community for reduced parameters, computational cost, and greater accuracy. workout 's pose offers us a complete of 33 key factors to use, from the nose to the index finger of the left foot. workout 's pose has two machine learning models: Detector and Estimator. The detector is used to reduce the human phase of a given entered image. The estimator enters the images provided by way of the detector and gives an output.

1.7 Project Outcomes and Deliverables

We present quantitative and qualitative results from Pose Trainer on four different free-motion dumbbell exercises: bicep curl, front raise, shrug, and standing shoulder press. For each exercise, we use a geometrical/heuristic approach and machine learning. Dynamic time warping approach

1.8 Novelty of Work

Many of the researchers who proposed the new system collaborated with past technologies that gave the state of the art results. Nowadays, deep convolutional neural networks provide dominant solutions. There are two mainstream methods of regression: the position of key-points and estimating key-point heat map, followed by choosing the

locations with the highest heat values as the key-points pifpaf is a new method based on the bottom-up approach for 2D multi-person human pose estimation. It uses a part intensity field for body part localization and a part association field for association of body parts to form full human poses.

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. The subject of pose estimation has been given a lot of attention and interest, with much development already in progress. The new approach will be specific to workouts and allow for easier data organization and labeling, which can benefit the accuracy and dependability of the model. The first to use a deep neural network to improve pose detection and the location of each body joint using regression on CNN features.

REQUIREMENT ANALYSIS

2.1 Literature Survey

2.1.1 Theory Associated with Problem Area

Service replication is not a complete solution to availability in networked file systems, as we would have to face consistency and integrity issues between servers, so we would be back at the beginning of our problem. We could replicate our network file system, but it would take extra effort to get it working properly, and we'd have to use all the security mechanisms we need in both. On the other hand, traffic filtering can help us avoid any attacks because network file systems are usually accessible for a well-known range of addresses (usually the LAN range), so any traffic from these services flowing from or to addresses outside this range is an unauthorized operation. In addition, other measures can be taken at the service layer, such as dropping connections from sources that have failed to connect too many times in a certain period of time.

2.1.2 Existing Systems and Solutions

Evaluation of the exercise posture classification system will be done using the confusion score classification matrix and human evaluation. The system will predict the sequence of exercise positions

performed by the user in real time and we can verify that the prediction made by the system is correct. The results will also be compared with existing methods. Current methodology primarily focuses on the amount of time the user exercises, not on proper posture. Instead, it focuses on the length of time the exercise is performed. The new system found promising results after testing on more than 50 different users. With the rapid development of deep learning solutions in recent years, it has been shown that deep learning outperforms classical computer vision methods in various tasks, including image segmentation or object detection. Therefore, deep learning techniques have brought significant progress and performance enhancement in position estimation tasks. There are many deep learning estimation approaches available like openpose, movenet, deeppose, posnet, bodynet etc. In our scenario we use Blazepose because it is the latest model developed by Google and works smoothly on lightweight devices like browsers or mobile . Thus, BlazePose can be used to estimate either a single pose or multiple poses.

2.1.3 Research Findings for Existing Literature

Title of paper	Tools /technology	findings	citation
Pose Trainer: Correcting Exercise Posture using Pose Estimation	deep convolutional neural networks (CNNs), dynamic time warping (DTW), nearest neighbour classifier.	We present quantitative and qualitative results of Pose Trainer on four different dumbbell (free motion) exercises: bicep curl, front raise, shoulder shrug, and standing shoulder press. For each exercise, we take both a geometric/heuristic approach, as well as a machine learning approach using dynamic time warping.	Steven Chen, Richard R. Yang,” Pose Trainer: Correcting Exercise Posture using Pose Estimation”, arXiv:2006.11718v1 [cs.CV] 21 Jun 2020
PoseEstimation and action recognition sports and fitness	. OPEN CV, CNN	During the experimentation phase, we broke down the process into a few steps which were repeated over two different types of workouts. Initially, we began with squats, and once we had a working end to end model, we added pull-ups. Our goal was to	Vyas, Parth. “POSE ESTIMATION AND ACTION RECOGNITION IN SPORTS AND FITNESS.” <i>SJSU ScholarWorks</i> , doi.org, 1 Jan. 2019, https://doi.org/10.31979/etd.w8ug-4v5c .

		choose the Silhouette model with the highest accuracy	
Pose Estimation and Correcting Exercise Posture	CNN, OpenPose, pose estimation	An application is presented which provides feedback on human posture while performing exercises using pose detection, visual geometry and machine learning. The output of pose estimation is used to calculate human body key points from the video provided. Machine learning algorithms are used for deciding posture correctness and geometric algorithms for providing feedback on exercise improvement.	Kanase, Rahul Ravikant, et al. "Pose Estimation and Correcting Exercise Posture ITM Web of Conferences." <i>Pose Estimation and Correcting Exercise Posture ITM Web of Conferences</i> , doi.org, 9 Aug. 2021, https://doi.org/10.1051/itmconf/20214003031 .
Fitness Freaks: A System For Detecting Definite Body Posture Using Open Pose Estimation	Computer vision, Open pose, CNN	To explain the results of the system built we take an example of some users performing Warrior Pose. From the user's value and ideal value, we calculate the error and accuracy of the user's yoga pose. Each rule has functions written to measure the values such as the slope of arms, angle between hip, knee, and ankle, etc. as we get coordinates of all the joints from which we can define functions and calculate different angles, slopes, and ratios to build the system	Harshwardhan Pardeshi, Aishwarya Ghaiwat, Ankeet Thongire, Kiran Gawande, and Meghana Naik. "Fitness Freaks: A System For Detecting Definite Body Posture Using Open Pose Estimation, Computer Engineering Department, Sardar Patel Institute of Technology, Andheri (West), Mumbai 400059, India
Lightweight Deep Learning Models for Resource	MLP, Computer vision, CNN, LSTM	the experimented models, SVM obtained accuracy results of 0.9319, CNN obtained accuracy results of 0.9858, and CNN + LSTM achieved accuracy results of 0.9938.	Thoutam, Vivek Anand, et al. "Yoga Pose Estimation and Feedback Generation Using Deep Learning." <i>Yoga Pose Estimation and Feedback Generation Using Deep Learning</i> , doi.org, 24 Mar.

Constrained Devices			2022, https://doi.org/10.1155/2022/4311350 .
---------------------	--	--	--

2.1.4 Problem Identified

Human activity recognition is a well-established computer vision problem that has presented several challenges over the years. It is a problem of locating key points and the position of the human body from sensor data. Activity recognition is useful in many fields, including biometrics, video-surveillance, human-computer interaction, assisted living, sports arbitration, home health monitoring, etc.

To support progress in this area, we focused on the problem of exercise assistance and focused on injury prevention. A system for tracking the number of exercises performed by the user and detecting errors in the exercise pose using computer vision, in which we use the OpenCV python library, Openpose, which uses the underlying CNN network, and the COCO dataset. We have defined rules for different exercise positions, exercises and accordingly we get the results for the number of repetitions of the user performing the exercises and find out . exercise errors, if any, feedback is provided to users based on observed results. To do this, the user needs to run the system on his laptop, there is no need to carry any strength tape or other extra load while performing this activity. After the user's exercise is analysed, the user is given feedback about the exercise using the voice assistant. It helps the user track repetitions and focus more on correcting posture during exercise.

2.2 Software Requirement Specification

Hardware:

1. Processor: Intel Core i3 or more.
2. RAM: 4GB or more.
3. Hard disk: 250 GB or more.

Software:

1. Operating System: Windows 10, 7, 8.

2. Python.
3. Anaconda.
4. Spyder, Jupyter notebook, Flask.
5. MYSQL.
6. Android Studio

Technologies Used: -

Python:

Python could likewise be a taken item organized basic level language with dynamic derivation its straightforward level in-created information structures got together with unique organization and dynamic restricting sort it outrageously interesting for speedy application advancement what's more on be utilized as a pre piece or glue language to relate existing components on pythons clear direct to be told accentuation highlights quality by then decreases the cost of program fixes python maintains modules and packs that moves program quality and code utilize the python go-between and what's more the escalated standard library are offered in give or combined sort to nothing of charge for each and every fundamental stage and wish to be uninhibitedly spread of programmers fall stricken with python because of the misrepresented strength it gives since there is no aggregation step the special stepped area test-investigate cycle is unfathomably expedient work python programs is basic a bug or unfortunate information won't ever cause a division deformity taking everything into account once the interpreter discovers a blunder it raises an extraordinary case once the program doesn't get the exception the go-between prints a stack follow a stock level program licenses assessment of local and world elements examination of self-emphatic enunciations setting breakpoints wandering through the code a line at a rapidly on the program is written in python itself vouching for pythons smart power barring generally the quick in view of right a program is to incorporate a few print clarifications to the accessibility the quick modify test-explore cycle makes this simple philosophy dreadfully amazing.

FLASK:

A Flask is a Web Application Framework that is built with Flexibility and Speed In the Mind. Flask is Built in Python , which many data Scientists are familiar with . Flask takes

care of the Environment and Project setup involved in web Applications Allowing the Developer to focus on their application rather than thinking about HTTP, routing, dataset etc. Flask allows Data Scientists to create simple Single page Applications and one should Help or look into if they want to create Products for Consumers Flask is a micro web framework written in Python. It is classified as a microframework because it doesn't require particular tools or libraries. it's no database abstraction layer, form validation, or the other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions which will add application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and a number of other common framework related tools Flask was created by Armin Conacher of Pocono, a world group of Python enthusiasts formed in 2004. According to Conacher, the thought was originally an April Fool's joke that was popular enough to form into significant application. When Conacher and Georg Brandi created a bulletin board system written in Python, the Pocono projects Werke and Jinja were developed. Flask has become popular among Python enthusiasts. As of October 2020, its second most stars on GitHub among Python web-development frameworks, only slightly behind Django, and was voted the foremost popular web framework within the Python Developers Survey 2018.

These are some Important features of the Flask:

1. it is a Development Server
2. Debugger
3. RESTful request dispatching
4. Unicode Based
5. Flask have google app engine Compatibility

MySQL:

MySQL is prestigious as world's most by and large utilized ascii archive data back-end its most guarantee data for pup as MySQL is most habitually utilized ascii record pre arranging data attempt workers offer for MySQL is ideal and diminishes our work to an outsized degree.

2.2.1.1 Purpose

The purpose of these programs is to help users perform these exercises independently. Feedback improvement can be increased by designing targeted actions and specific suggestions regarding the body part used and the weight of the equipment. Exercises performed with proper form can be visualized using a graphical simulation to highlight the user's error and how to improve it.

The system is a web application that runs on a laptop. The user needs enough space to perform the exercise and position the camera so that the user's entire body sits at the camera angle.

there are hundreds of different exercise videos on the internet that contain short exercise videos for different exercises The purpose of these programs is to help users perform these exercises separately we present the quantitative and qualitative results of the posetrainer on four different free movements with dumbbells exercises biceps curl front shrug shrug and press on standing shoulders for each exercise we use both a geometric-rich heuristic approach and a machine learning approach using dynamic time warping.

Such a system can replace personal trainers for the correction of body posture and the need for their constant attention when performing exercises or exercise positions.

The constant need for attention of personal trainers in gyms and exercise classes while performing exercises is attracted to AI Fitness Tracker. The constant monitoring of users' body and joint movement helps users maintain proper posture, which is one of the most fundamental parts of exercise. Current methodology primarily focuses on the amount of time the user exercises rather than the correct posture of the user, instead focusing on the amount of time the exercise is performed.

2.2.1.3 Project Scope

In this project, using the latest techniques in posture estimation, we help people perform exercises with proper posture by developing a project that detects users' postures during exercise and provides feedback and suggests improvements when necessary. The goal of this project is to prevent injuries and improve the human form of exercise with just a computer and a camera. The first step of the project is to use human pose estimation, which is a highly applicable domain of computer vision. It also helps in solving complex problems involving motion detection. OpenPose is used which uses neural networks to derive this project. The second part of this project involves determining the quality of the human position for the given exercise. It is approached using heuristic and machine learning models. The full application

consists of two main components that can record exercise video and provide feedback to the user.

The motivation for this project comes from the great success achieved by several machine learning models of computer vision. In particular, position estimation provided a number of options with key point results.

This work demonstrates activity recognition for practical applications. An approach comparable to this can be used for position recognition in tasks such as sports, tracking, healthcare, etc. Multi-person position estimation is a completely new problem in itself and has great scope for research. There are many scenarios where estimating the position of one person would not be enough, for example, estimating the position in crowded scenarios would have multiple people, which will involve tracking and identifying the position of each individual. Many factors such as background, lighting, overlapping characters, etc.

2.2.2 Overall Description

We are trying to create an application that encourages 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 media pipe, which can run the application on a very small number of CPU devices. Due to the rapid development of deep convolutional neural networks, the estimation of human posture has a significant improvement in performance, which helps to accurately analyse the exercise performed by the user. Human Pose Estimation locates key body points to accurately recognize the positions of individuals shown in images or video. This step is a crucial prerequisite for training analysis. We describe a method of detecting a user's posture during training and comparing their posture to professional reference training to help solve this problem. Based on the latest advances in deep learning for human body pose estimation, we represent the human body as a set of limbs and calculate the angles between them to detect errors and provide accuracy to the user. Other features like rep counting, real-time body motion recognition can be done using the blaze pose model.

2.2.2.1 Product Perspective

The study of human body movement, also known as kinesiology, plays a major role in human lifestyle. From simple prevention and rehabilitation of injured body parts to improving sports performance by following strict training routines. Initially, these tasks were supervised by a trainer or physiotherapist. However, improvements in technology have allowed individuals to monitor their own improvement using sensory devices that provide feedback data. For example, the Apple Watch, which was originally released in

2015, uses an accelerometer to track the number of steps and calculate how many calories an individual burns. The Beast is another product that was released in 2017 and also tracks exercise using accelerometers, gyroscopes and compasses.

Developments in the field of fitness and mental well-being have grown exponentially in the last decade, which includes fit-bands, calorie counters, diet planners, trackers, etc.

2.2.2.2 Product Features

a system like this can replace personal trainers to correct posture and need their constant attention when doing exercises or exercise positions the system can be improved by adding more exercises and exercise positions to the system we can create a user portal that tracks and records data about their previous exercises and exercises performed in the database of the system, variation can be brought by adding sections for men, women and children depending on their age group and separating different sections based on the difficulty of the exercises, a system with all these features can be added as a daily routine to avoid injuries and muscle strain when doing exercises, also keep track of all exercise counts and keep a user performance report.

2.2.3 External Interface Requirements

2.2.3.1 User Interfaces

Function 1	Login/Signup
Input	Name, email address, and password of the user
Processing	Validate the given details and record the information into the database.
Output	Redirect to user's home page

Functional Requirements:

- Fundamental skill and Knowledge in Technical Field
- System should be able to match required configurations.

2.2.4 Other Non-functional Requirements

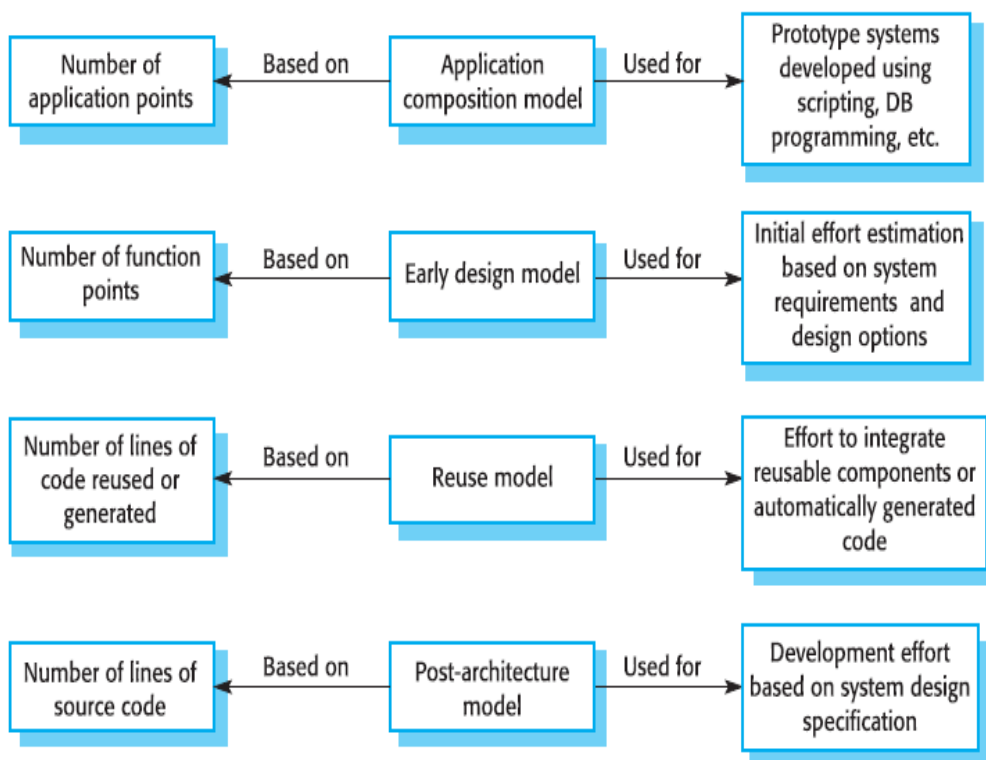
- The reliability of the product will be dependent on the accuracy of the data.
- Website is hands on or friendly so that customers can view / use it easily.
- CPU usage and memory occupation must be less.
- Android application should stream video to predict exact reps.

2.2.4.1 Performance Requirements

In recent years, human pose estimation has greatly benefited from deep learning and huge gains in performance have been achieved, the detector should be powerful enough to detect hard or relatively smaller objects, so the performance of the pose estimator has improved, and the performance of the models varies depending on the device and the output model outperforms other methods in terms of lower resolution and better performance in crowded places, we also plan to experiment with basic cnn networks and compare the performance with the hybrid model, but additional equipment and specialized hardware are expected, and the performance is not always good in different environments models machine learning, although not widely used for human pose estimation, will be explored for comparison with deep learning models the model accuracy curve represents the maximization of the accuracy score, which means that a higher score means better model performance, and a well-fitting curve loss model is one in which the training and validation loss decreases and reaches a stability point and has a minimal gap between the final loss values models are built using python libraries such as TensorFlow, keras, numpy, scikit-learn on a system with 4gb memory this is used because it allows to measure the output performance of the densely connected layer with softmax activation this loss function is used to classify multiple classes and since we have multiple classes of yoga poses, it makes sense to use categorical cross-entropy application of pose estimation in fitness and sports can help prevent injuries and improve people's exercise performance. The performance of the models depends on the quality of the open pose estimation, which may not perform well in cases of overlap between people or overlap between body parts.

2.2.4.3 Security Requirements

1.2 Cost Analysis



2.4 Risk Analysis

New data is emerging that exercise can reduce the risk of acute respiratory distress syndrome, the leading cause of death in patients with the disease 2020 Coronavirus (COVID-19). Just as COVID-19 has changed the way health care is delivered, it has also changed the way consumers approach physical activity. Although gyms and exercise classes are crowded areas with lots of surfaces, they can carry infections. To avoid these problems, gyms and fitness centres across the country have been closed during this period to ensure safety.

There are hundreds of different exercise videos on the internet that contain short exercise videos for different exercises. The purpose of these programs is to help users perform these exercises independently. Despite these features, they lack the ability to track the user's training. It is often observed that even regular users of gyms have difficulty in performing all the steps correctly while exercising. Doing the wrong exercise all the time can eventually lead to serious long-term

injuries. It is recommended that all adults, even those with chronic health conditions, get at least 30 minutes to 60 minutes of moderate-intensity exercise daily if they are able. exercise is impossible unless people opt for a personal trainer. Even if they were assisted by a personal trainer, they would have to adjust their time for it and both of these methods are quite expensive and not everyone can afford it. Also during this global pandemic people are stuck at home and do not have access to a gym or even risk contact with a personal trainer.

3.2 Proposed System:-

The suggested data set can be extended by adding the desired yoga pose key points. The technology can also be used to perform real-time predictions and self-training on a mobile device. There are several examples of real-life applications where a single individual location assessment will not suffice; for example, position estimation in a crowded environment will need to detect and recognize the position of each participant. It is quite challenging to include many positions and get models in many positions (classification of many positions). The Keras position estimate affects model performance; Steps should be taken to get key points when body parts are overlapping or missing to get better results. This method for extracting angles as features can be used for other applications such as activity detection and sports activity tracking.

First, all the joints involved in the exercise are identified, then the number pointing to the joints is identified using the coconut human position estimation model, then the professional trainer's video is used to detect the ideal exercise movements, and for the next exercise, the position estimation is used to track the professional trainer's joint movements, they are detected angles between the joints and a certain threshold value is maintained to neglect the dis-proportionality caused by different body types and sizes depending on gender and age when exercising as well as detection of exercises under one roof for biceps curl exercises the desired distance angle and limb movement are taught to the system using trainer videos and for Warrior ii exercises the position of the professional exercise instructor is recorded inside the system, once the rules are captured the video of the user is fed into the system and the moments are detected using computer vision i.e. position estimation using o The OpenCV rules are checked based on the exercise performed by Tensorflow errors are detected and repetitions are tracked for the biceps curl exercise.

Human position estimation

Pose estimation is a machine learning task that estimates the position of a person from an image or video by estimating the spatial location of specific body parts (key points). Position estimation is a computer vision technique to track the movement of a person or object. This is usually done by finding the location of the key points for the given objects. Based on these key points, we can compare different movements and positions and gain insights.

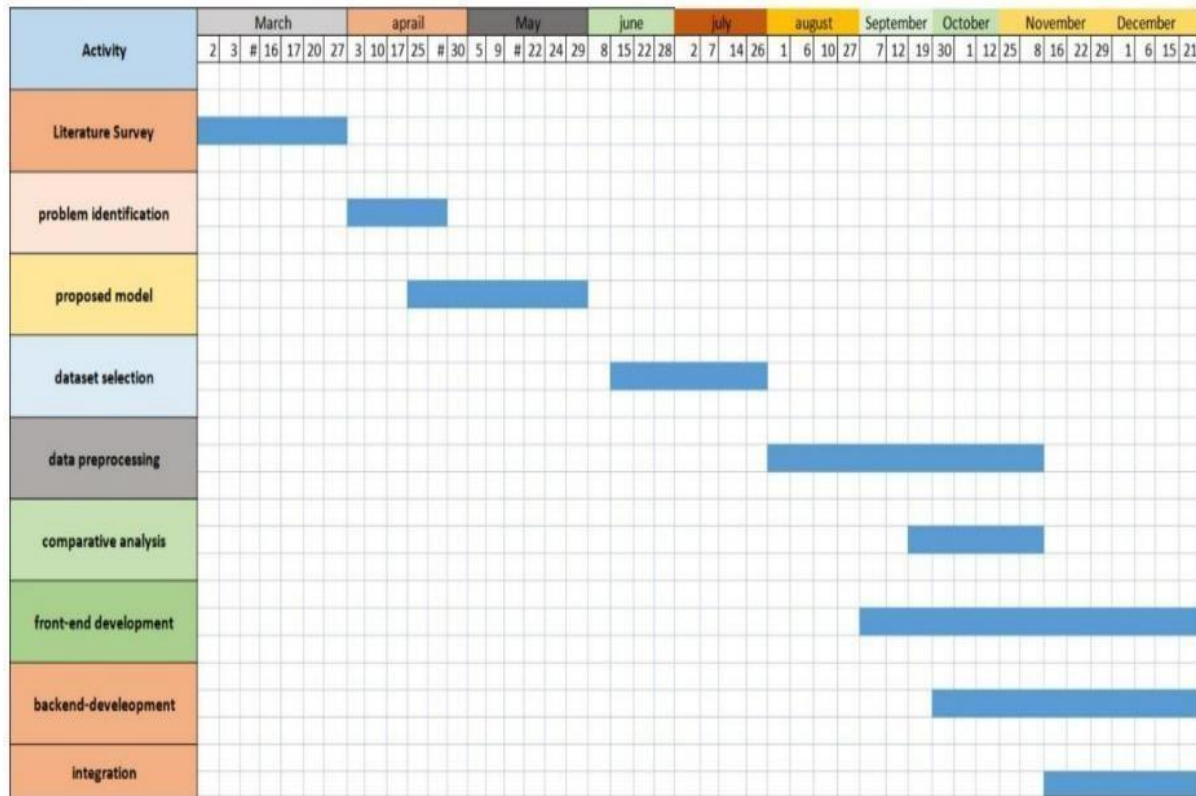
Position estimation with deep learning

With the rapid development of deep learning solutions in recent years, it has been shown that deep learning outperforms classical computer vision methods in various tasks, including image segmentation or object detection. Therefore, deep learning techniques have brought significant progress and performance enhancement in position estimation tasks. There are many deep learning estimation approaches available, e.g., openpose, movenet, deeppose, posnet, bodynet[6] etc. In our scenario, we use training pose because it is the latest model developed by Google and works smoothly on lightweight devices like browsers or mobile devices.

Estimated position for one person

The single position estimation algorithm is the simpler and faster of the two. It is an ideal use case when there is only one person in the center of the input image or video. The downside is that if there are multiple people in the image, key points from both people are likely to be estimated as part of the same single pose - meaning that, for example, Person 1's left arm and Person 2's right knee might be associated by the algorithm as belonging to the same pose.

3.3 Work Breakdown Structure



DESIGN SPECIFICATIONS

4.1 System Architecture

System flowchart:

A stream diagram could even be a spread of characterize that addresses a standard or strategy showing the proposes that as boxes of shifted types and their solicitation by interfacing them with bolts this depict outline shows a response for a given recoil procedure exercises territory unit depict in these compartments and bolts rather there calm by the sequencing of undertakings flowcharts region unit used in taking apart emerging with documenting or managing the lone way or program in a few fields

Arrows

Showing "stream of the board" partner bolt returning from one picture and finishing at another picture addresses that control passes to the picture the bolt focuses to. the street for the bolt is strong or broken. The significance of the bolt with broken line could differ from one stream diagram to an uncommon and ought to be laid out inside the legend.

Generic processing steps

Addressed as square shapes Examples: "Add one to X"; "supplant known part"; "save changes" or comparable.

Subroutines

Tended to as square shapes with twofold influenced vertical edges these are adjusted show tangled connection steps which may be included during an exceptionally particular language model live records one bundle may require various clear area centres or leave streams see co day by day follow forward therefore these are showed up as checked wells inside the quadrangle and subsequently the leaders bolt interface with these wells

Input/output

Tended to as a quadrilateral Examples: Get X from the customer; show X Prepare prohibitive drawn as a two-dimensional figure Shows exercises that don't have any outcome close to fitting a cost for a later unforeseen or elective development (see under).

Conditional or decision

Tended to as a gem rhombus showing wherever a decision is fundamental typically a certifiable request or genuine bogus check the prohibitive picture is whimsical during this its two bolts start of it to a great extent from total base explanation and right explanation one adore affirmed or valid and one love no or bogus the bolts had the opportunity to be named more than two bolts may moreover be utilized in any case this is regularly frequently regularly frequently generally a simple marker that a tangled choice is being taken inside that case its having the possibility to should be isolated any or replaced with the pre-portrayed live picture

Junction symbol

For the most part portrayed with a dark mass showing any place different administration streams meet during one leave stream an intersection picture can have very one bolt returning into it anyway only one going out in direct cases one may simply have partner bolt reason to an exceptional bolt all things being equal these are supportive to address partner monotonous strategy what in designing is named a circle a circle may for instance incorporate a connective any place the board first enters measure steps a contingent with one bolt leaving the circle and one returning to the connective for added clearness where 2 lines incidentally cross inside the drawing one through and through them could even be drawn with minimal plane figure over the other showing that no intersection is assumed

Labelled connectors

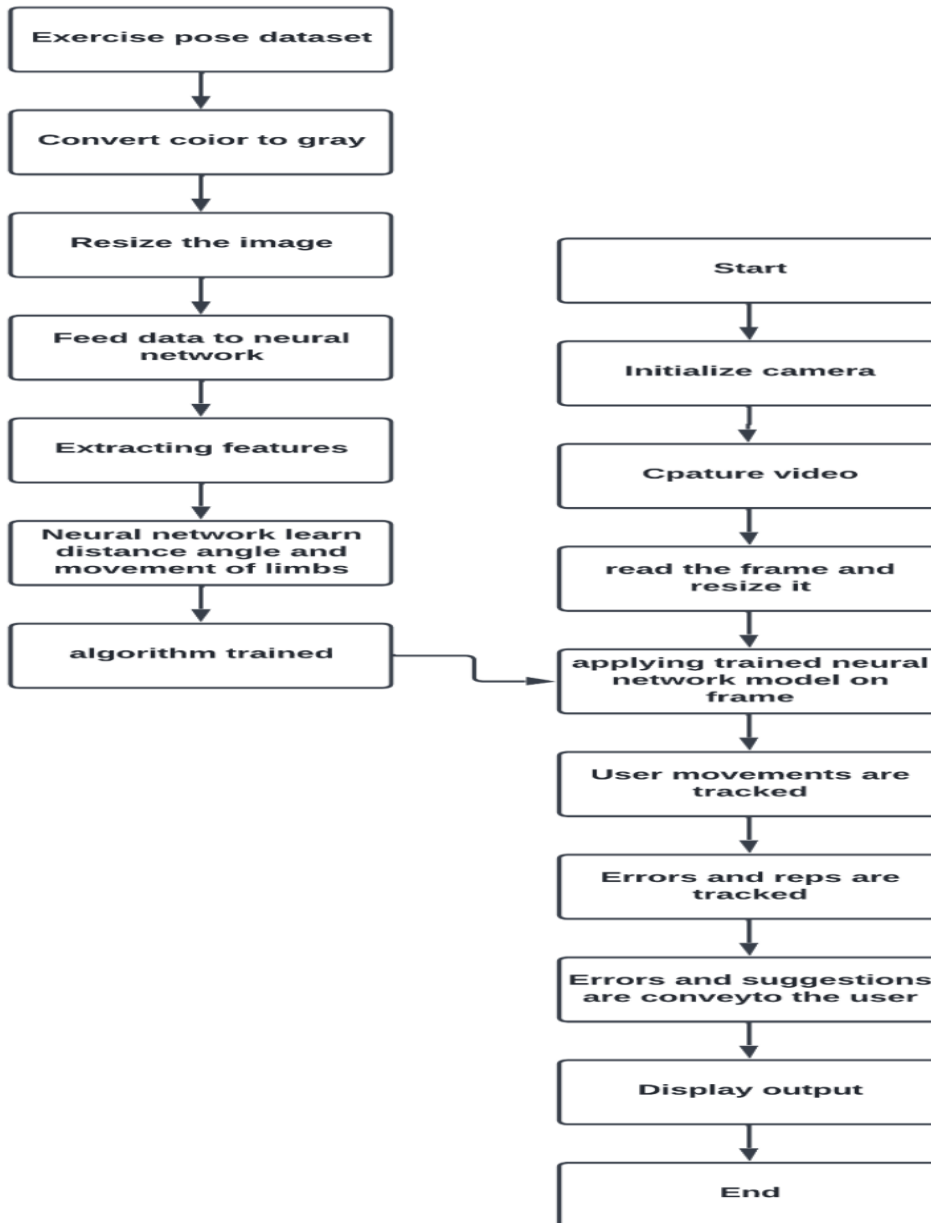
Addressed by A distinctive mark inside a circle. marked connectors are used in cutting edge or multi-sheet charts to fill in for bolts. for each name, the "surge" connective ought to be unmistakable, anyway there's additionally such a "inflow" connectors. During this case, an intersection up to the hustle stream is known.

Concurrency symbol

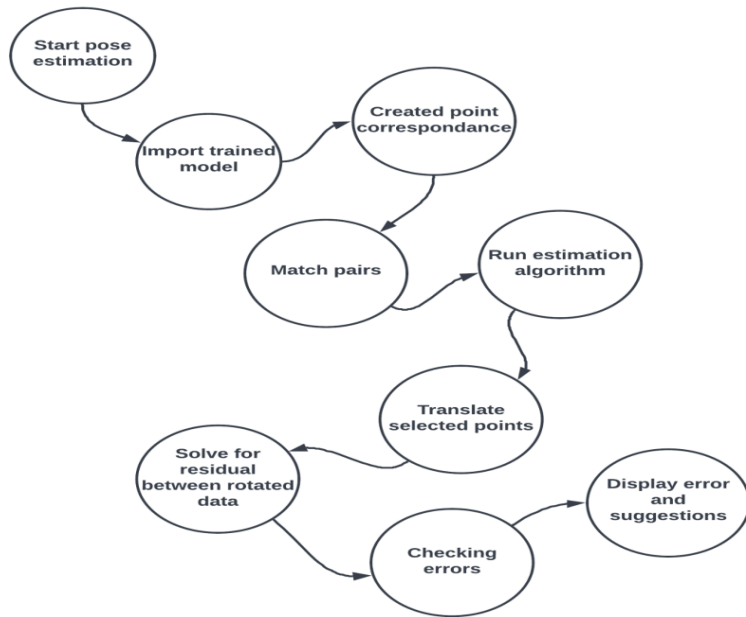
Addressed by a twofold cross-over line with any scope of section and leave bolts These images are utilized at whatever point 2 or extra administration streams ought to work at a comparable time. The leave streams are enacted at an identical time once the entirety of the passage streams have arrived at the simultaneousness picture. A simultaneous picture with one section stream could likewise be a fork; one with one live stream could likewise be a piece of. it is fundamental to make sure to stay these associations consistent so as. All cycles need to move from prime to base and left to right.

4.2 User Interface Diagrams

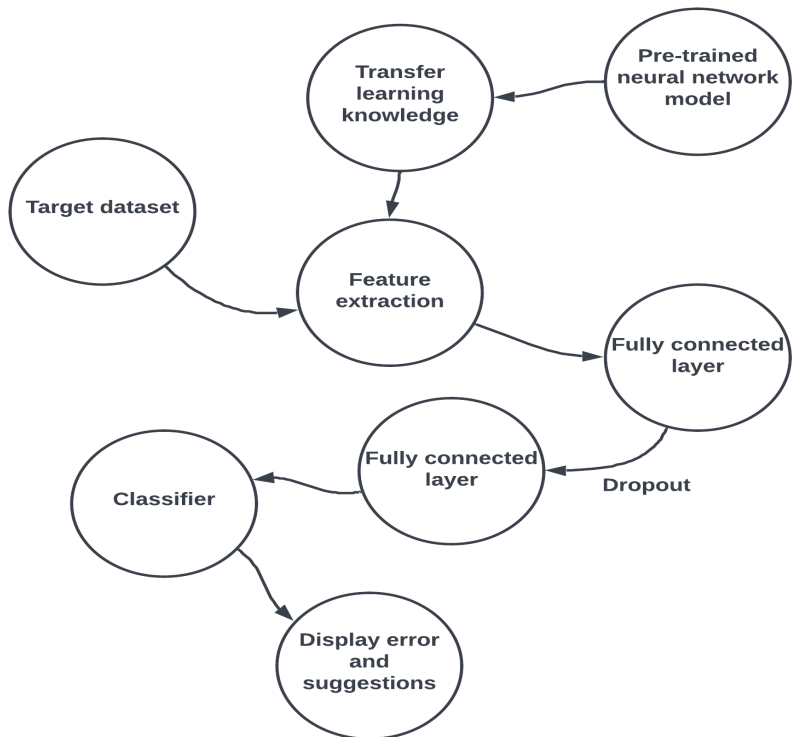
Flow chart



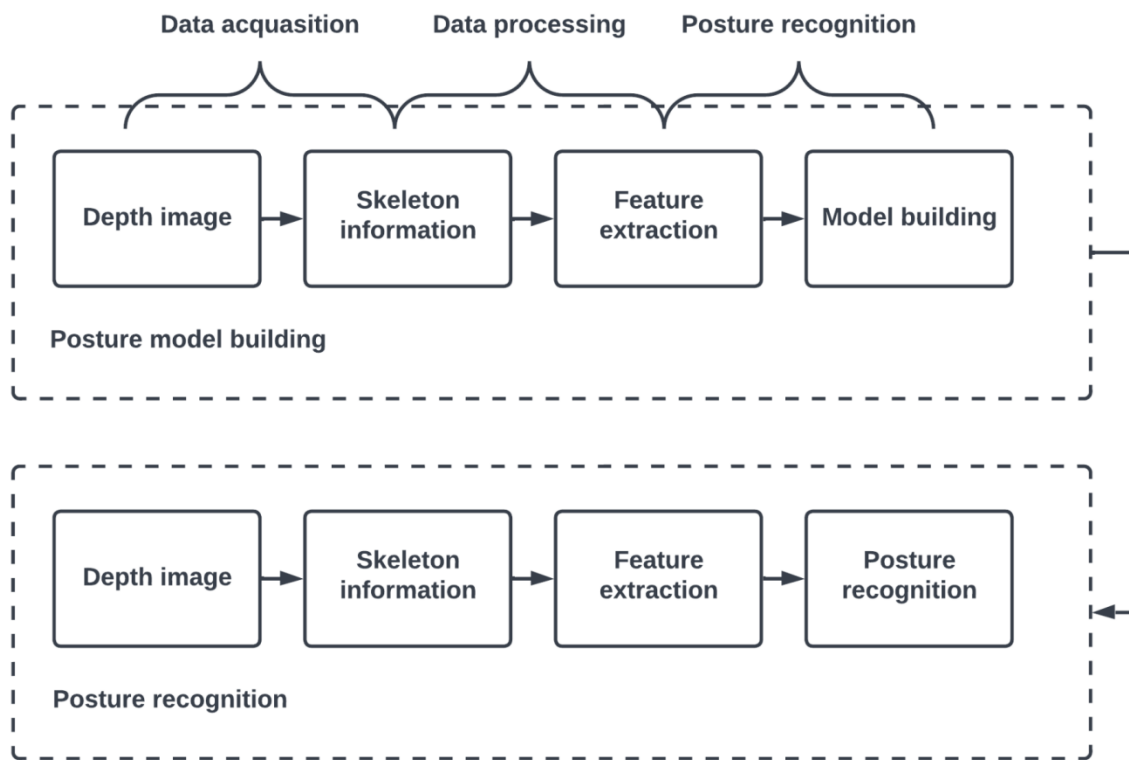
DFD1:



DFD2:



BLOCK diagram:



4.3 Design Level Diagrams

SYSTEM IMPLEMENTATION

Execution incorporates each one of those exercises that end up changing over from the new framework to the new. The new framework comprises of manual tasks, that is worked terribly very surprising way from the arranged new framework. a precise execution is essential to supply a dependable framework to fulfil the prerequisites of the associations. partner inappropriate establishment could affect the achievement of the prepared framework.

IMPLEMENTATION METHODS:

There are a few different ways for taking care of the execution and furthermore the subsequent transformation from the past to the new prepared framework.

The chief secure method for transformation from the past framework to the new framework is to run the past and new framework in equal. During this methodology, a private may work inside the manual more seasoned cycle framework still as start employable the new prepared framework.

This framework offers high security, as a consequence of in spite of the fact that there is a defect inside the handled framework, we'll rely upon the manual framework. Nonetheless, the value for keeping 2 frameworks in equal is unfathomably high. This exceeds its benefits.

Another unexpected procedure may be a prompt cut over from this manual framework to the prepared framework. The correction is moreover at stretches each week or at spans on an everyday basis. There aren't any equal exercises. Notwithstanding, there is no cure only in the event of a drag. This procedure needs cautious emerging with.

A working rendition of the framework can even be upheld in one neighbourhood of the association and furthermore the faculty are having the opportunity to steer the framework and changes are made as and once required. anyway, this framework might be a more modest sum liked because of the deficiency of the entireness of the framework.

IMPLEMENTATION PLAN:

The execution orchestrate incorporates an outline of the relative multitude of exercises that must happen to carry out the new framework and to place it into activity. It recognizes the staff answerable for the exercises and readies a period outline for executing the framework. The execution orchestrates the subsequent stages.

- Rundown all records required for execution.
- Recognize all data expected to make new documents all through the execution.
- Rundown every single new report and strategies that enter the new framework.

The execution orchestrate ought to expect achievable issues and will be prepared to manage them. the quality issues could even be missing records; blended data designs among current and documents, blunders in data interpretation, missing data and so forth

DFD (Data Flow Diagram)

An information programming language did may be a graphical outline of the progression of information through associate in nursing framework an information programming language can likewise be utilized for the visual picture of information measure organized plan its ordinary apply for an architect to draw a setting level did first that shows the collaboration between the framework and out of entryways substances this setting level did is then detonated to implies extra detail of the framework being sculptures.

CONCLUSION AND FUTURE SCOPE

5.1 Work Accomplished

In this project, an application is presented that provides feedback on human posture while performing exercises using pose detection, visual geometry, and machine learning. The pose estimation output is used to calculate the key points of the human body from the provided video. Machine learning algorithms are used to make decisions about correct posture and geometric algorithms to provide feedback to improve exercise. Four exercises were considered which can be extended to many more exercises for future work. To get feedback at any location, a mobile application can be developed that allows the user to record a video from a smartphone and upload it to the application. A web page can be created to display the outputs provided by the project. Feedback improvement can be increased by designing targeted actions and specific suggestions regarding the body part used and the weight of the equipment. Exercises performed with proper form can be visualized using a graphical simulation to highlight the user's error and how to improve it.

5.2 Conclusions:

There are several applications for position detection in real life here we will dive into one such application to learn more about position detection a smartphone or tablet with a high resolution camera has the same capabilities as a laptop or desktop because mobile phones and tablets have the ability to estimate their position has been taken to new heights we present an application to monitor training without any involvement of a personal trainer the application offers features such as real-time position estimation training analysis and injury prevention and achieves the best results the system is limited to exercises for single-person compatibility purposes the system will combine fitness and technology to successfully bring users the progress of tracking and acting as a personal trainer without actually requiring the assistance of any real trainer, brings the user full flexibility to perform

exercise at any time of the day according to their free time availability constant need for personal attention ch trainers in gyms and in exercise classes when performing exercises is attracted and with a fitness tracker, the constant monitoring of the movement of the body and joints of the users helps with the correct posture, which is one of the most basic components during exercise, the current methodology primarily focuses on the time for which the user exercises, and not on the correct posture of the user, instead it focuses on the time for which the exercise is performed the system found promising results after testing on more than 50 different users ideal values are calculated by averaging the value of the ratio of slopes and angles from a data set of more than 100 trainers performing combat position.

5.4 Future Work Plan-

The proposed models currently only classify exercise, there are a number of exercise and therefore creating a posture estimation model that can be successful for all is a challenging problem the data set can be expanded by adding more exercise postures performed not only by individuals in indoor environments but even outdoors, the performance of models depends on the quality of open pose estimation, which may not perform well in cases of overlap between people or overlap between body parts, a portable self-training device and real-time predictions can be implemented for this system, this work demonstrates activity recognition for practical applications, an approach comparable to this can be used for position recognition in tasks such as sports surveillance, health care, etc. multi-person position estimation is a completely new problem in itself and has a large scope for research, there are many scenarios where single person position estimation would not be sufficient, for example, the position of es Timing in crowded scenarios should have more people, c which will involve tracking and identifying the position of each individual, many factors such as overlapping background lighting values, etc., which we discussed earlier in this survey, would further complicate the estimation of the position of multiple individuals.

APPENDIX A: References

1. H. Xiong, S. Berkovsky, R. V. Sharan, S. Liu, and E. Coiera, "Robust visionbased workout analysis using diversified deep latent variable model," in 2020 42nd Annual International Conference of the IEEE Engineering in Medicine Biology Society (EMBC), pp. 2155–2158, 2020.

Link: <https://ieeexplore.ieee.org/document/9175454>

2. S. Yadav, A. Singh, A. Gupta, and J. Raheja, "Real-time exercise recognition using deep learning," Neural Computing and Applications, vol. 31, pp.https://link.springer.com/article/10.1007/s00521–019, 12 2019.

Link: <https://link.springer.com/article/10.1007/s00521-019-04232-7>

3. Y. Gu, S. Pandit, E. Saraee, T. Nordahl, T. Ellis, and M. Betke, "Home-based physical therapy with an interactive computer vision system," in 2019 IEEE/CVF International Conference on Computer Vision Workshop (ICCVW), pp. 2619–2628, 2019.

Link:<https://ieeexplore.ieee.org/document/9022034>

4. C. Huang, Y.-Z. He, and C.-C. Hsu, "Computer-assisted exercise training system," Multimedia Tools and Applications, vol. 77, 09 2018.

Link: <https://link.springer.com/article/10.1007/s11042-018-5721-2>

5. S. Chen and R. Yang, "Pose trainer: Correcting exercise posture using pose estimation," 03 2018.

Link:https://www.researchgate.net/publication/324759769_Pose_Trainer_Correcting_Exercise_Posture_using_Pose_Estimation

6. P. Keshari, "Wrong posture detection using opencv and support vector machine," 01 2020.

Link:https://www.researchgate.net/publication/343635363_Wrong_posture_detection_using_OpenCV_and_Support_vector_Machine

7. A. Nagarkoti, R. Teotia, A. K. Mahale, and P. K. Das, "Realtime indoor workout analysis using machine learning amp; computer vision," in 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 1440–1443, 2019.

Link:<https://ieeexplore.ieee.org/document/8856547>

8. Y. Agrawal, Y. Shah, and A. Sharma, "Implementation of machine learning technique for identification of exercise poses," in 2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT), pp. 40–43, 2020.

Link:<https://ieeexplore.ieee.org/document/9115758>

9. Z. Cao, G. Hidalgo, T. Simon, S. Wei, and Y. Sheikh, "Openpose: Realtime multiperson 2d pose estimation using part affinity fields," IEEE Transactions on Pattern Analysis & Machine Intelligence, vol. 43, pp. 172–186, jan 2021.

Link: <https://arxiv.org/pdf/1812.08008.pdf>

10. D. Kumar and A. Sinha, "exercise pose detection and classification using deep learning," International Journal of Scientific Research in Computer Science Engineering and Information Technology, 11 2020.

Link:https://www.researchgate.net/publication/346659912_exercise_Pose_Detection_and_Classification_Using_Deep_Learning

13. F. Sajjad, A. F. Ahmed, and M. A. Ahmed, "A study on the learning based human pose recognition," in 2017 9th IEEE-GCC Conference and Exhibition (GCCCE), pp. 1-8, 2017.

Link:<https://ieeexplore.ieee.org/document/8448200>